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WBAN MANUAL OF SURFACE OBSERVATIONS

CIRCULAR N
Sixth Edition

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UNITED STATES DEPARTMENT OF COMMERCE • Charles Sawyer, Secretary
WEATHER BUREAU • F. W. Reichelderfer, Chief

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RECORD OF CHANGES

Amendment number	Date effective	Pages affected	Initials	Date

FOREWORD

This manual was prepared by Weather Bureau personnel, with the collaboration of representatives of the Air Force and Navy, to secure uniformity in taking and recording surface observations.

The manual is supplemented by an addendum issued separately by the Weather Bureau, Air Force, and Navy. The instructions in the manual will be followed by all personnel taking surface observations; the instructions in the addendum will be followed only by personnel of the organization issuing the addendum. Amendments to this manual will be issued as revised pages for insertion in the manual in accordance with instructions accompanying them. Station copies of the manual will be corrected promptly upon receipt of each amendment. The effective date and number of each amendment and the pages or paragraphs affected will be entered on the page entitled "Record of Changes." The entries will be initialed by personnel who make them.

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INTRODUCTION

It will be helpful in using this manual to keep in mind that the material in it has been organized under (1) taking observations, and (2) recording and reporting observations. The first portion of the manual comprises chapters 1 to 9, and describes standard procedures for evaluating the elements of surface observations. The second portion comprises chapters 10 and 11, and describes standard procedures for entries on forms and coding for transmission.

It follows from the nature of this organization that each observational element will be treated twice in the manual: first, from the point of view of observing and evaluating the element without reference to its ultimate use; and second, from the point of view of making a permanent record of it and preparing it for dissemination. To find instructions applicable to a given topic, it is necessary to determine whether the problem is one of observations, which would be found in the first portion of the manual, or of coding, etc., which would be found in the second portion.

To facilitate use of the manual, a complete index has been included, which should be consulted whenever there is any doubt as to whether material sought is in the first or second portion. Items are listed in the index from the general to the particular, e. g., reporting visibility by quadrants would be listed as "Visibility, reporting by quadrants." In some cases, where a given topic might equally well be given two listings, cross listings have been included.

Taking observations is the primary duty of the observer. Nothing except the most pressing demands upon the observer's attention should be given precedence to this fundamental duty. Since life, property, and the convenience of travelers, as well as accurate forecasts, may depend upon his observations, the observer should make every effort to take the observations as accurately and completely as possible, and to file them in sufficient time for scheduled transmission. Every observation must be accurate in all its parts, and it must convey a complete picture of the meteorological situation existing at the station.

Observations of clouds, visibility, and atmospheric phenomena will be taken from as many points at the station as are necessary to view the entire horizon.

When computations require the disposal of decimals, the following procedure will be observed:

(1) If the decimal to be disposed of is greater than 5, or is 5 with a remainder, the preceding digit will be increased by 1.

(2) If the decimal to be disposed of is 5 exactly, the preceding digit will be increased by 1 when odd, and will remain unchanged when even; the result will always be an even number.

(3) If the decimal to be disposed of is less than 5, the preceding digit will remain unchanged.

CHAPTER 1. CLOUDS AND OBSCURING PHENOMENA

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CHAPTER 1. CLOUDS AND OBSCURING PHENOMENA

1000. GENERAL

1010. Code numbers for cloud forms and states of the sky are described in detail in Weather Bureau Circular S and the International Cloud Atlas. Instructions in this chapter are confined to those necessary for observing clouds and obscuring phenomena with respect to their amount, stratification, direction of movement, height of bases, and the effect of obscuring phenomena on vertical visibility.

1100. DETERMINATION OF SKY COVER

1110. DEFINITION OF SKY COVER. Sky cover is a term used to denote one of the following conditions:

(1) Amount of sky covered by clouds,
(2) Amount of sky rendered unobservable by the presence of obscuring phenomena, or
(3) A combination of (1) and (2).

The tenths of sky cover plus the tenths of sky visible will always equal 1.0 (10/10). All sky cover observations may be taken without the use of instruments, although at night it will frequently be necessary to observe the clouds and obscuring phenomena passing through the beam from a ceiling light or ceilometer projector over a period of several minutes in order to obtain a more nearly representative picture of the amount and extent of layers of clouds and obscuring phenomena. Determine the amount of sky cover in accordance with paragraphs 1120 through 1123.

1120. WITH ADVANCING CLOUD LAYER. To estimate the amount of cloudiness in an advancing (or receding) cloud layer, determine the angular elevation above the horizon of the forward or rear edge of the layer as seen against the sky. This may be done with a theodolite or clinometer until experience is gained in estimating vertical angles. Convert the angle to tenths of sky cover by use of Table 1.

1120.1. When the cloud layer does not extend to the horizon, determine the angular elevation of the forward and rear edges and the tenths of sky cover corresponding to each elevation. The difference would be the required sky cover. For example: Forward edge 78°=0.4 sky cover. Rear edge 53°=0.2 sky cover. Total sky cover is the difference between the two, or 0.2 sky cover.

TABLE 1.—*Sky cover with advancing or receding cloud layers*

Angles subtended by sky cover	Tenths of sky cover	Angles subtended by sky cover	Tenths of sky cover
Less than 37°	0. 0	102°—113°	0. 6
37°—52°	0. 1	114°—126°	0. 7
53°—65°	0. 2	127°—143°	0. 8
66°—77°	0. 3	144°—179°	0. 9
78°—89°	0. 4	180°	1. 0
90°—101°	0. 5		

1121. WITH CONTINUOUS LAYER SURROUNDING STATION. To estimate the amount of cloudiness present when a continuous layer of clouds surrounds the station and extends to the horizon, determine the angular elevation of cloud edges, and convert to tenths of sky cover by use of Table 2.

TABLE 2.—*Sky cover with cloud layer surrounding station*

Angular elevation	Tenths of sky cover	Angular elevation	Tenths of sky cover
Less than 6°	0. 0	37°—43°	0. 6
6°—11°	0. 1	44°—52°	0. 7
12°—16°	0. 2	53°—63°	0. 8
17°—23°	0. 3	64°—89°	0. 9
24°—29°	0. 4	90°	1. 0
30°—36°	0. 5		

1122. WITH UNEVEN DISTRIBUTION. When the clouds are unevenly distributed over the sky, imagine the sky to be divided into quarters and then estimate the amount covered by the clouds in each quarter. The sum of the estimated amounts will be the total sky cover.

1123. WITH OBSCURING PHENOMENA. Whenever the sky cover cannot be evaluated in terms of cloud cover, because of the presence of fog, lithometeors, or precipitation, determine the amount of sky rendered unobservable by these phenomena similarly to cloud cover. (See pars. 1120–1122.)

1200. DETERMINATION OF STRATIFICATION

1210. DEFINITION OF LAYER. When clouds or obscuring phenomena whose bases are at approximately the same level cover at least 0.1 of the sky, they are regarded as a layer. The layer may be continuous or composed of detached elements. The use of the term layer does not imply that a clear space exists between the layers or that the clouds or obscuring phenomena composing them are of the same type. (See par. 1230.) Clouds are termed thin if the outline of the sun, moon, or stars is visible through them. Clouds unusually dark or threatening in appearance are termed dark. Obscuring phenomena, thin enough to reveal the sky, clouds or other obscuring phenomena directly above the observer, or phenomena, not overhead but thin enough to reveal the sky through them, are termed thin.

1220. EVALUATION OF MULTIPLE LAYERS. Frequent observation is necessary to evaluate stratification. A series of observations will often show the existence of upper layers above a lower layer. Through thin lower layers it may be possible to observe higher layers. Differences in the directions of cloud movements are often a valuable aid in observing and differentiating cloud stratification, particularly when haze, smoke, etc., render depth perception difficult.

1230. INTERCONNECTION OF LAYERS. Cumulo-type clouds developing below other clouds may reach or penetrate them. Also, by horizontal extension, swelling cumulus or cumulonimbus may form stratocumulus, altocumulus, or dense cirrus.

1300. DETERMINATION OF DIRECTION

1310. CLOUD DIRECTION. Cloud direction is the direction from which the cloud bases are moving. This direction will be determined visually by one of the methods indicated in paragraphs 1310.1–1310.3.

1310.1. Observe the movement of clouds past a structure that forms a right angle in either a horizontal or a vertical plane. When the orientation of the structure is known, the direction is indicated by equal or unequal movement of clouds along both sides of the angle, or by movement of clouds parallel to either side.

1310.2. Sight a distinctive point of the cloud over a projection. Move about to keep this point in the same position with respect to the projection. The direction toward which the observer moves is the cloud direction; that is, the direction from which the cloud is moving.

1310.3. When clouds are moving slowly, their direction can be determined with reasonable accuracy by taking several observations a few minutes apart, and noting the relative positions of the clouds.

1320. DIRECTION OF OBSCURING PHENOMENA. Determine direction of movement of obscuring phenomena aloft similarly to clouds. When the base of the obscuring phenomena is at the surface, the direction will be that of the surface wind.

1400. CEILING AND CLOUD HEIGHT

1410. CEILING DEFINITION. When 0.6 or more of the sky is covered with clouds, obscuring phenomena, or both, the ceiling is defined, and is expressed in numerical terms, as:

(1) The height of the lowest layer of clouds that, in summation with all lower layers of clouds and obscuring phenomena, covers 0.6 or more of the sky.
(2) The vertical visibility into obscuring phenomena not classified as thin that, in summation with all lower layers, cover 0.6 or more of the sky.
(3) The height of clouds visible through obscuring phenomena when the combination covers 0.6 or more of the sky.

The ceiling is termed "unlimited" and is not expressed as a numerical value when the conditions listed above are not satisfied. At all other times, the ceiling is expressed as a numerical value in feet above the surface. (See par. 1412.)

1411. VERTICAL VISIBILITY. Vertical visibility is a ceiling value used when obscuring phenomena make it impossible to express ceiling in terms of cloud height above the surface. (See par. 1441.2.)

1412. SURFACE. "Surface" as used here is a 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 elevation at the point of observation.

1420. VARIABLE CEILING. The term "variable ceiling" describes a condition in which the ceiling rapidly increases and decreases. The average of all values secured will be used as the ceiling. (See par. 1441.1.)

1430. CEILING CLASSIFICATION. When the ceiling is expressed as a numerical value, it will be classified in accordance with the following:

1431. MEASURED CEILING. A ceiling is classified as measured:

(1) Whenever obtained by means of a ceiling light or ceilometer, provided penetration of the beam is not in excess of that normally experienced for the cloud height.
(2) Whenever a raob balloon is observed to disappear abruptly into a cloud base whose height is computed from the recorder record.
(3) Whenever determined from the known heights of unobscured portions of objects, other than natural landmarks, within 1½ miles of the point of observation.

1432. AIRCRAFT CEILING. A ceiling is classified as an aircraft ceiling when it is determined by a pilot while in flight over, or within 1½ miles of the boundary of, the airport.

1433. BALLOON CEILING. A ceiling is classified as a balloon ceiling when its height is ascertained by means of a ceiling balloon or a pilot balloon, provided that (a) the clouds cover more than 0.9 of the sky in a single layer, and (b) the balloon disappears abruptly into them (i. e., 10 seconds or less elapse from the time of first obscuration to complete disappearance). The height at which obscuration begins will be regarded as the height of the cloud base.

1434. INDEFINITE CEILING. A ceiling is classified as indefinite:

(1) Whenever a ceiling projector or ceilometer beam penetrates the cloud to an extent greater than that normally experienced for the cloud height. The height corresponding to the lower end of the most clearly defined portion of the spot or first maximum reaction of the ceilometer will be regarded as the height of the cloud base.
(2) Whenever a balloon disappears slowly (i. e., more than 10 seconds elapse from the time of first obscuration to complete disappearance) into a tenuous or an irregular overcast comprising one layer only. The height at which obscuration begins will be regarded as the height of the cloud base.
(3) Whenever hydrometeors, other than precipitation, or lithometeors obscure the cloud base and prevent a determination of its height. Under these circumstances, the height corresponding to the upper limit of a ceilometer reaction, the top of a ceiling light projector beam, or the height at which a balloon completely disappears will be used as a guide in determining the value of an indefinite ceiling. If none of these guides are available, the ceiling will be determined on the basis of experience.

Ceiling values discussed in this paragraph are based on estimations. The values nevertheless are classified as "indefinite," which should not be confused with the classification "estimated."

1435. PRECIPITATION CEILING. A ceiling is classified as a precipitation ceiling when precipitation obscures the cloud base and prevents a determination of its height. The value ascribed to a precipitation ceiling is an estimation that may be based on experience; or, when equipment is available, the limit of penetration of a projector beam or the upper limit of a ceilometer reaction may be used as a guide in determining the value of a precipitation ceiling. Although this value is an estimation, it is classified as a precipitation ceiling, which should not be confused with the classification "estimated."

1436. ESTIMATED CEILING. A ceiling is classified as estimated:

(1) Whenever determined by means of the "Convective Cloud Base Height Diagram" under conditions appropriate to and in accordance with instructions for its use. (See par. 1447.)
(2) Whenever a ceiling balloon or pilot ballon is observed to enter a base of clouds covering 0.9 or less of the sky, or the base of an overcast comprising more than one layer.
(3) Whenever determined from the known heights of unobscured portions of natural landmarks, or of objects more than 1½ miles from the point of observation.
(4) Whenever determined on the basis of experience provided that the sky is not obscured by hydrometeors or lithometeors, and other guides are lacking.

1440. METHODS OF DETERMINING CEILING AND CLOUD HEIGHTS. The methods indicated in paragraphs 1441 to 1447.2 will be used in determining ceiling and cloud heights.

1441. CEILING LIGHT (OR CEILOMETER PROJECTOR). The ceiling light will be used in determining cloud heights as follows:

(1) Turn on the ceiling light.
(2) Sight through the clinometer, and center the intersection of the cross hairs upon the lower part of the most clearly defined portion of the spot.
(3) When the pendant has come to rest, clamp it in position, without moving the clinometer.
(4) Turn off the ceiling light.
(5) Read the angle to the nearest whole degree.
(6) Obtain the height from prepared tables appropriate to the baseline. (See Table 3 for heights computed for baselines of 500, 1,000, and 1,500 feet.)
(7) Add algebraically to the tabular value the difference between the height of the observation point and the official field elevation; if an official field elevation has not been established, add the height of the observation point above the ground.

1441.1 INDICATIONS OF VARIABLE CEILING. Rapid fluctuation of the light spot will indicate an irregular cloud base whose height will be regarded as measured but variable. (See par. 1420.)

1441.2 INDICATIONS OF VERTICAL VISIBILITY. Precipitation and obstructions to vision may prevent use of the ceilometer or the ceiling light to determine cloud heights. However, if the horizontal visibility is equal to or greater than the length of the baseline, the upper limit of penetration of the beam can be used as a guide in evaluating vertical visibility. (Under these circumstances the ceiling would be classified as indefinite or precipitation.) (See par 1411.)

1441.3. OBSERVATIONS ON REDUCED BASELINE. When the horizontal visibility is less than the length of the baseline, pace the distance towards the projector to a point from which a spot can be observed. Use this shorter baseline to compute the height. For any given angle, the height will be proportional to the lengths of the baseline in accordance with the following equation:

$$h=\frac{b}{B}\times H \text{ or } \frac{h}{H}=\frac{b}{B}$$

where

B=normal baseline
H=height from tables at observed angle with normal baseline
b=normal baseline minus distance paced
h=height determined from short baseline and table for H.

1441.4. CORRELATION WITH VISUAL OBSERVATION. Data taken from the ceilometer or ceiling light must be supported by visual observations to insure that the data are representative of the cloud base to which they are ascribed. For example, under conditions of multiple cloud layers, a cloud height value must not be reported as a ceiling when actually it is the height of a cloud layer above or below the layer constituting the ceiling.

TABLE 3.—*Height of cloud base, feet, light projected vertically*

Angle \ Base Line	500′	1,000′	1,500′	Angle \ Base Line	500′	1,000′	1,500′
5	44	87	131	46	518	1, 036	1, 554
6	52	105	157	47	536	1, 072	1, 608
7	62	123	185	48	556	1, 111	1, 667
8	70	141	211	49	575	1, 150	1, 725
9	79	158	237	50	596	1, 192	1, 788
10	88	176	264	51	618	1, 235	1, 853
11	97	194	291	52	640	1, 280	1, 920
12	106	213	319	53	664	1, 327	1, 991
13	116	231	347	54	688	1, 376	2, 064
14	124	249	373	55	714	1, 428	2, 142
15	134	268	402	56	742	1, 483	2, 225
16	144	287	430	57	770	1, 540	2, 310
17	153	306	459	58	800	1, 600	2, 400
18	162	325	487	59	832	1, 664	2, 496
19	172	344	516	60	866	1, 732	2, 598
20	182	364	546	61	902	1, 804	2, 706
21	192	384	576	62	940	1, 881	2, 821
22	202	404	606	63	982	1, 963	2, 945
23	212	424	636	64	1, 025	2, 050	3, 075
24	222	445	667	65	1, 072	2, 144	3, 216
25	233	466	699	66	1, 123	2, 246	3, 369
26	244	488	732	67	1, 178	2, 356	3, 534
27	255	510	765	68	1, 238	2, 475	3, 713
28	266	532	798	69	1, 302	2, 605	3, 907
29	277	554	831	70	1, 374	2, 748	4, 122
30	288	577	865	71	1, 452	2, 904	4, 356
31	300	601	901	72	1, 539	3, 078	4, 617
32	312	625	937	73	1, 636	3, 271	4, 907
33	324	649	973	74	1, 744	3, 487	5, 231
34	338	675	1, 013	75	1, 866	3, 732	5, 598
35	350	700	1, 050	76	2, 006	4, 011	6, 017
36	364	727	1, 091	77	2, 166	4, 332	6, 498
37	377	754	1, 131	78	2, 352	4, 705	7, 057
38	390	781	1, 171	79	2, 572	5, 145	7, 717
39	405	810	1, 215	80	2, 836	5, 671	8, 507
40	420	839	1, 259	81	3, 157	6, 314	9, 471
41	434	869	1, 303	82	3, 558	7, 115	10, 673
42	450	900	1, 350	83	4, 072	8, 144	12, 276
43	466	933	1, 399	84	4, 757	9, 514	14, 211
44	483	966	1, 449	85	5, 715	11, 430	17, 175
45	500	1, 000	1, 500	86	7, 150	14, 301	21, 441

1442. PILOT AND CEILING BALLOONS. Heights of cloud bases and vertical visibility into obscuring phenomena may be determined from the elapsed time of flight and the ascensional rate appropriate to the balloon used. Observe the following procedure in determining the heights of clouds or vertical visibility into obscuring phenomena:

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

(2) Watch the balloon continuously, determining with a stop watch (or any watch having a second hand) the length of time that elapses between release of the balloon and entry of it into the cloud base or disappearance into the obscuring phenomenon.

(3) Determine the height by means of the table appropriate to the balloon used. (See Table 4 for ascensional rate of ceiling balloons.) Interpolate if necessary.

(4) Add algebraically to the tabular value the difference between the height of the observation point and the official field elevation; if an official field elevation has not been established, add the height of the observation point above ground.

804519°—48——2

1442.1. LIMITATIONS. Ceiling and pilot balloons may be used when drizzle of any intensity, or any other form of precipitation of light intensity, is occurring, since significant changes in the ascensional rate are not caused by these phenomena. However, owing to other factors that may affect the ascensional rate, cloud heights determined by their use will be classified as "balloon" only when the clouds form an overcast comprising one layer. This does not preclude the use of ceiling balloons to estimate the height of overcasts comprising more than one layer or of clouds covering 0.9 or less of the sky.

TABLE 4.—*Height, in feet, determined by ceiling balloon*

Type of balloon / Time (minutes)	10-Gram Spherical		Type of Balloon / Time (minutes)	10-Gram Spherical	
	For Weather Bureau use (45 grams free lift)[1]	For Air Force and Navy use (40 grams free lift)[2]		For Weather Bureau use (45 grams free lift)[1]	For Air Force and Navy use (40 grams free lift)[2]
½	250	250	5½	2, 510	2, 110
1	500	480	6	2, 720	2, 290
1½	730	670	6½	2, 930	2, 470
2	960	850	7	3, 140	2, 650
2½	1, 190	1, 030	7½	3, 350	2, 830
3	1, 420	1, 210	8	3, 560	3, 010
3½	1, 650	1, 390	8½	3, 770	3, 190
4	1, 880	1, 570	9	3, 980	3, 370
4½	2, 090	1, 750	9½	4, 190	3, 550
5	2, 300	1, 930	10	4, 400	3, 730

[1] Add 210 feet for each additional ½ minute after the tenth minute.
[2] Add 180 feet for each additional ½ minute after the tenth minute.

1443. RADIOSONDE. The height may be computed whenever a radiosonde balloon is observed to enter a cloud base, or disappears into obscuring phenomena and the entry is marked on the recorder record. (See pars. 1431 (2); 1434 (2); and 1434 (3).)

1444. PILOT OBSERVATIONS. Heights of clouds and obscuring phenomena reported by pilots will be used in accordance with paragraph 9211. These heights will ordinarily be expressed by the pilot in terms of feet above mean sea level, and will be converted to feet above field elevation if necessary. It must be determined, in any case, whether the report refers to field elevation or sea level. If the report of ceiling height is obtained within 1½ miles of the airport, the ceiling is classified as aircraft; if more than 1½ miles, the report will be used as basis for an estimation.

1445. BUILDINGS, ETC. Determination of cloud heights may be based on interception by clouds of objects (buildings, etc.) other than natural landmarks whose heights are known. Allow, so far as possible, for any appreciable slope in the cloud base from the point of observation to the point of interception of the object. When the objects, etc., are within 1½ miles of the boundaries of the airport, the cloud height may be regarded as measured. When they are more than 1½ miles from airport boundaries, heights are regarded as estimated.

1446. NATURAL LANDMARKS. Cloud heights based on the unobstructed portion of hills or mountains surrounding the station, when their height above the elevation of the station is known, will be classified as estimated. Orographic lifting may cause these clouds to differ in height from those immediately above the station. Estimates of cloud heights based on mountains more than 50 miles away will not be regarded as applicable to those overhead.

1447. CONVECTIVE CLOUD HEIGHT DIAGRAM. This diagram eliminates the computations necessary in determining height of convective-type clouds by use of a dew point formula. It is not suitable for use at stations situated in mountainous or hilly terrain and will, therefore, not be used at these stations. Heights determined in this manner will be classified as estimated. (See Fig. 1.)

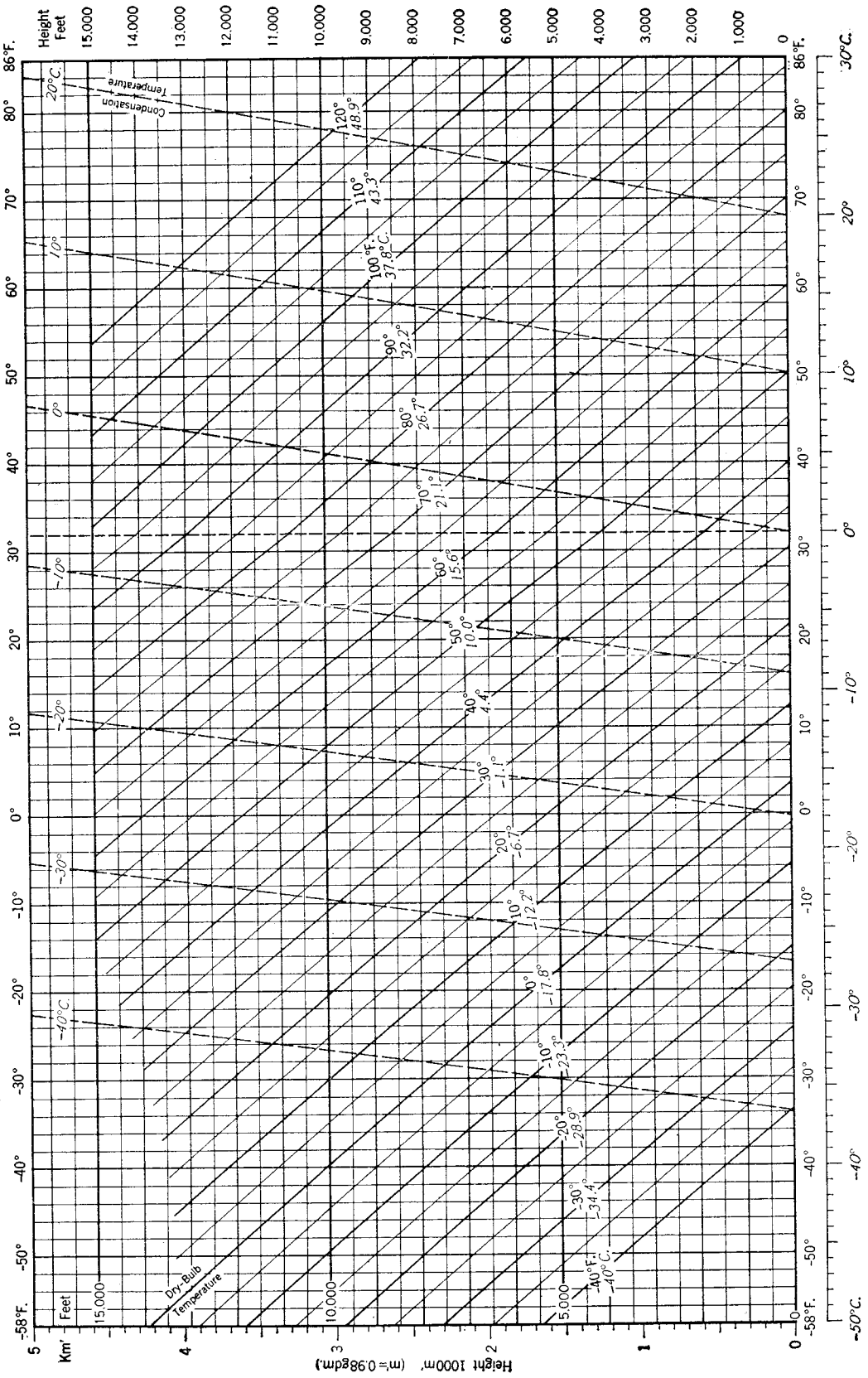

FIGURE 1.—Diagram for determining height of convective-type clouds.

1447.1 The diagram will be used only when the clouds present are formed by active surface convection near the point of observation. The diagram is usually most accurate when used to compute the height of cloud bases 5,000 feet or below; but at land stations in coastal regions, sea breezes frequently render it inapplicable to clouds formed over land before the onset of the sea breeze.

1447.2. Obtain the estimated height of a cloud base above the point of observation as follows:

(1) Locate the point of intersection of the vertical line (abscissa) corresponding to the observed dew point temperature, and the curve (sloping upward to left) corresponding to the observed dry-bulb temperature.

(2) Find the height of the convective cloud base above the ground at the scale value (printed along the right side of the chart) corresponding to the point found in (1).

CHAPTER 2. VISIBILITY

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CHAPTER 2. VISIBILITY

2000. GENERAL

2010. Visibility is a term that denotes the greatest distance an object of specified characteristics can be seen and identified. This term may express the visibility in a single direction or the prevailing visibility based on all directions. Binoculars, theodolites, etc., will not be used in taking visibility observations.

2100. GUIDES IN DETERMINING VISIBILITY

2110. CHART OF VISIBILITY MARKERS. Each station will have on display a chart of prominent objects and their distances from the observation point. This chart should include objects suitable for determining the visibility at night as well as by day.

2120. VISIBILITY MARKERS AT NIGHT. The most suitable objects for determining visibility at night are unfocused lights of moderate intensity at known distances, and the silhouettes of mountains or hills, etc., against the sky. The brilliance of stars near the horizon may also be a useful indication. Because of their intensity, airway beacons may not be used as visibility markers, but their degree of brilliance may be used as an aid to indicate whether visibility is greater or less than the distance of the beacon. "Course lights" (red or green) of beacons may be used as definite visibility markers. These and all other lights normally used as visibility markers should be used with caution after storms, for their intensity may be reduced by snow or freezing precipitation.

2130. VISIBILITY MARKERS DURING DAYLIGHT. For accurate determinations during daylight hours, confine the choice of markers to black, or nearly black, objects against the horizon sky rather than to light-colored markers and those appearing against terrestrial backgrounds.

2140. SIZE OF VISIBILITY MARKERS. In order that visibility values may be representative, they must apply to objects of specified minimum size or larger. An object that subtends an angle of less than 0.5 degree at the eye becomes invisible at a shorter distance than larger objects under the same conditions. Therefore, objects whose angular size is 0.5 degree or greater should be selected as visibility markers whenever possible. A hole 0.3 inch (or $\frac{5}{16}''$) in diameter punched in a card that is held at arm's length subtends an angle of approximately 0.5° at the eye. If the portion of any object above the horizon completely fills the hole when the card is held as explained above, the object is of suitable size for a marker.

2150. DAY AND NIGHT VISIBILITY. The change from darkness to daylight, and vice versa, does not as such affect the visibility. Therefore, abrupt changes in visibility values as between night and day should be based on definite changes in atmospheric conditions; e. g., frequently the visibility decreases sharply at dawn, owing to the photochemical effect of sunlight on smoke.

2160. ESTIMATIONS OF VISIBILITY. In estimating the visibility when the farthest object is at a comparatively short distance, note the sharpness with which the object stands out. Sharp outlines in relief, with little or no blurring of color, indicate that the visibility is much greater than the distance of the reference object. On the other hand, blurred or indistinct objects indicate the presence of haze or other phenomena that has reduced the visibility to not less than the distance of the objects.

2200. VISIBILITY IN A DEFINITE DIRECTION

2210. Visibility in a definite direction is the greatest horizontal distance at which the outlines of visibility markers can be distinguished against the horizon sky under the conditions existing at the time of observation.

2300. PREVAILING VISIBILITY

2310. DEFINITION. Prevailing visibility is the maximum visibility common to sectors comprising ½ or more of the horizon circle. Under nonuniform conditions the sectors may be distributed in any order. Under uniform conditions the prevailing visibility is the same as the visibility in any direction. The term variable visibility describes a condition in which the prevailing visibility rapidly increases and decreases. The average of the extremes is used as the prevailing visibility.

2320. DETERMINATION. To determine prevailing visibility under nonuniform conditions, regard the horizon circle as divided into several sectors of equal size in each of which the visibility is substantially uniform. Select the highest value that is equal to or less than the visibility of sectors that cover at least one-half of the horizon circle. For example, if the horizon circle were divided into 6 sectors and the respective visibility values were 1/16, ⅛, ¼, ½, ¾, and 1 mile, the prevailing visibility would be ½ mile. This is evident from the fact that ½ mile is the highest value equal to or less than the visibility values of ½ or more of the horizon circle. This is illustrated in Figure 2.

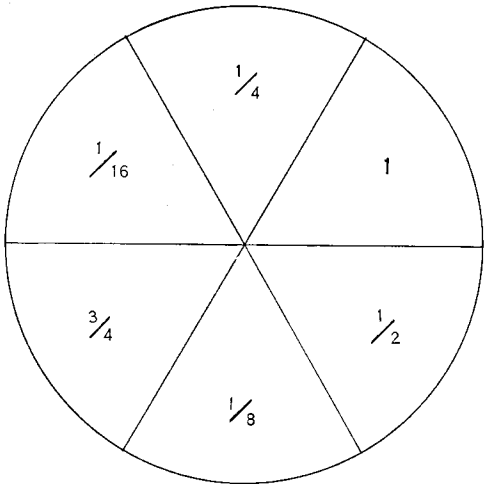

FIGURE 2.—Visibility in sectors of horizon circle.

