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MANUAL OF
SURFACE OBSERVATIONS
ABRIDGED
(For CAA Stations)

FROM

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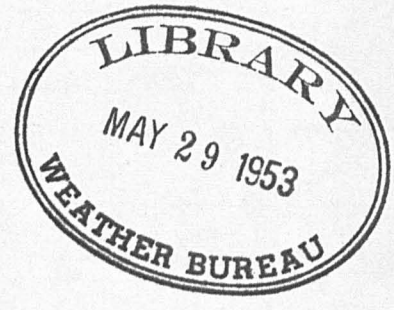
Sixth Edition
(Revised)



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RECORD OF CHANGES

Amendment number	Date effective	Pages affected	Initials	Date

FOREWORD

This manual is an abridged edition of the Manual of Surface Observations (WBAN), the Weather Bureau addendum thereto, and the Additive Data Coding Manual. It will be used at designated CAA stations only.

Certain paragraphs from the unabridged instructions have been restated to meet the special needs of CAA stations. In all other respects, including the general organization and the numbering of paragraphs, the abridged edition corresponds to the basic manuals.

Where practicable, addendum paragraphs (identified by an "A" prefixed to the paragraph number) that pertain to observed data primarily, and not to the operation and maintenance of instruments, have been placed after the associated WBAN paragraphs.

Amendments to this manual will be issued as revised pages for insertion in the manual. 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.

A record of instrument maintenance performed, Form 450-3 (formerly Form 1141) will be kept at all stations. This form will be bound after the last chapter of this manual and retained until it has been reviewed by a field aide.

Insofar as frequency of visits permits, field aides will perform maintenance duties at CAA stations.

Unless otherwise instructed, correspondence pertaining to the observational program, including the repair and replacement of equipment, should be sent to the Weather Bureau regional office. When ordering replacement instruments, include sufficient description to identify the items required, i.e., make, model, type, stock number if known, etc. Such identification is often listed on Form 450-1, Description of Topography and Exposure of Instruments, and Form 450-3, (formerly Form 1141), Record of On-Station Instrumental Maintenance.

References to WBAN-10 forms in this manual relate to WBAN-10 (CAA) exclusively.

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INTRODUCTION

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 parts, and it must convey a complete picture of the meteorological situation existing at the station.

Weather-observing duties are secondary with respect to primary functions, such as communications, flight assistance, etc. Weather observations will be taken and transmitted as primary duties permit. (See also ¶ A9120.2(3)).

When computations require that a number be rounded, the following procedure will be observed:

(1) If the fractional part to be disposed of is one-half or greater, the preceding digit will be increased by one.

(2) If the fractional part to be disposed of is less than one-half, the preceding digit will remain unchanged, e.g., 29.248 rounded to the nearest tenth is 29.2.

Algebraic signs will be disregarded - e.g., 1.5 = 2; -1.5 = -2.

CHAPTER 1. CLOUDS AND OBSCURING PHENOMENA

1000. GENERAL

1010. Observations of clouds and obscuring phenomena will be taken from as many points as necessary to view the entire sky. Pilots' reports of sky cover will not be included in the surface observation, but will be sent as pireps only (see Chapter 10).

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, but not necessarily hidden by clouds or obscuring phenomena aloft.

(2) Amount of sky concealed by obscuring phenomena on the ground.

(3) A combination of (1) and (2).

Sky cover may refer either to the amount of sky covered by a particular layer, or to the total amount covered by all layers. If the sky cover is opaque (i.e., conceals the sky), the tenths of sky cover plus the tenths of sky visible will always equal 1.0 (10/10). Sky cover is estimated with reference to the actual, rather than celestial, horizon. It is reported to the nearest tenth, with decimals disposed of in accordance with the Introduction (e.g., sky cover of .07 is regarded as one tenth, .95 as ten tenths). Sky-cover observations may be taken without the use of instruments. 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 distribution. Determine the amount of sky cover in accordance with ¶ 1120 through 1121, and select corresponding sky-cover symbols from Table 1a.

Table 1a. Sky-Cover Symbols

Symbol and Meaning	Explanation
X Obscuration.....	Ten tenths of sky hidden by precipitation or obstructions to vision (bases at surface).
-X Partial obscuration.....	0.1 to 0.9 sky hidden by precipitation or obstructions to vision (base at surface).
O Clear.....	0.0 total sky cover (This symbol is not used in combination.)
⊙ 1/ Scattered.....	0.1 to 0.5 sky cover.
◍ 1/ Broken.....	0.6 to 0.9 sky cover.
⊕ 1/ Overcast.....	Ten tenths of sky cover. (This symbol will be used in combination with a lower overcast symbol only if the latter is classified thin.)

1/ Symbols for thin ("-") and dark ("+") will be prefixed to these symbols in accordance with ¶ 1511.

1120. With Advancing Layer.--To estimate the amount of an advancing (or receding) layer, determine the angular elevation above the horizon of the forward or rear edge of the layer as seen against the sky. This will be done with a 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 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 will 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 layers

Angles subtended by sky cover	Tenths of sky cover	Angles subtended by sky cover	Tenths of sky cover
Less than 26°.....	0.0	96° - 107°.....	0.6
26° - 45°.....	0.1	108° - 119°.....	0.7
46° - 59°.....	0.2	120° - 134°.....	0.8
60° - 72°.....	0.3	135° - 154°.....	0.9
73° - 84°.....	0.4	155° - 180°.....	1.0
85° - 95°.....	0.5		

1121. With Continuous Layer Surrounding Station.--To estimate the amount when a continuous layer surrounds the station and extends to the horizon, determine the angular elevation of the edges, and convert to tenths of sky cover by use of Table 2.

Table 2. Sky cover with layer surrounding station

Angular elevation	Tenths of sky cover	Angular elevation	Tenths of sky cover
Less than 3°.....	0.0	34° - 40°.....	0.6
3° - 8°.....	0.1	41° - 48°.....	0.7
9° - 14°.....	0.2	49° - 58°.....	0.8
15° - 20°.....	0.3	59° - 71°.....	0.9
21° - 26°.....	0.4	72° - 90°.....	1.0
27° - 33°.....	0.5		

1200. DETERMINATION OF STRATIFICATION

1210. Definition of Layer.--Clouds or obscuring phenomena whose bases are at approximately the same level are regarded as a layer. The layer may be continuous or composed of detached elements. 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 ¶ 1230).

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. When clouds that are formed in this manner are attached to a parent cloud, they will be regarded as a separate layer only if their bases appear horizontal and at a different level from the parent cloud. Otherwise, the entire cloud system will be regarded as a single layer at a height corresponding to that of the base of the cumulonimbus.

1400. DETERMINATION OF HEIGHTS

1410. Ceiling Definition.--The ceiling is the height ascribed to the lowest layer of clouds or obscuring phenomena that is reported as broken, overcast, or obscuration (see Table 1a) and not classified "thin" or "partial." Note that, for obscurations, this height represents vertical visibility into the obscuring phenomena, rather than the height of the base. The ceiling is termed "unlimited" when the foregoing conditions are not satisfied. At all other times, the ceiling is expressed in feet above the surface. (See ¶ 1412.)

1411. Vertical Visibility.--Vertical visibility is a ceiling value used to express the distance that an observer in an obscuring medium can see vertically upward into the medium. The sky-cover symbols "X" and "-X" (see Table 1a) are always used when vertical visibility is reported. The ceiling ascribed to "X" must be classified "W", "P" or "A." Other sky-cover symbols are used with "X" and "-X" to report visible cloud layers (see ¶ 1511, example 5).

1412. Surface.--"Surface" as used here is a horizontal plane, whose elevation above sea level equals the field elevation (see ¶ 1441). 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 by one or more reportable values during the period of observation. It will be

reported only for ceilings less than 3000 feet. The average of all values secured will be used as the ceiling. Rapid fluctuation of the spot produced by a ceiling-light projector will indicate an irregular base whose height will be regarded as measured but variable. Distinguish this type of fluctuation from that which is due to multiple layers (see ¶ 1441.3).

1430. Ceiling Classification.--The ceiling is classified in accordance with Table 2a.

Table 2a. Ceiling-Classification Symbols

M	Measured	W	Indefinite
A	Aircraft	P	Precipitation
B	Balloon	E	Estimated

1431. Measured Ceiling.--A ceiling is classified as measured whenever it pertains to clouds or obscuring phenomena aloft and is determined by means of:

(1) A ceiling light or ceilometer, provided penetration of the beam is not in excess of that normally experienced for the height and type of layer (see ¶ 1441.2).

(3) The known heights of unobscured portions of objects, other than natural landmarks, within 1-1/2 statute miles of any runway of the airport.

1432. Aircraft Ceiling.--A ceiling is classified as an aircraft ceiling when it is determined by a pilot while in flight over, or within 1-1/2 statute miles of, any runway of the airport. Aircraft ceilings may refer to vertical visibility (see ¶ 1411), or clouds, or obscuring phenomena aloft.

1433. Balloon Ceiling.--A ceiling is classified as a balloon ceiling whenever it pertains to clouds or obscuring phenomena aloft and is determined by means of ceiling or pilot balloons. (See ¶ 1442.)

1434. Indefinite Ceiling.--A ceiling is classified as indefinite

whenever it pertains to hydrometeors, other than precipitation, or lithometeors whose bases are at the surface. All indefinite ceilings are estimations, but 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.

1435. Precipitation Ceiling.--A ceiling is classified as a precipitation ceiling when precipitation obscures the cloud base and prevents a determination of its height. All precipitation ceilings are estimations, but the guides indicated in ¶ 1434 should be used. These guides will usually indicate values that are lower than the actual vertical visibility.

1436. Estimated Ceiling.--A ceiling is classified as estimated:

(1) Whenever determined by means of the "Convective Cloud-Base-Height Diagram" (Fig. 1) under conditions appropriate to, and in accordance with instructions for, its use. (See ¶ 1447.)

(2) Whenever penetration of the ceilometer or ceiling-light beam is in excess of normal for the particular height and type of layer (see ¶ 1441.2).

(3) Whenever determined from the known heights of unobscured portions of natural landmarks, or of objects more than 1-1/2 miles from any runway of the airport.

(4) Whenever determined on the basis of experience provided that the sky is not obscured by surface-based hydrometeors or lithometeors, and other guides are lacking, or considered unreliable.

1440. Methods of Determining Ceiling and Cloud Heights.--The methods indicated in ¶ 1441 to 1447.2 will be used in determining heights. Heights of 5000 feet or less will be determined to the nearest 100 feet; heights of more than 5000 feet but less than 10,000 feet to the nearest 500 feet; and heights of 10,000 feet or more to the nearest 1000 feet. When the ceiling is halfway between two reportable values, select the lower value (e.g., 50 feet will be reported as "0"). Unless otherwise specified, all heights are with reference to the height of the base of cloud layers above the surface, not above sea level.

1441. Ceiling Light (or Ceilometer Projector).--The ceiling light will be used in determining 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) Read the angle to the nearest whole degree.

(5) Repeat steps 2 - 4 three times and obtain an average angular reading.

(6) Turn off the ceiling light.

(7) Obtain the height from prepared tables appropriate to the baseline. (See Table 3 for heights computed for baselines of 500, 1000, and 1500 feet.)

(8) Add algebraically to the value in Table 3 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.††

† The field elevation (H_f) is the elevation above mean sea level of the highest portion of the usable landing area at airport stations. Its value is determined by the Civil Aeronautics Authority, and is recorded on Form 450-1 to the nearest foot.

†† If a separate table has been computed for this purpose, the difference between the height of the point of observation and the field elevation should be incorporated in the table by adding it to each tabular value. If this has been done, step 8 will be omitted.

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

Angle \ Base Line	500′	1,000′	1,500′
5	44	87	131
6	52	105	157
7	62	123	185
8	70	141	211
9	79	158	237
10	88	176	264
11	97	194	291
12	106	213	319
13	116	231	347
14	124	249	373
15	134	268	402
16	144	287	430
17	153	306	459
18	162	325	487
19	172	344	516
20	182	364	546
21	192	384	576
22	202	404	606
23	212	424	636
24	222	445	667
25	233	466	699
26	244	488	732
27	255	510	765
28	266	532	798
29	277	554	831
30	288	577	865
31	300	601	901
32	312	625	937
33	324	649	973
34	338	675	1,013
35	350	700	1,050
36	364	727	1,091
37	377	754	1,131
38	390	781	1,171
39	405	810	1,215
40	420	839	1,259
41	434	869	1,303
42	450	900	1,350
43	466	933	1,399
44	483	966	1,449
45	500	1,000	1,500

Angle \ Base Line	500′	1,000′	1,500′
46	518	1,036	1,554
47	536	1,072	1,608
48	556	1,111	1,667
49	575	1,150	1,725
50	596	1,192	1,788
51	618	1,235	1,853
52	640	1,280	1,920
53	664	1,327	1,991
54	688	1,376	2,064
55	714	1,428	2,142
56	742	1,483	2,225
57	770	1,540	2,310
58	800	1,600	2,400
59	832	1,664	2,496
60	866	1,732	2,598
61	902	1,804	2,706
62	940	1,881	2,821
63	982	1,963	2,945
64	1,025	2,050	3,075
65	1,072	2,144	3,216
66	1,123	2,246	3,369
67	1,178	2,356	3,534
68	1,238	2,475	3,713
69	1,302	2,605	3,907
70	1,374	2,748	4,122
71	1,452	2,904	4,356
72	1,539	3,078	4,617
73	1,636	3,271	4,907
74	1,744	3,487	5,231
75	1,866	3,732	5,598
76	2,006	4,011	6,017
77	2,166	4,332	6,498
78	2,352	4,705	7,057
79	2,572	5,145	7,717
80	2,836	5,671	8,507
81	3,157	6,314	9,471
82	3,558	7,115	10,673
83	4,072	8,144	12,276
84	4,757	9,514	14,211
85	5,715	11,430	17,175
86	7,150	14,301	21,441

1441.1. 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:

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

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.

1441.2. Determination of Normal Penetration.--The average vertical extent of the brightest portion of the spot produced by a ceiling light or ceilometer projector is approximately 300 feet. This value corresponds to the period during which the ceilometer reaction remains at a maximum, and should be used as an index determining normal penetration as specified in ¶ 1431. It is not an absolute criterion, since it will vary with the efficiency and exposure of instrumental equipment. In general, most heights determined by means of a ceilometer or ceiling light, including those pertaining to very low layers, should be classified "measured."

1441.3. 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 layer to which they are ascribed. For example, under conditions of multiple layers, a height value must not be reported as a ceiling when actually it is the height of a layer above or below the layer constituting the ceiling.

1442. Balloons.--Observe the following procedure in determining the heights of clouds or obscuring phenomena aloft. (See ¶ 1434 for use of balloons as guides in determining vertical visibility.)

(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 seconds hand) the length of time that elapses between release of the balloon and entry into the base of the layer. The point of entry will be considered as midway between (a) the time at which the balloon begins to fade and (b) the time of complete disappearance. If there is doubt as to the accuracy of the balloon's indications (such as might occur if the balloon did not enter a representative portion of the cloud base, or if its ascensional rate might have been affected by precipitation), the value indicated by the balloon will be used as a guide, but the ceiling will be classified estimated in accordance with ¶ 1436(4).

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

TABLE 4. Height in Feet, Determined by Ceiling or Pilot Balloon

Time Minutes and Seconds	10 gm. Spherical Nozzle lift - 45 gm.	30 gm. Nozzle lift - 139 gm.
0:10	80	120
0:20	170	230
0:30	250	350
0:40	330	470
0:50	420	590
1:00	500	710
1:10	580	820
1:20	650	920
1:30	730	1030
1:40	810	1140
1:50	880	1250
2:00	960	1360
2:30	1190	1680
3:00	1420	2010
3:30	1650	2320
4:00	1880	2630
4:30	2090	2940
5:00	2300	3250
5:30	2510	3540
6:00	2720	3840
6:30	2930	4130
7:00	3140	4430
7:30	3350	4720
8:00	3560	5020

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

1442.1. Limitations.--Ascensional rates of ceiling and pilot balloons are not affected by drizzle of any intensity, or any other form of precipitation of light intensity, except hail and freezing rain. During other precipitation conditions, use these balloons only as guides in estimating the ceiling.

1444. Pilot Observations.--Height of clouds and obscuring phenomena 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, and to a location within 1-1/2 statute miles of any runway of the airport. Pilots' reports in which the ceiling is indicated as estimated, rather than obtained by actual flight near the base, will not be used as "aircraft" ceilings.

1444.1. When a pilot's report of ceiling meets the requirements for "aircraft" ceiling as specified in ¶ 1432 and 1444, but differs from the ceiling reported in the current observation, redetermine the ceiling immediately, provided a "measured" ceiling classification can be expected. Unless a "measured" ceiling can be obtained, the "aircraft" ceiling value will be considered current, and a special observation will be filed if required by ¶ 9132.1. If the redetermined ceiling value is classified as measured, the measured value will be considered as the current ceiling, but the pilot's report will nevertheless be distributed in accordance with ¶ 10210.

1445. Buildings, etc. --Determination of heights may be based on the point at which layers are intercepted by objects (buildings, etc. other than natural landmarks) whose heights are known. Allow, so far as possible, for any appreciable slope in the layer from the point of observation to the point of interception of the object.

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† If a separate table has been computed for this purpose, the difference between the height of the point of observation and the field elevation should be incorporated in the table by adding it to each tabular value. If this has been done, step 4 will be omitted.

1446. Natural Landmarks.--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 layers to differ in height from those immediately above the station. Estimates of height 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.)

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 at or below 5000 feet; 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).