CHAPTER 3. ATMOSPHERIC PHENOMENA

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CHAPTER 3. ATMOSPHERIC PHENOMENA

3000. GENERAL

3010. Atmospheric phenomena observed as weather elements of an observation comprise tornadoes, waterspouts, thunderstorms, squalls, and precipitation in any form. Hydrometeors other than precipitation, and lithometeors, are termed obstructions to vision. Igneous and luminous meteors, such as lightning, rainbows, halos, coronas, and auroras, are also observed. Observations of these phenomena, except freezing rain and the determination of intensity of precipitation, are taken without the use of instruments. Terms in parentheses indicate equivalents as used in synoptic reports, e. g., Light (Slight).

3100. TORNADOES AND WATERSPOUTS

3110. DESCRIPTION. These storms occur when meteorological conditions are favorable for intense thunderstorm activity. The distinguishing feature is the funnel-shaped appendage that hangs from the base of the cloud. The storm is described as a tornado when it occurs over land and as a waterspout when it occurs over water.

3120. OBSERVATION. Note the direction from the station, and the direction toward which it is going. The direction of motion is the same as that of the cloud with which the phenomenon is associated; however, it should be remembered that the direction of motion of a cloud is observed as the direction from which the cloud is moving. Intensity values are not ascribed to tornadoes or waterspouts. See Table 29, Item 16, for public reports of tornadoes.

3200. THUNDERSTORMS

3210. DEFINITION. A thunderstorm is regarded as occurring at the station when thunder is heard.

3220. OBSERVATION. Note the following:

(1) Occurrence of thunder.
(2) Location of storm center with respect to the station.
(3) Direction toward which the storm is moving, when this can be determined with reasonable accuracy.
(4) Whether lightning is occurring from cloud to cloud, cloud to ground, or within clouds.
(5) Intensity of the storm.

3230. DETERMINATION OF INTENSITY. Classification of a thunderstorm as light (slight),[1] moderate or heavy is based upon the appearance of the storm from the point of observation. The thunderstorm may be classified as light throughout its history as viewed from this point, or it may be classified during its passage by the station as light, moderate, heavy; and, as it recedes, moderate, and light. Description of intensity will be based on the following general guides:

3231. LIGHT (SLIGHT) THUNDERSTORM. Lightning occurs within the cloud and rainfall accompanying it is light or moderate. Small hail may also be observed. The thunder is not loud, and lightning occurs at intervals of a minute or more. The surface wind speed at the beginning of or during the storm does not exceed 30 miles and hour (26 knots), and any sudden increase in speed is of short duration. The classification also applies to occasional peals of thunder during a general rain storm.

[1] The classification "light (slight)" is used only in synoptic observations.

3232. MODERATE THUNDERSTORM. Loud peals of thunder occur at brief intervals and frequent flashes of lightning occur from cloud to ground, as well as from cloud to cloud; rain is moderate or heavy, and small hail is light or moderate. An onrush of wind may precede the storm, with a speed as high as 40 miles an hour (35 knots). Extensive masses of dark clouds showing visible indications of turbulent motion and rapid horizontal translation are usually observable.

3233. HEAVY THUNDERSTORM. Sharp and pronounced thunder and lightning occur almost continuously. Heavy rain occurs, sometimes accompanied by hail. The wind preceding and accompanying the storm may reach a speed in excess of 40 miles an hour. A rapid drop in temperature occurs, sometimes as much as 20° F. in 5 minutes.

3300. SQUALLS

3310. A squall is a strong wind that increases suddenly in speed, maintains a peak speed over a period of minutes, and decreases in speed; similar fluctuations will occur at succeeding intervals. The occurrence of squalls is indicative of turbulence near the surface. Although squalls are classified as an atmospheric phenomenon, instructions for observing them will be found in paragraph 8320, because their observational criteria are exclusively wind.

3400. HYDROMETEORS—PRECIPITATION

3410. GENERAL. The term hydrometeors includes all atmospheric phenomena composed of liquid or solid forms of water. Clouds are not described here since they are considered separately in Chapter 1. The term precipitation includes all forms of moisture that fall to the earth's surface—rain, snow, hail, etc. Dew, frost, and rime, although classified as precipitation, are discussed in this chapter as miscellaneous hydrometeors.

3420. CHARACTER OF PRECIPITATION. Determine character of precipitation in accordance with the following criteria:

3421. CONTINUOUS. Intensity increases or decreases gradually.

3422. INTERMITTENT. Intensity increases or decreases gradually and precipitation stops and recommences at least once within 1 hour preceding the time of observation.

3423. SHOWERY. Precipitation associated with cumuliform clouds, especially swelling cumulus and cumulonimbus. Intensity varies rapidly. Showers begin and end abruptly.

3424. COMBINATIONS. Showers and continuous or intermittent rain may occur in combination, when the precipitation does not always cease between showers. Under these conditions, showery precipitation is marked by a sudden increase and decrease in intensity as the showers abruptly begin and end.

3430. INTENSITY OF PRECIPITATION. Intensities of precipitation are determined by one of two methods:

(1) Rate of accumulation (vertical depth of water per unit time, or depth on ground in solid form per unit time).
(2) Degree to which the precipitation affects visibility.

3431. Intensities of all forms of precipitation except snow are determined by (1) above. Intensities of all forms of snow, when they occur alone, are determined by (2) above. When any form of snow occurs in combination with one or more hydrometeors or lithometeors, the intensity of the precipitation will be on the basis of the rate of accumulation (1) above.

3432. The rate of accumulation, measured by the vertical depth of water, can be accurately and quickly determined with a recording rain gage at stations equipped with one. Criteria for intensities will be found in Table 5.

TABLE 5.—*Criteria for determining intensity of rain*

Light (Slight)	Trace 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.

3433. For approximate determination of the rate of accumulation for liquid forms, the guides indicated in Table 6 will be used.

TABLE 6.—*Guides for approximating intensity of rain*

Light (Slight)	Individual drops are easily identifiable; spray observable over pavements, roofs, etc., is slight; puddles form very slowly; over two minutes may be required to wet pavements and similarly dry surfaces; sound on roofs ranges from slow pattering to gentle swishing; steady small streams may flow in gutters and downspouts.
Moderate	Individual drops are not clearly identifiable; spray is observable just above pavements and other hard surfaces, puddles form rapidly; downspouts on buildings run ¼ to ½ full; sound on roofs ranges from swishing to gentle roar.
Heavy	Rain seemingly falls in sheets; individual drops are not identifiable; heavy spray to height of several inches is observable over hard surfaces; downspouts run more than ½ full; visibility is greatly reduced; sound on roofs resembles roll of drums or distinct roar.

3434. Determine the rate of accumulation of sleet and all forms of hail by estimating the accumulating amount on the ground. This applies also to forms of snow when occurring in combination with hydrometeors and lithometeors. Drizzle will be estimated in accordance with the intensities indicated in Table 7.

TABLE 7.—*Intensity of drizzle on rate-of-fall basis*

Light (Slight)	Trace to 0.01 inch per hour.
Moderate	More than 0.01 inch to 0.02 inch per hour.
Heavy	More than 0.02 inch per hour.

NOTE.—When precipitation equals or exceeds 0.04 inch per hour, there is a strong presumption that the precipitation is rain.

3435. The intensity to be ascribed to snow occurring alone will be determined from Table 8.

TABLE 8.—*Intensity of snow with visibility as criteria*

Light (Slight)	Visibility 1,100 yards or more.
Moderate	Visibility less than 1,100 yards but not less than 550 yards.
Heavy	Visibility less than 550 yards.

3440. TYPES OF PRECIPITATION. For purposes of these instructions, precipitation is divided into liquid, freezing, and frozen types. These types are discussed in paragraphs 3441 to 3443.7. A combination of types or of forms of one type will be individually observed and reported regardless of existing meteorological conditions that might appear to be inconsistent with them.

3441. LIQUID PRECIPITATION. Liquid precipitation is classified as rain or drizzle in accordance with the criteria below.

3441.1 RAIN. The falling from clouds of drops of water (in the liquid state) in which most drops are larger—or if not larger, sparser—than the drops in drizzle. Rain, as used in this manual, excludes drizzle and freezing rain.

3441.2. DRIZZLE. Very small and uniformly dispersed droplets that appear to float in the air and to follow very slight air currents. Drizzle usually falls from low stratus clouds and is frequently accompanied by low visibility and fog.

3442. FREEZING PRECIPITATION. Freezing precipitation is classified as freezing rain or freezing drizzle, in accordance with criteria below.

3442.1 FREEZING RAIN. Rain that falls in liquid form but freezes to the exposed surface of the ground, or to unheated objects on the ground. If the fall is so rapid that run-off occurs, the formation of ice will usually appear as glaze.

3442.2 FREEZING DRIZZLE. Drizzle that freezes similarly to rain (see paragraph 3442.1) is classified as freezing drizzle.

3443. FROZEN PRECIPITATION. Solid precipitation is classified in accordance with the criteria in paragraphs 3443.1 to 3443.7.

3443.1. SLEET (ICE PELLETS). Transparent, more or less globular, hard grains of ice about the size of raindrops, that rebound when striking hard surfaces. Its fall may be continuous, intermittent, or showery.

3443.2. HAIL. Ice balls or stones, ranging in diameter from that of medium-size raindrops to an inch or more. They may fall detached or frozen together into irregular, lumpy masses. They are composed either of clear ice or of alternating clear and opaque snowflake layers. Hail often accompanies thunderstorm activity. Surface temperatures are usually above freezing when hail occurs. Determination of size will be based on the diameter, in inches, of normally shaped hailstones.

3443.3 SMALL HAIL. Semitransparent, round or conical, grains of frozen water. Each grain generally consists of a smaller grain of soft hail as a nucleus, surrounded by a very thin ice layer, which gives it a glazed appearance. The grains are wet when they fall at temperatures above freezing. They are not crisp or easily compressible, and do not generally rebound or burst even when they strike hard ground.

3443.4. SNOW. White or translucent ice crystals chiefly in complex branched hexagonal form (six-pointed "stars"), often mixed with simple crystals. It occurs under meteorological conditions similar, with the exception of the accompanying temperatures, to those with which corresponding forms of rain are associated.

3443.5. SNOW PELLETS (SOFT HAIL). White, opaque, round or occasionally conical, kernels of snow-like consistency, 1/16 to 1/4 inch in diameter. They are crisp and easily compressible, and may rebound or burst when striking hard surfaces. They occur almost exclusively in showers.

3443.6. SNOW GRAINS (GRANULAR SNOW). The solid equivalent of drizzle. They take the form of minute, branched, star-like snowflakes, or of very fine simple crystals. At times they have the appearance of rime. They occur under meteorological conditions similar to those of drizzle, except that the termperature is lower.

3443.7. ICE CRYSTALS. Small, unbranched crystals in the form of rods or plates that have a descending motion and that may be observed when the sky is clear. Ice crystals are associated with halo phenomena and with temperatures near or below 0° F.

3500. HYDROMETEORS—MISCELLANEOUS

3501. FOG. Minute droplets suspended in the atmosphere. These droplets have no visible downward motion. Fog differs from clouds in that the base of fog is at the surface and the base of clouds is above the surface. It is easily distinguished from haze by its dampness and grey color. It is unusual for fog to form when the difference between the air temperature and the temperature of the dew point is greater than 4.0° F.

3502. GROUND FOG. Same as fog except that the top is not contiguous with the base of clouds that may be above it and obscures less than 0.6 of the sky, i. e., the sky condition above an angle of 36° (see Table 2, Chapter 1) is observable.

3503. SHALLOW FOG. Low-lying fog that does not obstruct horizontal visibility at a level 6 feet or more above the surface.

3504. ICE FOG. Suspended particles in the form of ice crystals. It occurs at low temperatures, and usually in clear, calm weather in high latitudes. The sun is usually visible, and may cause halo phenomena.

3505. DEW. Liquid water that condenses upon objects at or near the surface of the earth at temperatures above freezing. Condensation results when a shallow layer of air immediately above these objects is cooled by conduction until the dew point of the air is reached. Dew occurs on calm, clear nights.

3506. FROST AND FREEZE. Frost and freeze are defined as follows.

3506.1. FROST (HOARFROST). Thin ice crystals in the form of scales, needles, feathers, or fans, deposited under conditions similar to dew, except that temperatures of the surfaces on which frost forms are 32° F. or lower. Air temperatures several degrees above freezing may occur a few feet above the surface upon which frost appears. Determine the intensity in accordance with paragraphs 3506.11 and 3506.12.

3506.11. LIGHT. Surface objects, vegetation, etc., covered with a thin deposit of frost which may be more or less patchy.

3506.12. HEAVY. Surface objects, vegetation, etc., covered with a copious deposit of frost.

3506.2. FREEZE. The condition of the lower atmosphere when the temperature of surface objects is 32° F. or lower. Air temperatures several degrees above the freezing point may occur a few feet above the region where a freeze occurs. A freeze may or may not be accompanied by an actual deposit of frost. When vegetation is injured by relatively low temperature without the occurrence of frost, the condition is termed a freeze. Classification follows.

3506.21. LIGHT. A freezing condition having little destructive effect on vegetation except on tender plants and vines, often accompanied by temperatures of 32° F. or higher at the 5′ observation level.

3506.22. KILLING. A freezing condition capable of having widely destructive effects on staple vegetation usually accompanied by temperatures below 32° F. at the 5′ observation level.

3506.23. HARD. A freezing condition capable of completely destructive effects on staple vegetation which freezes the ground surface solid under foot and causes heavy ice formation on small water surfaces such as puddles and water containers.

3507. RIME. Rime is classified as soft or hard.

3507.1. Soft rime consists of white layers of ice crystals deposited chiefly on vertical surfaces—especially on points and edges of objects—generally in supercooled fog or light fog. On the windward side soft rime may grow to very thick layers, or long feathery cones, or needles pointing into the wind and having a structure similar to that of frost.

3507.2. Hard rime is opaque, granular masses of ice deposited chiefly on vertical surfaces in wet fog at temperatures below 32° F. It is more compact and amorphous than soft rime, and may build out into the wind as glazed cones or feathers.

3508. DRIFTING SNOW. Snow raised from the surface by the wind to a height less than 6 feet above the surface. Drifting snow is not regarded as an obstruction to vision (see Table 29, Item 20 (d)) since it does not restrict visibility at 6 feet or more above the surface. When snow is raised 6 feet or more above the surface, it is classified as blowing snow.

3509. BLOWING SNOW. Snow lifted from the surface by wind to a height 6 feet or more above the surface and blown about in such quantities that the horizontal visibility is restricted at and above that height.

3510. GLAZE. Glaze is composed of homogeneous, transparent ice layers that are built up on exposed surfaces either by supercooled rain or drizzle, or by rain or drizzle that freezes upon contact with surfaces whose temperature is 32° F. or lower. The use of ice-accretion indicators, at stations equipped with them, is required in determining whether or not rain or drizzle is freezing at the time of observation.

3600. LITHOMETEORS

3610. GENERAL. Lithometeors comprise a class of atmospheric phenomena, among which dry haze and smoke are the most common examples. In contrast to a hydrometeor, which consists largely of water, a lithometeor is composed of solid dust or sand particles, or the ashy products of combustion.

3620. HAZE. Dust or salt particles so small that they cannot be felt, or individually seen by the unaided eye; however, they reduce visibility and lend a characteristic opalescent appearance to the air. Haze resembles a uniform veil over the landscape that subdues its colors. This veil has a bluish tinge when viewed against a dark background, such as a mountain; but it has a dirty yellow or orange tinge against a bright background, such as the sun, clouds at the horizon, or snow-capped mountain peaks. When the sun is well up, its light may have a peculiar silvery tinge owing to haze. These color effects distinguish haze from light fog, whose thickness it may sometimes attain. NOTE:—Irregular differences in air temperature may cause a shimmering veil over the landscape; this is called "optical haze."

3630. SMOKE. An ashy product of combustion consisting of fine particles suspended in the atmosphere. When smoke is present the disk of the sun at sunrise and sunset appears very red and during the daytime has a reddish tinge. Smoke at a distance, such as from forest fires, usually has a light grayish or bluish color and is evenly distributed in the upper air.

3640. DUST. Finely divided earthy matter, uniformly distributed in the air. It imparts a tannish or grayish hue to distant objects. The sun's disk is pale and colorless or has a yellow tinge at all periods of the day.

3650. DUST DEVIL. Small, vigorous whirlwind, usually of short duration, made visible by dust picked up from the surface.

3660. BLOWING DUST. Dust picked up locally from the surface by the wind and blown about in clouds or sheets. Blowing dust may completely obscure the sky.

3670. DUSTSTORM. Blowing dust that reduces the visibility to less than 1,100 yards, but not less than 550 yards.

3671. HEAVY (SEVERE) DUSTSTORM. Blowing dust that reduces the visibility to less than 550 yards.

3680. BLOWING SAND. Sand picked up from the surface by the wind and blown about in clouds or sheets.

3690. SANDSTORM. Sand blown through the air by a very strong wind or gale. Visibility is reduced to less than 1,100 yards but not less than 550 yards. The sand particles are not carried to appreciable distances from their source.

3691. HEAVY (SEVERE) SANDSTORM. Blowing sand that reduces visibility to less than 550 yards.

3700. IGNEOUS METEORS

3710. LIGHTNING. A visible electrical discharge occurring in the atmosphere. Lightning is the only common igneous meteor of importance in meteorology. It occurs as a discharge within a cloud; from cloud to cloud; or from cloud to ground. Distant lightning is any lightning that occurs so far from the observer that the resulting thunder cannot be heard. It may be observed as streaks or sheets.

3800. LUMINOUS METEORS

3810. GENERAL. Optical phenomena, with the exception of aurora, are caused by reflection, refraction, or diffraction of the light from the sun or moon as it passes through clouds or other hydrometeors.

3820. HALO, SOLAR OR LUNAR. A luminous ring, commonly of 22° radius around the sun or moon. It usually appears whitish, but it may show the spectral colors with the red on the inside. The sky is darker inside the ring than outside. Halos are formed by refraction of the light as it passes through ice crystals. NOTE.—This description applies only to the 22° halo. Other phenomena are the 46° ring, parhelia, tangent arc, etc.

3830. CORONA, SOLAR OR LUNAR. A luminous ring surrounding the sun or moon and formed by diffraction of light by water droplets. It may vary greatly in size, but is usually smaller than a halo. All the spectral colors may be visible, with the red on the outside, but frequently the inner colors are not visible. Sometimes the spectral colors or portions of them are repeated several times and are somewhat irregularly distributed; this is called iridescence.

3840. RAINBOW. A semicircular arc seen opposite the sun, usually exhibiting all the primary colors, with red on the outside. It is caused by diffraction, refraction and reflection of light within rain drops, which often produces a secondary bow outside the primary one. In this case the colors are reversed.

3850. FOG BOW. A whitish, semicircular arc, seen opposite the sun in fog. Its outer margin has a reddish and its inner a bluish tinge. The middle of the band is white. An additional bow, with the colors reversed, sometimes appears inside the first.

3860. AURORA. A luminescence, frequently called Northern Lights. It is usually seen in the northern skies in lower latitudes, and overhead, or even to the southward of the zenith, in higher latitudes. It may appear in such forms as arcs, rays, curtains, coronas, etc. It is usually of a whitish color but may have various other colors. The lower edges of the arcs and curtains of the aurora are usually fairly well defined, while the upper edges are ill-defined.

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CHAPTER 4. MEASUREMENT OF PRECIPITATION

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CHAPTER 4. MEASUREMENT OF PRECIPITATION

4000. METHOD OF DETERMINING VERTICAL DEPTH OF WATER AND WATER EQUIVALENT

4010. GENERAL. Measurements of all forms of precipitation are expressed in terms of vertical depth of water (or water equivalent, in the case of solid forms) accumulated within a specified time on a horizontal surface. It is assumed that no loss from evaporation occurs. Solid forms of precipitation are also measured on the basis of actual depth of accumulations.

4020. UNIT OF MEASUREMENT. The inch is the unit of measurement of precipitation. The vertical depth of water or water equivalent is expressed to the nearest 0.01 inch; 0.005 inch or less is called a trace. The actual depth of solid forms is expressed to the nearest 0.1 inch, and 0.05 inch or less is called a trace.

4030. TYPES OF GAGES. Precipitation measurements are made from samples caught in gages, or from samples taken from representative areas when the catch of solid forms in the gage is not representative. When more than one type of gage is in use, the official measurement will be taken from the gage appearing highest on the following list:

(1) Shielded gage of any type.
(2) Stick measurement of tipping-bucket gage.
(3) 8-inch gage.
(4) 4-inch gage.
(5) Weighing gage.

All other measurements will be corrected to agree with the official measurement.

4040. MEASUREMENT OF RAIN. If a tipping-bucket gage is used, drain the catch into the measuring tube. If an 8-inch gage is used, it is not necessary to remove the tube to make a measurement. Insert a dry measuring stick into the measuring tube. Permit the stick to rest on the bottom of the tube for two or three seconds. Withdraw the stick and read the depth of precipitation at the upper limit of the wet portion of the stick. Precipitation collected in the 4-inch gage is measured by lining up the top of the catch with the measuring scale on the transparent wall of the receiver.

4041. If the measuring tube of the 8-inch gage is full (this equals two inches of precipitation), carefully remove it from the overflow container and empty it. Pour the overflow into the measuring tube, measure it, and add the value to the two inches emptied from the tube. If in removing the full measuring tube some water is spilled into the overflow container, measure the amount remaining in the tube before measuring the amount of the overflow. The total precipitation is the sum of the individual measurements. When measurement is completed, empty the measuring tube and reassemble the gage.

4050. MEASUREMENT OF SNOW, SLEET, HAIL, FREEZING RAIN. Pour a measured quantity of warm water into the overflow container of the 8-inch gage to melt the collected snow or ice. Pour the entire contents into the measuring tube. Measure the water as outlined in paragraph 4040. To obtain the water equivalent of the precipitation, subtract the amount of water used to melt the solid forms from the total measurement.

4051. When moderate or strong winds occur during a snowfall, the amount of snow collected in the overflow container will not be representative of the actual snowfall, and the catch should be discarded. To obtain a representative amount invert the overflow container of the 8-inch rain gage and use it to cut a cylindrical sample from the snow to be measured at a location where the fall seems least affected by drifting. Melt the sample and measure it in accordance with instructions in paragraph 4050. If the snow is deeper than the inside vertical height of the container, any cylinder with an 8-inch diameter may be used.

4052. When the procedure described in paragraph 4051 is used, the snow sample must not include snow resulting from a previous storm. When the ground has once been covered with snow, greater accuracy in taking future snow samples will be secured if pieces of thin wood or its equivalent at least 2 feet square are placed on top of the first fall at various locations, all of which are not likely to be subject to drifting from a single storm. An observation for the next succeeding storm could then be based on a sample taken from the top of the snow to the wooden square, after which the square would be moved to the top of the snow to serve as a reference point for future observation. When taking a sample, estimate the depth of snow as a check on the vertical thickness of the sample, to insure that a hard crust is not mistaken for the ground or for the reference board.

4053. When an observation is taken of the water equivalent of snow on the ground, the sample of snow will be secured in the same manner as that described in paragraph 4051 except that the sample will extend from the top of the snow to the ground.

4100. ESTIMATION OF WATER EQUIVALENT OF SNOW

4110. When the water equivalent of snow cannot be accurately measured by melting, use one-tenth of the average snow depth as the water equivalent. For example, 10 inches of snow correspond to 1 inch of melted snow.

4200. DEPTH MEASUREMENT OF SOLID FORMS

4210. GENERAL. For purposes of depth measurements, the term snow also includes sleet, glaze, hail, any combination of these, and sheet ice formed directly or indirectly from precipitation. Therefore, if snow falls, melts, and refreezes, the depth of ice formed will be included in depth measurements of snow.

4220. MEASUREMENT OF TOTAL DEPTH. Measurement of total depth will be made in accordance with the following instructions:

4221. UNDRIFTED SNOW. Thrust the measuring stick vertically into the snow so that the end rests on the ground surface. Read the depth to the nearest 0.1 inch. Repeat at several spots 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.

4222. DRIFTED SNOW. When the snow is drifted, a reasonably accurate depth measurement may be made by taking the average of several measurements over representative areas. These should include the greatest and least depths. For example, if spots with no snow are visible, one of the values should be zero.

4230. SNOWFALL WITHIN SPECIFIED PERIODS. These measurements are most conveniently made on a surface that has been cleared of previous snowfall. If such a spot is not available, measure the total depth of snow and subtract the depth previously measured. If the previous snowfall has crusted, the new fall may be measured by permitting the end of the measuring stick to rest on the crust. If different falls of snow are mixed by drifting, measure the total depth of snow and subtract the previously measured depth. The remainder is the approximate depth of the new fall, which will be adjusted if necessary to correct for evaporation and run-off.

CHAPTER 5. TEMPERATURE

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CHAPTER 5. TEMPERATURE

5000. GENERAL

5010. SCALE: With certain specified exceptions, Fahrenheit thermometers are used to measure temperature. It will therefore be assumed, lacking a statement to the contrary, that temperatures as used in these instructions refer to the Fahrenheit scale.

5020. TYPES OF THERMOMETERS. The Fahrenheit thermometers in general use include the following nonrecording and recording types:

5020.1. Nonrecording mercurial or spirit-filled thermometers.
(1) Dry-bulb (exposed).
(2) Wet-bulb (with muslin-covered bulb).
(3) Psychrometer (dry- and wet-bulb mounted on a common back).
(4) Maximum.
(5) Minimum.

5020.2. Nonrecording electrical resistance thermometers.
(1) Telethermoscope.

5020.3. Recording thermometers.
(1) Thermograph (including hygro-thermograph).
(2) Telepsychrometer.

5100. TEMPERATURE READINGS FROM NONRECORDING THERMOMETERS

5110. READING THE THERMOMETER. Determine the temperatures indicated by any mercurial or spirit thermometer as follows:
(1) Stand as far from the thermometer as is consistent with accurate reading, to prevent body heat from affecting the instrument.
(2) Insure that the line of sight from the eye to the top of the liquid column makes an angle of 90° with the thermometer tube. This will avoid an error of parallax.
(3) Read the thermometer to the nearest 0.1°. A degree interval begins at the middle of the degree markings etched on the tube.

5120. DRY-BULB TEMPERATURE. The dry-bulb temperature is the temperature of the free air taken at a specified location under conditions designed to eliminate as completely as possible the effects of extraneous sources of heat and the effects of radiation on the measuring apparatus.

5120.1. With driving rain or snow, the dry-bulb thermometer may become wet. When this occurs, dry the bulb and shield it from the precipitation for a few seconds, or longer if necessary, to permit dissipation of extraneous heat before reading it again. Use this reading for psychrometric purposes rather than the reading made when lowest wet-bulb reading was taken.

5130. WET-BULB TEMPERATURE. The wet-bulb temperature is the lowest temperature to be secured by evaporating water from the muslin-covered bulb of a thermometer at a specified rate of ventilation. It differs from the dry-bulb temperature in an amount dependent on the temperature and relative humidity of the air. At temperatures below −35° F. the wet-bulb thermometer will not be read.

5131. MOISTENING THE WET-BULB. The procedure used in moistening the wet-bulb varies according as the temperature is above or below freezing and as the relative humidity is high or low.

is approximately equal to one r. p. s. (revolution per second) of the geared (2 to 1 ratio) whirling psychrometer crank, 2 r. p. s. of the sling psychrometer, and 3½ r. p. s. of the psychrometer fan or rotor (direct drive) whirling psychrometer. Psychrometric tables and slide rules are based upon this rate of ventilation, which must be maintained to obtain accurate humidity measurements.

5150.1 The sling psychrometer should be used as follows:

(1) Select a shady spot with no obstructions within radius of the whirling sling.
(2) Face into the wind.
(3) Whirl the psychrometer as far in front of the body as possible.

5151. PSYCHROMETRIC READINGS. Obtain readings from the dry- and wet-bulb thermometers in accordance with paragraph 5110 and the following instructions.

5151.1 Saturate the muslin of the wet-bulb thermometer with clean water.

5151.2. After ventilating the psychrometer for about 10 seconds, quickly read both thermometers, the wet-bulb first. Repeat until two successive readings of the wet-bulb are the same, indicating that the wet-bulb has reached its lowest temperature. If the temperature of the wet-bulb should rise between two successive readings, the muslin will have dried and must be moistened again, and the process of ventilation repeated. Before commencing for a second time, permit the wet-bulb to assume as low a temperature as possible.

5151.3. It is especially important that thermometers should be read accurately at low temperatures, for as temperatures (especially below freezing) become lower, a given difference between the dry- and wet-bulb readings has a progressively greater effect upon the accuracy of humidity values computed from them.

5151.4. Read the dry- and wet-bulb temperatures at the time of the lowest wet-bulb reading. (See paragraph 5120.1.)

5151.5. Apply corrections, if necessary, in accordance with paragraph 5140.

5160. MAXIMUM READINGS. The maximum thermometer is a mercurial thermometer made with a constriction in the bore near the bulb to prevent the mercury from withdrawing into the bulb when the temperature falls.

5161. To read the maximum thermometer, release the catch on the support and lower the bulb end slowly until the thermometer is vertical or approximately so, and the mercury column is resting on the constriction at the base. Read similarly to the dry-bulb thermometer.

5162. Before setting the maximum thermometer, be sure that the mercury column is resting on the constriction at the base. Otherwise, the glass forming the constriction may be broken when the thermometer is spun. To set it, spin the thermometer until its reading is the same as that of the dry-bulb temperature. Lock the thermometer in place on the support.

5163. If the maximum thermometer reading is known to be in error, obtain the maximum temperature to the nearest whole degree from a thermogram, if one is available; otherwise, use the highest corrected temperature observed within the observation period.

5170. MINIMUM READINGS. Alcohol is used in the minimum thermometer. A freely moving dark-colored glass index is placed in the bore. As the temperature falls, the retreating upper end of the alcohol column retracts the index, which remains at the position of the lowest temperature until reset.

5171. The minimum temperature is read at the end of the colored glass index farther from the bulb. Read the thermometer without disturbing it and while it is in its correct position for exposure. It will be read before reading the maximum thermometer. Set the minimum thermometer after the maximum thermometer has been set, by turning it to a vertical position and holding it bulb end up until the index reaches the end of the column. Return the thermometer to its correct position.

5172. Minimum thermometers are subject to errors caused by separation of the spirit column. Sometimes the spirit vapor condenses in the upper end of the bore to form one or two short segments above the rest of the column. At other times, bubbles that form in the column may trap the index. Erroneous readings will result in both cases, and therefore the thermometer should be examined at each observation for separation of the column. Errors also result from recession of the index owing, chiefly, to the shelter's being jarred or subjected to vibration by the wind.

5173. If the minimum thermometer reading is known to be erroneous, obtain the minimum temperature to the nearest whole degree from the thermogram, if one is available, or use the lowest corrected temperature observed within the observation period.

NOTE.—The maximum and minimum temperatures for any observation period must be at least as high and low, respectively, as any temperature observed within the period, including those observed at the beginning and end of the period.