1450. Frequency of Ceiling Measurements.--Whenever available, a 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 height value can be secured. Stations not equipped with ceilometers will use balloons during daylight hours as specified in ¶ 1451. (See also ¶ 1442.1.)

1451. At stations where hourly observations for scheduled transmission are taken, balloons will be used as follows to determine the ceiling value:

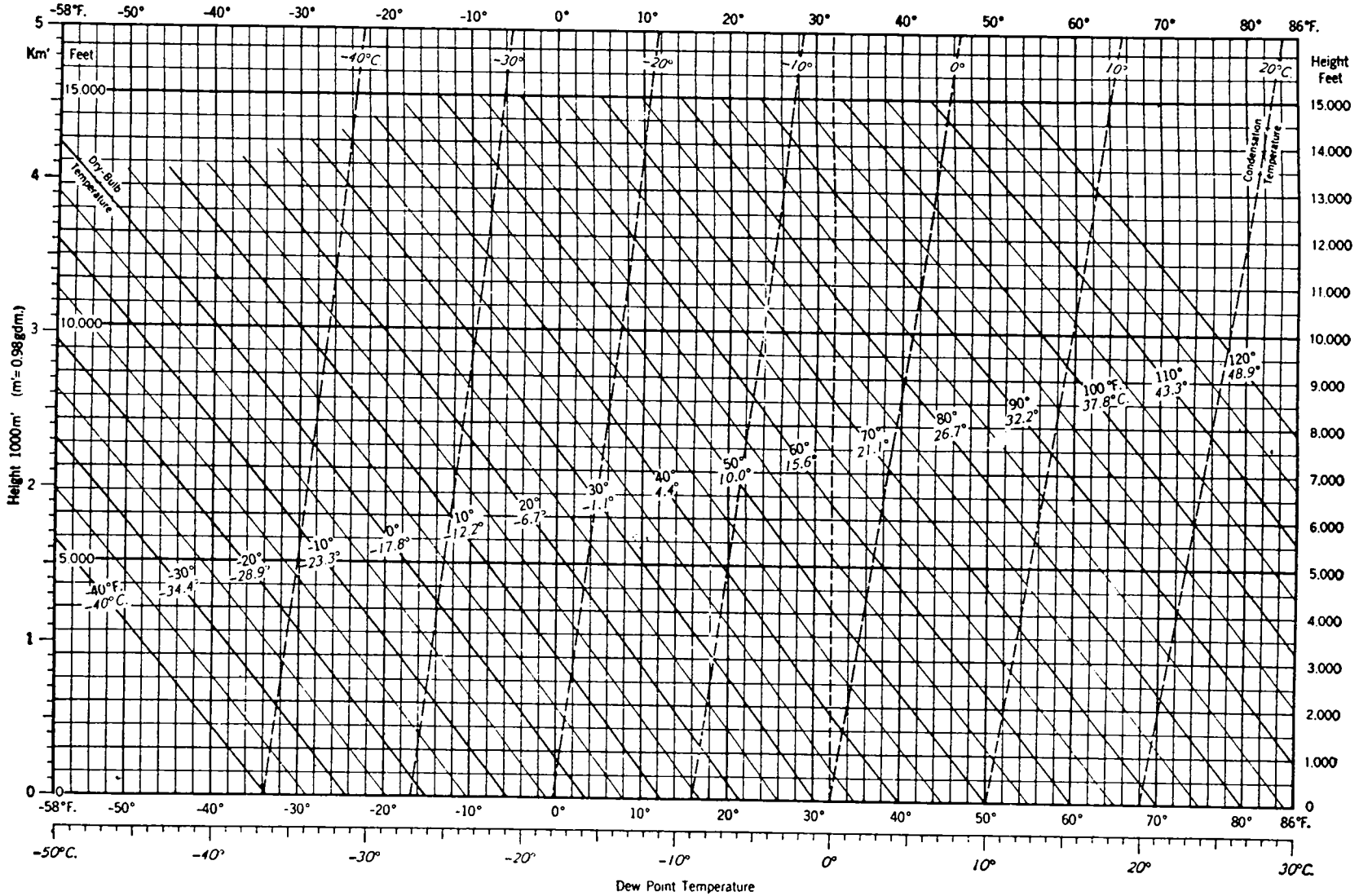

FIGURE 1.—Diagram for determining height of convective-type clouds.

(Convert sub-freezing dew-point temperatures from a water to ice basis by means of Table 9 before using this diagram)

(1) At the discretion of the observer, when the ceiling is estimated as 2000 feet or more.

(2) At hourly intervals or more frequently, when the ceiling is between 1000 and 2000 feet, unless the highest instrument minimum† for the airport is above 1000 feet, in which case (3) applies

(3) At half-hour intervals or more frequently, when the ceiling is below 1000 feet, or at or below the highest instrument minimum† for the airport.

1451.1. Ceiling balloons should be used when more than one communicator is on duty and no interference with primary duties will result (see Introduction). However, the equipment should be kept available for emergency use at other times, such as when only one communicator is on duty.

1500. ENTRIES ON WBAN-10

1510. Ceiling and Sky (Col. 3). --Enter in ascending order of height the appropriate sky-cover symbol for each layer, selected in accordance with the summation principles stated in ¶ 1511. Prefix the corresponding height in hundreds of feet (see ¶ 1440) to each sky-cover symbol, and an appropriate ceiling classification symbol to the ceiling layer only. Heights ascribed to "X" will represent vertical visibility. A numerical value will not be ascribed to "-X" since unlimited vertical visibility is indicated. If the ceiling is variable (see ¶ 1420), enter the letter "V" following the ceiling value, e.g., M5VⓄ.

1511. Summation. --The sky-cover symbol for each layer represents the summation total of all sky cover (see ¶ 1110) at and below that level, including the amount of sky hidden by surface-based obscuring phenomena. In determining summation totals, disregard portions of surface-based obscuring phenomena that do not conceal the sky, and portions of upper-cloud layers that are visible only through transparencies in lower layers. If any portion of the sky cover is transparent, determine, in addition to the foregoing summation, the summation of opaque sky cover at each level (see examples 7 and 8 below). If, at any level aloft, the ratio of opaque to total sky cover (summation values) is 1/2 or less, prefix "-" (thin) to the corresponding sky-cover symbol. Omit this prefix if the ratio exceeds 1/2. Prefix "+" to layers that are unusually dark or threatening.

† These minimums are with reference to instrument minimums exclusive of ILS, GCA, or alternate minimums.

EXAMPLES

Opaque sky cover:

	Layers	Summation	Sky Cover Symbol
(1)	0.4 sky hidden by fog	0.4	-X
	0.3 sky cover at 1000'	0.7	M10 ⊕
	0.2 sky cover at 5000'	0.9	50⊕
(2)	Less than 0.1 sky cover at 500'	0.0	(None)
	Less than 0.1 sky cover at 2000' (Total sky cover 0.1)	0.1	20⊕
(3)	0.6 sky cover at 1000'	0.6	M10⊕
	0.3 sky cover at 5000'	0.9	50⊕
	0.1 sky cover at 10,000' (with breaks)	1.0	100⊕. . (with remark: BINOVC)
(4)	0.1 sky cover at 1000' (Smoke aloft)	0.1	10⊕ . . (with remark: KLYR 10⊕)
	0.3 sky cover at 5000'	0.4	50⊕
	0.1 sky cover at 10,000'	0.5	100⊕
(5)	0.2 sky cover at 500'	0.2	5⊕
	Sky hidden by snow, vertical visibility 1500'	1.0	P15X
(6)	0.8 sky hidden by snow	0.8	-X
	0.2 sky cover at 500'	1.0	M5⊕

Transparent or partially opaque sky cover:

	Layers	Summation Total	Summation Opaque Portions	Sky-Cover Symbol
(7)	0.8 sky cover at 500' (0.0 opaque)	0.8	0.0	†5-⊕
(8)	0.1 sky hidden by surface smoke	0.1	0.1	-X
	0.7 sky cover at 1000' (0.1 opaque)	0.8	0.2	†10-⊕
	0.2 sky cover at 5000' (all opaque)	1.0	0.4	†50-⊕

† Note that the ceiling classification letter is omitted because the layer is classified as "thin."

1520. Remarks (Col. 13).--Enter data pertaining to clouds and obscuring phenomena in remarks as follows:

Observed	Instructions for Entry
(1) Breaks in overcast; one overcast layer only.	Enter "BINOVC," followed by direction of breaks where practicable; e.g. "BINOVC E."
(2) Breaks in higher overcast; two or more overcast layers reported (lower one classified thin).	Enter "BRKHIC"
(3) Higher clouds visible through breaks in overcast not classified thin.	Enter "HIR CLDS VSB"
(4) Direction of breaks in broken layer with ceiling at or below highest instrument minimums. (Omit if breaks are in all quadrants).	Enter "BRKS," followed by direction, e.g., "BRKS N" or "BRKS OVR MID MKR"
(5) Obscuring phenomena (smoke, etc.) aloft.	Enter "KLYR," "HLYR," etc., followed by height and corresponding sky-cover symbol, e.g., "KLYR 10Ⓞ"
(6) Special cloud types (see Circ. S for definitions)	
a. Towering cumulus	Enter "TWRG CU," followed by direction from station.
b. Cumulonimbus	Enter "CB," followed by direction from station and direction of movement, if known; also enter estimated distance from station in statute miles if practicable, e.g., "CB 25 MI W MOVG NE."
c. Cumulonimbus mammatus (mammato-cumulus)	Enter "CM," followed by same information as for item 6(b).

d. Altocumulus castellatus	Enter "ACC," followed by direction from station.
e. Virga	Enter "VIRGA," followed by direction from station.
(7) Variable sky condition	Enter ranges of variability, separated by letter "V"; e.g., "⊕V⊕" to indicate that a layer reported as broken in Col. 3 is occasionally scattered; "1 8⊕V⊕" to indicate that one of two or more broken layers is occasionally scattered; "-⊕V⊕" to indicate that a thin layer is occasionally opaque.
(8) Variable ceiling	Enter range of variability separated by letter "V," and prefix entire remark with abbreviation "CIG"; e.g., "CIG 15V20" (see ¶ 1420).
(9) Differing ceiling or sky condition at distance from station.	Enter appropriate remarks, such as "CIG LWR OVR CITY," "LWR CLDS W APCHG STN," etc.
(10) Condensation trails observed from ground and still forming at time of observation. (Distinguish carefully from cirrus clouds or skywriting.)	Enter "CONTRAILS," followed by height in hundreds of feet MSL when reported by pilot; e.g., "CONTRAILS 450 MSL" where contrails observed from ground are reported by pilot at height of 45,000 ft.

1530. Total Sky Cover (Col. 21).--At each record hourly observation, enter tenths of total sky cover as a whole number as defined in ¶1110, e.g., enter 0.6 as 6.

1544. Total Opaque Sky Cover (Col. 36).--Enter the tenths of sky that are hidden by clouds or obscuring phenomena as a whole number. (Note that this entry is similar to the entry of total sky cover in column 21, except that sky cover through which the sky is visible is disregarded when determining the entry in column 36.)

A1200. CEILOMETER

A1210. General.--Although ceilometers are mentioned in this chapter, instructions for their maintenance and operation have been omitted pending general installation at CAA stations.

U S DEPARTMENT OF COMMERCE, WEATHER BUREAU

SURFACE WEATHER OBSERVATIONS

STATION_____ DATE_____

TYPE	TIME (LST)	SKY and CEILING (Hundreds of Feet)	VISIBILITY (Miles)	WEATHER and OBSTRUCTIONS TO VISION	SEA LEVEL PRESS (mbs)	TEMP (°F)	DEW PT (°F)	WIND DIRECTION	WIND SPEED (mph)	WIND CHARACTER AND SHIFTS	ALTIMETER SET (mbs)	REMARKS AND SUPPLEMENT
		Obscuring Phenomena Aloft:										
		15-Ⓓ										KLYR 15-Ⓓ
		M8Ⓓ										KLYR 8Ⓓ
		Obscuring Phenomena At Surface:										
		P25X	2	TRWA								
		WOX	0	L-F								
		-X	2	F								
		Clouds and Obscuring Phenomena:										
		10Ⓓ100Ⓓ										KLYR 10Ⓓ
		400600E2008										KLYR 60Ⓓ
		M50Ⓓ25⊕										KLYR 5Ⓓ
		40Ⓓ100Ⓓ E20⊕										KLYR 20⊕
		15Ⓓ30-Ⓓ										KLYR 30-Ⓓ
		-XE15Ⓓ	5	H								
		M21Ⓓ50-⊕										HLYR 50-⊕
		Multiple Overcast Layers:										
		5-⊕20-⊕E50⊕										HIR CLDS VSB

OBSERVED SKY CONDITION SERVING AS A BASIS FOR ENTRIES ON WBAN-10

Layer of smoke covering 0.4 sky at measured (by ceiling light) height of 1500 feet. Ratio opaque to total sky cover 1/4.

Layer of smoke covering 0.9 sky at measured (by ceiling light soon after dark) height of 800 feet; 0.7 of layer opaque. Ratio opaque to total sky cover 7/9.

All of sky obscured by rain. Vertical visibility estimated 2500 feet on basis of ceiling light observation. Ratio opaque to total sky cover 10/10.

All of sky obscured by fog. Vertical visibility zero. Ratio opaque to total sky cover 10/10.

Fog obscures 0.8 sky; 0.2 sky visible overhead; therefore, vertical visibility unlimited, and obscuration is termed partial (see par.1510).

Layer of smoke (0.2 opaque) covering 0.4 sky at height of 1000 feet. Layer of clouds (0.2 opaque) covering 0.2 sky at 10,000 feet. Total sky cover 0.5. Ratio opaque to total sky cover 4/5.

Layer of clouds covering 0.2 sky at height of 4000 feet. Layer of smoke (0.2 opaque) covering 0.3 sky at 6000 feet; summation total at this level 0.5. Layer of clouds covering 0.6 sky at estimated height of 20,000 feet. Total sky cover 1.0. Ratio opaque to total sky cover 10/10.

Layer of smoke (0.5 opaque) covering 0.6 sky at measured height of 500 feet. Layer of clouds (0.6 opaque) covering 0.6 sky at 2500 feet. Total sky cover 1.0. Ratio opaque to total sky cover 10/10.

Layer of clouds (0.2 opaque) covering 0.2 sky at 400 feet. Layer of clouds (0.1 opaque) covering 0.1 sky at 1000 feet; summation total at this level 0.3. Layer of smoke (0.7 opaque) covering 0.7 sky at estimated height of 2000 feet. Total sky cover 9 . Ratio opaque to total sky cover 9+/9+.

Layer of clouds (0.2 opaque) covering 0.2 sky at 1500 feet. Layer of smoke (0.1 opaque) covering 0.6 sky at 3000 feet. Total sky cover 0.8. Ratio opaque to total sky cover 3/8.

Layer of haze obscuring 0.6 sky at surface. Layer of clouds (0.3 opaque) covering 0.3 sky at estimated height of 1500 feet. Total sky cover 0.8. Ratio opaque to total sky cover 8/8.

Layer of clouds (0.4 opaque) covering 0.6 sky at measured height of 2100 feet. Layer of haze (completely transparent) covering all of sky at 5000 feet. Total sky cover 1.0. Ratio opaque to total sky cover 4/10.

Layer of clouds (0.2 opaque) covering 1.0 sky at 500 feet. Layer of clouds (0.2 opaque) covering 0.2 sky at 2000 feet; summation total at this level 1.0; ratio opaque to summation-total sky cover at this level 4/10. Layer of clouds (0.4 opaque) covering 0.6 sky at estimated height of 5000 feet; summation total at this level 1.0; ratio opaque to summation-total sky cover at this level 8/10. Layer of clouds (0.1 opaque) covering 0.2 sky at 25,000 feet. Total sky cover 1.0. Ratio opaque to total sky cover 9/10.

Fig. 1a. Entries of clouds and obscuring phenomena on WBAN-10

A1300. CEILING LIGHTS

A1310. General.--A ceiling-light projector consists of a light source mounted at the focus of a parabolic reflector. The light is adjusted and aligned to project a vertical beam of light approximately three degrees in width.

A1311. The lights are rigidly mounted on a pipe support, which is usually set in or on a firmly-anchored concrete base. The light is controlled by a switch in the power-supply cable. The switch should be located conveniently near the office or point of observation, preferably the latter so that the observer may turn it on and off during an observation to facilitate identification of indistinct light spots. A pilot light is usually installed at the switch to indicate whether the light is on or off. Do not leave the lamp on longer than is necessary to take an observation. This precaution is particularly important at stations having projectors that use 1000 watt, 105-120 volt lamps.

A1330. K100- and K100B-Type Projectors.--The instructions in this paragraph are applicable to K100 (see Figs. A1-38 and A1-39) and K100B projectors, and are also generally applicable to older style projectors. The effectiveness of the lamp in the K100 and K100B projectors is increased by the use of a small reflector (A) mounted just above the lamp so that it increases the concentration of the light at the focal point of the parabolic reflector (B). A step-down transformer, mounted either in the lower portion of the reflector housing or housed separately below the light, provides the necessary line-voltage reduction for 11.8 volt lights (12-volt nominal voltage). A hinged glass cover (C) provides access to the lamp and reflector. Ventilation and drainage holes, about one-half inch in diameter and fitted with wire screens, are usually provided in the bottom of the housing. Setscrews in an adapter below the transformer are used to fasten the projector to a vertical, rigidly-mounted, four-inch pipe.