5180. TELETHERMOSCOPE READINGS. The telethermoscope is used to obtain air temperatures at a location remote from the observer. It is an electrical resistance thermometer, the resistance of which changes with the temperature. The instruments are calibrated to read directly in degrees Fahrenheit.

5200. RECORDING THERMOMETERS

5210. THERMOGRAPH. The thermograph consists of a temperature-sensitive element whose movements are communicated by suitable linkage to a pen bearing upon a chart that is mounted on a clock-driven drum. A continuous record of temperature is traced upon the chart, which is called a thermogram. The temperature-sensitive element is either a bimetallic thermometer or a Bourdon-tube assembly. When the thermograph is combined with a humidity measuring instrument it is called a hygrothermograph.

5211. The temperature is read on a thermogram by first finding the point at which the appropriate printed time curve intersects the temperature trace. This point is evaluated in terms of temperature by referring it to the closest of the horizontal printed lines of the thermogram. These lines correspond to the engraved degree marks on a thermometer tube, and are labeled accordingly. Interpolation may be necessary for values of temperature and time intermediate between those corresponding to the printed lines of the thermogram.

5212. At specified times, make a time-check mark on the trace by depressing the pen the width of two temperature intervals printed on the chart. (See paragraph 9381.)

5300. SNOW SURFACE TEMPERATURE OBSERVATIONS

5310. GENERAL. Snow surface temperature observations will be taken at specified raob stations north of the 40th parallel under the conditions stated below. They will be taken not later than 10 minutes after the release of the nighttime radiosonde and preferably as soon after release as possible.

(1) $\frac{5}{10}$ of the ground is covered with snow not less than 2 inches in average depth.
(2) A snow-covered area is available that is remote from buildings and that will permit exposure of the thermometer, in accordance with paragraph 5320, within 200 feet of the instrument shelter.
(3) Snow between shelter and point of exposure is relatively level.
(4) Precipitation is not occurring and fog is not present.
(5) Height of the dry-bulb thermometer above the snow-surface thermometer can be determined with reasonable accuracy.

5320. EXPOSURE OF THE THERMOMETER. The thermometer will be exposed as follows:

(1) At least 50 feet from the edge of the snow-covered area, whenever complete snow coverage is not present.
(2) As close to the instrument shelter as possible and preferably under it.
(3) If the snow is too light to support the weight of the thermometer, place it on a piece of

metal light enough to be supported by the snow, with the bulb extending beyond the metal support.

(4) Cover the bulb with ⅛ to ½ inch of snow.

(5) Expose the thermometer for at least ten minutes prior to reading it.

5330. READING THE THERMOMETER. Read the thermometer to the nearest whole degree before removing it from the snow and while it is in a horizontal position. At the same time note the depth of snow under the thermometer.

5340. HEIGHT OF DRY-BULB ABOVE SNOW SURFACE. Favorable exposure sites within 200 feet of the instrument shelter should be sketched on a map to assist in selecting a suitable site for exposing the snow surface thermometer under various conditions. When there is no snow on the ground, compute the differences in elevation between these exposure sites and the dry-bulb thermometer. The height of the dry-bulb above the snow surface at each observation thereafter will be determined by subtracting algebraically the depth of snow under the exposed thermometer from the difference in elevation between the exposure site and the dry-bulb thermometer.

5400. WATER TEMPERATURE OBSERVATIONS

5410. Read the temperature of the water surface (sea or lake) to the nearest 0.1° F. at designated stations.

CHAPTER 6. HUMIDITY MEASUREMENT

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CHAPTER 6. HUMIDITY MEASUREMENT

6000. DEFINITIONS

6010. GENERAL. These instructions are concerned with the expression of humidity in terms of relative humidity and dew point. These data are calculated with psychrometric tables or slide rules, based on atmospheric pressures of 23, 25, 27, 28, 29, and 30 inches of mercury. At Weather Bureau stations if a psychrometric slide rule is available, it will be used in preference to the tables.

6010.1. Relative humidity and dew point data can be expressed with respect to ice or water. For purposes of this manual, it is required that these data be expressed at all temperatures with respect to water. The circular slide rule satisfies this requirement. Psychrometric tables numbered WB 235 express values of relative humidity with respect to ice when the dry-bulb is less than 32°, and of dew points, with respect to ice when the dew point is less than 32°. These values must be converted to their water equivalent, and Tables 9 and 10 are provided for this purpose.

6020. DEW POINT. The dew point is the temperature to which a sample of air must be cooled, while the mixing ratio [1] and barometric pressure remain constant, in order to attain saturation [2] with respect to water. The dew point is expressed to the nearest whole degree Fahrenheit.

6030. RELATIVE HUMIDITY. Relative humidity is the percentage of (a) the mixing ratio of a sample of air to (b) the mixing ratio of air saturated with respect to water at the same temperature and pressure as those of the sample.

6100. PSYCHROMETRIC COMPUTATIONS

6110. DEPRESSION OF THE WET-BULB. The depression of the wet-bulb is the algebraic difference between the dry- and wet-bulb temperatures. It is used with the slide rule and psychrometric tables to make dew point and relative humidity computations.

EXAMPLES:

(1)	Dry-bulb temperature	40. 6
	Wet-bulb temperature	32. 1
	Depression	8. 5
(2)	Dry-bulb temperature	1. 2
	Wet-bulb temperature	−0. 7
	Depression	1. 9
(3)	Dry-bulb temperature	−3. 4
	Wet-bulb temperature	−4. 7
	Depression	1. 3

6110.1. When the wet-bulb is covered with water and a depression cannot be obtained, the relative humidity will be regarded as 100%, and the temperature of the dew point as the same as that of the wet-bulb. If the wet-bulb is covered with ice, the relative humidity and the dew point will be converted to their water equivalents. (See pars. 6131.1—6131.2.)

[1] MIXING RATIO. The mixing ratio of moist air is the ratio of the mass of water vapor to the mass of dry air with which the water vapor is associated.

[2] SATURATION. Saturation as used here denotes a state in which the mixing ratio of a sample of air is equal to that of air immediately over a flat surface of pure water, where equality exists between the rates of evaporation from and condensation of water vapor on the surface, provided that the temperature and barometric pressure of the sample are the same as those of the surface and the superjacent air.

6120. PSYCHROMETRIC SLIDE RULE. Use the slide rule based on the barometric pressure nearest the normal station pressure. (See par. 6010.) Instructions for use of the rule are printed on it. Note that different scales of the rule will be used according as the wet-bulb is covered with ice or water at the time of observation.

6130. PSYCHROMETRIC TABLES. Use the tables based on the barometric pressure nearest the normal station pressure. (See par. 6010.) The arguments are (a) the dry-bulb temperature as given in the vertical column at the left of the table, and (b) the depression of the wet-bulb printed across the top of the table. Dew point and relative humidity data are given as tabular values on correspondingly captioned pages.

6131. The dew point and relative humidity are found from the tables as follows:

(1) When the temperature of the dry-bulb and the depression of the wet-bulb coincide with those given in the tables, the dew point or relative humidity is the tabular value at the intersection of the vertical column corresponding to the wet-bulb depression and the horizontal row corresponding to the air temperature.
(2) When either the air temperature or the depression of the wet-bulb is between the values given in the tables, find, by single interpolation, the proportional part to be used in determining the dew point or relative humidity from the tabular values.
(3) When both the air temperature and the depression of the wet-bulb are between the values given in the tables, double interpolation is required to determine the proportional parts to be used in the calculation of the dew point from the tabular values.

6131.1. When the dew point is less than 32°, dew points derived from the tables are expressed with respect to ice. (See par. 6010.1.) Before these data are used for any purpose, they must be converted to their water equivalent. Using Table 9, find on the upper scale the value with respect to ice derived from the psychrometric tables. Read this point in terms of the lower scale to find the corresponding value with respect to water.

6131.2. When the temperature of the dry-bulb is less than 32°, relative humidity data derived from the tables are with respect to ice and must be converted to their water equivalent. Using Table 10, find the tabular value at the intersection of (1) the vertical column corresponding to the value derived from the psychrometric tables, and (2) the horizontal row corresponding to the dry-bulb temperature in whole degrees. Interpolation will be made for values of relative humidity between those printed at the top of the table.

EXAMPLE: A small portion of the psychrometric tables is reproduced below.

Temperature of dew point in degrees Fahrenheit

(Pressure=29.0 inches)

Air temperature	Depression of wet-bulb thermometer ($t-t'$)				
	0.2	0.4	0.6	0.8	1.0
−10	−12	−14	−17	−19	−23
−9	−11	−13	−15	−18	−21
−8	−10	−12	−14	−16	−19
	0.5	1.0	1.5	2.0	2.5
40	39	38	37	35	34
41	40	39	38	37	35
42	41	40	39	38	36

Relative humidity, percent—Fahrenheit temperatures

(Pressure=29.0 inches)

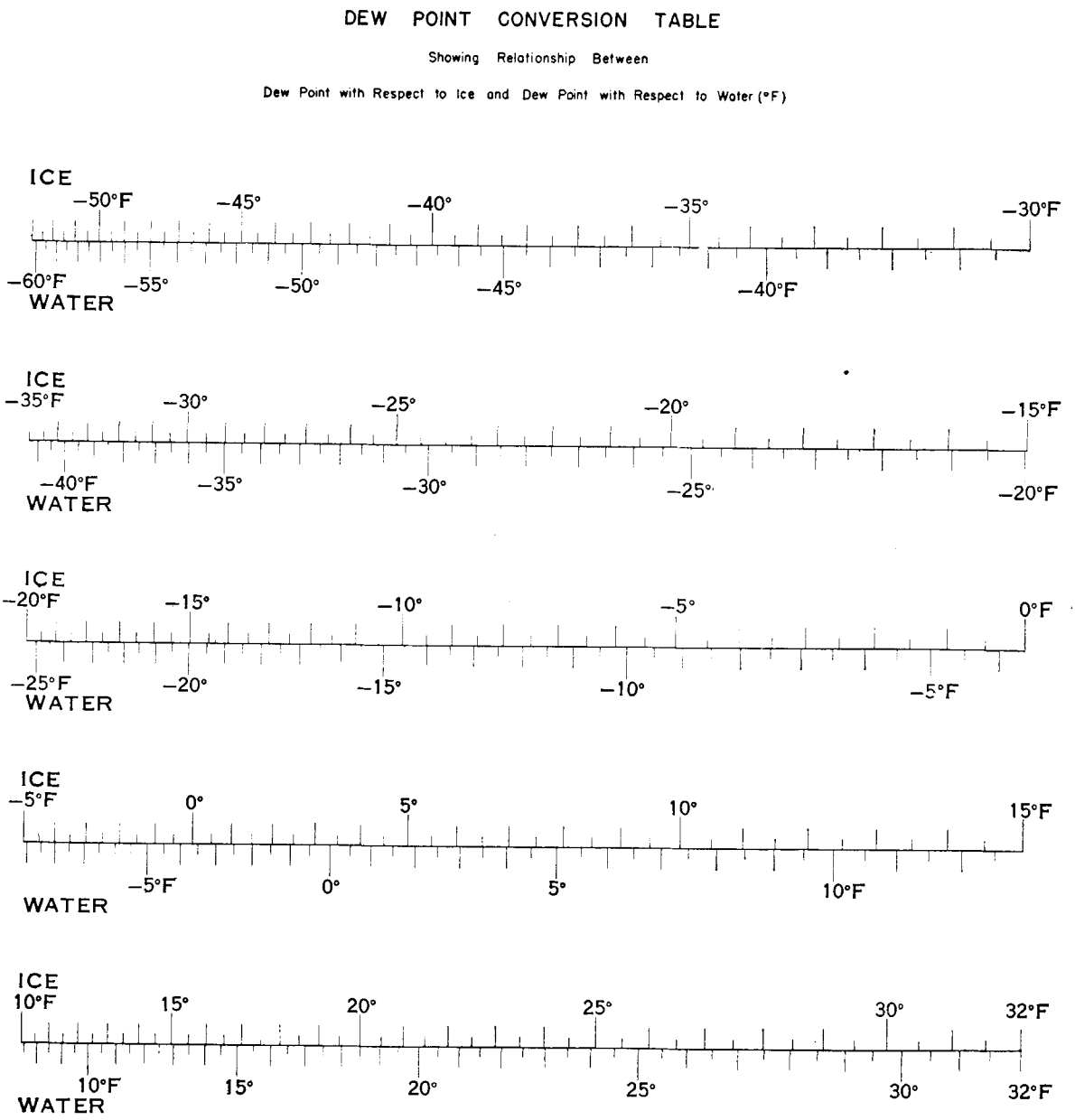
Air temperature	Depression of wet-bulb thermometer (t−t′)				
	0.2	0.4	0.6	0.8	1.0
−10	90	79	69	58	48
−9	90	80	70	60	51
−8	91	81	72	62	53
	0. 5	1. 0	1. 5	2. 0	2. 5
40	96	92	88	84	80
41	96	92	88	84	80
42	96	92	88	85	81

COMPUTATIONS

Dry-bulb reading	−9. 6°	−8. 4°	41. 3°	−10. 0°
Wet-bulb reading	−10. 2°	−9. 3°	39. 9°	−10. 7°
Depression of wet-bulb	0. 6°	0. 9°	1. 4°	0. 7°
Dew point temperature (ice)	−16°	−18°		−18°
Dew point temperature (water) (See Table 9)	−21°	−23°	38°	−23°
Relative humidity (ice)	69	57		64
Relative humidity (water) (See Table 10)	55	46	89	51

(Note that the relative humidity and dew point for temperatures below freezing in this example are with respect to ice and must be converted to their water equivalents.)

TABLE 9.—*Dew point conversion table, showing relationship between dew point with respect to ice and dew point with respect to water (° F.).*



[NOTE.—Saturation vapor pressures over ice and water, used in computing this table, are based on formulas by J. A. Goff and S. Gratch, *Trans. Amer. Soc. Heat. and Vent. Eng.*, vol. 52, p. 95, 1946. Formula for saturation vapor pressure over water assumed to apply from −60° F. to 140° F.]

TABLE 10A—*Relative humidity conversion table*

[Tabular values are relative humidities with respect to water (RH_w) corresponding to relative humidities with respect to ice (RH_i) given at heads of the columns]

Dry bulb temp. (°F.)	Relative humidity with respect to ice (RH_i)										Dry bulb temp. (° F.)	Relative humidity ratio RH_w/RH_i
	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%		
	%	%	%	%	%	%	%	%	%	%		
−11	7.9	15.8	23.8	31.7	39.6	47.5	55.5	63.4	71.3	79.2	−11	0.7922
−10	8.0	15.9	23.9	31.9	39.8	47.8	55.7	63.7	71.7	79.6	−10	.7963
−9	8.0	16.0	24.0	32.0	40.0	48.0	56.0	64.1	72.1	80.1	−9	.8007
−8	8.1	16.1	24.2	32.2	40.3	48.3	56.4	64.4	72.5	80.5	−8	.8051
−7	8.1	16.2	24.3	32.4	40.5	48.6	56.7	64.8	72.9	80.9	−7	.8095
−6	8.1	16.3	24.4	32.6	40.7	48.8	57.0	65.1	73.2	81.4	−6	.8139
−5	8.2	16.4	24.6	32.7	40.9	49.1	57.3	65.5	73.7	81.8	−5	.8184
−4	8.2	16.5	24.7	32.9	41.1	49.4	57.6	65.8	74.1	82.3	−4	.8230
−3	8.3	16.5	24.8	33.1	41.4	49.6	57.9	66.2	74.4	82.7	−3	.8271
−2	8.3	16.6	24.9	33.3	41.6	49.9	58.2	66.5	74.8	83.2	−2	.8315
−1	8.4	16.7	25.1	33.4	41.8	50.2	58.5	66.9	75.2	83.6	−1	.8360
0	8.4	16.8	25.2	33.6	42.1	50.5	58.9	67.3	75.7	84.1	0	.8410
+1	8.5	16.9	25.4	33.8	42.3	50.7	59.2	67.6	76.1	84.5	+1	.8454
2	8.5	17.0	25.5	34.0	42.5	51.0	59.5	68.0	76.5	85.0	2	.8501
3	8.5	17.1	25.6	34.2	42.7	51.3	59.8	68.4	76.9	85.5	3	.8546
4	8.6	17.2	25.8	34.4	43.0	51.6	60.2	68.7	77.3	85.9	4	.8593
5	8.6	17.3	25.9	34.6	43.2	51.8	60.5	69.1	77.8	86.4	5	.8641
6	8.7	17.4	26.1	34.7	43.4	52.1	60.8	69.5	78.2	86.8	6	.8685
7	8.7	17.5	26.2	34.9	43.7	52.4	61.1	69.9	78.6	87.3	7	.8733
8	8.8	17.6	26.3	35.1	43.9	52.7	61.5	70.2	79.0	87.8	8	.8780
9	8.8	17.7	26.5	35.3	44.1	53.0	61.8	70.6	79.5	88.3	9	.8829
10	8.9	17.8	26.6	35.5	44.4	53.3	62.1	71.0	79.9	88.8	10	.8876
11	8.9	17.9	26.8	35.7	44.6	53.6	62.5	71.4	80.3	89.3	11	.8927
12	9.0	17.9	26.9	35.9	44.9	53.8	62.8	71.8	80.8	89.7	12	.8974
13	9.0	18.0	27.1	36.1	45.1	54.1	63.2	72.2	81.2	90.2	13	.9024
14	9.1	18.1	27.2	36.3	45.4	54.4	63.5	72.6	81.6	90.7	14	.9072
15	9.1	18.2	27.4	36.5	45.6	54.7	63.8	73.0	82.1	91.2	15	.9121
16	9.2	18.3	27.5	36.7	45.9	55.0	64.2	73.4	82.5	91.7	16	.9171
17	9.2	18.4	27.7	36.9	46.1	55.3	64.5	73.8	83.0	92.2	17	.9220
18	9.3	18.5	27.8	37.1	46.4	55.6	64.9	74.2	83.4	92.7	18	.9270
19	9.3	18.6	28.0	37.3	46.6	55.9	65.3	74.6	83.9	93.2	19	.9322
20	9.4	18.7	28.1	37.5	46.9	56.2	65.6	75.0	84.3	93.7	20	.9371
21	9.4	18.8	28.3	37.7	47.1	56.5	65.9	75.4	84.8	94.2	21	.9421
22	9.5	18.9	28.4	37.9	47.4	56.8	66.3	75.8	85.3	94.7	22	.9473
23	9.5	19.1	28.6	38.1	47.6	57.2	66.7	76.2	85.7	95.3	23	.9526
24	9.6	19.2	28.7	38.3	47.9	57.5	67.0	76.6	86.2	95.8	24	.9576
25	9.6	19.3	28.9	38.5	48.1	57.8	67.4	77.0	86.7	96.3	25	.9629
26	9.7	19.4	29.0	38.7	48.4	58.1	67.8	77.4	87.1	96.8	26	.9680
27	9.7	19.5	29.2	38.9	48.7	58.4	68.1	77.9	87.6	97.3	27	.9733
28	9.8	19.6	29.4	39.1	48.9	58.7	68.5	78.3	88.1	97.9	28	.9786
29	9.8	19.7	29.5	39.4	49.2	59.0	68.9	78.7	88.5	98.4	29	.9838
30	9.9	19.8	29.7	39.6	49.5	59.4	69.2	79.1	89.0	98.9	30	.9892
31	9.9	19.9	29.8	39.8	49.7	59.7	69.6	79.6	89.5	99.4	31	.9944
32	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	32	.9999

NOTE: Saturation vapor pressures over ice and water, used in computing this table, are based on formulas by J. A. Goff and S. Gratch, *Trans. Amer. Soc. Heat. and Vent. Eng.*, vol. 52, p. 95 (1946). Formula for saturation vapor pressure over water assumed to apply from −60° F. to 140° F.

TABLE 10B—*Relative humidity conversion table*

Tabular values are relative humidities with respect to water (RH_w) corresponding to relative humidities with respect to ice (RH_i) given at heads of the columns]

Dry-bulb temp. (°F)	Relative humidity with respect to ice (RH_i)										Dry bulb temp. (° F)	Relative humidity ratio RH_w/RH_i
	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%		
	%	%	%	%	%	%	%	%	%	%		
−60	6.1	12.3	18.4	24.5	30.7	36.8	42.9	49.0	55.2	61.3	−60	0.6130
−59	6.2	12.3	18.5	24.6	30.8	37.0	43.1	49.3	55.4	61.6	−59	.6160
−58	6.2	12.4	18.6	24.8	31.0	37.1	43.3	49.5	55.7	61.9	−58	.6191
−57	6.2	12.4	18.7	24.9	31.1	37.3	43.5	49.8	56.0	62.2	−57	.6220
−56	6.3	12.5	18.8	25.0	31.3	37.5	43.8	50.0	56.3	62.5	−56	.6252
−55	6.3	12.6	18.9	25.1	31.4	37.7	44.0	50.3	56.6	62.8	−55	.6284
−54	6.3	12.6	18.9	25.3	31.6	37.9	44.2	50.5	56.8	63.1	−54	.6315
−53	6.3	12.7	19.0	25.4	31.7	38.1	44.4	50.8	57.1	63.5	−53	.6347
−52	6.4	12.8	19.1	25.5	31.9	38.3	44.7	51.0	57.4	63.8	−52	.6379
−51	6.4	12.8	19.2	25.6	32.1	38.5	44.9	51.3	57.7	64.1	−51	.6412
−50	6.4	12.9	19.3	25.8	32.2	38.7	45.1	51.5	58.0	64.4	−50	.6444
−49	6.5	13.0	19.4	25.9	32.4	38.9	45.4	51.8	58.3	64.8	−49	.6479
−48	6.5	13.0	19.5	26.0	32.5	39.0	45.6	52.1	58.6	65.1	−48	.6507
−47	6.5	13.1	19.6	26.2	32.7	39.2	45.8	52.3	58.9	65.4	−47	.6541
−46	6.6	13.2	19.7	26.3	32.9	39.5	46.0	52.6	59.2	65.8	−46	.6576
−45	6.6	13.2	19.8	26.4	33.1	39.7	46.3	52.9	59.5	66.1	−45	.6611
−44	6.6	13.3	19.9	26.6	33.2	39.9	46.5	53.2	59.8	66.5	−44	.6646
−43	6.7	13.4	20.0	26.7	33.4	40.1	46.7	53.4	60.1	66.8	−43	.6677
−42	6.7	13.4	20.1	26.9	33.6	40.3	47.0	53.7	60.4	67.2	−42	.6716
−41	6.8	13.5	20.3	27.0	33.8	40.5	47.3	54.0	60.8	67.5	−41	.6751
−40	6.8	13.6	20.4	27.1	33.9	40.7	47.5	54.3	61.1	67.8	−40	.6785
−39	6.8	13.6	20.5	27.3	34.1	40.9	47.7	54.6	61.4	68.2	−39	.6820
−38	6.9	13.7	20.6	27.4	34.3	41.1	48.0	54.8	61.7	68.6	−38	.6855
−37	6.9	13.8	20.7	27.6	34.5	41.4	48.3	55.2	62.1	69.0	−37	.6895
−36	6.9	13.9	20.8	27.7	34.6	41.6	48.5	55.4	62.3	69.3	−36	.6928
−35	7.0	13.9	20.9	27.9	34.8	41.8	48.8	55.7	62.7	69.6	−35	.6965
−34	7.0	14.0	21.0	28.0	35.0	42.0	49.0	56.0	63.0	70.0	−34	.7002
−33	7.0	14.1	21.1	28.2	35.2	42.2	49.3	56.3	63.4	70.4	−33	.7039
−32	7.1	14.2	21.2	28.3	35.4	42.5	49.5	56.6	63.7	70.8	−32	.7077
−31	7.1	14.2	21.3	28.5	35.6	42.7	49.8	56.9	64.0	71.1	−31	.7114
−30	7.2	14.3	21.5	28.6	35.8	42.9	50.1	57.2	64.4	71.5	−30	.7152
−29	7.2	14.4	21.6	28.8	36.0	43.2	50.3	57.5	64.7	71.9	−29	.7192
−28	7.2	14.5	21.7	28.9	36.1	43.4	50.6	57.8	65.1	72.3	−28	.7229
−27	7.3	14.5	21.8	29.1	36.3	43.6	50.9	58.1	65.4	72.7	−27	.7267
−26	7.3	14.6	21.9	29.2	36.5	43.8	51.2	58.5	65.8	73.1	−26	.7308
−25	7.3	14.7	22.0	29.4	36.7	44.1	51.4	58.8	66.1	73.4	−25	.7344
−24	7.4	14.8	22.2	29.5	36.9	44.3	51.7	59.1	66.5	73.9	−24	.7386
−23	7.4	14.8	22.3	29.7	37.1	44.5	52.0	59.4	66.8	74.2	−23	.7425
−22	7.5	14.9	22.4	29.9	37.3	44.8	52.3	59.7	67.2	74.6	−22	.7465
−21	7.5	15.0	22.5	30.0	37.5	45 0	52.5	60.0	67.5	75.0	−21	.7504
−20	7.5	15.1	22.6	30.2	37.7	4o.3	52.8	60.4	67.9	75.5	−20	.7546
−19	7.6	15.2	22.8	30.3	37.9	45.5	53.1	60.7	68.3	75.9	−19	.7586
−18	7.6	15.3	22.9	30.5	38.1	45.8	53.4	61.0	68.6	76.3	−18	.7627
−17	7.7	15.3	23.0	30.7	38.3	46.0	53.7	61.3	69.0	76.7	−17	.7668
−16	7.7	15.4	23.1	30.8	38.5	46.3	54.0	61.7	69.4	77.1	−16	.7709
−15	7.8	15.5	23.3	31.0	38.8	46.5	54.3	62.0	69.8	77.5	−15	.7751
−14	7.8	15.6	23.4	31.2	39.0	46.8	54.6	62.4	70.1	77.9	−14	.7794
−13	7.8	15.7	23.5	31.3	39.2	47.0	54.8	62.7	70.5	78.4	−13	.7835
−12	7.9	15.8	23.6	31.5	39.4	47.3	55.1	63.0	70.9	78.8	−12	.7878
−11	7.9	15.8	23.8	31.7	39.6	47.5	55.5	63.4	71.3	79.2	−11	.7922

NOTE: Saturation vapor pressures over ice and water, used in computing this table, are based on formulas by J. A. Goff and S. Gratch, *Trans. Amer. Soc. Heat. and Vent. Eng.*, vol. 52, p. 95 (1946). Formula for saturation vapor pressure over water assumed to apply from −60° F. to 140°F.

6200. HYGROGRAPH

6210. GENERAL. The hygrograph provides a continuous record of relative humidity. To read the relative humidity from the hygrograph, follow the same procedure as that for the thermograph, described in paragraph 5211. The scale is based on relative humidity values from 0 to 100 percent. When the hygrograph is adjusted to correspond with a psychrometric reading made at dry-bulb temperatures below freezing, the psychrometric value of relative humidity with respect to water will be used.

6220. TIME-CHECK LINES ON HYGROGRAM. A time-check line will be made on the hygrogram at any convenient time by depressing the pen about the width of two divisions of the graph.

CHAPTER 7. PRESSURE

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CHAPTER 7. PRESSURE

7000. GENERAL

7010. Atmospheric pressure is the pressure exerted by the weight of a column of air, of unit area, extending vertically from the reference surface to the top of the atmosphere. Atmospheric pressure is measured by means of a barometer, four types of which are in general use:

(1) Mercurial barometers (adjustable and fixed-cistern).
(2) Aneroid barometers.
(3) Aneroid barographs.
(4) Altimeter setting indicators.

Pressure is not determined from types (2), (3), and (4) above unless an approved mercurial barometer is available for periodically checking them.

7100. READING MERCURIAL BAROMETERS

7110. ADJUSTABLE-CISTERN BAROMETERS. The construction of adjustable-cistern barometers requires that the mercury surface in the cistern be adjusted to the tip of an ivory point projecting downward into the cistern. The tip corresponds to the zero line of a scale calibrated in inches and hundredths.

7111. Prior to reading the barometer scale perform the following operations in the order given below:

(1) Read to the nearest 0.5° F. the thermometer attached to the barrel.
(2) Turn the thumb-screw at the bottom of the barometer until the surface of the mercury in the cistern touches the tip of the ivory point. The tip of the ivory point should be coincident with its image in the mercury. If a dimple forms on the surface, the cistern has been raised too far. Contact of the mercury with the ivory point is seen more easily against a white background.
(3) Tap the barrel near the top of the column of mercury.
(4) Set the vernier (movable scale) so that the base just cuts off light at the highest point of the meniscus. The meniscus is the curved upper surface of the mercury column. The front and rear sighting edges of the base of the vernier coincide when they are on a level with the eye. A white background is helpful when making this adjustment of the vernier.
(5) Lower the mercury about ¼ inch from the ivory point; do not change the vernier setting.

7112. Verniers on adjustable-cistern barometers are constructed in two ratios: 10 to 9, and 25 to 24. (See Figure 3.) The scale with which the 10 to 9 vernier is used is graduated at intervals of 0.100 inch. The length of the graduated portion of the vernier, 0.900 inch, is divided into 10 spaces, each 0.090 inch in length. Therefore, each vernier interval is 0.010 inch shorter than scale intervals. With these verniers the scale may be read without interpolation to the nearest 0.010 inch. The length of the 25 to 24 vernier, 1.200 inches, is divided into 25 intervals, each 0.048 inch in length. As the scale is graduated at intervals of 0.050 inch, each space on the vernier is 0.002 inch shorter than the spaces on the scale. With these verniers the scale may be read without interpolation to the nearest 0.002 inch.

7113. Obtain the barometer reading to the nearest 0.001 inch as follows:

(1) When both the zero and the top graduation lines of the vernier coincide with scale lines, read the scale at its coincidence with the zero line of the vernier; no further reading is necessary. If the zero line of the vernier lies between two lines on the fixed scale, read on the scale the value of the lower line, and proceed as outlined in (2) and (3) below.
(2) Select on the vernier the line that lies exactly opposite, or the shortest distance above, a line on the scale. For the 10 to 9 vernier multiply the number of this line by 0.010 and add the product to the reading obtained in step (1). For the 25 to 24 vernier multiply the number of the line by 0.002 and add the product to the reading obtained in step (1).
(3) Estimate the final thousandths, if any, from the proportional parts, and add to the sum obtained in step (2).