A1331. Maintenance.--Once a week, and more frequently if necessary to insure full beam intensity, clean the cover glass on the projector housing and the surface of the reflectors. Inspect the drainage holes in the mirror and housing, and clean them as frequently as is necessary to insure adequate drainage and ventilation of the enclosure. When bright sunlight is shining into the projector, the intensity of heat and light concentrated in the area above the parabolic reflector, especially near its focal point, may be sufficient to burn the skin or seriously injure the eyes. Dark glasses must always be worn when looking

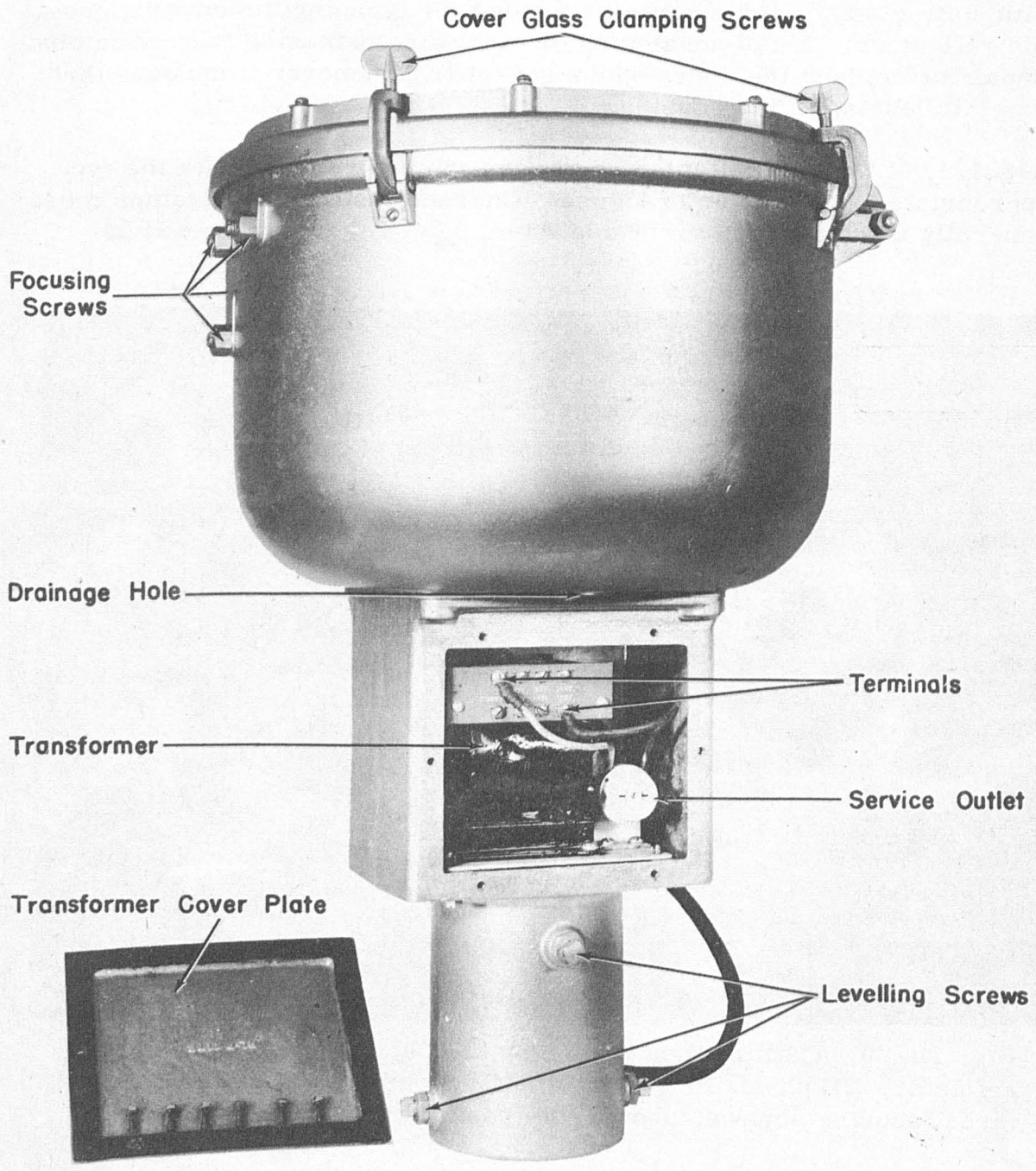

Fig. A1-38. Ceiling-light projector, K100.

directly into the reflector or at the lighted filament of the lamp. Liquid glass-cleaner and other non-abrasive cleaners (e.g., Bon-Ami), used with soft, clean cloths are recommended for cleaning the cover glass and reflectors. Avoid scratching or otherwise damaging the reflectors. Repair or replace the cover-glass gasket (E) whenever it appears that water is leaking in the housing.

A1331.1. Lamps.--Replace defective lamps promptly with the type appropriate to the projector in use. Characteristics of the lamps most generally used are listed in Table A1-4.

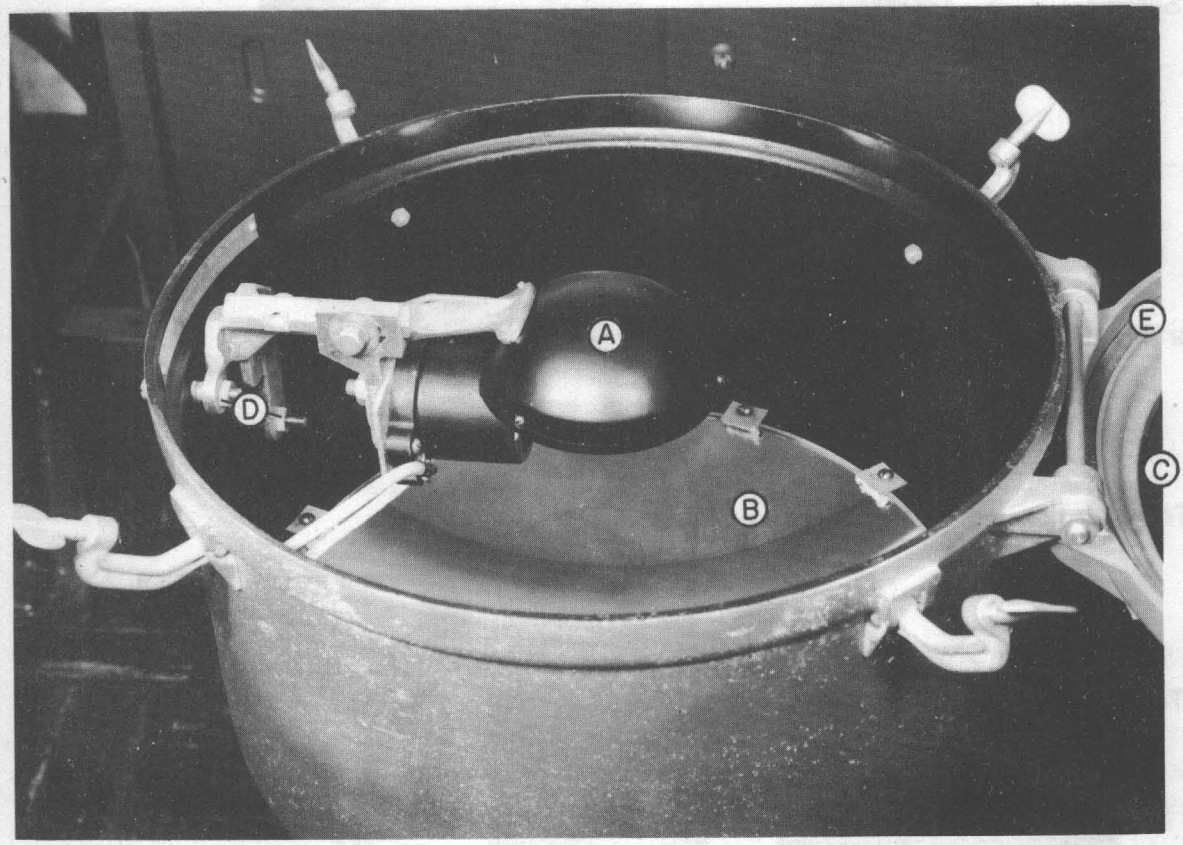

Fig. A1-39. Ceiling-light projector, K100, showing (A) secondary reflector, (B) parabolic reflector, (C) cover glass, (D) two of the three focusing screws, and (E) the gasket in the cover.

Table A1-4. Ceiling-Light Lamps

Lamp Type	Lamp Voltage (Nominal)	Watts	Base	Projector Identification
G-25	12	420	Mogul Prefocus	Crouse-Hinds or Westinghouse serial numbers 481 and above.
G-30	105, 110, 115, or 120	250	Mogul Screw	
G-40	105, 110, 115, or 120	500 or 1000	Mogul Screw	
T-20	105, 110, 115, or 120	1000	Mogul Screw	

The efficiency of a ceiling light is reduced when:

(1) The lamp has begun to blacken.