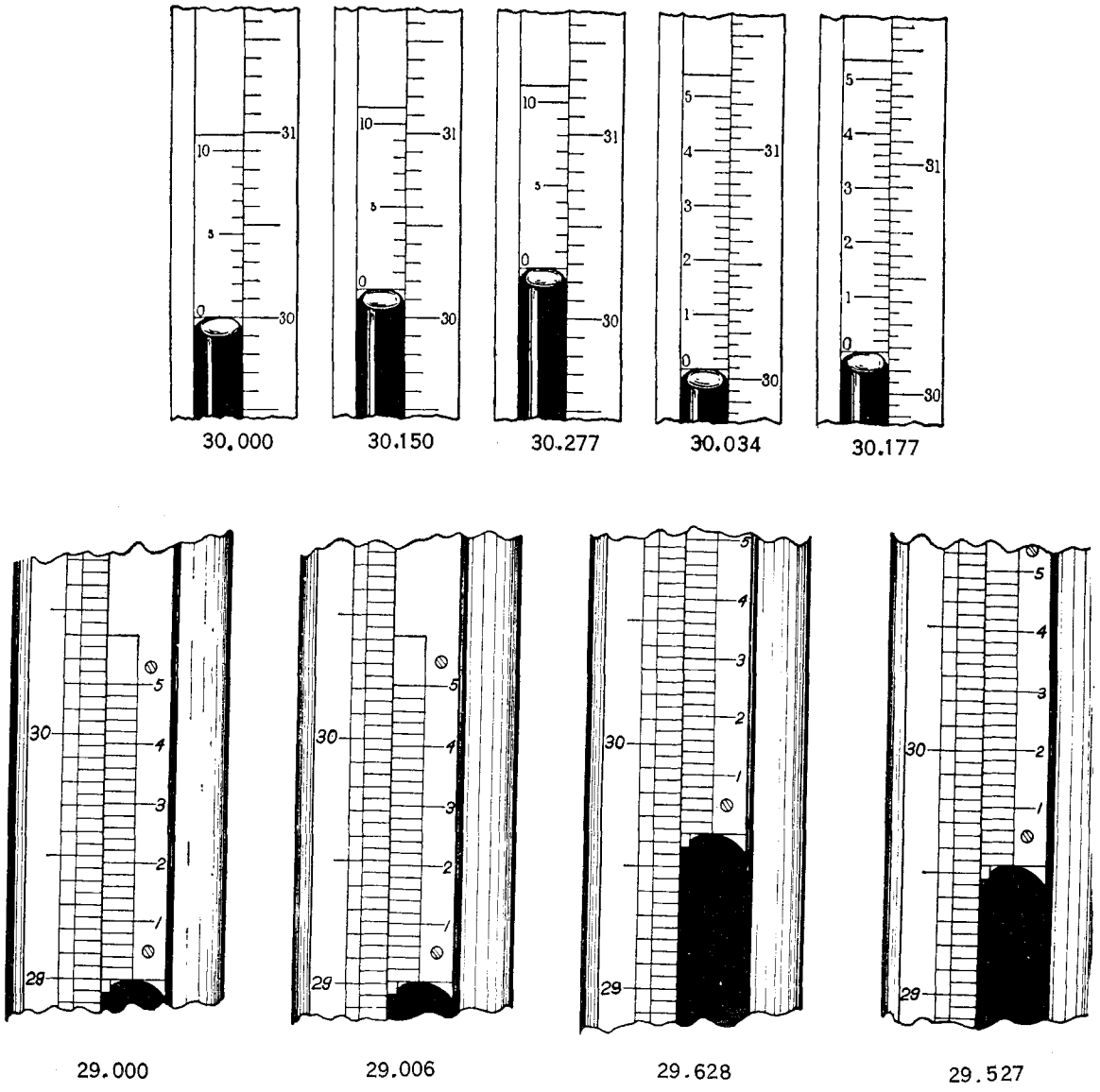

FIGURE 3.—Barometer verniers.

7120. FIXED-CISTERN BAROMETERS. The Bowen fixed-cistern barometer is calibrated to give pressure readings in millibars; the attached thermometer is in the centigrade scale.

7121. Before reading the Bowen barometer:
(1) Read the attached thermometer to the nearest 0.5°C.
(2) Tap the barrel near the meniscus.
(3) Set the vernier as for the adjustable-cistern type.

7122. The vernier on this barometer is so made that 10 spaces on the vernier are equal in length to 19 millibar spaces on the scale. That is, the length of 1 division on the vernier is equivalent to 1.90 millibars.

7123. Read the barometer to the nearest 0.01 millibar as follows:
(1) If the zero line of the vernier is exactly opposite a line on the scale, read the scale directly to whole millibars at that line. If the zero line of the vernier falls between two lines on the scale, read the value of the lower line, and continue as indicated in (2) and (3) below.

(2) Select the line on the vernier that lies exactly opposite, or the shortest distance above, a line on the scale. Multiply the number of this vernier line by 0.10, and add the product to the reading obtained in step (1).
(3) Estimate the hundredths of millibars, and add the value to the result obtained in step (2).

7200. DETERMINATION OF STATION PRESSURE

7210. GENERAL. Station pressure is determined at fixed intervals by means of corrected mercurial barometer readings, and at intermediate times by means of aneroid barometers or barographs periodically corrected to mercurial readings. Station pressure from mercurial barometer readings is the pressure value obtained after all required corrections have been applied to the observed mercurial reading. Station pressure from aneroid barometers and barographs is the value obtained after the correction established from the mercurial barometer reading has been applied.

7220. STATION ELEVATION. Station pressure is related to an assigned station elevation (H_b) above mean sea level. This assigned elevation remains constant even should the station be moved to a different elevation. If it should be moved, a "removal correction" is applied to readings taken at the new location. The corrected reading is then very close to what it would have been if it had been taken at the original location.

7230. CORRECTIONS TO BAROMETER READINGS—GENERAL. Atmospheric pressure from the observed barometer readings must be corrected for temperature, local gravity, and instrumental error. In addition, to make the pressure value comparable with previous pressure values at the same station, the application of a removal correction may be required (see paragraph 7220). Corrections to be applied to the different types of mercurial barometers are described as follows.

7231. CORRECTIONS TO ADJUSTABLE-CISTERN BAROMETERS. Corrections applied to readings of adjustable-cistern barometers comprise a temperature correction, a scale error and capillarity (instrumental) correction, local gravity correction, and sometimes a correction to assigned station elevation. The temperature correction is determined from the publication "Correction of Mercurial Barometer for Temperature, English Measures." Corrections for scale error and capillarity, local gravity, and removal are collectively referred to as the "sum of corrections." They are listed on the barometer correction card furnished with each barometer. The correction to station elevation may be constant. If the correction varies with temperature, owing to the amount of difference between assigned station elevation and the elevation of the barometer, the "sum of corrections" will be found on the back of the card. It will facilitate computation if the "sum of corrections" and the temperature corrections are incorporated into a single table. The algebraic sum of the temperature correction and the "sum of corrections," as defined above, in such a table is referred to as the total correction. To obtain the total correction from this table use as arguments the attached thermometer reading to the nearest 0.5° Fahrenheit or centigrade and the observed barometer reading in inches and thousandths or millibars and tenths.

7232. CORRECTIONS TO BOWEN FIXED-CISTERN BAROMETER. Corrections applied to the Bowen barometer comprise temperature, volume, gravity, residual, and removal (if required). These corrections are incorporated into a table furnished to the stations requiring it. To obtain the total corrections from this table, use as arguments the attached thermometer reading to the nearest 0.5° C. and the observed reading in millibars and hundredths.

7240. ANEROID BAROGRAPH. A continuous record of station pressure is recorded on a chart by the aneroid barograph. The barograph consists of an aneroid pressure unit with pen linkage, and a clock-driven drum upon which the chart is fastened. The scale of the 2½ to 1 open-scale microbarograph is magnified, or opened, so that a pressure difference of 1 inch of mercury is represented on the chart by a linear distance of 2½ inches. The distance between adjacent pressure ordinates printed on the chart is equivalent to 0.020 inch of mercury. On the 1 to 1 scale, a pressure difference of 1 inch of mercury is represented on the chart by a linear distance of 1 inch. The distance between adjacent pressure ordinates is equivalent to 0.050 inch of mercury.

7241. To determine station pressure from the barograph:
(1) Tap the instrument lightly, on the top of the case.

(2) Read to the nearest 0.005 inch the pressure value indicated by the position of the pen on the chart, estimating for values lying between the printed ordinates.
(3) Apply the correction established for the barograph in accordance with instructions in paragraph 7242.

7242. A barograph will not be used for original determination of pressure unless a correction is established every 6 hours by comparison with the station pressure determined from the mercurial or precision aneroid barometer or altimeter setting indicator. Determine to the nearest 0.01 inch the correction necessary to make the barograph reading agree with the station pressure computed from the barometer reading. If this correction exceeds .05 inch, the barograph should be reset at the time the barometer reading is made. If the barometer is calibrated in millibars, the barograph correction will be determined by converting station pressure from millibars and tenths to inches and hundredths. Apply this correction to all barograph readings until another correction is established at the next succeeding 6-hourly comparison. Post the correction so that it will be available to all personnel taking pressure readings from the barograph.

7243. Make a time-check line on the barograph sheet after the barograph correction is determined. This 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. If the instrument is so exposed that the dash-pot liquid becomes cold, which prevents the pen from returning to position, do not make a time-check line.

7244. Whenever a reading is taken, ascertain that the clock is running and that the ink is flowing properly. When it appears that the pen will pass off the printed divisions of the chart, set the pen up or down, equivalent to one full inch of pressure, by means of the adjusting screw, renumber the lines accordingly, and indicate on the chart the time of the adjustment.

7250. ANEROID BAROMETER. Pressure is indicated on an aneroid barometer by the position of a hand on a graduated dial. Aneroids have dials graduated at intervals equivalent to inches and hundredths of mercury or millibars and tenths. Rapid changes of temperature, or exposure to direct heat or sunlight, may cause erratic performance in an aneroid barometer, and jars or shocks may dislocate elements of the linkage system. If an aneroid barometer is observed to have a correction that tends to be erratic (for example, +0.01 inch at one mercurial barometer comparison, +0.04 inch at the next, and a −0.02 inch at a third) the matter will be reported immediately. An unusually high wind will cause an aneroid barometer to indicate a pressure differing from one obtained from a mercurial barometer. This difference is especially apparent when the exposures of the two instruments are dissimilar. Differences noted at the time of high winds need not be reported unless they persist after the disappearance of the atmospheric conditions first associated with them.

7251. To determine station pressure from the aneroid barometer:
(1) Tap the face of the instrument lightly with the finger or the eraser-end of a pencil to bring the hand to its true position.
(2) Read to the nearest 0.005 inch or 0.1 millibar estimating for values between the scale graduations.
(3) Apply any necessary correction established in accordance with paragraph 7252.

7252. Corrections to be applied to precision-type aneroid barometers will be determined in accordance with instructions issued to the stations requiring them. Other types of aneroid barometers will not be used for original determination of pressure unless a correction is established at 6-hourly intervals by comparison with the station pressure determined from the mercurial or precision-aneroid barometer; or altimeter setting indicator. This correction is the difference between the station pressure computed from the mercurial barometer reading and the pressure indicated at the same time by the aneroid barometer. Apply the correction to all aneroid readings until another is established at the next succeeding 6-hourly observation. Post the correction so that it will be available to all personnel taking pressure readings from the aneroid barometer.

7260. STATION PRESSURE FROM ALTIMETER SETTING INDICATORS. Station pressure will be determined from altimeter setting indicators in accordance with the following instructions, provided that the indicators are periodically compared with mercurial barometers as required by instructions issued to stations having both instruments.

(1) Determine the corrected altimeter setting to the nearest 0.01 inch from the altimeter setting indicator.
(2) Find in the altimeter setting tables the tabular value corresponding to the altimeter setting determined in (1).
(3) Read at the side and top of the table the corresponding station pressure to the nearest 0.01 inch.

NOTE.—If the exact value of the altimeter setting determined in (1) does not appear in the altimeter setting tables, interpolate to obtain the station pressure and dispose of the thousandths digit in accordance with instructions in the Introduction.

7300. SEA-LEVEL PRESSURE

7310. GENERAL. Sea-level pressure represents the atmospheric pressure at sea level under prevailing meteorological conditions of temperature and station pressure. When the station is not at sea level, the station pressure is said to be reduced to sea level. The reduction is accomplished by the use of tables supplied each station. The tables are based on the elevation of the individual station at which they are to be used, and upon certain assumptions implicit in the hypsometric equation employed in their computation. The reduction table may be expressed in inches of mercury, or expressed directly in millibars, according as the original pressure readings are in inches or millibars. The arguments used in the tables are station pressure and temperature. Mean temperature intervals in the reduction tables vary with the station elevation as follows:

Station elevation	Mean temperature intervals
0— 50 feet	None (constant correction)
51— 500 feet	10°
501—1000 feet	5°
1001 feet or more	2°

7320. REDUCTION OF STATION PRESSURE TO SEA-LEVEL PRESSURE. In reducing station pressure to sea-level pressure, use as arguments:
(1) The station pressure rounded to the nearest 0.01 inch or 0.1 millibar in accordance with instructions contained in the Introduction.
(2) The 12-hour mean temperature, to tenths, obtained from the current air temperature, and the air temperature 12 hours previously. If a temperature observation was not made 12 hours previously, determine from the thermograph, to whole degrees, the temperature 12 hours previously.

7321. Determine the sea-level pressure from reduction tables as follows:
(1) When observed values of mean temperature and station pressure correspond exactly with tabular arguments, find the sea-level pressure as a tabular value at the intersection of the respective columns.
(2) In all other instances, interpolate for pressure or temperature or both, by use of proportional parts tables, or by means of arithmetical interpolation.

7322. Four tables of proportional parts, which are described below, are available to facilitate the interpolation referred to in (2) above:
Table 1—Temperature increments of 0.1° from 0.0° to 2.0°. Pressure increments of 0.01 inch from 0.01 to 0.04 inch. This table is for use with sea-level reduction tables having temperature arguments of 2° increments.
Table 2—Temperature increments of 0.1° from 0.0° to 1.0° and increments of whole degrees from 1.0° to 5.0°. Pressure increments of 0.01 inch from 0.01 inch to 0.04 inch. This table is for use with sea-level reduction tables having temperature arguments of 5° increments.
Table 3—Temperature increments of 0.1° from 0.0° to 1.0° and increments of whole degrees from 1.0° to 10.0°. Pressure increments of 0.01 inch from 0.01 to 0.04 inch. This table is for use with sea-level reduction tables having temperature arguments of 10° increments.
Table 4—Pressure increments of 0.01 inch from 0.00 to 0.10 inch for horizontal tabular differences (as found in sea-level reduction tables) in increments of 0.01 inch from 0.10 to 0.15 inch.

7323. The station pressure will be reduced to sea-level by use of a sea-level reduction table and tables of proportional parts in accordance with the following instructions. Each step in the instructions is illustrated by an example based upon a given station pressure and a given 12-hour mean temperature. Portions of the sea-level reduction and proportional parts tables necessary to evaluate the example are reproduced following par. 7324.

Given: Station pressure=24.17
12-hour mean temperature=58.7°

(1) Find the station pressure argument in the table next lower to the actual station pressure. In the example, 24.10 would be selected as next lower to 24.17.

(2) Find the temperature argument in the sea-level table next higher to the 12-hour mean temperature. In the example, 60 would be selected as next higher to 58.7.

(3) Find the tabular value at the intersection of the columns selected in accordance with (1) and (2) above. In the example, this tabular value would be 30.71.

(4) Find the vertical pressure difference between the tabular value selected in accordance with (3) above and the next higher tabular value. In the example this would be 0.01 (difference between 30.71 and the next higher value, 30.72).

(5) Find the horizontal pressure difference between the value found in accordance with (3) above and the next higher tabular value. In the example, the difference would be 0.12 (difference between 30.71 and the next higher horizontal value, 30.83).

(6) Find the temperature difference to tenths between the actual 12-hour mean temperature and the value selected in accordance with (2) above. In the example this would be 1.3 (the difference between 58.7 and 60.0).

(7) Find the pressure difference between the actual station pressure and the value selected in accordance with (1) above. In the example, this would be 0.07 (the difference between 24.17 and 24.10).

(8) To summarize, the following values have been found:
(a) Vertical pressure difference (this equals 0.01 in the example).
(b) Horizontal pressure difference (this equals 0.12 in the example).
(c) Temperature difference (this equals 1.3 in the example).
(d) Pressure difference (this equals 0.07 in the example).

(9) Select the vertical pressure versus temperature table of proportional parts appropriate to the station sea-level table in accordance with paragraph 7322. In the example, the difference between successive temperature arguments is 2°; therefore, proportional parts Table 1 is used.

(10) Using the table selected in accordance with (9), find the vertical pressure argument corresponding to the value found in (4) and the temperature argument corresponding to the value found in (6). Find the tabular value at the intersection of the respective columns. In the example this would be 0.006.

(11) Using proportional parts Table 4, find the horizontal pressure argument corresponding to the value found in (5), and the pressure difference found in (7). Find the tabular value at the intersection of the respective columns. In the example, this would be 0.084.

(12) Add the values found in (3), (10), and (11). The sum is the sea-level pressure. In the example this would be 30.800, which is obtained as follows:
(a) From (3), a tabular value of sea-level pressure=30.71.
(b) From (10), an interpolated value of pressure using Table 1=0.006.
(c) From (11), an interpolated value of pressure using Table 4=0.084.
(d) From (12) a sum that equals the sea-level pressure=30.800.
The thousandths digit is disposed of in accordance with instructions contained in the Introduction.

7324. Sea-level reductions in terms of millibars will be made similarly to the foregoing by use of proportional parts Tables 5–8. In all operations, values as they appear in the tables will be carried forward to the final computation before disposing of the final digit.

PORTIONS OF SEA-LEVEL REDUCTION AND PROPORTIONAL PARTS TABLES

Mean temperature (° F.)	Station pressure (inches)			
	24. 00	24. 10	24. 20	24. 30
56	30. 61	30. 74	30. 87	30. 99
58	30. 60	30. 72	30. 85	30. 98
60	30. 58	30. 71	30. 83	30. 96
62	30. 57	30. 69	30. 82	30. 95

FROM PROPORTIONAL PARTS TABLE 1

Temperature increments (° F.)	Vertical tabular differences (inch)	
	0. 01	0. 02
1. 2	0. 006	0. 012
1. 3	. 006	. 013
1. 4	. 007	. 014

FROM PROPORTIONAL PARTS TABLE 4

Pressure increments (inch)	Horizontal tabular differences (inch)	
	0. 12	0. 13
0.06	0. 072	0. 078
0.07	. 084	. 091
0.08	. 096	. 104

7400. COMPUTATION OF HEIGHT OF THE 850-MILLIBAR SURFACE ABOVE SEA LEVEL

7410. DESCRIPTION OF DIAGRAMS. The height of the 850-millibar surface (25.10 inches) is computed by means of one of the hypsometric diagrams listed below. The diagrams used for the computation must have ranges of pressure and temperature that include the current values of station pressure and mean virtual temperature.

Form number	Temperature Range, ° F	Pressure range, inches of mercury
1154C	10 to 90	28.80 to 25.10
1154D	10 to 90	27.70 to 22.75
1154E	10 to 90	25.10 to 20.60
1154F	−50 to 30	28.80 to 25.10
1154G	−50 to 30	28.00 to 22.50
1154H	−50 to 30	25.10 to 20.60

Forms 1154D and G are for intermediate values of pressure that overlap pressure ranges of other diagrams. Two linear scales, one in g. ft. and one in kilometers, are printed at the left of the diagram. To the right of the diagram is a millibar-inch pressure conversion scale for use at stations supplied with barometers calibrated in millibars.

7420. DESCRIPTION OF SCALE. A g.-ft. scale which is available as a separate form, is used in computing the height of the 850-millibar surface. It is furnished in a height range from 2,350 to 9,500 feet for use with all diagrams listed in paragraph 7410. A kilometer scale is printed on the right in a range equivalent to the range of the g.-ft. scale. The station elevation in g.-ft. should be indicated on the scale with a fine, thin penciled arrow that extends across the width of the scale. The position of this arrow on the scale should be verified for accuracy by another of the station personnel, after which the arrow should be retraced with permanent ink. The head of the arrow should terminate about $\frac{1}{16}''$ from the edge of the scale. Trim the scale so that the line in the center becomes the right edge, and the graduations and legends remain on the left side. The scale is subject to contraction and expansion with changes in humidity and temperature. Precautions should therefore be taken to avoid subjecting the diagrams and the scales to extremes of either humidity or temperature.

7430. COMPUTATION OF MEAN VIRTUAL TEMPERATURE. Enter the following temperature data on the form provided for computation of the mean virtual temperature:

(1) Current temperature.
(2) Current temperature.
(3) Temperature 6- hours previously.
(4) Sum of (1), (2), (3).
(5) One-third of (4) (whole degrees).
(6) Correction from table entitled "Correction for Lapse Rate and Humidity," using as arguments the values closest to the current station pressure and the temperature computed in (5).
(7) Algebraic sum of (5) and (6).

7440. SELECTION OF DIAGRAM. Select a diagram whose range of pressure, printed along the side, includes the station pressure, and whose range of temperature, printed along the top, includes the mean virtual temperature computed in accordance with paragraph 7430 above. The slanting lines of the hypsometric diagrams represent values of pressure in increments of five-hundredths of an inch corresponding to station pressure; the vertical lines represent temperature in whole degrees Fahrenheit corresponding to values of mean virtual temperatures.

7450. USE OF SCALE. (Form 1154J). Place the g.-ft. scale on the hypsometric diagram so that height in g.-ft. increases with decrease in pressure. Place the edge of the scale parallel with and immediately adjacent to the vertical line corresponding to the mean virtual temperature, to the nearest whole degree Fahrenheit. Slide the scale vertically until the tip of the arrow coincides with the value of station pressure to the nearest 0.01 inch. The height of the 850-millibar surface above sea level will be read on the g.-ft. scale at its intersection with the 25.10 line, which is a dashed horizontal line with arrow heads at its extreme tips.

EXAMPLE

Given:

Station elevation g.-ft	5, 290
Station pressure	24. 645
Current temperature (t)	29. 3° F
Temperature 6 hours previously (t_6)	33. 6° F

(1) To determine temperature argument:

t	29. 3°
t	29. 3°
t_6	33. 6°
Sum	92. 2°
Mean	30. 7°
t'' (to nearest whole ° F)	31°.
c= Correction from lapse rate and humidity correction table (at intersection of 24.60 pressure line (closest to 24.64) and 30° F temperature column (closest to 31°)	+2
t_{mv}= Mean virtual temperature argument, nearest whole ° F	33°

(2) Pressure argument (station pressure to nearest 0.01 inch) 24. 64 inches

(3) To determine the height of the 850-millibar surface above sea level:
Using 24.64 as the pressure argument place the edge of the scale along the 33° temperature line with the arrow marking the station elevation, 5,290, at the 24.64 inch pressure value. At the intersection of the scale with the 25.10 inch pressure line (equivalent to 850-millibar) read the height of the 850-millibar surface above sea level (to nearest 10 g.-ft.). Height equals 4,810 g.-ft.

7500. ALTIMETER SETTING

7510. GENERAL. The altimeter setting is a pressure, in inches, used for setting a pressure-scale type sensitive altimeter in an airplane so that upon landing of the airplane the instrument will indicate an altitude reading equal or very close to that of the field elevation above sea level. The altimeter setting is sometimes called the standard atmosphere sea-level pressure, since it is based on the standard atmosphere. Computation of the altimeter setting is independent of temperature. Altimeter settings are determined only at stations equipped with an approved mercurial barometer with whose readings those of any pressure instrument used in determining the altimeter setting are periodically compared.

7520. DETERMINATION OF ALTIMETER SETTING FROM STATION PRESSURE. Altimeter setting tables, containing station pressure arguments for obtaining altimeter settings, are furnished to stations requiring them. The station pressures pertain only to the elevation of the station at which the table is designed to be used. Therefore, each table may be used only at a station whose elevation corresponds with that of the one used in computing the table. The station pressure arguments are given at the side of the table to tenths of an inch and at the top of the table to hundredths of an inch.

7521. To determine the altimeter setting, read the station pressure to the nearest 0.01 inch and find in the body of the table the value corresponding to the station pressure. No interpolation is necessary.

EXAMPLES

A portion of the altimeter setting table for Kansas City, Mo., follows:

ALTIMETER SETTINGS, KANSAS CITY, MO., FIELD ELEVATION 742 FEET

Station pressure (inches)	.01	.02	.03	.04
28.80	29. 60	29. 61	29. 62	29. 63
28.90	29. 70	29. 71	29. 72	29. 73

Station elevation, $H_b = 750.0$ feet. Actual elevation barometer $H_z = 760.328$ feet.

(1) Given:
Station Pressure 28.825, rounded to the nearest 0.01 inch 28. 82
Value from table found in column headed .02 ..... 29. 61
(2) Given:
Station Pressure 28.927, rounded to the nearest 0.01 inch 28. 93
Value from table found in column headed .03 ..... 29. 72

7530. ALTIMETER SETTING INDICATORS. The altimeter setting indicator is a special form of aneroid barometer so designed that after installation and proper adjustment, the altimeter setting may be read directly from the scale. Corrections for this instrument will be determined in accordance with instructions issued to stations requiring them.

7600. DETERMINATION OF CHARACTERISTIC AND AMOUNT OF BAROMETRIC TENDENCY

7610. The barometric tendency comprises three elements: (1) the net change in barometric pressure within a specified time before an observation, (2) indication as to whether the barometric pressure is higher or lower at the end of a period than at the beginning of the period, and (3) the characteristic of the change during the period.

7620. Pressure tendencies will be determined only at stations equipped with a barograph. The characteristic and amount of barometric tendency will be determined directly from the barogram. Determine the characteristic from the trace for the full 3-hour period preceding the actual time of observation, or, at specified stations, for the full 3-hour period ending three hours before the time of observation. Observe whether the pressure is the same as, or higher or lower than, at the time of the beginning of the period, and whether the trace shows a falling, rising, steady,

or unsteady tendency, or a combination of these. If the characteristic is so variable over the period that it cannot be identified, determine it for the period immediately preceding the observation, or for whatever interval will permit of a reasonably accurate determination of a characteristic.

7630. To find the amount of change, determine to the nearest 0.005 inch the net change over the interval. The net change is the difference in pressure values indicated by the trace between the beginning and the end of the period. No correction is to be applied to the value of the trace at these points.

7640. When the barogram indicates a rapid fall in pressure followed by an abrupt rise of 0.06 inch or more, the lowest pressure in the "V" will be noted and converted to sea-level pressure at airway stations for reporting in accordance with instructions in Table 29, item 21. The mean temperature used in the reduction will be determined in accordance with the following:

(1) When a thermograph is available, select the temperatures corresponding to the time of the lowest pressure and to the time 12 hours previously.

(2) When a thermograph is not available, select the temperatures at the preceding observation and at a time 12 hours previously

CHAPTER 8. WIND

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CHAPTER 8. WIND

8000. GENERAL

8010. Wind is measured in terms of velocity, a vector that includes direction and speed. The absence of apparent motion in the air is termed "calm." Wind direction, speed, character, and shifts are determined instrumentally, or by estimation when instrumental determination is not possible.

8100. DETERMINATION OF DIRECTION

8110. GENERAL. Wind direction is defined as the direction from which the wind is blowing. Wind direction is determined with reference to true north, and is expressed to 16 points of the compass or nearest 10 degrees. (See Table 11.)

TABLE 11.—*Wind direction in degrees, to 16 compass points*

Direction	Compass point	Degrees	Direction	Compass point	Degrees
North	N	349°–11°	South	S	169°–191°
North-northeast	NNE	12 –33	South-southwest	SSW	192 –213
Northeast	NE	34 –56	Southwest	SW	214 –236
East-northeast	ENE	57 –78	West-southwest	WSW	237 –258
East	E	79 –101	West	W	259 –281
East-southeast	ESE	102 –123	West-northwest	WNW	282 –303
Southeast	SE	124 –146	Northwest	NW	304 –326
South-southeast	SSE	147 –168	North-northwest	NNW	327 –348

8120. NONINSTRUMENTAL. When the station is not equipped with wind-indicating equipment or the equipment is unserviceable, the direction will be determined by observing the wind cone or tee at an airport, or the drift of smoke, or the movement of twigs, leaves, and similar flexible objects elsewhere. True direction can be estimated quite accurately by facing into the wind in unsheltered areas.

8130. INSTRUMENTAL. Wind direction is taken from 4- and 9-light (4- and 8-point) wind-direction indicators, recorders, or from direct-reading dials, by observing the indicator for a 1-minute interval in accordance with the following instructions for the type of indicator in use.

8131. The lamps of a 4-point indicator are assigned the cardinal directions, North, East, South, and West. When one lamp of a 4-light (4-point) indicator burns steadily, or one lamp burns steadily with flashes occasionally from a lamp on either side of it, the lamp burning steadily indicates the wind direction. When one lamp burns steadily with occasional flashes of a lamp on one side only, the wind direction is between the cardinal and intermediate directions, e. g., north-northeast. When two adjacent lamps burn steadily or intermittently, the direction is the intermediate one between them, e. g., northeast.

8132. The lamps of an 8-point indicator are assigned the cardinal and intermediate directions, North, Northeast, East, Southeast, South, Southwest, West, and Northwest. When one lamp, for a cardinal or intermediate direction, of a 9-light (8-point) indicator burns steadily, with or without occasional flashes of either or both adjacent lamps, the direction is the cardinal or intermediate one indicated by the lamp burning steadily. When one lamp burns steadily with an adjacent lamp burning more than 50 percent of the time, or when both lamps burn intermittently, the direction is between the intermediate and cardinal directions represented by the lamps.

8133. Directions from a direct-reading dial will be indicated by the average position of the pointer during a 1-minute interval.

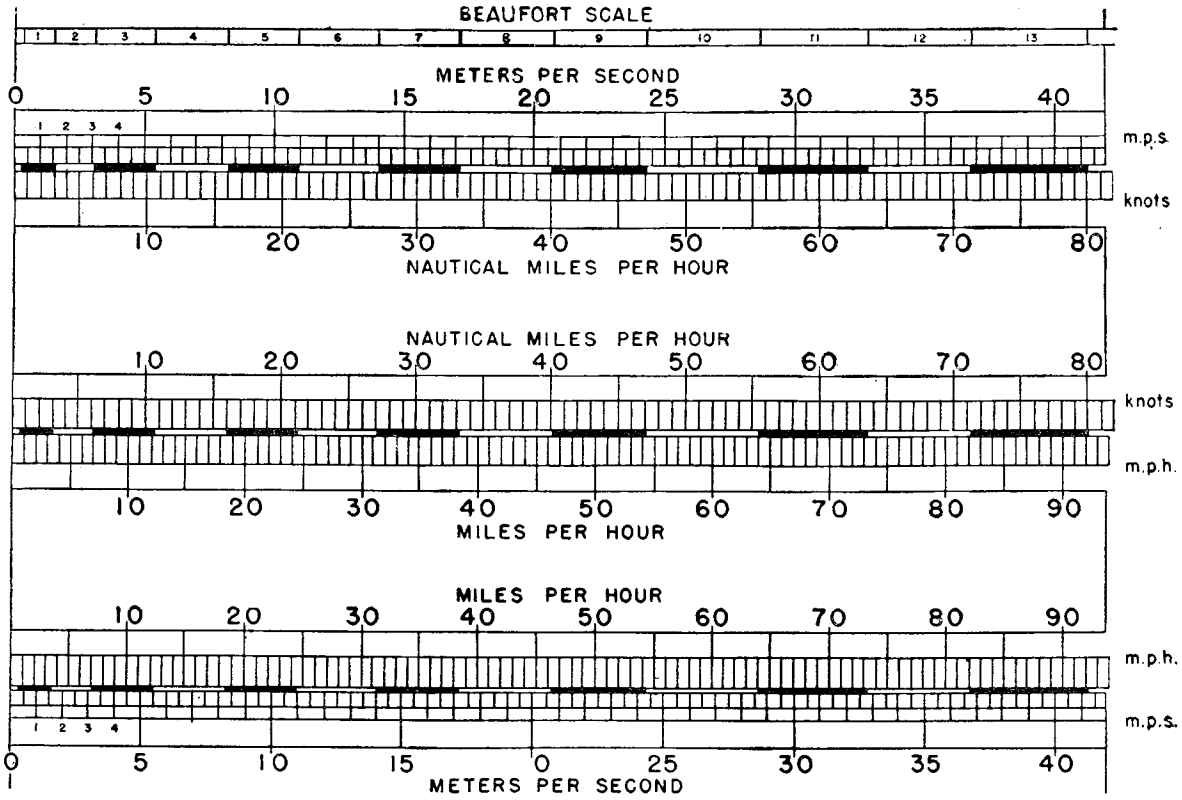
8134. Wind velocity recorders of the continuous registering type may be used for determining the direction, which will be that of the last full minute of record preceding the observation.