(2) The operating voltage across an 11.8-volt lamp is less than 11.3 volts.

(3) The filament of the lamp sags to a noticeable extent.

(4) The lamp is out of focus, or the reflectors are in poor condition.

Whenever the intensity of the spot from a new lamp appears to be subnormal for existing conditions, try another new lamp and, if the condition persists, report the circumstances to the Weather Bureau regional office. Voltage fluctuations may cause variations in intensity. Whenever these variations noticeably affect the efficiency of the light, the circumstances, including the times and frequency of the variations, should be reported. Replace the lamp when it begins to blacken noticeably. The removal of mogul screw-base lamps may be facilitated by the application of a little powdered graphite to the threads before installing the lamp. Remove the lamp with care, since the leverage afforded by the size and shape of the bulbs makes it easy to break the seal between the glass and the metal base if much force is used to turn it in the socket.

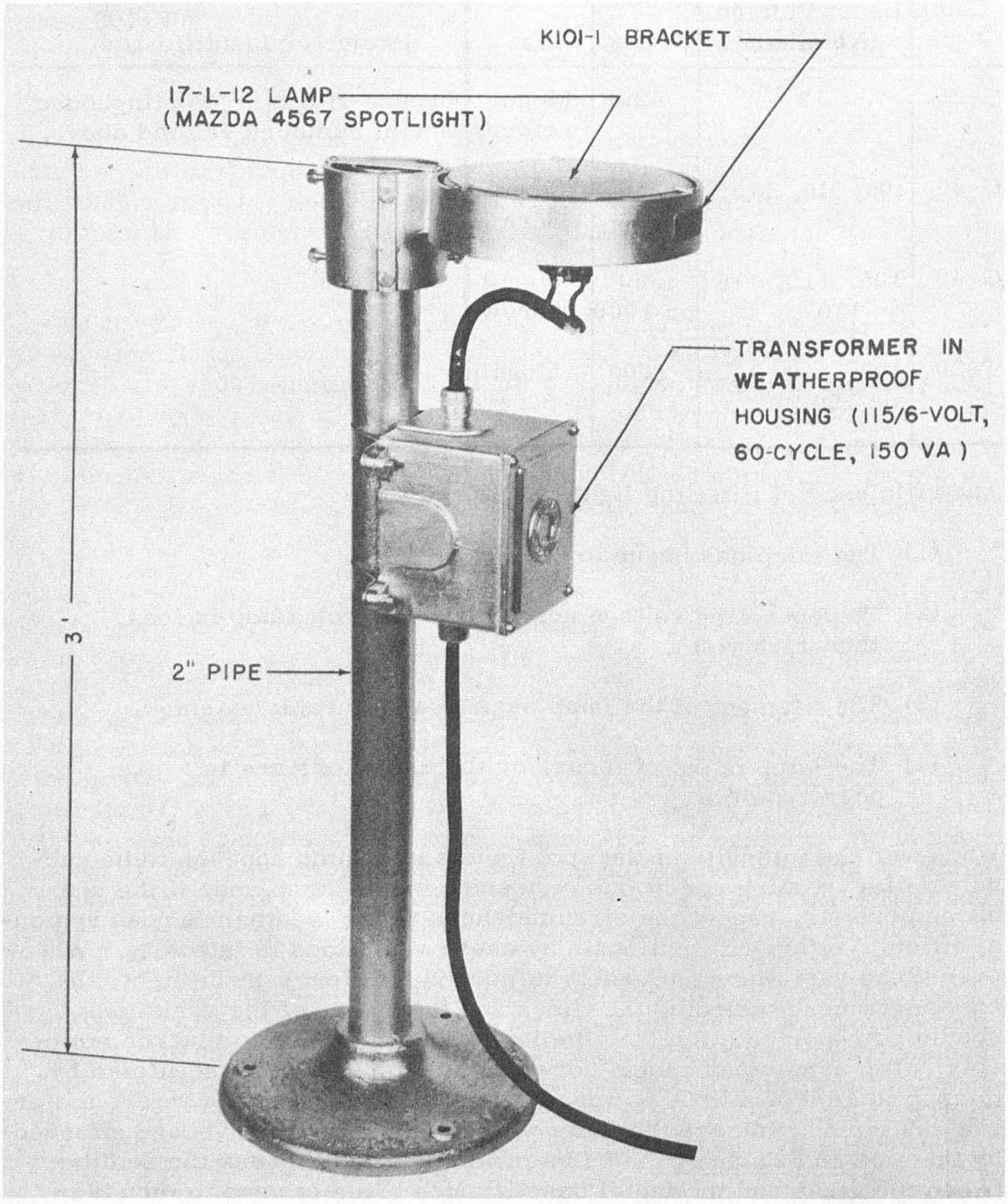

Fig. A1-39a. K101, ceiling-light projector.

A1340. K101-Type Projectors.--The K101 ceiling-light projector (see Fig. A1-39a) consists of a sealed-beam spotlight (100-watt, 6-volt, Mazda No. 4567 lamp or equivalent) and transformer mounted on a two-inch pipe.

A1341. Transformer.--The normal operating voltage of the lamp (measured under nighttime operating conditions) should not exceed six volts, and should not drop below 5.5 volts. Higher voltages reduce the life of the lamps substantially; lower voltages reduce the intensity of the beam of light to an undesirable extent.

A1344. Maintenance.--Once a week, and more frequently if necessary to insure full beam intensity, clean the lens of the lamp. Replace defective lamps promptly with 17-L-12 lamps (100-watt, 6-volt, Mazda No. 4567 or equivalent). Whenever the intensity of the spot from a new lamp appears to be subnormal for existing conditions, try another new lamp and, if the condition persists, report the circumstances to the Weather Bureau regional office.

A1400. CLINOMETERS

A1410. General.--The clinometer (see Fig. A1-40) consists of a hollow tube fitted with cross hairs (A) mounted in the large end, and an eyepiece (B) in the small end. An elevation-angle scale (C), calibrated in whole degrees from 0° to 90°, is attached to the outside of the tube. The pendant-like indicator may be locked at any angle by means of a friction clutch on the shaft of the indicator. The index line (D) on the indicator matches 0° on the scale when the line of sight of the tube is horizontal, and matches 90° on the scale when the line of sight is vertical. A box is provided for storage of the clinometer when it is not in use. The box should be mounted or placed in a dry protected inside location, as convenient as possible to the observation point.

A1420. Operation.--Unlock the friction clutch by unscrewing the knurled locknut (E) on the indicator. Make sure that the indicator responds freely to slight changes in the elevation of the line of sight through the clinometer before determining the cloud height (see ¶ 1441).

A1430. Maintenance.--The clinometer should be protected adequately to prevent denting of the tube or scale mechanism, or dislocation of the cross hairs or eyepiece. Whenever the operation is faulty and the trouble cannot be corrected, inform the Weather Bureau regional office.

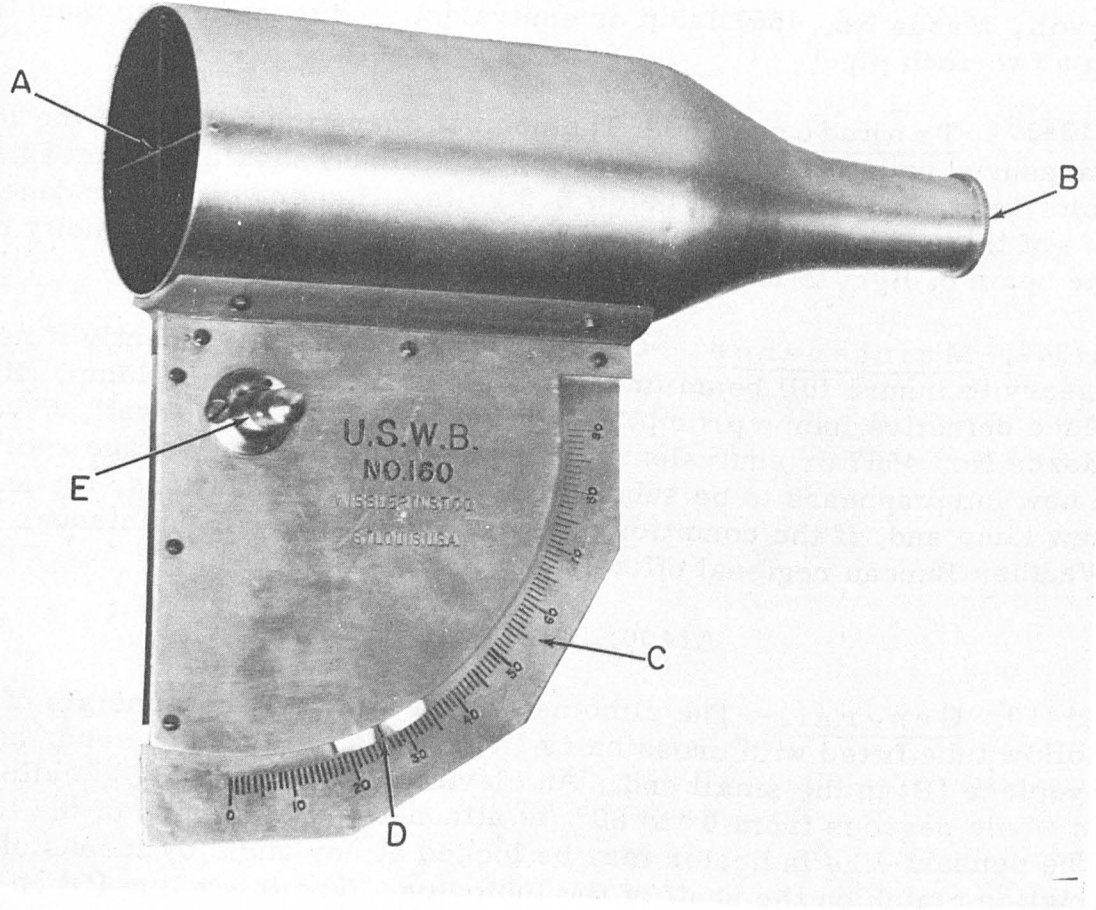

Fig. A1-40. Clinometer, K110, showing (A) cross hairs, (B) eyepiece, (C) elevation-angle scale, (D) index, and (E) clutch and locknut for the index.

1430.1. Examine the clinometer once a month as follows:

(1) Inspect the scale graduations for legibility - clean the scale if necessary.

(2) Test the action of the clutch and indicator. When unlocked, the indicator should respond freely to elevation-angle changes of one or two degrees. If it does not, there is excessive friction between the scale and the indicator, or in the clutch and bearings. One drop of light oil (SAE 10 or anemometer oil) on the bearings

may improve the indicator action if neither the scale nor the indicator is dented or otherwise damaged. When the clutch is locked, ordinary vibration or light shocks should not disturb the index setting.

(3) Determine whether the alignment and condition of the cross hairs are satisfactory.

A1500. CEILING BALLOONS

A1510. Storage.--Ceiling balloons should be stored at approximately normal room temperatures. Avoid storage at temperatures much below 70°F. Since these balloons are generally made of neoprene (a synthetic rubber that is injured by ozone), they should be stored away from large electric motors or generators.

A1520. Conditioning.--When balloons from a particular package have a tendency to burst during inflation or flight, remaining balloons from that package should be conditioned within about twenty-four hours before inflation. Conditioning consists of uniformly heating the balloon for thirty minutes to eight hours or more depending upon the temperature to which the balloon is heated; that is, thirty minutes at air temperatures near the boiling point of water (approximately 212°F.), or eight hours at temperatures near 120°F. Temperatures under 120°F. will not condition the balloon; temperatures much above the boiling point of water are likely to scorch or harden the rubber.

A1521. Balloons may be heated by suspending them in a stream of hot air (above 120°F.) from a heating system, or by placing them on a hot-water or steam radiator, or on the reflector of a small incandescent lamp (not over 100 watts). When a balloon is heated through contact with a solid object, the balloon should be turned occasionally to insure uniform conditioning of the rubber. This precaution is more important at relatively high temperatures. The temperature of a surface may be tested quickly with a few drops of water. If the water boils or evaporates rapidly, the surface is likely to be too hot for contact with the balloon.

A1522. A balloon may also be conditioned in boiling water. Insert a plug of cork, or wood, etc. in the neck of the balloon to keep the water out, and immerse all of the balloon except the plugged end in the water for about five minutes. Shake all free water from the balloon, and have it relatively dry before inflation.

A1530. Inflation.--The nozzle used to inflate balloons weighs 45 grams. It is usually identified by the letters "HE" stamped on the nozzle. If it is not, stamp or scratch the letters on it.

A1531. The balloon should be dry inside, and relatively dry outside, especially in freezing weather, to prevent the formation of a film of ice on the rubber. Remove any trapped air by folding and squeezing the balloon carefully in the hand, then stretch the neck sufficiently to insert the inflation nozzle. Place the nozzle so that the tubing connecting the nozzle to the regulator rests on a support and is not suspended from the nozzle. Inflate the balloon slowly (see ¶ A1531.1). Turn off the gas as soon as the balloon begins to lift the nozzle. Add or remove gas slowly from the balloon as necessary. The balloon is properly inflated when the nozzle is suspended about 1/4 inch above the inflation platform after any motion of the balloon has stopped. Listen for leaks in the balloon. Tie the neck of the balloon securely just above the nozzle, and remove it from the nozzle. Double the end of the neck over the tied portion, and either tie the doubled portion or secure it with a rubber band.

A1531.1. To inflate the balloon:

(1) Close the valve on the regulator by clockwise rotation of the control shown on the preset-type regulator in Fig. A1-41. Some dual-gage diaphram-type regulators require counterclockwise rotation.

(2) Open the cylinder valve fully by counterclockwise rotation of the handwheel (see ¶ A1621(6)), and slowly open the regulator valve:

(a) Sufficiently to inflate the balloon in approximately one minute (two minutes in cold weather), where a single gage (cylinder-pressure indicating gage) regulator is used.

(b) To an inflation pressure of five pounds or less as indicated on the low-pressure gage of dual-gage regulators†.

† The high-pressure gage indicates the cylinder pressure, which serves as an approximate indication of the amount of helium in the cylinder.

(3) When the balloon is inflated (see ¶ A1531):

(a) Close the regulator and cylinder valves completely. (See ¶ A1621.)

(b) Remove the balloon from the nozzle.

(c) Open the regulator valve and listen for escaping gas. If gas is escaping, try to close the cylinder valve tighter(by hand only).

(d) Although the cylinder valve should be checked in the foregoing manner to eliminate unnecessary pressure on the regulator diaphram, the regulator valve should be closed in the event that leakage of gas through the cylinder valve cannot be stopped completely, especially in the case of cylinders that are nearly full of helium.

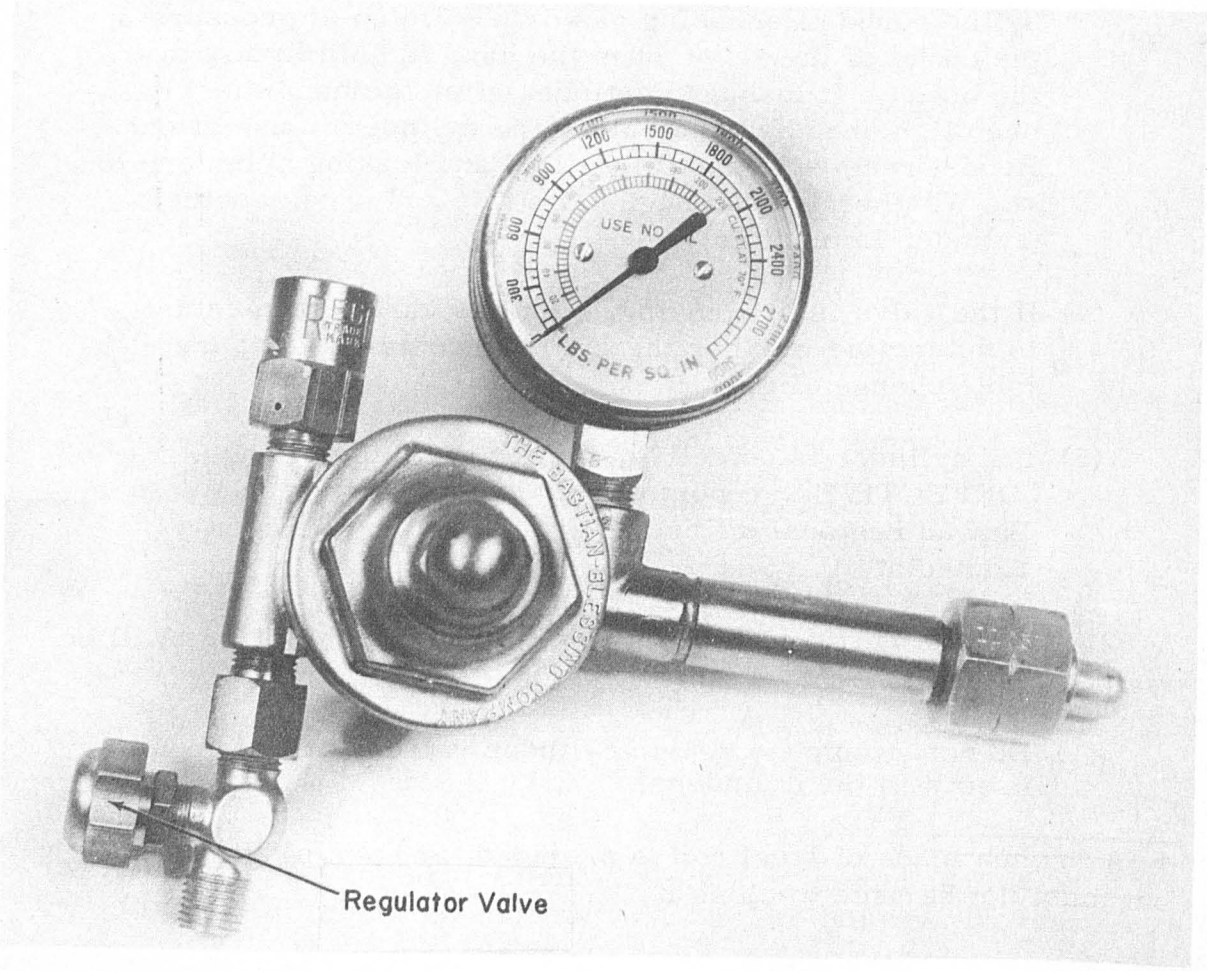

Fig. A1-41. Preset helium regulator, J412.