8135. Direction from a single or multiple register will be obtained by averaging the indications over a 5-minute period.

8200. DETERMINATION OF SPEED

8210. GENERAL. Speed of the surface wind will be determined to the nearest statute mile per hour or knot, depending on the anemometer used. Conversion will be made as required by means of Table 12. In general, observed wind speeds are a 1-minute mean, but may also be a 5-minute mean, or the fastest mile, when the speed is determined from recording equipment. So far as possible, mean wind speed observations will not be taken during periods of extreme wind speeds—either high or low.

TABLE 12.—*Wind speed conversion.*



8220. NONINSTRUMENTAL. If equipment for observing wind speed is not available, the speed may be estimated by means of Table 13 (usually known as the Beaufort scale of wind speeds).

TABLE 13.—*Wind equivalents—Beaufort scale*

Beaufort number	M. P. H.	Knots	International description	Specifications
0	Less than 1	Less than 1	Calm	Calm; smoke rises vertically.
1	1–3	1–3	Light air	Direction of wind shown by smoke drift; but not by wind vanes.
2	4–7	4–6	Light breeze	Wind felt on face; leaves rustle; ordinary vane moved by wind.
3	8–12	7–10	Gentle breeze	Leaves and small twigs in constant motion; wind extends light flag.
4	13–18	11–16	Moderate breeze	Raises dust, loose paper; small branches are moved.
5	19–24	17–21	Fresh breeze	Small trees in leaf begin to sway; crested wavelets form on inland waters.
6	25–31	22–27	Strong breeze	Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty.
7	32–38	28–33	Moderate gale	Whole trees in motion; inconvenience felt walking against wind.
8	39–46	34–40	Fresh gale	Breaks twigs off trees; generally impedes progress.
9	47–54	41–47	Strong gale	Slight structural damage occurs; (chimney pots, slates, removed).
10	55–63	48–55	Whole gale	Seldom experienced inland; trees uprooted; considerable structural damage occurs.
11	64–72	56–63	Storm	Very rarely experienced; accompanied by widespread damage.
12	73–82	64–71	Hurricane	
13	83–92	72–80		
14	93–103	81–89		
15	104–114	90–99		
16	115–125	100–108		
17	126–136	109–118		

8230. INSTRUMENTAL. Instrumental measurement of a 1-minute mean speed will be made by one of the following methods:

8231. Using the $\frac{1}{60}$ mile indicator (statute or nautical), count the number of times the center lamp lights or the buzzer sounds during an exact 60-second interval. Apply the correction, from Table 14, appropriate to the type of anemometer in use.

TABLE 14.—*Corrections to indicated wind speeds*

(⅙- or one-mile anemometers)

Speed Indicated				
By 3-cup "S" type anemometer, m. p. h.	By 4-cup anemometer, m. p. h.	By 4-cup anemometer with beaded cups, m. p. h.	By small airway "SA" type anemometer, m. p. h.	Corrections in whole miles per hour
0* to 16	0* to 8	0* to 5	0* to 35	+1
17 to 26	9 to 12	6 to 13	35 to 57	0
27 to 35	13 to 16	14 to 20	(Corrections for higher velocities not determined; use zero.)	−1
36 to 44	17 to 20	21 to 27		−2
45 to 52	21 to 24	28 to 34		−3
53 to 61	25 to 28	35 to 41		−4
62 to 70	29 to 32	42 to 48		−5
71 to 79	33 to 36	49 to 55		−6
80 to 87	37 to 39	56 to 62		−7
88 to 96	40 to 43	63 to 69		−8
97 to 105	44 to 47	70 to 75		−9
106 to 114	48 to 51	76 to 82		−10
115 to 122	52 to 54	83 to 89		−11
123 to 132	55 to 58	90 to 96		−12
133 to 139	59 to 62	97 to 103		−13
140 to 149	63 to 65	104 to 110		−14
150 to 157	66 to 69	111 to 117		−15
158 to 166	70 to 73	118 to 124		−16
167 to 174	74 to 77	125 to 131		−17
175 to 184	78 to 80	132 to 138		−18
185 to 192	81 to 84	139 to 145		−19
193 to 200	85 to 88	146 to 152		−20
	89 to 91	153 to 158		−21
	92 to 95	159 to 165		−22
	96 to 99	166 to 171		−23
	100 to 103	172 to 178		−24
	104 to 106	179 to 185		−25
	107 to 110	186 to 192		−26
	111 to 114	193 to 200		−27
	115 to 117			−28
	118 to 121			−29
	122 to 125			−30
	126 to 128			−31
	129 to 132			−32
	133 to 136			−33
	137 to 140			−34
	141 to 143			−35

*Movement of anemometer cups observed.

8232. Condenser discharge indicators give an uncorrected mean value at the highest point reached on the scale during a single pulse or oscillation. Observe the face of the indicator over a period of one minute and take the mean of the corrected highest points reached by the meter needle during successive pulses or oscillations. Apply the correction indicated in Table 15.

TABLE 15.—*Corrections to indicated wind speeds*

(Condenser-discharge type anemometers)

A. Type "S" anemometer		B. Type "SA" anemometer	
Uncorrected speed (m. p. h.)	Correction (whole m.p.h.)	Uncorrected speed (m. p. h.)	Correction (whole m. p. h.)
0–59	0	0–87	0
60–69	−1	88–94	+1
70–79	−2	95–100	+2
80–100	−3		

8233. Direct-reading indicators and recorders usually indicate almost instantaneous values. (Note that the condenser-discharge indicator is not considered direct-reading since an instantaneous wind speed cannot be taken directly from the indicator.) Observe the indicator or recorder trace for a 1-minute period and take the mean of the high and low values of successive fluctuations. Apply to the mean value the correction furnished for the particular instrument. If no correction table has been furnished, the correction will be assumed zero.

8234. If it is impossible to obtain a wind speed from any indicator described above, the wind speed may be taken from a single or multiple register record. Determine the average speed over the 5-minute interval immediately preceding the observation and apply the appropriate correction from Table 14.

8235. When the anemometer cups are moving so slowly that a speed is not registered on the indicator, the speed will be regarded as one m. p. h. or one knot. When the anemometer cups are not moving, the wind speed is regarded as calm.

8300. CHARACTER OF WIND

8310. GUSTINESS. Gustiness is characterized by sudden, intermittent increases in speed, with at least 10 miles per hour or 9 knots variation (corrected) between peaks and lulls. The peak speed must reach at least 19 m. p. h. or 17 knots before the wind is characterized as gusty. Gustiness is termed "fresh" or "strong" depending upon the peak speed, as shown in Table 16.

TABLE 16.—*Gustiness*

Description	Peak speed	
	M. P. H.	Knots
Fresh	19–24	17–21.
Strong	More than 24	More than 21.

8311. Gustiness will be estimated from 1/60 mile (buzzer or light) indicators by noting the variations in the time interval between buzzes or flashes, and will be determined from direct-reading indicators by observing the pointer. Gustiness cannot be determined directly with the condenser-discharge type indicator, but an estimate can be made after successive fluctuations of the pointer have been noted.

8312. At stations equipped with gust recorders, the character of the wind may be taken from recorders.

8320. SQUALLS. (See par. 3310 for definition.) The intensity to be ascribed to squalls will be determined from the peak speed of the gusts, in accordance with Table 17.

TABLE 17.—*Intensity criteria for squalls*

Description	Speed of gusts	
	M. P. H.	Knots
Light	Not to exceed 24	Not to exceed 21.
Moderate	25–39	22–34.
Heavy	More than 39	More than 34.

8330. WIND SHIFTS. Wind shifts, as defined and used in this manual, are associated with the following phenomena, characteristic of a cold-front passage. These phenomena are:

(1) Gusty winds shifting in a clockwise manner in the Northern Hemisphere, i. e., south shifting to west, or southwest shifting to northwest (shifting counterclock-wise in the Southern Hemisphere).
(2) Rapid drop in the dew point.
(3) Rapid drop in temperature.
(4) Rise in pressure.
(5) In summer; lighting, thunder, heavy rain, and possibly hail.
(6) In winter; frequent rain or snow squalls with cloud heights changing rapidly—either to higher or lower heights than existed prior to the wind shift.

8332. In the Northern Hemisphere, whenever the wind shifts suddenly to a westerly or northerly quadrant, be alert for the characteristic changes accompanying a shift. If some of the changes accompanying a shift are noted before the wind changes direction or speed, watch for a clockwise shift of wind direction, an increase in speed, or a change in direction of low clouds.

8333. In flat regions, wind shifts without precipitation, but accompanied by strong winds, sometimes occur. The visibility may be greatly restricted by blowing dust over extensive areas.

8335. Use the criteria indicated in Table 18 in classifying wind shifts.

TABLE 18.—*Intensity criteria for wind shifts*

Accompanying phenomena	Intensity		
	Light	Moderate	Heavy
Both precipitation and a decrease in cloud heights.	Does not exceed 24 m. p. h., 21 knots.	Exceeds 24 m. p. h. but not 39 m. p. h., 21–34 knots.	Exceeds 39 m. p. h., 34 knots.
No precipitation nor decrease in cloud heights.	Does not exceed 34 m. p. h., 30 knots.	Exceeds 34 m. p. h. but not 49 m. p. h., 30–42 knots.	Exceeds 49 m. p. h., 42 knots.

CHAPTER 9. AIRWAY AND SUPPLEMENTARY OBSERVATIONS

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CHAPTER 9. AIRWAY AND SUPPLEMENTARY OBSERVATIONS

9000. GENERAL

9010. An observation is an evaluation of the meteorological situation at the point where the observation is taken. The component parts of an observation, when referred to in a general sense, are termed elements. The evaluation of the state of the various elements consists in observing them. Meteorological elements observed at or from the surface are usually limited to clouds, visibility, atmospheric phenomena, wet- and dry-bulb temperatures, precipitation, pressure, wind, and duration of sunshine.

9011. The terms "airway observation" and "synoptic observation" connote the assemblage of specified observational elements in a manner designed to satisfy meteorological and operational requirements. The instructions in this chapter are concerned principally with the various types of airway observations. Pilots' reports of meteorological phenomena encountered in flight are used to supplement airway observations.

9012. The observation of elements will be taken in the order given below, unless the sites of instrumental equipment require deviation:

(1) Sky
(2) Visibility
(3) Atmospheric phenomena
(4) Temperature
(5) Precipitation measurement
(6) Humidity
(7) Pressure
(8) Wind

Observation of the elements listed above will be taken in accordance with applicable instructions elsewhere in this manual. At designated stations visibility observations will be taken at the control tower or the approximate level of the control tower, as well as at the usual point of observation, whenever the visibility at the usual point of observation is less than three miles. Under these circumstances, visibility observations taken at the control tower will be used for all purposes, such as record, coding and summary that require visibility data (paragraph 11105.3). The observer will inform himself of the nature of the visibility-restricting phenomena at the control tower level.

9013. All scheduled observations will be started just sufficiently in advance of the time of transmission to permit accurate evaluation of all the elements.

9100. AIRWAY OBSERVATIONS

9110. GENERAL. Airway observations are primarily intended to provide (a) immediate weather information for aviation interests, and (b) data for climatologists. The observations are classified as record, special, record-special, local extra, and check. The time and conditions under which the observations are taken, and the elements observed, are specified in the following paragraphs. When two or more types of observations coincide, all the elements observed for each type will be included in the observation, with the exception specified in paragraph 9142.

9120. RECORD OBSERVATIONS. A record observation is taken at scheduled hourly intervals and will be prepared for teletype transmission at least two minutes prior to the time of entrance into the sequence in which it first appears. An observation at an off-teletype station will be telephoned or telegraphed to a relay station at a time to be specified in separate instructions.

9121. The elements listed below will be observed insofar as the instrumental equipment of the station permits:

(1) Ceiling
(2) Sky
(3) Visibility
(4) Weather
(5) Obstruction to vision
(6) Sea-level pressure
(7) Temperature
(8) Dew Point
(9) Wind direction, speed, character, and shifts
(10) Altimeter setting

9130. SPECIAL OBSERVATIONS. A special observation is taken to provide information on significant developments in meteorological conditions occurring at other than scheduled periods.

9131. The number of elements included in a special observation depends on the conditions being reported. The special observation may consist of only one element (e. g., tornado) or of most of those included in a record observation. Each of the elements that may be included in a special observation is listed in paragraph 9134.01 to 9134.10. Following each element is listed the magnitude or nature of the change in it that would require a special observation. Any element listed in paragraph 9132 may be reported alone as a special observation. When a change in one or more of the elements listed in paragraph 9133 requires a special observation, the additional elements listed beside them must also be included in the observation. When changes in two or more elements individually satisfy the criteria for a special observation, the elements will be included in a single special observation. In all cases, remarks will be added as required.

9132. When a change in one of the following elements satisfies the criteria for a special observation, it may be reported alone as a special observation.

(1) Tornado or waterspout
(2) Dust-storm and sand-storm
(3) Altimeter setting
(4) Wind shift and increases in wind speed

9133. When a change in one or more of the following elements satisfies the criteria for a special observation, the observation will include all the elements listed to the right of them:

Elements, a specified change in any one of which requires a special observation.	All elements below to be reported with any element in opposite column.
(1) Ceiling	Ceiling
(2) Sky	Sky
(3) Visibility	Visibility
(4) Weather	Weather
(5) Obstructions to vision	Obstructions to vision
	Wind

9134. CRITERIA FOR TAKING SPECIAL OBSERVATIONS. A special observation will be taken whenever one or more of the elements listed below have changed in the amount specified. The amount of change is with reference to the preceding record or special observation.

9134.01. CEILING.

(1) The ceiling after decreasing by 50% or more is 5,000 feet or less.
(2) A ceiling of 5,000 feet or less increases by 100% or more.
(3) The ceiling decreases to less than 1,500 feet or increases to 1,500 feet or more.
(4) The ceiling decreases to less than 1,000 feet, or increases to 1,000 feet or more.
(5) The ceiling decreases to less than 500 feet, or increases to 500 feet or more.
(6) The ceiling increases from zero to 100 feet or more.
(7) The ceiling decreases to a value equal to or lower than the highest airline operating minimum for the airport.
(8) The ceiling increases to a value equal to or higher than the highest airline operating minimum for the airport.

9134.02. SKY CONDITION.*

(1) A change in total sky cover from clear to broken or overcast, and vice versa; or from scattered to overcast, and vice versa.
(2) A change in sky cover from clear to scattered
    a. below 1,000 feet or
    b. at or below the highest airline operating minimum for the airport.

9134.03. VISIBILITY.

(1) The visibility after decreasing by 50% or more is 5 miles or less.

*Note that in some instances a special observation not required because of a change in sky condition might nevertheless be required because of an associated change in ceiling. For example, a change in total cloudiness from scattered to broken would not require a special observation in accordance with paragraph 9134.02 but if the clouds were 5,000 feet or less, a special observation would be required in accordance with paragraph 9134.01.

(2) The visibility having been five miles or less, increases by 100% or more.
(3) The visibility decreases to less than:
  (a) 3 miles
  (b) 1 mile
  (c) ¾ mile
  (d) ½ mile } C. A. A. ILS stations only
  (e) ¼ mile
(4) The visibility increases to equal or exceed:
  (a) 3 miles
  (b) 1 mile
  (c) ¾ mile
  (d) ½ mile } C. A. A. ILS stations only
  (e) ¼ mile
  (f) 1/16 mile

9134.04. TORNADO.
(1) Is observed
(2) Disappears from sight
(3) Is reported by the public to have occurred within preceding six hours.

9134.05. THUNDERSTORM.
(1) Begins
(2) Increases in intensity
(3) Ends. (Special observation 15 minutes after thunder is last heard at station.)

9134.06. PRECIPITATION.
(1) Hail begins or ends.
(2) Liquid precipitation begins or ends. An observation will be required 15 minutes after ending of rain showers and intermittent rain. Special observation not required to report the beginnings and endings of showers occurring simultaneously with continuous rain, or to report changes of showers to continuous rain and vice versa.
(3) Freezing precipitation begins or ends.
(4) Sleet begins or ends.
(5) Snow begins or ends. An observation will be required 15 minutes after ending of snow showers and intermittent snow. Special observation not required to report the beginnings and endings of snow showers occurring simultaneously with continuous snow, or to report changes of snow showers to continuous snow and vice versa.

9134.07. FOG.
(1) Beginning and ending of fog, ground fog, or ice fog, or a change from one type of fog to another.

9134.08. SAND-STORM, DUST-STORM.
(1) Is observed within 6 miles of station.
(2) Disappears from sight.

9134.09. WIND AND WIND SHIFTS.
(1) Sudden doubling of speed (over a one-minute interval) to more than 30 miles per hour (26 knots).
(2) Wind-shift.

9134.10. ALTIMETER SETTING. A change in altimeter setting, as shown by a change in station pressure, at the rate of 0.08 inch (2.7 mb.) or more per hour. Special observations owing exclusively to rapid changes in pressure as specified above will be taken at 15-minute intervals as long as this rate of change persists.

9134.11. The foregoing will be regarded as the minimum requirements for taking a special observation. In addition, any meteorological situation that, in the opinion of the observer, is of importance to the safety or efficiency of aircraft operations will be reported in a special observation.

9140. LOCAL EXTRA OBSERVATIONS. Local extra observations are taken, at designated stations, for local distribution only. The changes requiring a local extra observation are within

narrower limits than changes requiring a special observation. When a local extra observation reveals a change in conditions that requires a special observation, the local extra observation will be classified as a special observation and treated accordingly.

9141. At designated stations, local extra observations will be taken at intervals not exceeding 15 minutes, beginning whenever:

(1) Ceiling or visibility decreases to a value equal to or less than the highest airline minimum applying to the airport.
(2) The ceiling decreases to 500 feet or less.
(3) The visibility decreases to one mile or less.

9141.1. Local extra observations will be discontinued when values above these minimums have been reported. Record or special observations coming within the 15-minute interval will also serve as the local extra observation. The 15-minute interval will begin at the time of the record or special observation.

9141.2. Except when taken in accordance with paragraph 9142 and 9143 the observation will include the following elements:

(1) Ceiling
(2) Sky
(3) Visibility
(4) Weather
(5) Obstructions to vision

Remarks will be added as required.

9142. Local extra observations of one or more elements requested for aircraft arrivals or departures will be taken and recorded at designated stations, in the usual manner, even though weather conditions do not warrant taking a special observation.* In this case the name of the agency requesting the local extra observation will be noted under "Remarks."

9143. Local extra observations will be taken whenever ceiling or visibility changes to a value above, equal to, or below

a. the minimum prescribed for the airport, or
b. any air carrier minimum applicable to the local airport.

This requirement is applicable only when takeoffs and landings impend. Suitable arrangements will be made at each station to keep informed of scheduled arrivals and departures as well as of operations involving delayed schedules.

9144. An observation of all elements ordinarily included in a record observation will be taken immediately following any aircraft accident in the vicinity of an airport at which a weather-observing station is situated. (See Fig. 8.)

9150. CHECK OBSERVATIONS. Check observations will be taken at specified stations where scheduled broadcasts of local weather are made. The local schedule of broadcasting will determine the time of taking them. The check observation will be taken within 20 minutes of the scheduled time of local broadcast, preferably as near to the time of the broadcast as practicable. The 20-minute requirement is waived when a pilot balloon observation is being taken. (See paragraph 10220.) If the broadcast equipment is inoperative, check observations will not be taken. A notation indicating the period of and reason for the suspension of check observations will be entered on WBAN 10.

9151. The check observations will include the following elements:

(1) Ceiling
(2) Sky
(3) Visibility
(4) Weather
(5) Obstructions to vision
(6) Wind
(7) Altimeter setting

9160. CORRECTED REPORTS. A corrected observation will be coded and disseminated in accordance with instructions in paragraph 10080.

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*If a special observation is also required, a local extra observation of the one or more elements requested will be filed, after which the other elements required for the special observation will be evaluated, and the special filed.

9200. PILOT REPORTS

9210. GENERAL. Pilot reports of meteorological phenomena encountered in flight are variously termed PIREPS, AFREPS, NYREPS, POREPS, RMREPS, ALREPS. Pireps will be used as a basic term for convenience of discussion. These reports of weather are an extremely valuable source of information that often is not otherwise available. Observers will cooperate to the fullest extent possible with pilots and with ground personnel of commercial airlines to secure all available pilots' reports promptly after each observation is taken by the pilot.

9211. All pilots' reports, except those pertaining to ceiling within 1½ miles of the airport boundaries, will be disseminated by Navy and Weather Bureau stations immediately as a pireps; Air Force stations will handle these reports in accordance with policies established by Wing and Group Commanders. When a pilot's report pertains to ceiling within 1½ miles of the airport boundaries, and the report differs from the ceiling value of the current weather observation in an amount that would require the filing of a special or local extra observation, personnel of all three services will proceed as follows:

1. If the current ceiling value is classified as measured,
   a. redetermine the ceiling value immediately;
   b. If the redetermined ceiling value is not classified as measured, disseminate the pilot's report of ceiling in the form of a local extra or special observation with the ceiling classified as aircraft;
   c. If the redetermined ceiling value is classified as measured, enter the pilot's report in parentheses on WBAN 10, for record purposes only.
2. If the current ceiling value is not classified as measured,
   a. Disseminate the pilot's report immediately as a pireps and then as a special or local extra observation with the ceiling classified as aircraft;
   b. Redetermine the ceiling value immediately;
   c. If the redetermined ceiling value is classified as measured, file a special or local extra observation reporting the value;
   d. If the redetermined ceiling value is not classified as measured, enter the redetermined ceiling value on WBAN 10 in parentheses, for record purposes only.

9212. When a ceiling value classified as measured cannot be obtained, a pilot's report of ceiling will be used in subsequent airway observations taken within the succeeding 15 minutes, provided the ceiling has not changed to a degree that makes the pilot's report of ceiling inapplicable.

9213. Pireps of the following elements will be given the same dissemination as a special observation:

(1) Local ceiling (observed within 1½ miles of airport boundaries)
(2) Tops of cloud layers
(3) Icing
(4) Winds aloft exceeding 60 m. p. h., or 52 knots
(5) Turbulence
(6) Hail
(7) Electric discharge
(8) Any other elements of meteorological or operational importance (e. g., reports of ceiling, visibility, precipitation, and the presence or absence of fog or clouds (a) through mountain passes, (b) over mountainous regions and (c) over coastal channels, bays, or sounds.)

9214. Pilot reports will be coded in accordance with instructions in section 10300.

9215. All pireps prepared for transmission will be distributed by interphone or equivalent means to local operations similarly to special observations as described in paragraph 10230.

9300. SUPPLEMENTARY OBSERVATIONS AND EVALUATION OF ELEMENTS

9310. REQUIREMENTS. The weather will be observed and the various elements evaluated between record observations as often as is consistent with the condition of the weather and the station workload deriving from other duties. Changing weather situations that might require a special or local extra observation will be watched most closely to insure that an observation will

804519°—48——6

be filed promptly after the change necessitating it occurs. In the following paragraphs certain requirements are stated with respect to the frequency of observation and the evaluation of specified elements. These are minimum requirements that must be met unless specific exceptions for special purposes are made elsewhere.

9320. CEILING MEASUREMENTS. Whenever available, ceiling measuring instruments (ceiling light or ceilometer) will be used as frequently as observations are taken, provided clouds are present at the observation and it appears likely that a cloud-height measurement can be secured within a reasonable time.

9330. CEILING BALLOONS. Stations equipped with ceiling balloons but not with ceilometers will use the balloons during daylight hours, provided the intensity of any precipitation present (other than drizzle) is light. (See paragraph 1442.1.)

9331. At airway weather-observing stations where hourly observations for scheduled transmission are taken, balloons will be used as follows to determine the ceiling value reported in observations prepared for transmission:

(1) At the discretion of the observer when clouds are at an estimated height of 2,000 feet or more.
(2) At hourly intervals or more frequently when the clouds are between 1,000 and 2,000 feet unless the highest ceiling minimum for the commercial air carriers at the airport where the station is situated is above 1,000 feet.
(3) At half-hour intervals or more frequently, when the clouds are at or below 1,000 feet or when the clouds are at or below the highest ceiling minimum for commercial air carriers where the station is situated.

9332. At stations not taking hourly airway observations ceiling balloons will be used whenever the clouds are estimated to be less than 3,000 feet.

9340. PRESSURE. Station and sea-level pressure data will be derived from readings of the mercurial barometer, precision aneroid, or altimeter setting indicator every 6 hours at the time of the 6-hourly synoptic observations. If less than four synoptic observations are taken daily, the pressure data will be derived from one of these instruments whenever the synoptic observations are taken.

9341. For observations other than synoptic, station pressures will be taken from an aneroid barometer, barograph, or altimeter setting indicator, for which corrections have been established by comparison with a mercurial barometer.

9350. ALTIMETER SETTING. A new determination of the altimeter setting will be made whenever the information is requested and the latest determination was made 30 minutes or more before the request.

9360. MISCELLANEOUS PHENOMENA. Miscellaneous phenomena will be included in observations whenever the phenomena are considered to be of importance to forecasters or to aircraft operations. They will be coded in accordance with instructions in Chapter 11.

9370. RECENCY. All elements reported in an airway observation prepared for transmission will have been observed within the 15 minutes preceding the time of entry on WBAN 10A. This has particular reference to ceiling classification. For instance, a ceiling classified as "measured" more than 15 minutes before an observation, must be differently classified at the time of observation, if a measured ceiling could not be determined within the preceding 15 minutes.

9380. SYNOPTIC OBSERVATIONS. Data to be included in synoptic observations are those specified in current synoptic codes. The required data will be observed and evaluated in accordance with instructions in this manual.

9381. At the time of taking each 6-hourly synoptic observation, observe the following procedure:

(1) Make a time check mark on all recording instrument charts in accordance with paragraphs 5212, and 7243.

(2) Set the maximum and minimum thermometers in accordance with paragraphs 5162 and 5171.
(3) Measure the precipitation, if any, and empty all but the weighing type gages.
(4) Observe the state of the ground with respect to the form and amount of precipitation, if any, accumulated upon it, and observe whether the ground appears to be frozen hard. If dew alone is on the ground, the state of the ground will not be regarded as "wet."

9390. MIDNIGHT OBSERVATION. At midnight, local standard time, an observation of maximum and minimum temperatures and of precipitation, will be taken at all stations having personnel in duty status at that time. This observation must be considered when determining the maximum and minimum temperatures, and the total amount of precipitation, for the 6-hour period ending at the time of the first 6-hourly observation taken after midnight.

9391. The maximum and minimum thermometers will be reset after reading them, and the readings entered on WBAN 10. After the precipitation is measured, the gages, except the weighing type, will be emptied. The measurement will be entered on WBAN 10.

CHAPTER 10. DISSEMINATION AND TRANSMISSION OF AIRWAY AND PILOT REPORTS

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CHAPTER 10. DISSEMINATION AND TRANSMISSION OF AIRWAY AND PILOT REPORTS

10000. ELEMENTS IN THE AIRWAY CODE

10010. GENERAL. Airway observations are disseminated in a code that consists of symbols and numerals arranged in groups with relatively fixed positions. Word and phrase contractions or complete words are used in a specified manner to supplement the coded data.

10020. GROUPING OF ELEMENTS. The elements of the observation are placed in groups as specified below. Spaces separate Groups I to V; and oblique lines (slants), used as mechanical devices, separate numerical data that might otherwise be misinterpreted. Further instructions on use of slants are to be found in paragraphs 10030, and 11002. Reference to specific instructions for coding are listed beside each item below.

Group number	Element number	Element	Instructions paragraph number
I	1	Station identification	10120
II	2	Type of report	10130, 11101
III	3	Time of report	10140, 11102
IV	4	Ceiling and cloud height	11103
	5	Sky condition	11104
	6	Visibility	11105
	7	Weather	11106
	8	Obstructions to vision	11106. 2
V	9	Sea-level pressure	11107
	10	Temperature	11108
	11	Dew point	11109
	12	Wind	
	a.	Direction	11110
	b.	Speed	11111
	c.	Character	11112
	d.	Shifts	11112
	13	Altimeter setting	11113
VI	14	Remarks	11114

10021. The letter symbol "M" is used to indicate missing data, or data entered in parentheses (see par. 11020), pertaining to an element normally included in a report. Elements regularly omitted are indicative of data not observed at a particular station.

10030. HOURLY REPORTS. Data pertaining to record observations are coded in Groups I, IV, V, and VI. Slants rather than spaces are used to separate Group V from VI. Slants are also used within Group V between sea-level pressure and temperature, temperature and dew point, wind data and altimeter setting, altimeter setting and remarks. Additive data are separated by a slant and a space from the last element of the record observation with which they are transmitted.

EXAMPLE: DCA E38⏀12 271/74/58←↙8/032/CIG VRBL 36 TO 40/ 2002

10040. SPECIAL REPORTS. Special reports invariably include Groups I through III, and remarks, if required. In addition they contain either one element only (Group IV- 7, V- 12 or V- 13), or Group IV plus V- 12, according as the instructions for special observations (Chapter 9) apply. When a significant change, as defined in Chapter 9, occurs in altimeter setting, Group V-13 is included in the special report. When a check report coincides with a special report, all the

elements of a check report, as stated in paragraph 10050 below, are included in the special report. When any combination of elements V- 12, V- 13 and Group VI appears in a special report they are separated from each other by slant symbols.

10050. CHECK REPORTS. Check reports are composed of Groups I, II, III, IV, V- 12, V- 13, and VI.

10060. LOCAL EXTRA REPORTS. Local extra reports are composed of Groups I, II, III, IV, and VI.

10070. Group VI will contain pertinent general remarks, RAFRZ, RAICG, and 700-mb. data and PIREPS as required. These data will be transmitted with hourly (not 3- or 6-hourly) airway reports, with the exception of general remarks and pireps, which may be transmitted at any time.

10080. CORRECTED REPORTS. A report correcting a previously transmitted report will be identified by the letters "CQN" immediately preceding the station identification. The report will include Groups I and III; if the observation to be corrected is a special, record-special, or local extra report, the correcting report will also include Group II. If an error in a record, or record-special observation is discovered within the hour after the observation has been transmitted on the teletype, a complete corrected observation will be filed immediately, regardless of special observations that might have been transmitted in the meantime. If an error is discovered in a special or local extra observation before the next succeeding observation is given teletype or local distribution, a corrected observation will be filed. If an error is discovered in a check observation, a corrected observation will be given to the broadcaster. When more than an hour has elapsed before an error in a transmitted observation has been discovered at the originating station, a corrected report will not be transmitted.

10100. CODING FOR TELETYPE TRANSMISSION

10110. GENERAL. Instructions in Chapter 11 will be observed in coding individual elements of observations for teletype and radio distribution. Instructions for the coding of station identification, type of report, and time ascribed to observation follow.

10120. STATION IDENTIFICATION. The station identification is a three letter symbol assigned to the station for use in teletype transmissions. These symbols are listed in Federal Airways Manuals of Operations of the Civil Aeronautics Administration.

10130. TYPE. Record-type reports prepared at hourly intervals for scheduled sequence teletype transmission are not identified by any symbol in teletype transmission. Special and record-special reports are identified by the letter "S" followed by a serial number. Serial numbers are assigned consecutively for each day. Number 1 is the first special or record-special report filed for transmission on or after 0000, local standard time, of a given day. Local extra reports transmitted on local teletype circuits are identified by the contraction "LCL."

10140. TIME. The time of record and record-special observations is not included in the report, since the time of the sequence in which the reports are included appears at the heading of the sequence collection. The time of the sequence collection may therefore be used as a reference time. However, a corrected report of a record observation will include the sequence time of the record observation immediately following the station identification. The time of special and local extra reports is the local standard time of making the last entry on WBAN 10. In special and local extra reports, when coded for teletype transmission, the time, in four figures, is followed by the correct time zone indicator selected from Table 19, except that AF stations and other designated stations will use Greenwich mean time and the indicator "Z."

TABLE 19.—*Standard time zones and indicators*

Time zone	Indicator	Time zone	Indicator
Eastern	E	Alaskan	A
Central	C	Bering	B
Mountain	M	Yukon	Y
Pacific	P		

10200. FILING FOR DISSEMINATION

10210. GENERAL. Record and special airway observations will be transmitted by teletype or radio where suitable facilities are available. These transmissions will be made in accordance with communication manuals specified by the individual services.

10220. SCHEDULED BROADCASTS. At stations having broadcast facilities, observations filed for use in scheduled broadcasts will be the most recent and, if practicable, they will have been taken just prior to the broadcast, but at least within 20 minutes of the scheduled time of the broadcast. However, the 20-minute requirements may be disregarded when a pilot balloon is being observed. Under these circumstances the assumption will be that, in the absence of a special observation, there have been no significant changes in weather.

10230. LOCAL DISTRIBUTION. All observations of a change in weather will be distributed locally by interphone, telautograph, telephone, etc., to military agencies, local airline offices, Civil Aeronautics Administration facilities requiring them, and other agencies requesting them. When observations are communicated, acknowledgment should be received from recipients, if possible, and noted on WBAN 10.

10231. Altimeter settings based on mercurial barometer, precision aneroid, or altimeter setting indicator readings at the time of the 6-hourly synoptic observations will be interphoned to local operations immediately after their determination. These readings are required for purposes of comparison and are in addition to those normally transmitted in observations to local operations.

10300. CODING OF PILOT REPORTS

10310. GENERAL. When pilot reports are received by weather-observing personnel they will be coded in accordance with the following instructions. All reference to heights of phenomena encountered in flight will be expressed in hundreds of feet to the nearest hundred above mean sea level, indicated by the letters "MSL".[1] Authorized weather symbols, international cloud abbreviations, word and phrase contractions will be used or, if they are lacking, complete words.

10311. All phenomena having an authorized symbol (see Tables 26 and 27) will be reported in symbol form followed, if required, by the appropriate intensity indicator. "U" will be used for "intensity unknown." If the phenomenon has been reported in general terms by the pilot ("precipitation" without indication of rain or snow, etc.) the phenomenon and its intensity will be reported in an authorized phrase contraction, or lacking that, in one or more complete words.

10320. CODING OF ELEMENTS. In general, the order of coding will be:
(1) Station identification.
(2) Time of entering pilot report on WBAN 10.
(3) The term PIREPS, or authorized equivalent (AFREPS, etc.)
(4) Location or extent of phenomena with respect to a well-known point.
(5) Time of pilot's observation, whenever known.
(6) Phenomena reported.
(7) Altitude.
(8) Type of aircraft, whenever known.

10321. ICING. Code pilot reports of airfoil icing conditions as follows:
(1) Use the contraction "ICG" with indication of intensity and type, if known. For example:

ICG TRACE=Trace of ice.
LGT RIME ICG=Light rime icing condition.
MDT ICG=Moderate icing condition.
HVY ICG=Heavy icing condition.

(2) Code the height of the base and top of the icing area whenever known. Use slants to indicate that the base or top of the icing area is unknown.

[1] NOTE.—Pilot reports of cloud heights used as a ceiling in an airway observation will be converted to feet above the surface by the observer and coded in the intervals given in Table 21.

EXAMPLES:

The pilot of a Stinson, flying between Seattle and Oakland, reports to Medford that at 0700 PST he encountered light icing conditions 5 to 20 miles north of Eugene, Oreg., at 2,000 feet MSL; the top of the icing was not reported:

MFR 0715P PIREPS 5-20 N EUG 0700P LGT ICG 20—// MSL STSN

The pilot of an F–38 flying between Oakland and Burbank reports that he encountered heavy icing conditions at 0925 PST over mountains north of Burbank, with the top of the icing at 11,500 MSL, base unknown (note that AF stations use GCT.):

SRF 1731Z AFREPS MTNS N BUR 1725Z HVY ICG //—115 MSL F38

10322. ELECTRICAL DISCHARGE OR LIGHTNING STROKE. Use the word "DISCHARGE."

EXAMPLES:

A pilot flying a PBY between Richmond, Va., and Washington, D. C., reports to Washington that at 1620 EST his aircraft experienced an electrical discharge 20 miles south of Washington at an altitude of 5,000 feet MSL:

DCA 1629E NYREPS 20 S DCA 1620E DISCHARGE 50 MSL PBY

The pilot of a Flying Fortress enroute from St. Louis, Mo., to Chicago, Ill., reports to Chicago that at 1515 CST his plane experienced an electrical discharge over the Kankakee River at an altitude of 2,500 feet MSL:

CHI 1535C RMREPS 15 S JOT 1515C DISCHARGE 25 MSL B17

10323. TURBULENCE. Use the contraction "TURBC" followed by an indication of intensity as illustrated in the following list:

LGT TURBC=Light turbulence.
MDT TURBC=Moderate turbulence.
HVY TURBC=Heavy turbulence.

EXAMPLES:

A pilot reports to Kansas City, Missouri, that his C–54 encountered heavy turbulence at 2330 CST, 10 miles northeast of Knoxville, Tenn., at 6,000 feet MSL:

MKC 2335C AFREPS 10 NE TYS 2330C HVY TURBC 60 MSL C54

The pilot of a DC–3 flying at 10,000 feet MSL through Donner Summit Pass, Calif., reports to Reno, Nev., that light turbulence is being experienced 1050 PST.

RNO 1055P ALREPS OVR DOS 1050P LGT TURBC 100 MSL DC3.

10324. HAIL. Use the authorized teletype symbol for hail and indicate the intensity in the same manner as in weather reports of hail. Use the symbol "U" to indicate unknown intensity.

NOTE: It is quite possible that a pilot report of hail will be added to a report of turbulence and electrical discharge. All these phenomena may be included in the same "Pireps".

EXAMPLES:

The pilot of a DC–4 reports to Omaha, Nebr., at 1617 CST that he is flying through moderate hail 10 miles south at an altitude of 3,500 feet MSL:

OMA 1619C PIREPS 10 S OMA 1617C A 35 MSL DC4.

At 1628 CST the same pilot reports that he is flying in light hail and heavy rain, with heavy turbulence at 3,000 feet MSL, 15 miles southwest of Omaha, and that at 5,000 feet MSL his plane had experienced a discharge:

OMA 1635C PIREPS 15 SW OMA 1628C HVY TURBC R+A— 30 MSL DISCHARGE 50 MSL DC4.

10325. WINDS ALOFT EXCEEDING 60 MILES PER HOUR OR 52 KNOTS. Code winds aloft reported to exceed 60 mph or 52 knots as follows:

(1) Use the contraction "WND".

(2) Code true direction from which the wind is blowing in 3 figures representing the degrees of the compass, to the nearest 10 degrees.
(3) Use figures to code the wind speed in miles per hour or knots.

EXAMPLES:

At 0845 CST the pilot of an F–80 reports to Bismarck, N. Dak., that he is encountering an 82-knot wind west of Bismarck at 6,000 feet MSL, wind direction 80 degrees:

BIS 0850C AFREPS W BIS 0845C WND 080 82 KNOTS 60 MSL F80

At 1215 CST the pilot of a PBY reports to Madison, Wis., that he is encountering a 72-knot wind from 240 degrees, 20 miles southeast of the station, at 8,500 feet MSL.

MSN 1225C NYREPS 20 SE MSN 1215C WND 240 72 KNOTS 85 MSL PBY

10326. TOPS OF OVERCAST. Use the contraction "TOVC".

NOTE:—Intervals used in reporting ceiling heights are not applicable to pilot reports of tops of overcast.

EXAMPLES:

The pilot of a B–24 flying over Navasota, Tex., at 0613 CST reports to Houston that the top of the overcast is at 8,500 feet MSL:

HOU 0618C AFREPS OVR AVS 0613C TOVC 85 MSL B24

If the plane had been 15 miles southeast of Navasota when the pilot determined the height of the top of the overcast, the coded report would read:

HOU 0618C AFREPS 15 SE AVS 0613C TOVC 85 MSL B24

10327. CEILING HEIGHTS. Use the contraction "CIG".

EXAMPLES:

The pilot of a DC–3 flying over Washington, D. C. reports at 1110 EST to Washington that the ceiling is 1,500 feet MSL:

DCA 1118E PIREPS OVR DCA 1110E CIG 15 MSL DC3

A pilot flying between Casper and Sheridan, Wyo., reports to Sheridan that the ceiling over Kaycee is 14,000 feet MSL. The type of aircraft was not reported, nor the time of the observation.

SHR 1850M PIREPS 65 S SHR CIG 140 MSL

CHAPTER 11. ENTRIES ON FORM WBAN 10 (REVISED)

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CHAPTER 11. ENTRIES ON FORM WBAN 10 (REVISED)

11000. GENERAL

11001. Form WBAN 10 revised, consisting of parts A, B, and D, will constitute the basic original record of surface observations at all stations at which the form is prepared. A new WBAN 10A–B will be started for recording each day's observations, beginning with the first observation at or following 0000 local standard time, as defined below. One page of WBAN 10B and as many pages of WBAN 10A as are needed will be used for each day. WBAN 10D will be prepared monthly in accordance with instructions on the form.

11002. Enter observations as legibly as possible in chronological order, restricting data, so far as possible, to the columns appropriate to them as indicated by the column headings. Ditto marks will not be used. At stations where the form is used by the communications operator directly, slants to separate data in the airway code may be used as specified in Chapter 10.

11003. The name of the station and date will be entered in the spaces provided.

11010. MISSING DATA. The symbol "M" will be entered only for missing data normally recorded. Appropriate notes explaining the missing data will be entered in column 90.

11020. STATISTICAL DATA. Data entered in parentheses are for statistical purposes only (see pars. 11109 and 11419) and are not to be transmitted as an element of an airway observation. (See paragraph 10021.)

11030. CORRECTION OF ENTRIES. When incorrect data have been entered, corrections will be made as follows:

11031. If the error is discovered before the report is transmitted, the erroneous entry will be erased and correct entry made.

11032. If an error is discovered in an observation after the report is transmitted, a red line will be drawn through the erroneous entry only and the correction entered in red immediately above it. If a correction is transmitted, enter the phrase "CQN (Time)" in red in column 14 of the erroneous observation. Carbon copies, if prepared, need not be corrected in red.

11040. TIME. For the purpose of securing a uniform understanding of time for use in Form WBAN 10, certain definitions are established as follows:

11041. GREENWICH CIVIL TIME. Greenwich Civil Time (G. C. T.) is sometimes called "universal time" because time used in most other parts of the world is derived from G. C. T. Greenwich Civil Time is the local civil time, standard time, and zone time within the time zone of Greenwich (0° longitude).

11042. LOCAL STANDARD TIME. In the United States, standard time zones have been established by law, and the time within these zones is the mean solar time at the meridians in Table 20. The time based upon any of the standard time meridians can be converted to G. C. T. by adding one hour for each 15° of longitude west from Greenwich. A conversion table follows:

TABLE 20.—*Meridians of standard time zones and conversion to G. C. T.*

Standard Time Zone	Meridian	To convert to G. C. T., add—
Atlantic Standard Time	60°	4 hours.
Eastern Standard Time (EST)	75°	5 hours.
Central Standard Time (CST)	90°	6 hours.
Mountain Standard Time (MST)	105°	7 hours.
Pacific Standard Time (PST)	120°	8 hours.
Yukon Standard Time (YST)	135°	9 hours.
Alaskan Standard Time (AST)	150°	10 hours.
Bering Standard Time (BST)	165°	11 hours.

11100. WBAN 10A

11101. TYPE. (Col. 1.) The type of report will be indicated by one of the following designations:

(1) *R* Record observation.
(2) *S* (followed by serial number) Special observation. Serial numbers are assigned consecutively for each day. Number 1 is the first special (or record-special) filed for transmission on or after 0000, LST, of a given day.
(3) *RS* (followed by serial number) Record-special observation.
(4) *L* Local extra observation.
(5) ✓ Check observation. (If a check observation requires local extra procedure, enter "L.")
(6) 6*H* Six-hourly (not applicable to AF stations).

11102. TIME ENTRIES. (Col. 2.) The time ascribed to an observation is that of the last entry on Form WBAN 10. Entries will be in local standard time to the nearest minute in terms of the 24-hour clock. The first two figures will indicate the hour, and the last two the minutes. For example, 0000 indicates the beginning of the day; 0235 indicates 2:35 A. M.; 1346 indicates 1:46 p. m.; 2359 indicates the end of the day.

11103. CEILING. (Col. 3.) Enter the ceiling as required by Table 21. When a value is half-way between two reportable values, the lower value will be selected, e. g., 50 feet will be entered as "0." Prefix an appropriate classification symbol selected from Table 22 to each ceiling value. All heights pertaining to symbols for sky condition (see par. 11104) are with reference to height above surface, not above sea level, except heights that may be recorded in Column 14 as a part of a pireps.

TABLE 21.—*Reportable ceiling values*

0 to 5,050 feet	To nearest 100 feet, in hundreds of feet.
5,051 to 9,750 feet	To nearest 500 feet, in hundreds of feet.
Above 9,750 feet	To nearest 1,000 feet in hundreds of feet.

TABLE 22.—*Ceiling classification symbols*

A	Ceiling reported from aircraft
B	Balloon ceiling
E	Estimated ceiling
M	Measured ceiling
P	Precipitation ceiling
W	Indefinite ceiling

11103.1. Whenever the ceiling is observed as variable, the range of variability will be recorded in column 14 (see Table 29, items 1–2). If the variable ceiling is less than 2,000 feet, the letter V will be entered immediately after the ceiling value.

11103.2. An entry is required in column 3 when 0.6 or more of the sky is covered by obscuring phenomena not classified as thin and by clouds. Note that the height ascribed to obscuring phenomena for entry in column 3 is the vertical visibility into the phenomena and not the base of the phenomena.

11103.3. If a thin obscuration is present, an entry will be made in column 3 only if
(1) Clouds are visible above the thin obscuration, or
(2) Clouds cover more than 0.6 of the sky below the thin obscuration. (See Table 24.)

NOTE.—See Table 24 for illustrations of entries in column 3; see Table 29, items 3–6, 10–12, for instructions for recording in column 14 heights of cloud layers not recorded in column 3, and bases of obscuring phenomena above the surface.

11104. SKY. (Col. 4) Record state of the sky in terms of the standard teletype symbols, or combinations* of them, listed in Table 23. See Table 24 for illustration of entries in column 4

*The symbol for clear will not be used in combination with any other sky condition symbol.

under various sky conditions. See Table 29 for instructions on reporting in column 14 cloud layers not reported in column 4.

11104.1. The symbols ◑, ◍, and ⊕ may be modified by the prefixes plus (+) and minus (−) for dark and thin clouds respectively. The symbol X may be modified by the prefix minus (−) for thin obscuration.

TABLE 23.—*Sky-condition symbols*

Symbol and meaning	Explanation
X Obscuration	0.6 or more of the sky obscured by precipitation or obstructions to vision either alone or in combination with lower clouds, and irrespective of higher clouds.
○ Clear	Less than 0.1 total sky cover, or less than 0.6 obscuring phenomena with clouds not visible.
◑ Scattered Clouds	0.1 to less than 0.6 sky cover.
◍ Broken Clouds	0.6 to 0.9 sky cover.
⊕ Overcast	More than 0.9 sky cover.

11104.2. HEIGHT OF SCATTERED CLOUDS. The height of scattered clouds immediately precedes the sky condition symbol to which it applies whenever (1) the symbol appears alone, e. g., 20◑, or (2) the symbol is the second in a combination of sky condition symbols, e. g., ◑20◑. In all other cases the height of scattered clouds is reported in column 14. (See Table 29.)

TABLE 24.—*Examples of entries in columns 3, 4, and 14 under various sky conditions*

NOTE:—This table illustrates conditions requiring not more than two sky-condition symbols. (See Table 29 for instructions on reporting additional symbols in column 14.)

Conditions observed	Col. 3	Col. 4	Col. 14
CLOUDS ALONE VISIBLE			
1. Less than 0.1 of sky covered	----------	○	----------
2. 0.1–0.5 of sky covered by one layer	----------	240◑	----------
3. 0.1–0.5 of sky covered by two layers	----------	◑18◑	130◑
4. 0.6–0.9 of sky covered by one layer	M65	◍	----------
5. 0.6–0.9 of sky covered by two layers:			
a. Lower layer covering less than 0.6 of sky	M25	◍10◑	----------
b. Lower layer covering 0.6–0.9 of sky	A27	◍◍	E50◍
6. More than 0.9 of sky covered by one layer	M26	⊕	----------
7. More than 0.9 of sky covered by two layers:			
a. Lower layer covering less than 0.6 of sky	M140	⊕35◑	----------
b. Lower layer covering 0.6–0.9	M35	⊕◍	M75⊕
OBSCURING PHENOMENA ALONE VISIBLE			
8. Less than 0.6 of sky obscured	----------	○	BASE K LYR W E20
9. 0.6 or more of sky obscured by one layer:			
a. Sky overhead visible	----------	−X	BASE K LYR E5
b. Sky overhead not visible	P2	X	----------
COMBINATIONS OF CLOUDS AND OBSCURING PHENOMENA VISIBLE			
10. Obscuration beneath clouds:			
a. 0.9 or less of sky covered by combination:			
(1) Sky or clouds overhead not visible through obscuration but visible at horizon	W8	◍X	E50◍
(2) Sky or clouds overhead visible through obscuration	M45	◍−X	----------
b. More than 0.9 of sky covered by combination:			
(1) Sky or clouds overhead not visible through obscuration but visible at horizon	W8	⊕X	E30⊕
(2) Sky or clouds overhead visible through obscuration	M50	⊕−X	----------

TABLE 24.—*Examples of entries in columns 3, 4, and 14 under various sky conditions*—Continued

Conditions observed	Col. 3	Col. 4	Col. 14
COMBINATIONS OF CLOUDS AND OBSCURING PHENOMENA VISIBLE—continued			
11. Obscuration above clouds:			
a. Less than 0.6 clouds:			
(1) Obscuration not thin	W25	X10◑	BASE K LYR E23
(2) Thin obscuration		−X10◑	BASE H LYR E50
b. 0.6 or more clouds:			
(1) Obscuration not thin	E25	X◍	BASE H LYR E48
(2) Thin obscuration	M18	−X◍	BASE H LYR E50
12. Obscuring phenomena at the same level as, or beneath, clouds with obscuring phenomena alone covering less than 0.6 of sky:			
a. Total sky cover less than 0.6		45◑	LWR K LYR W
b. Total sky cover 0.6–0.9	M48	◍	K LYR N
c. Total sky cover more than 0.9	E180	⊕	K LYR S
13. Obscuring phenomena above clouds with 0.1–0.5 total sky cover		25◑	K LYR E80

Note that if summation of obscuring phenomena and lower clouds is 0.6 or more, an obscuration exists, and item 11 applies.

11105. VISIBILITY. (Col. 5.) Enter the prevailing visibility, selecting the closest corresponding value from Table 25. When the prevailing visibility is exactly half-way between two of the values, select the lower value.

TABLE 25.—*Table of values for recording visibility in columns 5 and 14*

Fractional increments	1-mile increments when visibility is 3 to 15 miles, inclusive. 5-mile increments when visibility is more than 15.
0	1
1/10	1 1/4
1/8	1 1/2
3/16	1 3/4
1/4	2
5/16	2 1/4
3/8	2 1/2
1/2	
5/8	
3/4	

11105.1 VARIABLE VISIBILITY. Whenever the visibility is variable, the range of variability will be recorded in column 14 (See Table 29, item 13). If the prevailing visibility is less than 2 miles, the letter "V" will be entered immediately after the visibility value.

11105.2. A plus sign (+) will be entered following the figure 15 when the visibility is estimated to be more than 15 miles and the most distant visibility marker is 15 miles or less.

11105.3. CONTROL TOWER VISIBILITY. When the visibility at the usual level of observation is less than 3 miles, the visibility at the control tower level will be recorded in column 5 at Weather Bureau stations participating in the control tower visibility program. The visibility at the usual point of observation, when it differs from that at control tower level, and the height of the restricting phenomena, when known, will be recorded in column 14. (See Table 29, item 15.)

11105.4. See Table 29, item 14, for recording visibility differing in various quadrants in column 14.

11106. WEATHER AND OBSTRUCTIONS TO VISION. (Col. 6.) Entries of weather

and obstructions to vision will be made in accordance with Tables 26 and 27. Two or more entries for a single observation will be made in the following order:

(1) Tornado (or waterspout).
(2) Thunderstorm.
(3) Liquid precipitation, in the order of decreasing intensity.
(4) Freezing precipitation, in the order of decreasing intensity.
(5) Frozen precipitation, in the order of decreasing intensity.
(6) Obstructions to vision in the order of decreasing predominance, if discernible.

Note that an entry is required in column 6 whenever the visibility is less than 7 miles.

11106.1. WEATHER AND INTENSITY. Enter the character of hydrometeors and other phenomena occurring at the time of observation in printed letter symbols in accordance with Table 26.* Use a plus sign after symbols for precipitation and squalls to indicate a heavy degree of intensity and a minus sign to indicate a light degree; the absence of any sign indicates moderate intensity. (See also paragraphs below captioned Thunderstorms and Tornados, and Waterspouts.)

TABLE 26.—*Symbols for weather*

TORNADO or WATERSPOUT (always written out in full)			
T+	Heavy Thunderstorm	S	Snow
T	Thunderstorm	SW	Snow Showers
R	Rain	SP	Snow Pellets
RW	Rain Showers	SG	Snow Grains
L	Drizzle	IC	Ice Crystals
ZR	Freezing Rain	A	Hail
ZL	Freezing Drizzle	AP	Small Hail
E	Sleet	Q	Squall

11106.11. PRECIPITATION. Precipitation of a showery or intermittent character not occurring at the time of observation will be reported in remarks (Table 29, item 19) for a period not exceeding 15 minutes after cessation of active precipitation.

11106.12. SQUALLS. A squall observed within 15 minutes of the observation will be reported in the symbol Q. When precipitation occurs at the time of observation and squalls occur at the same time or within 15 minutes prior to it, the precipitation will be coded in the symbols appropriate to its character and form (R—, RW, etc.) and prefixed to the squall symbol, e. g., RWQ, S—Q, etc.

11106.13. THUNDERSTORMS. Thunderstorms will be reported if 15 minutes or less have elapsed since thunder was last heard. Thunderstorms are reported as either heavy or moderate; that is, all thunderstorms not classified as heavy are reported as moderate.

11106.14. TORNADOS AND WATERSPOUTS. The direction of a tornado or waterspout from the station will immediately follow the term TORNADO or WATERSPOUT. (See Table 29, item 16, for entries in column 14.) Tornados and waterspouts will be reported without indication of intensity.

NOTE.—See Table 29, items 16–19, for additional information concerning weather to be reported in column 14.

11106.2. OBSTRUCTIONS TO VISION. Enter obstructions to vision in printed letter symbols in accordance with Table 27.

TABLE 27.—*Symbols for obstructions to vision*

F	Fog	IF	Ice Fog
GF	Ground Fog	H	Haze
BS	Blowing Snow	K	Smoke
BD	Blowing Dust	D	Dust
BN	Blowing Sand		

NOTE.—See Table 29, items 15 and 20, for additional information concerning obstructions to vision to be reported in column 14.

*See Table 29 for instructions for reporting intermittent and showery precipitations occurring within 15 minutes prior to the observation.

11107. SEA-LEVEL PRESSURE. (Col. 7) The initial "9" or "10" of the sea-level pressure will be omitted and the pressure will be entered as three figures (without a decimal point) representing tens, units, and tenths of millibars; e. g., 1013.2 would be entered as 132.

NOTE.—See Table 29, items 21 and 22, for reporting pressure data in column 14.

11108. TEMPERATURE. (Col. 8) Enter the dry-bulb temperature to the nearest whole degree Fahrenheit. Prefix a minus sign to temperatures below zero.

11109. DEW POINT. (Col. 9) Enter the dew point temperature to the nearest whole degree Fahrenheit. Prefix a minus sign to dew point temperatures below zero. Whenever the air temperature is below −35° F., the wet-bulb temperature will be regarded as the same as the dry-bulb temperature. Determine the corresponding dew point, with respect to water (see par. 6010.1), and enter this value in col. 9 in parentheses. (See par. 11020.)

11110. WIND DIRECTION. (Col. 10) Enter the wind direction to sixteen points of the compass by means of one or two short arrows, as shown in Table 28. When the wind is calm, make no entry in this column.

TABLE 28.—*Wind direction symbols*

↓ North	↑ South
↓↙ North-northeast	↑↗ South-southwest
↙ Northeast	↗ Southwest
←↙ East-northeast	→↗ West-southwest
← East	→ West
←↖ East-southeast	→↘ West-northwest
↖ Southeast	↘ Northwest
↑↖ South-southeast	↓↘ North-northwest

11111. WIND SPEED. (Col. 11) Enter the wind speed in units specified by the individual Services. If the wind speed is estimated, enter the letter E immediately following the speed. Enter C for calm.

11112. WIND CHARACTER AND SHIFTS. (Col. 12) Entries will be made without spaces to separate the data. The data will be entered in the following order.

11112.1. CHARACTER. When gustiness is present, enter in column 12 a minus sign to indicate fresh gusts, and a plus sign to indicate strong gusts (Table 16). When gustiness and a wind shift occur together, record the wind shift immediately following the intensity of the gustiness, without a space.

11112.2. WIND SHIFTS. Enter the direction of the wind before the shift to sixteen points of the compass with short arrows followed by the local standard time of the shift (24-hour clock) and a letter denoting the local standard time zone. Indicate the intensity of the shift after the time-zone indicator by a plus sign for a heavy shift, a minus sign for a light shift; the absence of a sign indicates moderate intensity. For example, if a heavy wind shift occurred from southeast to northwest in the Central time zone at 1614, the entry in the column would be "↖1614C+." Since the space provided in column 12 is not sufficient for wind shift data, distribute all wind data evenly among columns 10, 11, and 12.

NOTE.—See Table 29, item 23, for instructions on reporting peak speed of gusts in column 14.

11113. ALTIMETER SETTING. (Col. 13) Entries will be made in this column only at stations equipped with a mercurial barometer that is used to establish corrections for an altimeter setting indicator, barograph, or precision aneroid. Record the altimeter setting as three figures without a decimal point to represent units, tenths, and hundredths of inches. For example: 29.92 would be entered as 992.

11113.1. When the altimeter setting is the only element reported in a special observation, it will be preceded by the authorized contraction "ALSTG."

11114. REMARKS. (Col. 14) Certain conditions require the addition of explanatory remarks to the report. Instructions concerning conditions that require further explanation, or exclusive reporting, in column 14, together with examples of their use, have been condensed in

Table 29. The examples are not exhaustive, and when conditions other than those illustrated occur, the observer will amplify the report with such remarks as he judges to be pertinent to the meteorological situation and useful to the users of the data.

11114.1. When intensity of phenomena remote from the station cannot be determined, the symbol "U" will be placed after the symbol for the phenomena to indicate intensity unknown.

TABLE 29.—REMARKS: *Instructions and illustrations*

Conditions observed	Instructions for entry in column 14	Illustrations	
		Cols. 3–7 or 12	Col. 14
CEILING, CLOUD HEIGHTS, SKY			
1. Variable ceiling below 2000 feet.	Enter range of variability	M4V	CIG VRBL 2 TO 6
2. Variable ceiling 2000 feet or more.	Enter range of variability	M27	CIG VRBL 25 TO 30
3. Two broken, or overcast and broken, layers.	Enter classification, height, and symbol for upper layer.	M17◍◍ M28⊕◍	E31◍ E220⊕
4. Two scattered layers	Enter height and symbol for upper layer.	◍27◍	120◍
5. Intermediate broken layers between broken, or broken and overcast, layers.	Enter classification, height, and symbol for intermediate layers following entry for highest layer. See also item (3).	M47⊕◍	E140⊕E70◍E60◍
6. Several scattered layers below broken (or overcast) layer.	Enter height and symbol for scattered layers below the two highest layers.	E75◍55◍	35◍20◍
7. Variable sky condition	Enter corresponding sky condition symbols, separated by letter V.	33◍	◍V◍
8. Breaks in overcast	Enter contraction BINOVC, followed, if possible, by location of breaks.	M25⊕	BINOVC W
9. Special cloud types:			
(a) Towering cumulus	Enter appropriate abbreviations, as illustrated, followed by location of clouds, if practicable.	30◍	TWRG CU S
(b) Cumulonimbus		46◍	CB NW
(c) Cumulomammatus		M55⊕	CM OVHD
(d) Altocumulus castellatus		120◍	ACC SW
10. Less than 0.6 of the sky obscured and clouds not visible.	Enter nature and location of obscuring phenomenon.	○	K LYR E
11. 0.6 or more of sky obscured, base of obscuring phenomenon above surface.	Enter base and nature of obscuring phenomenon. (Note that if the obscuring phenomenon is at the surface the height of the base will not be entered in column 14.)	W7X	BASE K LYR E5
12. More than one layer of obscuring phenomena.	Enter character and elevation of additional layers.	−X	BASE K LYR E5 UPPER H LYR E80
VISIBILITY			
13. Variable prevailing visibility:			
(a) Less than 2 miles	Enter range of variability	1V	VSBY VRBL ½ to 1¾
(b) 2 miles or more		2	VSBY VRBL 1¼ to 3
14. Visibility differing in different quadrants:			
(a) Prevailing visibility less than 3 miles.	Enter visibility in each quadrant beginning with N or NE.	2½	VSBY N2E2½ S1¼W2½
(b) Prevailing visibility 3 miles or more.	Enter visibility in quadrants in which visibility differs by ½ or more or 100% or more from prevailing visibility.	4 5	VSBY S1½W10 VSBY E2
15. At designated stations—visibility differing at level of control tower from that at level of usual observation point; prevailing visibility less than 3 miles from latter point.	Enter visibility at level of usual observation point and height of visibility restricting phenomenon.	5	SFC VSBY 2 GFDEP 40

TABLE 29.—REMARKS: *Instructions and illustrations*—Continued

Conditions observed	Instructions for entry in column 14	Illustrations	
		Cols. 3–7 or 12	Col. 14
WEATHER			
16. Tornado and waterspout:			
(a) Observed from station	Enter direction toward which tornado or waterspout is moving. Entire report as a special observation appears as a remark.	TORNADO W	MOVG NEWD
(b) Reported by public	Enter (1) location with respect to weather-reporting station or a city or town, (2) direction toward which tornado is moving, (3) time tornado was observed.	----------	UNCONFIRMED TORNADO 15 MIS W DCA MOVG N 1600E
17. Thunderstorm	Enter direction, if observable:		
	(1) with respect to station	T	T NW MOVG EWD
	(2) direction toward which storm is moving.	T+	T+ OVHD MOVG EWD
18. Lightning, with or without audible thunder.	Enter, if observed:		
	(1) Frequency	----------	OCNL LTNG CLD TO CLD; LTNG CLD TO CLD AND TO GND; FQT LTNG CLD TO GND NW; OCNL LTNG N
	(2) Type (cloud to cloud, etc.)		
19. Precipitation:			
(a) Hail	Enter diameter in inches of largest hailstones.	A+	HLSTO 1¼ INCHES
(b) Intermittent	Enter intermittent character of precipitation:		
	(1) not occurring at time of observation	----------	INTMT R–
	(2) occurring at time of observation.	R–	R–INTMT
(c) Sparse	Enter appropriate abbreviation describing rain or snow showers, or steady precipitation, when precipitation is very light.	RW–	OCNL SPKL
		----------	OCNL SPKL
		SW–	OCNL SNW FLRY
		R–S–	PCPN VERY LGT
(d) Fine	Enter appropriate abbreviation describing precipitation in small drops (as opposed to sparseness).	R	R VERY FINE
(e) Variation of intensity	Enter abbreviation describing rapidly variable intensity.	R–	R– OCNLY R+
(f) Precipitation at a distance but not at station.	Enter form of precipitation if known and direction with respect to station.	----------	PCPN W INTSTY UNK RU OVR RIDGE N
20. Obstructions to vision:			
(a) Fog dissipating (or increasing).	Enter appropriate abbreviations	F	F DSIPTG
		F	F INCRG
(b) Smoke drifting over field	Enter appropriate abbreviations	K	K DRFTG OVR FLD
(c) Shallow fog (height less than 6 ft.)	Enter abbreviations for phenomena excluded from coding as obstructions to vision since they do not restrict visibility to 6 miles or less at 6 ft. or more above ground.	----------	SHLW F 2 FT DEEP
(d) Snow drifting but not obscuring vision at 6 ft. or more above ground.		----------	DRFTG SNW
(e) Dust devils	Enter description of phenomenon, and direction, if possible.	----------	DUST DEVILS NW

TABLE 29.—REMARKS: *Instructions and illustrations*—Continued

Conditions observed	Instructions for entry in column 14	Illustrations	
		Cols. 3–7 or 12	Col. 14
PRESSURE			
21. A sudden marked fall, then rapid rise of 0.06 inch or more in pressure, shown on barogram as a "V".	Enter in the next record observation lowest sea-level pressure in tens, units and tenths of millibars, time of its occurrence in local standard time, with amount of rise in millibars since lowest pressure.	665	LOWEST PRES 631 1745C RSG 3 MB
22. Rapidly falling (or rising) pressure.	Enter abbreviation: PRESFR (or PRESRR).	821	PRESFR
WIND			
23. Peak gusts	Enter peak wind speed of strong gusts if station is equipped with direct-reading wind equipment.	↘45+	G75

11114.2. Whenever possible, enter remarks in symbols or authorized contractions. Otherwise, use plain English.

11114.3. If necessary, use additional lines for column 14 to record phenomena. It is not intended that the physical limitations of the column shall limit in any way the information to be reported.

11114.4. Raob stations will enter RAFRZ, RAICG, and 700-mb. data in column 14.

11114.5. Additive data groups, transmitted by designated stations with record observations at 3- and 6-hourly periods, will be entered after "Remarks."

11114.6. (Cols. 14A and 14B) Dry- and wet-bulb temperature readings taken for specialized purposes will be entered in these columns.

11115. OBSERVER'S INITIALS. (Col. 15) The observer taking the observation will enter his initials in this column.

11200. ENTRY OF DATA AT 6-HOURLY SYNOPTIC PERIODS

11201. Data pertaining to 6-hourly observations will be entered on both WBAN 10A and 10B, similarly to the airway hourly observations to the extent that 6-hourly and hourly observations contain the same data. Since the 6-hourly observation and the next succeeding record observation very nearly coincide in point of time, a single set of entries will suffice for both observations unless a change is observed in reportable values of ceiling, sky, visibility, weather, or obstructions to vision. If a single set of entries represents both a 6-hourly and a record observation, R will be entered in column 1 and the time of the record observation in columns 2 and 16.

11202. If a change is observed in reportable values of ceiling, sky, visibility, weather, or obstructions to vision, 6H will be entered in column 1 and the time of the 6-hourly in column 2. A separate record observation will be entered on the next lower line of WBAN 10A. On WBAN 10B, the values pertaining to the 6-hourly observation and entered in columns 21 through 35, will be changed to agree with the corresponding entries in columns 2 to 5 pertaining to the record observation. The changed values will be entered in parentheses above the entries for the 6-hourly observation, and the time of the record observation entered in column 16 in accordance with paragraph 11416. (See Fig. 5.)

11300. ENTRY OF PILOT REPORTS ON WBAN 10A

11301. Pilot reports of weather within 1½ miles of the boundaries of the field will be entered on WBAN 10A in accordance with the following instructions:

(1) Column 2. Record the time of entry of the pilot report on the form, unless the pireps is added to an observation. In the latter case, record the time of entry of the complete observation.

(2) Column 14. Enter the term "pireps," or authorized equivalent, followed by the report coded in accordance with instructions in Chapter 10.

11310. All pireps pertaining to weather more than 1½ miles from the boundary of the field and filed with observing units, and all pireps filed with FAWS, will be entered on a supplementary WBAN 10A distinct from that used for official observations. This supplementary form will be treated in all respects as part of the observational record. When a pireps of weather more than 1½ miles from the boundary of the field is transmitted in the remarks portion of an observation, an appropriate note will be entered in parentheses following the pireps on the supplementary form to identify the observation with hich the pireps is transmitted (e. g., "sent with 1028 obs.").

11311. The supplementary WBAN 10A for pireps will be started the first of each month, and pireps for as many days as possible entered on each page. The period covered by each page will be indicated in the space provided for the date. Pireps for consecutive days will be separated by a line space and the date pertaining to the succeeding entries will be entered in this space near the center of the form. Dates will not be entered for days on which pireps are not received.

11311.1. Entry of pireps on the supplementary form will not be confined to column 14, but may extend across the entire form.

11400. WBAN 10B

11416. TIME. (Col. 16) Entries in this column will be in chronological order, to the nearest minute. The times will be the same as times of corresponding record observations. (See par. 11102.) Note that the first two figures of the time group are printed on the form.

11417. STATION PRESSURE. (Col. 17) Enter station pressure from mercurial or precision aneroid barometers to the nearest 0.001 inch, and from altimeter setting indicators to the nearest 0.01 inch (see par. 7260 for instructions for determining station pressure from altimeter setting indicators). The station pressure for other than 6-hourly observations may be taken from a barograph at stations equipped with one, provided a correction applicable to the barograph has been established within the preceding 6 hours, by comparison with the reading of a precision aneroid, a mercurial barometer, or altimeter setting indicator. Enter values taken from a barograph to the nearest 0.005 inch. At stations not equipped with a mercurial barometer, all entries will be omitted from this column.

11418. DRY-BULB. (Col. 18) Enter the temperature of the dry-bulb to the nearest degree and tenth, Fahrenheit, supplying minus signs as required.

11418.1. At stations equipped with telepsychrometers, when the dry-bulb is above 20° F., but the wet-bulb is 33° or less, the dry-bulb temperature obtained from the telepsychrometer will be entered in column 18; the wet- and dry-bulb temperatures obtained from mercurial thermometers and used in computing the dew point will not be recorded.

11419. WET-BULB. (Col. 19) Enter the temperature of the wet-bulb to the nearest degree and tenth, Fahrenheit, supplying minus signs as required. At air temperatures below −35° F., the dry-blulb temperature from col. 18 will be entered in parentheses in col. 19. (See par. 11020.)

11419.1. At stations equipped with telepsychrometers, when the wet-bulb is 33° F. or less and the dry-bulb is above 20° F., enter in column 19 the wet-bulb temperature as computed on the psychrometric diagram,* using (1) the dry-bulb temperature obtained from the telepsychrometer, and (2) the dew point obtained from mercurial thermometers.

*Relating dew point, dry- and wet-bulb temperatures.

11420. RELATIVE HUMIDITY. (Col. 20) Enter relative humidity for each record observation unless the air temperature is below —35° F. (See par. 11010.)

11420.1. At stations equipped with telepsychrometers, when the wet-bulb is 33° F. or less and the dry-bulb is above 20° F., enter in column 20 the relative humidity as computed on the psychrometric slide rule, using 1) the dry-bulb temperature obtained from the telepsychrometer, and 2) the dew-point temperature obtained from the mercurial thermometers.

11421. TOTAL SKY COVER. (Col. 21) At each record hourly and each 6-hourly synoptic observation, enter total tenths of sky covered by clouds or obscured. Enter zero if neither clouds nor obscuring phenomena are present. Enter 1— if less than 0.1 clouds and obscuring phenomena are present. Enter 9+ if breaks in an overcast are present; enter 10 if the sky is completely overcast or obscured. Note that visible sky plus "total sky cover" equals ten-tenths.

11422. CLOUDS AND OBSCURING PHENOMENA. (Cols. 22–35) Entries will be made in columns 22–35 for each 3- and 6-hourly synoptic observation to provide information of clouds and obscuring phenomena. Data will be entered in appropriate columns for clouds and obscuring phenomena in ascending order of height with respect to their distribution in space. When they are present at more than four levels, data for levels above the 4th will not be entered here, but the presence of these levels will be indicated by the entry for total sky cover (column 21). Additional information concerning these levels will be recorded in column 90.

11422.1. AMOUNT AND SUMMATION TOTAL. (Cols. 22, 25, 28, 29, 32, 33) Enter to the nearest tenth the amount of clouds and obscuring phenomena observed at each level. Amounts of obscuring phenomena will comprise the amount of clouds or sky actually obscured by the phenomena and will not include that portion of the phenomena through which sky or clouds are visible. (Note that the amount of thin obscuring phenomena therefore cannot exceed 9+.) Enter less than 0.1 of clouds or obscuring phenomena as 1—; more than 0.9 but less than 1.0 as 9+. Since a series of frequent observations or pilot reports often indicates the extent or existence of cloud layers above a layer of broken or overcast clouds, the sum of the number of tenths entered in columns 22, 25, 29 and 33 may exceed ten-tenths. However, the entries in columns 28 and 32 will be a summation of the amount of sky covered by clouds or obscured at and below the elevations reported in columns 27 and 31 respectively, and will not exceed 1.0. For example: If 0.4 clouds are visible at 1000 feet and a pilot reports 1.0 clouds at 3000 feet, the summation total entered in column 28 would nevertheless be only ten-tenths.

11422.11. When an observation of higher layers is impossible because lower cloud layers or obscuring phenomena cover more than 0.9 of the sky, a "U" will be entered in the amount columns and entries will be omitted in the type, height, and summation columns pertaining to higher layers unless a pilot report of a higher layer is available.

11422.12. When (1) clouds or obscuring phenomena are not present at any level, or (2) higher layers are not visible and 0.1 or more of the sky is visible, enter zeros in the appropriate amount columns and omit any entry in type and height columns.

11422.13. Entries will be made as follows in columns 28 and 32:

Columns 25 and 29	Columns 28 and 32
a. "U" entered in columns 25 and 29.	No entries in columns 28 and 32.
b. Numerical entry in column 25; "U" in column 29.	Numerical entry in column 28; no entry in column 32.
c. Numerical entries (including zero) in columns 25 and 29.	Numerical entries in columns 28 and 32.

11422.14. When two or more types of clouds or obscuring phenomena occur at the same level, their combined amounts will be entered in the appropriate column captioned "Amount" (par. 11422.21).

11422.2. TYPE. (Cols. 23, 26, 30, and 34.) Enter the appropriate abbreviation selected from Table 30 for clouds or obscuring phenomena observed. A minus sign (—) denoting thin will be prefixed to the abbreviation for any obscuring phenomena thin enough to reveal the sky directly above the observer.

11422.21. When two or more types of clouds or obscuring phenomena are observed at the same level, the predominating type will be recorded.

TABLE 30.—*Cloud types and obscuring phenomena*

Cloud type and obscuring phenomena	Abbreviations
CLOUDS	
Altocumulus	Ac
Altocumulus castellatus	Acc
Altostratus	As
Cirrocumulus	Cc
Cirrostratus	Cs
Cirrus	Ci
Cumulonimbus	Cb
Cumulonimbus mammatus (Mammato-cumulus)	Cm
Cumulus	Cu
Fractocumulus	Fc
Fractostratus	Fs
Nimbostratus	Ns
Stratocumulus	Sc
Stratus	St
OBSCURING PHENOMENA	
Precipitation	
Drizzle (any form and intensity including ZL)	L
OBSCURING PHENOMENA—continued	
Precipitation—Continued	
Hail (any form and intensity including AP)	A
Ice crystals	IC
Rain (any form and intensity including RW and ZR)	R
Sleet	E
Snow (any form and intensity including SW, SP, and SG)	S
Hydrometeors other than precipitation	
Blowing snow	BS
Fog (any form, including GF and IF)	F
Lithometeors	
Dust	D
Haze	H
Sand	N
Smoke	K

11422.3. DIRECTION. (Cols. 23, 26, 30, and 34) Enter the direction from which the clouds and obscuring phenomena are moving. When the direction is unknown, omit the entry. When motion is not discernible, enter "C" for calm; otherwise, enter an arrow denoting the motion to eight points of the compass immediately above the abbreviation as follows:

TABLE 31.—*Cloud direction*

↓	from north	↑	from south
↙	from northeast	↗	from southwest
←	from east	→	from west
↖	from southeast	↘	from northwest

11422.4. HEIGHT. (Cols. 24, 27, 31, 35) Enter height of clouds and the vertical visibility ascribed to obscuring phenomena not classified as thin in columns captioned "height." Enter the height of the base of obscuring phenomena classified as thin. Make all entries in hundreds of feet. Enter heights to the nearest 100 feet from the surface to 5,000 feet; to the nearest 500 feet between 5,000 and 10,000 feet; and to the nearest 1,000 feet above 10,000. Prefix an appropriate classification letter selected from Table 22 to the height entries.

11436. PRESSURE TENDENCY. (Col. 36) This entry will be made for 3- and 6-hourly synoptic observations at stations equipped with a barograph or microbarograph. Enter a single code figure, taken from Table 32 for pressure tendency during the 3-hour period ending at the time of observation.

11437. NET THREE-HOUR PRESSURE-CHANGE. (Col. 37) Entries will be made in this column at stations where pressure tendencies are entered in accordance with instructions for column 36 above. At the time of the 3- and 6-hourly observations, the net change in station pressure for the preceding three hours will be entered to the nearest 0.005 inch or 0.2 millibar, depending upon whether the barograph sheet is graduated in inches or millibars.

TABLE 32.—*Pressure tendencies*

Code figure	Description	
0	Rising, then falling.	Barometer now higher than, or the same as, 3 hours ago.
1	Rising, then steady; or rising, then rising more slowly.	
2	Unsteady or rising unsteadily.	
3	Steady or rising steadily.	
4	Falling or steady, then rising; or rising, then rising more quickly.	
5	Falling, then rising.	Barometer now lower than 3 hours ago.
6	Falling, then steady; or falling, then falling more slowly.	
7	Unsteady or falling unsteadily.	
8	Falling steadily.	
9	Steady or rising, then falling; or falling, then falling more quickly.	

11440. SYNOPTIC OBSERVATIONS. (Cols. 41–65) Entries for synoptic observations will be made in columns 41–65, in accordance with instructions in paragraphs 11441 through 11465. Entries in columns 44–56 will pertain to the synoptic periods and portions of synoptic periods indicated by entries in column 42. Entries on the first and sixth lines of these columns will be made at the time of the first synoptic observation after midnight and at midnight, LST, respectively.

11441. TIME. (Cols. 41 and 42) Entries in column 41 will be omitted unless otherwise instructed. In column 42 in the block captioned "Midnight to . . .," enter the time of the beginning of the first 6-hourly observation after 0000 LST. In the next four blocks below, enter the time of the beginning of the 6-hourly synoptic observation. The entries will be to the nearest minute in terms of the 24-hour clock.

11444. PRECIPITATION. (Col. 44) Entries in the 6-hourly spaces will comprise the total precipitation occurring during the six hours ending with the observation. On the line captioned "Midnight" enter the amount measured at midnight, i. e., the amount that has occurred between midnight and the preceding 6-hourly observation. On the line captioned "Midnight to . . . ," enter the amount of precipitation that has occurred between midnight and the succeeding 6-hourly observation. At stations where personnel are not on duty at midnight, this entry and the one opposite "Midnight" will be omitted. Entries will be in inches and hundredths, thus, 0.06. When precipitation has occurred in amounts of 0.005 inch or less, enter "T" denoting trace. When precipitation has not occurred, enter 0.00.

11445. SNOWFALL. (Col. 45) Enter the depth of snowfall, sleet, and hail (unmelted) to inches and tenths for the 6 hours ending with the observation. (Entries for hail will be followed by an asterisk and "*Hail" will be recorded in column 90.) When snow, sleet, or hail has fallen in amounts of 0.05 inch or less, enter "T" denoting trace. When none has occurred, enter 0.0. When snow, sleet, or hail melted as it fell, enter "T" with a note "Melted as it fell" under "Remarks, Notes, and Miscellaneous Phenomena." On the line captioned "Midnight" enter the amount occurring between midnight and the preceding 6-hourly observation. On the line captioned "Midnight to . . . ," enter the amount that has occurred between midnight and the succeeding 6-hourly observation. At stations where personnel are not on duty at midnight, this entry and the one opposite "Midnight" will be omitted.

11446. SNOW DEPTH. (Col. 46) Enter the depth of snow, sleet, hail, and ice on the ground at each 6-hourly observation to the nearest inch. (Entries for hail will be followed by an asterisk and "*Hail" will be recorded in column 90.) When snow, sleet, hail, or ice is on the ground and the depth amounts to 0.5 inch or less, enter "T" denoting trace. When none of these are on the ground, enter 0. In the column captioned "Midnight" enter the amount on the ground at midnight.

11447. MAXIMUM AND MINIMUM TEMPERATURES. (Cols. 47 and 48). These data will be entered only at stations equipped with maximum and minimum thermometers, telepsychrometers, or thermographs. Enter the maximum and minimum temperatures to degrees and tenths Fahrenheit for the six hours ending with the observation. Take the data from telepsychrometer or maximum and minimum thermometers, if available; if not, from the thermograph. Note that these temperatures must be as high and low respectively as any temperature recorded in the preceding 6 hours, including the current temperature. On the line captioned "Midnight" enter the maximum and minimum temperatures occurring between midnight and the preceding 6-hourly observation. On the line captioned "Midnight to . . .," enter the maximum and minimum temperatures occurring between midnight and the succeeding 6-hourly observation. Note that these are not necessarily the maximum and minimum temperatures for the 6-hourly observation. At stations where an observer is not on duty at midnight, the data will be taken from the thermograph, if available; otherwise, the entry will be omitted.

11449. HEIGHT OF 850-MILLIBAR SURFACE. (Col. 49) At stations designated to compute this datum, the height of the 850-millibar surface above sea level will be entered in feet to the nearest ten g-feet.

11450. STATE OF GROUND. (Col. 50) Entries for the state of ground will be made in accordance with Table 33.

TABLE 33.—*State of ground*

Code figures	Description
0	Surface of ground dry (no appreciable amount of dust or loose sand).
1	Surface of ground moist.
2	Surface of ground wet (standing water in small or large pools on surface).
3	Surface of ground bare and frozen.
4	Glaze on ground but no ice, slush, or snow.
5	Ice, slush, or snow covering less than one-half of ground.
6	Ice, slush, or firm or settled snow covering more than one-half of ground (but not completely).
7	Ice, slush, or firm or settled snow covering ground completely.
*8	Loose dry snow covering more than one-half of surface (but not completely).
*9	Loose dry snow covering surface completely.

* Figures 8 and 9 may be used to indicate dust or loose sand on the surface of the ground in the proportions indicated. Under these conditions, when the temperature is below 32° F., enter the words "State of ground—dust" or "State of ground—loose sand" in column 90.

NOTE.—Numbers 0 to 4 apply to representative bare ground and numbers 5 to 9 to an open representative area.

11451. SEA, STATE AND DIRECTION.[1] (Col. 51) State and direction of the sea refer only to the condition of the sea surface resulting from the action of winds prevailing in the immediate local area. It should be noted that it is possible for a "flat, oily" sea to co-exist with a "light," "moderate," or even "heavy" swell.

11451.1. The state of the sea will be recorded as a code figure in accordance with Table 34.

11451.2. The direction of the sea is the direction, to eight points of the compass, from which the sea is coming. It is recorded as an arrow.

EXAMPLE: A rough sea (waves 5–8 feet) from the southwest would be recorded as "5↗."

[1] The instructions in paragraphs 11451 to 11454.5 will apply to designated stations only.

TABLE 34.—*State of sea*

Code figures	Description	Approximate average wave height, feet
0	Flat, oily	0
1	Calm rippled	0
2	Smooth (wavelets)	1
3	Slight	1–3
4	Moderate	3–5
5	Rough	5–8
6	Very Rough	8–12
7	High	12–20
8	Very high	20–40
9	Mountainous	More than 40

11452. SWELL, HEIGHT AND DIRECTION. (Col. 52) The term "swell" is restricted in usage to the wave motion that underlies the "sea" raised and driven by the local wind. Swell usually has traveled over a considerable distance from the point where it was generated by the wind, and its direction and height may often differ widely from those of the local wind-driven waves ("sea").

11452.1. Height of swell is recorded as the estimated average height of swell in the open sea, measured in whole feet from crest to trough.

11452.2. Direction of swell is the direction, to eight points of the compass, from which the swell is coming. It is recorded as an arrow.

EXAMPLE: A three-foot swell from the west would be recorded as "3→."

11453. SWELL PERIOD. (Col. 53) Swell period is the average time between successive crests, measured to the nearest second. The swell period usually can be observed best by watching the rise and fall in the swell of a patch of foam or other floating object. When the elapsed time, measured by a stop watch, of ten successive rises of such an object has been obtained, a good average period may be recorded by taking one-tenth of the value.

11454. SURF. (Col. 54) A five-figure code comprises the "Primary Data Group" of the combined Surf Code (SURFCO). Enter it every 6 hours at stations (and ships when appropriate) with means of observing surf condition.

11454.1. PRIMARY SURF DATA GROUP. A five-figure code group, symbol form $H_sH_sM_sP_sD_s$.

11454.2. SYMBOL H_sH_s. Average height of waves in feet. 99 indicates average height impossible to estimate. Two figures to be entered for whole feet.

EXAMPLE: 01 for 1 foot, 12 for 12 feet, etc.

11454.3. SYMBOL M_s. Difference between height of maximum waves and average waves in a 5-minute interval. Third figure in group to be entered in accordance with code Table 35.

TABLE 35.—*Surf* (M_s)

Code No.	Difference between height of maximum waves and average waves	Code No.	Difference between height of maximum waves and average waves
0	0.	7	7 feet.
1	1 foot.	8	8 feet.
2	2 feet.	9	Greater than 8 feet except when H.H. is reported as 99, in which case this figure means that an estimate is impossible.
3	3 feet.		
4	4 feet.		
5	5 feet.		
6	6 feet.		

11454.4. SYMBOL P_s. Period, i. e., time between passage of successive breakers at a fixed point. Fourth figure of group to be entered in accordance with code Table 36.

TABLE 36.—*Surf (P_s)*

Code No.	Time between successive breakers	Code No.	Time between successive breakers
0	No surf.	5	11 or 12 seconds.
1	Less than 5 seconds.	6	13 to 15 seconds.
2	5 or 6 seconds.	7	16 to 18 seconds.
3	7 or 8 seconds.	8	Greater than 18 seconds.
4	9 or 10 seconds.	9	Time impossible to estimate.

11454.5. SYMBOL D_s. Angle of breakers with the beach and direction of wave travel (referred to observer on beach facing the sea.) Enter fifth figure of group in accordance with Table 37.

TABLE 37.—*Surf (D_s)*

Code No.	Angle of breakers with the beach	Code No.	Angle of breakers with the beach
0	Calm.	5	0° up to 10°
1	0° up to 10°	6	10° up to 20° from the right.
2	10° up to 20° from the left.	7	More than 20°
3	More than 20°	8	Confused, but predominantly from the right.
4	Confused, but predominantly from the left.	9	Not known.

11455. WATER TEMPERATURE. (Col. 55) Enter the water temperature to degrees and tenths Fahrenheit, on ships and at designated land stations only.

11456. SOIL TEMPERATURE. (Col. 56) Enter soil temperature to degrees and tenths *Fahrenheit at designated stations only.*

11458. STATION PRESSURE COMPUTATIONS. Station pressure computations for the 6-hourly synoptic observations will be entered in accordance with the following instructions:

11459. TIME. (Line 59) Enter the time of reading the barometer. (Note that this time will usually differ from that ascribed to the observation in columns 2 and 16.)

11460. ATTACHED THERMOMETER. (Line 60) Enter the temperature of the thermometer attached to the mercurial barometer to the nearest 0.5° Fahrenheit or centigrade. Entries will be omitted when the pressure readings are taken from precision aneroid barometers.

11461. OBSERVED BAROMETER. (Line 61) Enter the uncorrected observed reading of the mercurial or precision aneroid barometer to the nearest 0.001 inch or 0.05 millibar.

11462. TOTAL CORRECTION. (Line 62) Enter the sum of all corrections required to reduce the observed reading to station pressure.

11463. STATION PRESSURE. (Line 63) Enter to the nearest *0.001 inch or 0.05 millibar* for mercurial barometer readings, and to the nearest 0.001 inch or 0.1 millibar for precision aneroid readings.

11464. BAROGRAPH READING. (Line 64) Enter to the nearest *0.005 inch or 0.2 millibar*. When the barogram is changed at the time of the 6-hourly observation, take the barograph reading from the new barogram.

11465. BAROGRAPH CORRECTION. (Line 65) Enter to the nearest 0.01 inch or 0.2 millibar with proper sign the difference between the station pressure read on the barograph and

that determined with a mercurial or precision aneroid barometer. When the barogram is changed at the time of the 6-hourly observation the barograph correction is based on the indicated station pressure after the new barogram has been installed. If for any reason the barogram is changed after the time of the 6-hourly observation, enter the new barograph correction in column 90 and an asterisk in column 65 preceding the correction established at the time of the 6-hourly observation.

11466. SUMMARY OF DAY. (Cols. 66–81) Midnight to midnight refers to the interval 0000 to 2359 local standard time.

11467. MAXIMUM AND MINIMUM TEMPERATURES. (Cols. 66–67) Enter these data in whole degrees Fahrenheit. Note that the maximum and minimum temperatures must be at least as high and low, respectively, as any temperature recorded through the day.

11468. TWENTY-FOUR-HOUR PRECIPITATION. (Col. 68) Enter the total amount of precipitation (water equivalent of solid types) to the nearest 0.01 inch. If precipitation has occurred in amounts of 0.005 inch or less, enter "T" denoting trace. If precipitation has not occurred, enter 0.00. The sum of any number of "T" observations will be regarded as a trace unless recording equipment indicates the total is greater than 0.005 inch (liquid).

11469. TWENTY-FOUR-HOUR SNOWFALL. (Col. 69) Twenty-four-hour snowfall is the total amount, to tenths of an inch, of unmelted snow, sleet, or hail that falls during a 24-hour period. (Entries for hail will be followed by an asterisk, and "*Hail" recorded in column 90.) If there are separate snowfalls, each of which melts before the following occurs, the total for the day will be the sum of the maximum depth of each fall. Record the amount of snowfall (unmelted) in inches and tenths. When snow, sleet, or hail melts as it falls, enter "T" with a note "Melted as it fell" under "Remarks, Notes, and Miscellaneous Phenomena." If snow, sleet, or hail has fallen in amounts of 0.05 inch or less, enter "T" denoting trace. If none has fallen, enter 0.0.

11470. SNOW DEPTH. (Col. 70) This entry will be taken from the 0030 GCT snow depth entry, column 46.

11471. PEAK GUST. (Cols. 71–73) This datum will be entered only at stations supplied with gust-recording equipment. The peak gust is the highest velocity of wind recorded during the 24 hours. Enter (1) the direction to 16 points, if suitable recording equipment is available; otherwise to eight points; (2) the speed to nearest mile; and (3) time to nearest minute.

11474. THICKNESS OF ICE ON WATER. (Col. 74) This datum will be entered only at designated stations, to the nearest 0.1 inch.

11475. FROZEN GROUND LAYER. (Cols. 75–76) This datum will be entered only at designated stations, to the nearest whole inch.

11477. RIVER GAGE. (Col. 77) The river gage reading will be entered to the nearest 0.1 foot at stations where a river gage is read.

11480. (Cols. 82–90) Authorized teletype symbols and contractions, and plain English only, will be used in making entries in columns 82, 86, and 90. Since there will always be a time lapse between the occurrence or cessation of phenomena and their reporting, it will not be necessary to reconcile this difference in time with the time entries pertaining to the observations reporting their occurrence or cessation.

11482. PRECIPITATION AND THUNDERSTORMS. (Cols. 82–85) Enter times of beginnings and endings, to the nearest minute, of thunderstorms, precipitation, changes in forms and character of precipitation (e. g., rain to rain shower) and changes in intensity of thunderstorms and precipitation. Intervals of 15 minutes or less between the time of ending and recommencement need not be recorded unless occurring within one hour previous to the beginning of a 6-hourly observation, when all beginnings and endings will be recorded. This also applies to changes in intensity that do not last more than 15 minutes. When any of these phenomena is occurring at midnight, enter "cont." in column 84 for the day preceding midnight, and in column 83 for the day following midnight.

11483. OBSTRUCTIONS TO VISION. (Cols. 86–89) Enter the times of beginnings and endings of each obstruction to vision. When any of these phenomena is occurring at midnight, enter "cont." in column 84 for the day preceding midnight, and in column 83 for the day following midnight.

11484. DURATION. (Cols. 85 and 89) Unless otherwise designated, make no entries in these columns.

11485. REMARKS, NOTES, AND MISCELLANEOUS PHENOMENA. (Col. 90) All pertinent information will be entered concerning severe storms, floods, and miscellaneous hydrometeors, etc., and, when required, snow surface temperature data.

11485.1. HAILSTORMS. Enter all available information, including the diameters of the largest and average sized hailstones, damage caused, etc.

11485.2. TORNADO OR WATERSPOUT. Enter as complete information as possible on time, path, size of storm, its appearance, direction of movement, damage, etc., and source of information.

11485.3. LIGHTNING. Enter notes on approximate duration, distance, direction, frequency, etc., of lightning observed when a thunderstorm is not in progress at the station; i. e., when thunder is not heard.

11485.4. AURORA. Enter appropriate notes on extent, color, duration, etc.

11485.5. HARBOR ICE. Enter appropriate data on quantity, thickness, character, breaks, size of floes, persistence, conditions of aircraft landing area, conditions affecting the transfer of passengers from craft of all types, and any other conditions worthy of note.

11485.6. SNOW SURFACE TEMPERATURE. Snow surface temperature and related data will be entered at designated station. Example: "SNW SFC TMP —20° C., 0410 GCT, 4.6 FT. DIF."

11485.7. MISCELLANEOUS. Phenomena sent in synoptic messages as special phenomena groups, such as frost, glaze, etc., will be entered also.

11485.8. SUNRISE AND SUNSET. Character of sunrise and sunset will be entered in the spaces provided, as clear, cloudy, foggy, hazy, dusty, or smoky, at stations equipped with triple registers.

NOTE: Correct Figures 5, 8, and 10 as follows:
Figure 5, second line, column 23: Correct "GF" to read "F"
Figure 5, second line, column 24: Correct "0" to read "M0"
Figure 5, eleventh line, column 26: Correct "Cs" to read "$\overrightarrow{\text{Cs}}$"
Figure 8, tenth line, column 14: Delete "FILED"
Figure 8, 29th line, column 14: Correct "set" to read "sent"
Figure 10, third line, column 10: Correct "080MPH" to read "80MPH"
Figure 10, third line, column 14: Correct "P38" to read "F38"

W.B. FORM 1130 A Revised 7-1-48

U. S. DEPARTMENT OF COMMERCE, WEATHER BUREAU

WBAN 10 A

SURFACE WEATHER OBSERVATIONS

STATION WBAS SAN BRUNO, CALIF DATE JAN 12, 1949

	TYPE 1	TIME (LST) 2	CEILING (Hundreds of Feet) 3	SKY 4	VISIBILITY (Miles) 5	WEATHER and OBSTRUCTIONS TO VISION 6	SEA LEVEL PRESS. (mbs.) 7	TEMP (°F) 8	DEW PT. (°F) 9	WIND DIRECTION 10	WIND SPEED (m.p.h.) 11	WIND CHARACTER AND SHIFTS 12	ALTIMETER SET. (ins.) 13	REMARKS AND SUPPLEMENTAL CODED DATA 14	OBSERVERS INITIALS 15
	✓	0002		O	7					→↘	8		989	ST BNK NW	ALY
	R	0028		O	7		125	52	51	→↘	7		989	VSBY NW 2GF	ALY
	SI	0045		O	4	GF				→↘	8			VSBY N2W½	ALY
	✓	0100		O	3	GF				→↘	8		990	VSBY N1W½	ALY
	R	0126		O	3	GF	129	51	51	→↘	8		990	103	ALY
	✓	0200		O	5	GF				→↘	9		990	VSBY N2½	ALY
	R	0227		O	5	GF	129	51	49	→↘	8		990		ALY
	✓	0300		O	4	GF				↘	17		990	VSBY N¾E2	ALY
	R	0328		O	4	GF	129	51	50	→↘	11		990	VSBY N¾W3	ALY
	SZ	0345	W2	X	½	F				→↘	10				ALY
(1)	S3	0400	W2	X	3/8	F				→↘	10		990		ALY
	L	0415	W2	X	3/8	F									ALY
	R	0428	W2	X	3/8	F	129	51	51	→↘	11		990	0000	ALY
	L	0445	W2	X	3/8	F									ALY
	S4	0501		O	¾	GF				→↘	10		990	VSBY N½E½ 5¾ W1	ALY
	L	0515		O	¾	GF									ALY
	RS5	0527		O	¼	GF	129	51	51	→↘	10		990		ALY
	L	0545		O	¼	GF									ALY
(2)	S6	0600	W2	X	3/16V	F				→↘	10		990	VSBY VRBL 0 TO 5/8	ALY
	S7	0615	W2	X	¼	F				→↘	9				ALY
	R	0626	W2	X	¼	F	132	51	51	→↘	10		991		ALY
(3)	—	0635												ALREPS OVR SFO 0630P FLD CLRLY	
	—													VSB THRU F 25/MSL DC4	ALY
(4)	S8	0645		-X	½	F				↘	10			VSBY N¼E½ 5½W3 CNDS	
	—													RPDLY CHGBL	ALY
	S9	0658	M7	⊘	3	F				↘	10		991	VSBY N1E¾	ALY
	R	0728	M7V	⊘	3	F	135	52	53	↘	10		992	VSBY N1 C16 VRBL 5 TO 8 4DY 5006	ALY
	V	0800	E6	⊘	3	F				↘	12		993		THR
(5)	-	0810												PIREPS OVR SFO 0810P C16 4 HND DC3	THR
(6)	L	0817	A4												THR
(7)	S10	0814	A4	⊘	3	F				↘	12				THR
(8)	RS11	0828	M5	⊘	3	F	146	56	54	↘	14		995		THR
	S12	0846		6⊘	4	H				↘	18				THR
(9)	✓	0901		6-⊘	4	H				↘	22	+	995	G30	THR
	RS13	0928		200⊘	5	H	146	61	54	↘	24	+	995	G31 BD ON FLD SE	THR
	✓	1001		200⊘	6	H				↘	23	+	995	G34 BD ON FLD SE	THR
	6H	1015		200⊘	6	H	146	63	53	↘	20	+	995	G26	THR
(10)	RS14	1028	E200	-⊕	6	H	146	63	53	↘	18	-	995	5076/2	THR
	✓	1101	E200	-⊕	6	H				↘	17		995		THR
	R	1128	E200	-⊕	7		146	67	55	↘	16		995		THR

(1) VISIBILITY DECREASES TO LESS THAN ½ MILE — REFERENCE: 9134.03

(2) VISIBILITY DECREASES TO LESS THAN ¼ MILE — 9134.03

(3) PILOT REPORT OF FIELD CONDITION VIEWED FROM ALOFT — 9213 (8)

(4) THIN OBSCURATION - SKY DISCERNIBLE

(5) PILOT REPORT OF CEILING OVER FIELD - CURRENTLY REPORTED VALUE NOT MEASURED — 9211

(6) LOCAL EXTRA OF ONE ELEMENT ONLY — 9142, 9211

(7) SPECIAL FOR CEILING DECREASE TO LESS THAN 500 FT — 9134.01

(8) SPECIAL FOR CEILING INCREASE TO 500 FT (MEASURED) — 9211, 9134.01

(9) THIN LOWER CLOUDS

(10) RECORD-SPECIAL OBSERVATION DIFFERING FROM PRECEDING SYNOPTIC — 11202

CAS 47057-2

FIGURE 4.—Consecutive entries on WBAN 10A.

W B FORM 1130 B Revised 7-1-48

U. S. DEPARTMENT OF COMMERCE, WEATHER BUREAU

WBAN 10 B

SURFACE WEATHER OBSERVATIONS

STATION WBAS, San Bruno, Calif. DATE Jan 12, 1949

TIME (LST) 16	STATION PRESSURE (ins.) 17	DRY BULB (°F) 18	WET BULB (°F) 19	REL. HUMIDITY (%) 20	TOTAL SKY COVER 21	CLOUDS AND OBSCURING PHENOMENA — LOWEST LAYER: AMT 22	TYPE & DIR 23	HEIGHT 24	SECOND LAYER: AMT 25	TYPE & DIR 26	HEIGHT 27	SUMMATION TOTAL 28	THIRD LAYER: AMT 29	TYPE & DIR 30	HEIGHT 31	SUMMATION TOTAL 32	FOURTH LAYER: AMT 33	TYPE & DIR 34	HEIGHT 35	PRESSURE TENDENCY 36	NET 3-HR CHANGE 37	38	39	40
00 28	29.880	52.5	51.9	96	1-																			
01 26	29.885	51.1	50.8	98	1-	1-	GF	0	0			1-	0			1-	0			1	.020			
02 27	29.885	50.9	50.0	94	0																			
03 28	29.885	50.8	50.3	96	2																			
04 28	29.888	51.0	50.8	99	10	10	F	W2	U				U				U			4	.005			
05 27	29.890	50.8	50.8	100	4																			
06 26	29.900	51.3	51.3	100	10																			
07 28	29.910	53.4	53.2	99	9	9	St	M7	0			9	0			9	0			4	.025			
08 28	29.945	55.8	54.8	95	9																			
09 28	29.945	61.4	57.0	77	3																			
10 28	29.943	63.2	56.9	68	(10) 4	1-	St	E3	(10) 4	Cs	E200	(10) 4	0			(10) 4	0			1	.035			
11 28	29.940	66.9	59.8	66	10																			
12																								
13																								
14						(Note: Entries on this form																			
15						correspond to those on Fig. 4)																			
16																								
17																								
18																								
19																								
20																								
21																								
22																								
23																								

SYNOPTIC OBSERVATIONS

TIME (GCT) 41	TIME (LST) 42	NO. 43	PRECIP. (ins) 44	SNOW FALL (ins) 45	SNOW DEPTH (ins) 46	MAX TEMP (°F) 47	MIN. TEMP (°F) 48	HGT. 850 MB. SURFACE 49	STATE OF GRND 50	SEA STATE & DIR. 51	SWELL HGT. & DIR. 52	SWELL PERIOD 53	SURF H_s H_3 M_s P_s D_s 54	WATER TEMP 55	SOIL TEMP 56	57	58
	MID. TO 0405	X	0.00	0.0	X	53.2	50.2	X	X	X	X	X	X	X	X		
	0405	1	0.00	0.0	0	54.3	50.2										
	1005	2	0.00	0.0	0	63.9	49.0										
		3															
		4															
	MID	X						X	X	X	X	X	X	X	X		

STATION PRESSURE COMPUTATIONS

TIME (LST) 59	0408	1007
ATT. THERM 60	77.0	75.0
OBSRVD. BAR 61	30.040	30.090
TOTAL CORR 62	-.152	-.147
STA. PRESS 63	29.888	29.943
BAROGRAPH 64	29.890	29.943
BAR. CORR 65	0	0

SUMMARY OF DAY (MIDNIGHT TO MIDNIGHT)

24-HR MAX TEMP (°F) 66	24-HR MIN TEMP (°F) 67	24-HR PRECIP. (WATER EQUIV. ins) 68	24-HR SNOWFALL UNMLTD. (ins) 69	SNOW DEPTH (ins) 70	PEAK GUST: SPEED (m.p.h.) 71	DIRECTION 72	TIME (LST) 73	THICKNESS OF ICE ON WATER (ins) 74	FROZEN GRND LAYER (ins): TOP 75	BASE 76	RIVER GAGE 77	78	79	80	81

PRECIP & THDRSTM 82	BEGAN 83	ENDED 84	DUR. 85 hrs. mins	OBSTR. TO VIS. 86	BEGAN 87	ENDED 88	DUR. 89 hrs. mins
				GF	0040	0340	
				F	0340	0454	
				GF	0454	0555	
				F	0555	0840	
				H	0840	1120	

REMARKS, NOTES AND MISCELLANEOUS PHENOMENA 90

SUNRISE Foggy SUNSET

FIGURE 5.—Consecutive entries on WBAN 10B.

W B FORM 1130 A Revised 7-1-48 — U. S. DEPARTMENT OF COMMERCE, WEATHER BUREAU — WBAN 10 A

SURFACE WEATHER OBSERVATIONS

STATION _____ DATE _____

	TYPE (1)	TIME (LST) (2)	CEILING (Hundreds of Feet) (3)	SKY (4)	VISIBILITY (Miles) (5)	WEATHER and OBSTRUCTIONS TO VISION (6)	SEA LEVEL PRESS. (mbs.) (7)	TEMP (°F) (8)	DEW PT (°F) (9)	WIND DIRECTION (10)	WIND SPEED (m.p.h.) (11)	WIND CHARACTER AND SHIFTS (12)	ALTIMETER SET (ins.) (13)	REMARKS AND SUPPLEMENTAL CODED DATA (14)	14A	14B	OBSERVERS INITIALS (15)
(1)	R	1328		O	8		122	84	31	↑↖	8		010	K LYR NW BASE E15			CAR
(2)	RS4	1828	W8	X	8		200	53	38	↑	7		024	BASE K LYR E5			LAT
(3)	RS10	1127	P25	X	2	TRWA	146	74	62	→	19		016	T W MOVG EWD FQT LTNG CLD TO GND H LSTO 1/2 INCH			ERT
(4)	R	0926	P10	X	2	S-	119	62	53	→↘	14		007				HAN
(5)	R	2228	W0	X	0	L-F	176	57	56		C		020				YOT
(6)	R	1927		100 ⊕	7		112	71	23	↗	6		009	BASE K LYR E7			HIN
(7)	R	1828	E200	⊕40⊕	8		135	90	52	↑↗	5		013	BASE H LYR E55			KIT
(8)	R	0926	W5	⊕X	4	F	186	58	56	↖	2		022	BASE K LYR E3 E25⊕			LJD
(9)	R	0426	W20	X10⊕	7		166	52	29	↖	10		020	BASE K LYR E15 4⊕			CTL
(10)	R	0624		-X15⊕	8		129	89	30	↘	6		013	BASE K LYR E30			LMR
(11)	R	0327	E15	⊕-X	5	H	081	75	61	↑	4		993				RTK
(12)	R	0928	M21	-X⊕	7		105	70	29	↙	7		001	BASE H LYR E50			KLB

OBSCURING PHENOMENA ONLY VISIBLE:
(1) COVERING LESS THAN 0.6 OF SKY; BASE ALOFT
(2) COVERING 0.6 OR MORE OF SKY; BASE ALOFT
(3) (4) COVERING 0.6 OR MORE OF SKY; BASE AT SURFACE
(5)

CLOUDS AND OBSCURING PHENOMENA VISIBLE:
(6) CLOUDS ABOVE OBSCURING PHENOMENA
(7) CLOUDS ABOVE AND BELOW OBSCURING PHENOMENA
(8) CLOUDS ABOVE OBSCURATION
(9) CLOUDS BELOW OBSCURATION
(10) CLOUDS BELOW THIN OBSCURATION
(11) CLOUDS ABOVE THIN OBSCURATION
(12) CLOUDS BELOW THIN OBSCURATION

FIGURE 6.—Entries of obscuring phenomena on WBAN 10A.

W B FORM 1130 B Revised 7-1-48 — U. S. DEPARTMENT OF COMMERCE, WEATHER BUREAU — WBAN 10 B

SURFACE WEATHER OBSERVATIONS

STATION _____ DATE _____

	TIME (LST) (16)	STATION PRESSURE (ins.) (17)	DRY BULB (°F) (18)	WET BULB (°F) (19)	REL HUMIDITY (%) (20)	TOTAL SKY COVER (21)	CLOUDS AND OBSCURING PHENOMENA — LOWEST LAYER AMT (22)	LOWEST LAYER TYPE & DIR (23)	LOWEST LAYER HEIGHT (24)	SECOND LAYER AMT (25)	SECOND LAYER TYPE & DIR (26)	SECOND LAYER HEIGHT (27)	SUMMATION TOTAL (28)	THIRD LAYER AMT (29)	THIRD LAYER TYPE & DIR (30)	THIRD LAYER HEIGHT (31)	SUMMATION TOTAL (32)	FOURTH LAYER AMT (33)	FOURTH LAYER TYPE & DIR (34)	FOURTH LAYER HEIGHT (35)	PRESSURE TENDENCY (36)	NET 3-HR CHANGE (37)	(38)	(39)	(40)
00					(1)	4	4	-K	E15	0			4	0			4	0							
01					(2)	9	9	K	W8	0			9	0			9	0							
02					(3)	10	10	R	P25	〃				〃				〃							
03					(4)	10	10	S	P10	〃				〃				〃							
04					(5)	10	10	F	W0	〃				〃				〃							
05					(6)	5	4	K	W10	2	Ac	E100	5	0			5	0							
06					(7)	10	2	Cu	E40	3	H	W60	5	5	Ci	E200	10	〃							
07					(8)	10	6	K	W5	6	Sc	E25	10	〃				〃							
08					(9)	10	2	St	W4	1	Sc	E10	3	7	K	W20	10	〃							
09					(10)	8	2	Cu	E15	6	-K	E30	8	0			8	0							
10					(11)	8	6	-H	M0	3	Sc	E15	8	0			8	0							
11					(12)	9+	6	Sc	M21	9+	-H	E50	9+	〃				〃							
12																									
13																									
14							(NOTE: ENTRIES ON THIS FORM CORRESPOND																			
15							TO THOSE ON FIG 6.)																			
16																									

FIGURE 7.—Entries of obscuring phenomena on WBAN 10B.

W.B. FORM 1130 A Revised 7-1-48

U. S. DEPARTMENT OF COMMERCE, WEATHER BUREAU

SURFACE WEATHER OBSERVATIONS

WBAN 10 A

STATION _____ DATE _____

	TYPE 1	TIME (LST) 2	CEILING (Hundreds of Feet) 3	SKY 4	VISIBILITY (Miles) 5	WEATHER and OBSTRUCTIONS TO VISION 6	SEA LEVEL PRESS. (mbs.) 7	TEMP (°F) 8	DEW PT (°F) 9	WIND DIRECTION 10	WIND SPEED (m.p.h.) 11	WIND CHARACTER AND SHIFTS 12	ALTIMETER SET (ins) 13	REMARKS AND SUPPLEMENTAL CODED DATA 14 14A 14B	OBSERVERS INITIALS 15	
(1)	R	1528		O	15		129	72	60	↘	8		991		ART	(1)
(2)	R	1728	M90	⊕◐	12		091	72	31	↗	9		994	E200⊕A120◐40◐25◐ 973723	RQR	(2)
(3)	R	0627	M100	⊕	10		098	57	28	→	4		995		RRC	(3)
(4)	RS7	1828		4◐	8		132	87	24	→↗	5		011		RCA	(4)
(5)	R	2227	M37	⊕	10		125	76	24	↖	7		009	HIR LYR VSB THRU BRKS	RQB	(5)
(6)	R	1228		◐250◐	4	GF	142	67	66	↘	15		014	SFC VSBY 2½ 120◐	RQC	(6)
(7)	RS10	1827	W25	+⊕	3	RW-Q	115	82	70	↘28+↑	920E		007	G35	ARR	(7)
(8)	S4	1618												UNCONFIRMED TORNADO 20 MLS S		(8)
(9)	R	2226	M24	⊕◐	2½	ZL-S-	200	32	32	↙	14	*	025 027	MOVG NEWD 1530C	RQH	
(10)	R	0628	E250	-◐	12		173	60	M	→↘	20		021	E70⊕C *(CAN FILED 2240)	RQK	(9) (10)
(11)	R	1427		40◐	15+			76	27	↑↖	12				RQM	(11)
(12)	S2	0244									AL	STG	995		RQC	(12)
(13)	L	2135	M5											(FOR AAL)	RQH	(13)
(14)	L	2150		O	15+		186	84	68	↑↗	15	F	009	(ACFT ACCIDENT)	CG	(14)

(1) No clouds or obscuring phenomena
(2) More than four layers of clouds
(3) 1.0 sky cover at one level
(4) Special required by scattered clouds
(5) Upper layer of clouds visible through breaks in lower overcast
(6) (a). Scattered clouds at two levels
(b) Tower visibility at Weather Bureau station participating in control tower visibility program
(7) (a) Wind shift
(b) Dark clouds
(c) Squall
(8) Public report of tornado
(9) Erroneous observation transmitted - correction set (* These data entered in red.)
(10) Data missing that would ordinarily be transmitted by station
(11) Data missing that would not ordinarily be transmitted by station
(12) Altimeter setting — sent as single element special
(13) Local extra requested by airline
(14) (a) Local extra for aircraft accident
(b) Estimated wind

FIGURE 8.—Miscellaneous entries on WBAN 10A.

W.B. FORM 1130 B Revised 7-1-48

U. S. DEPARTMENT OF COMMERCE, WEATHER BUREAU

SURFACE WEATHER OBSERVATIONS

WBAN 10 B

STATION _____ DATE _____

TIME (LST) 16	STATION PRESSURE (ins.) 17	DRY BULB (°F) 18	WET BULB (°F) 19	REL. HUMIDITY (%) 20	TOTAL SKY COVER 21	CLOUDS AND OBSCURING PHENOMENA — LOWEST LAYER: AMT 22	TYPE B DIR 23	HEIGHT 24	SECOND LAYER: AMT 25	TYPE B DIR 26	HEIGHT 27	SUMMATION TOTAL 28	THIRD LAYER: AMT 29	TYPE B DIR 30	HEIGHT 31	SUMMATION TOTAL 32	FOURTH LAYER: AMT 33	TYPE B DIR 34	HEIGHT 35	PRESSURE TENDENCY 36	NET 3-HR CHANGE 37	38	39	40
00				(1)	0	0			0			0	0			0	0							
01				(2)	10	2	Fc	E25	2	Cb	M40	3	5	Ac	M90	7	2	As	A120					
02				(3)	10	10	Ac	M100	U				U				U							
03				(4)	2	2	St	E4	0			2	0			2	0							
04				(5)	10	9+	Sc	M37	10	Cs	E250	10	U				U							
05				(6)	5	2	Cu	E25	3	Ac	E120	5	0			5	0							
06				(7)	7	10	Cb	W25	U				U				U							
07				(8)																				
08				(9)	10	7	St	M24	7	Ac	E70	10	U				U							
09				(10)	8	8	Ci	E250	0			8	0			8	0							
10				(11)	4	4	Cu	M40	0			4	0			4	0							
11																								
12																								
13																								
14				Note:		Entries	on	this	form	correspond	with													
15						those	on	Fig.	8															
16																								
17																								
18																								
19																								
20																								
21																								
22																								
23																								

SYNOPTIC OBSERVATIONS

TIME (GCT) 41	TIME (LST) 42	NO. 43	PRECIP (ins) 44	SNOW FALL (ins) 45	SNOW DEPTH (ins) 46	MAX TEMP (°F) 47	MIN TEMP (°F) 48	HGT 850 MB. SURFACE 49	STATE OF GRND 50	SEA STATE & DIR. 51	SWELL HGT. & DIR. 52	SWELL PERIOD 53	SURF H_s H_s M_s P_s D_s 54	WATER TEMP 55	SOIL TEMP 56	57	58
	MID. TO	X			X			X	X	X	X	X	X	X	X		
		1															
		2															
		3															
		4															
	MID.	X						X	X	X	X	X	X	X	X		

STATION PRESSURE COMPUTATIONS

TIME (LST) 59				
ATT. THERM 60				
OBSRVD BAR 61				
TOTAL CORR 62				
STA. PRESS 63				
BAROGRAPH 64				
BAR. CORR 65				

SUMMARY OF DAY (MIDNIGHT TO MIDNIGHT)

24-HR MAX TEMP (°F) 66	24-HR MIN TEMP (°F) 67	24-HR PRECIP. (WATER EQUIV (ins) 68	24-HR SNOWFALL UNMLTD. (ins) 69	SNOW DEPTH (ins) 70	PEAK GUST: SPEED (m.p.h.) 71	DIRECTION 72	TIME (LST) 73	THICKNESS OF ICE ON WATER (ins) 74	FROZEN GRND LAYER (ins): TOP 75	BASE 76	RIVER GAGE 77	78	79	80	81

PRECIP & THDRSTM 82	BEGAN 83	ENDED 84	DUR. 85 hrs mins	OBSTR. TO VIS. 86	BEGAN 87	ENDED 88	DUR. 89 hrs mins

REMARKS, NOTES AND MISCELLANEOUS PHENOMENA 90

SUNRISE _____ SUNSET _____

(2) 3Ci E200 (1728 Obs)

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FIGURE 9.—Miscellaneous entries on WBAN 10B.

W B FORM 1130 A Revised 7-1-49

U. S. DEPARTMENT OF COMMERCE, WEATHER BUREAU

WBAN 10 A

SURFACE WEATHER OBSERVATIONS

STATION WBAS Los Angeles, Calif. DATE June 8-11

TYPE 1	TIME (LST) 2	CEILING (Hundreds of Feet) 3	SKY 4	VISIBILITY (Miles) 5	WEATHER and OBSTRUCTIONS TO VISION 6	SEA LEVEL PRESS. (mbs.) 7	TEMP (°F) 8	DEW PT (°F) 9	WIND DIRECTION 10	WIND SPEED (m.p.h.) 11	WIND CHARACTER AND SHIFTS 12	ALTIMETER SET (ins) 13	REMARKS AND SUPPLEMENTAL CODED DATA 14	14A	14B	OBSERVERS INITIALS 15
					June	8										
		ALREPS	40-60	S	OAK	0315P			LGT	ICG		115-130	MSL DC6 (sent with 0828 OBS)			A.T.D
		AFREPS	20	E	BUR	0605P			WND	270	080MPH	100	MSL P38 (SENT WITH 0626 OBS)			[illegible]
		ALREPS	45	NW	LAS	0745P			LGT	TURBC		90	MSL DC4 (SENT WITH 0828 OBS)			[illegible]
					June	9										
		PIREPS	50	NW	SFO	1714P			DISCHARGE			50	MSL LGT TURBC 35 MSL BCFT			
													(SENT WITH 1730 OBS)			[illegible]
	2115	NYREPS	75	S	LAS	2104P			TOVC			55	MSL PBY			J.H.A
		AFREPS	85	E	SFO	2312P			LGT	ICG		11-140	MSL B17 (SENT WITH 2330 OBS)			[illegible]
					June	11										
	0910	PIREPS	0	YR	BFL	0904P		C	IG			28	MSL ERCP			[illegible]
		AFREPS	10	S	LAS	1010P		C	IG			60	MSL TOVC 85 MSL B24 (Sent with 1026 OBS)			[illegible]
	1138	PIREPS	15	SW	BUR	1130P			SKY	CLR	STSN					[illegible]

FIGURE 10.—Entries of pilot reports on WBAN 10A.

SUMMARY OF CRITERIA FOR TAKING SPECIAL OBSERVATIONS

1. CEILING:
   - **a.** The ceiling after decreasing by 50% or more is 5,000 feet or less.
   - **b.** A ceiling of 5,000 feet or less increases by 100% or more.
   - **c.** The ceiling decreases to less than 1,500 feet or increases to 1,500 feet or more.
   - **d.** The ceiling decreases to less than 1,000 feet, or increases to 1,000 feet or more.
   - **e.** The ceiling decreases to less than 500 feet, or increases to 500 feet or more.
   - **f.** The ceiling increases from zero to 100 feet or more.
   - **g.** The ceiling decreases to a value equal to or lower than the highest air-line operating minimum for the airport.
   - **h.** The ceiling increases to a value equal to or higher than the highest air-line operating minimum for the airport.
2. SKY CONDITION:
   - **a.** A change in total sky cover from clear to broken or overcast, and vice versa; or from scattered to overcast, and vice versa.
   - **b.** A change in sky cover from clear to scattered
     - (1) below 1,000 feet, or
     - (2) at or below the highest air-line operating minimum for the airport.
3. VISIBILITY:
   - **a.** The visibility after decreasing by 50% or more is 5 miles or less.
   - **b.** The visibility having been 5 miles or less, increases by 100% or more.
   - **c.** The visibility decreases to less than:
     - (1) 3 miles
     - (2) 1 mile
     - (3) ¾ mile
     - (4) ½ mile } C. A. A. ILS station only.
     - (5) ¼ mile
   - **d.** The visibility increases to equal or exceed:
     - (1) 3 miles
     - (2) 1 mile
3. VISIBILITY—Continued
   - **d.** The visibility increases to equal or exceed—Con.
     - (3) ¾ mile
     - (4) ½ mile } C. A. A. ILS station only.
     - (5) ¼ mile
     - (6) 1/16 mile
4. TORNADO:
   - **a.** Is observed.
   - **b.** Disappears from sight.
   - **c.** Is reported by the public to have occurred within preceding six hours.
5. THUNDERSTORM:
   - **a.** Begins.
   - **b.** Increases in intensity.
   - **c.** Ends. (Special observation 15 minutes after thunder is last heard at station.)
6. PRECIPITATION:
   - **a.** Hail begins or ends.
   - **b.** Liquid precipitation begins or ends.
   - **c.** Freezing precipitation begins or ends.
   - **d.** Sleet begins or ends.
   - **e.** Snow begins or ends.
7. FOG:
   - **a.** Beginning and ending of fog, ground fog, or ice fog; or a change from one type of fog to another.
8. SANDSTORM, DUSTSTORM:
   - **a.** Is observed within 6 miles of station.
   - **b.** Disappears from sight.
9. WIND AND WIND SHIFTS:
   - **a.** Sudden doubling of speed to more than 30 miles (26 knots).
   - **b.** Wind-shift.
10. ALTIMETER SETTING:
    - **a.** A change in altimeter setting, as shown by a change in station pressure, at the rate of 0.08 inch or more per hour. (Special observations taken at 15-minute intervals as long as this rate of change persists.)
11. In addition, any meteorological situation of importance to the safety or efficiency of aircraft operations.

SUMMARY OF CRITERIA FOR TAKING LOCAL EXTRA OBSERVATIONS

1. At designated stations at intervals not exceeding 15 minutes, beginning whenever
   - **a.** ceiling or visibility decreases to a value equal to or less than the highest aircraft minimum applying to the airport.
   - **b.** ceiling decreases to 500 feet or less.
   - **c.** visibility decreases to one mile or less.

   Local extra observations discontinued when values above these minimums have been reported. Record or special observations coming within 15-minute interval also serve as the local extra observation.
2. Upon request for one or more elements for aircraft arrivals or departures at any station, even though weather conditions do not warrant a special observation.
3. At any station immediately following any aircraft accident in the vicinity of an airport at which a weather-observing station is situated.
4. Ceiling or visibility changes to a value above, equal to, or below
   - **a.** the minimum prescribed for the airport, or
   - **b.** any air carrier minimum applicable to the local airport.

   This requirement is applicable only when takeoffs and landings impend.

INTENSITY CRITERIA FOR THUNDERSTORMS

Heavy Thunderstorm: Nearly incessant thunder and lightning; heavy rain, and possibly moderate to heavy hail; high winds, exceeding 40 mph (35 knots) at peak of gusts; rapid drop in temperature.

Thunderstorm: Intensity less than heavy.

INTENSITY CRITERIA FOR PRECIPITATION

Rate of Fall (hundredths of inch)

Intensity	Rainfall		Drizzle
	Per 6-minute interval	Per hour	Per hour
Light	0.01 or less	0.10 or less	Trace to 0.01.
Moderate	More than 0.01–0.03.	0.11–0.30	More than 0.01–0.02.
Heavy	More than 0.03	More than 0.30	More than 0.02.

Visibility—Snow Occurring Alone*

Intensity	Visibility
Heavy	Less than 550 yards.
Moderate	Less than 1100 yards but not less than 550 yards.
Light	1100 yards or more.

*Rate of accumulation is intensity criterion for snow occurring in combination with lithometeors and other hydrometeors.

INTENSITY CRITERIA FOR WIND SHIFTS

Maximum speed of gusts of wind

Accompanying phenomena	Intensity		
	Light	Moderate	Heavy
Both precipitation and a decrease in cloud heights.	Does not exceed 24 m. p. h., 21 knots.	Exceeds 24 m. p. h. but not 39 m. p. h., 21–34 knots.	Exceeds 39 m. p. h., 34 knots.
No precipitation nor decrease in cloud heights.	Does not exceed 34 m. p. h. 30 knots.	Exceeds 34 m. p. h., but not 49 mp. h., 30–42 knots.	Exceeds 49 m. p. h., 42 knots.

INTENSITY CRITERIA FOR SQUALLS

Maximum speed of gusts of wind

Description	Speed of gusts	
	M. P. H.	Knots
Light	Not to exceed 24	Not to exceed 21.
Moderate	25–39	22–34.
Heavy	More than 39	More than 34.

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