A1600. HELIUM CYLINDERS

A1610. Procurement.--Notify the Weather Bureau regional office promptly when the reserve cylinder of helium is placed in use.

A1620. Inspection of Shipment.--When a cylinder of helium is received, inspect it as follows:

(1) Check both shipping tags to make certain that the cylinder was intended for the station (notify the Weather Bureau regional office immediately of any error).

(2) Remove the cylinder-valve cap and turn the handwheel of the cylinder valve clockwise by hand to make sure that th valve is closed.

(3) Loosen the valve-protecting cap nut (turn clockwise) and remove it unless there is evidence of a leak, as evidenced by the sound of escaping gas or a build up of pressure at the outlet of the valve when the hand is held firmly over the outlet. If leakage continues after the handwheel has been tightened by hand, place the cylinder in use at once. Report receipt of partially filled and leaking cylinders to the Weather Bureau regional office and order another cylinder immediately.

(4) If the valve is not leaking, open the valve† momentarily to determine whether the cylinder contains an appreciable charge of gas.

(5) If a cylinder is defective, mark both shipping tags "DEFECTIVE", report the circumstances to the Weather Bureau regional office and order another cylinder immediately.

A1621. Precautions.--The following list of precautions will be rigidly observed:

(1) Do not attempt to repair cylinder valves, or the regulators used with the cylinders.

† A wrench made of steel rod is provided for opening the cylinder valve, but must not be used to close it.

(2) Do not attempt to stop leakage around the safety nut (the small nut on the side of the valve stem opposite the outlet).

(3) Whenever a leaking cylinder cannot be placed in use at once, replace the cap nut which protects the valve outlet.

(4) Never use a wrench to close the handwheel.

(5) Do not use a pipe wrench on the cap nut.

(6) Do not use the cylinder valve as a "throttling" valve; that is, do not use the valve partially opened as a means of controlling the flow of gas from the cylinder.

(7) When a cylinder is empty, first close the valve, then remove the regulator and replace the cap nut. Do not leave the valve open on an empty cylinder.

(8) When attaching or detaching the regulator from the cylinder, note that left-hand threads are used in the coupling, i.e., counterclockwise rotation of the nut is required to attach the regulator.

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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. Visibility observations will be taken from as many points as necessary to view all appropriate markers. Except as specified in ¶ 2011, observations should be with reference to a plane six feet above the ground or, if station facilities preclude an observation at this level, as close as practicable to it. Visibility will be reported at land stations:

(1) In statute miles

(2) To the nearest value given in Table 4c; when the visibility is halfway between two reportable values, select the lower value.

Table 4c. Reportable Visibility Values (Miles)

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

† "15+" is recorded when the visibility is estimated to be greater than 15 miles and suitable markers beyond 15 miles are not available (see ¶ 2410).

2011. Unless otherwise authorized, all stations at which control towers are situated will take visibility observations at the control-tower level, as well as at the usual point of observation, whenever the visibility at the latter point is less than three miles.

A2011. Weather station personnel will notify the control tower when to start or stop taking observations.

A2011.1. The minimum data to be recorded by control-tower personnel follows:

(1) Date and time of observation.

(2) Prevailing visibility.

(3) Remarks (such as visibility in different quadrants).

(4) Observer's initials.

When visual recording communication facilities, such as teletypewriter or telautograph, are in use between the control tower and the weather station office, the transmitted copy will serve as the tower record. Otherwise, personnel at the tower will record the transmitted data on WBAN-10 or on another tabulation sheet, and give it to the weather station observer at the close of each day. The record may be destroyed after 90 days.

A2011.2. The control-tower observation may be used for aircraft operations immediately after it is taken; however, it should be recorded and transmitted to the weather station office as promptly as possible.

2100. GUIDES IN DETERMINING VISIBILITY

2110. Chart of Visibility Markers.--Each station will display charts of prominent objects and their distances from the observation point. These charts will include objects suitable for determining the visibility at night as well as by day. At least two charts will be available; one including all markers throughout the entire range of visible objects, and the other an expanded scale chart including only those markers within 1-1/2 miles of the observation point.

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 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.--Transparency of the atmosphere in the open country (except in polar regions) removed from sources of atmospheric pollutants changes but very little from daylight to darkness and vice versa. However, in areas subject to pollution (as smoke from domestic heating or cooking, and industrial exhausts) there may be systematic variations during the transition period about sunrise or sunset. In such areas a decrease in visibility often occurs near dawn particularly when a steep inversion exists near the surface. Before taking a visibility observation at night, the observer should spend two to six minutes in the dark (depending upon the contrast between office and outside illumination) to adapt his eyes to nighttime conditions.

2160. Estimations of Visibility.--When the visibility is greater than the distance to the farthest object, 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 in that direction 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 1/2 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. If the visibility is variable, i.e., the prevailing visibility rapidly increases and decreases by one or more reportable values during the period of the observation, use the average of all observed values as the prevailing visibility. Report the visibility as variable only if the prevailing visibility is less than three miles.

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 four sectors and the respective visibility values were 1/8, 1/4, 1/2, and 1 mile, the prevailing visibility would be 1/2 mile. This is evident from the fact that 1/2 mile is the highest value equal to or less than the visibility values of 1/2 or more of the horizon circle. This is illustrated in Fig. 2.

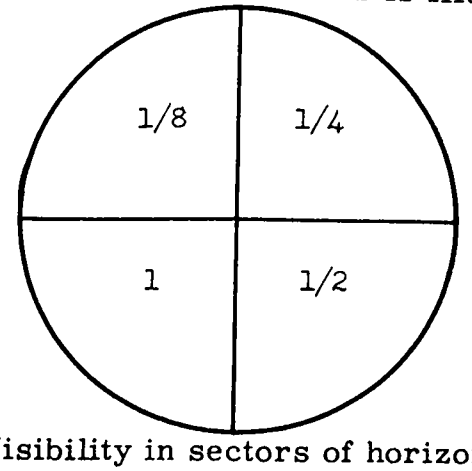

Fig. 2. Visibility in sectors of horizon circle.

2400. ENTRIES ON WBAN-10

2410. Visibility (Col. 4). --Enter the prevailing visibility in the increments listed in Table 4c. If the visibility is variable, enter "V" following the visibility (see ¶ 2310). Enter "15+" when the visibility is more than 15 miles but suitable distant markers for more precise determination are lacking. Enter the visibility at the control-tower level in this column when the visibility at the usual point of observation is less than three miles (see ¶ 2011).

2420. Remarks (Col. 13). --Enter visibility data in this column as follows:

(1) † Visibility by quadrants: Enter visibility for quadrants in which it differs from the prevailing visibility, provided the visibility in one or more quadrants is less than three miles. Prefix each value with the corresponding quadrant designator; e.g., "VSBY N1".

(2) Visibility at differing levels (see ¶ 2011 and 2410): When the visibility at the control-tower level (as entered in Col. 4) differs from the visibility at the usual point of observation, enter the latter value in Col. 13, followed by the height of the restricting phenomena if determinable; e.g., "SFC VSBY 2 GFDEP 50".

(3) † Variable visibility when prevailing visibility is less than three miles (see ¶ 2310): Enter range of variability separated by "V"; e.g., "VSBY 1V2".

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† These remarks will relate to the same observation point as the value entered in Col. 4; i.e., if tower visibility is recorded in Col. 4, remarks pertaining to visibility by quadrants or variable visibility will also represent control-tower values.

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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. Lightning, an igneous meteor is also observed. Hydrometeors other than precipitation, and lithometeors, are termed obstructions to vision. Observations of these phenomena are taken without the use of instruments, and from as many points as necessary to view the entire horizon.

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.

3130. Tornado Reports by Public.--The cooperation of local news-gathering agencies, police departments, and other organizations having special communication facilities will be solicited in obtaining public reports of tornadoes (see ¶ 3920).

3200. THUNDERSTORMS

3210. Definition.--A thunderstorm is regarded as occurring at the station when thunder has been heard within the previous fifteen minutes.

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 is based upon the appearance of the storm from the point of observation. All thunderstorms not classified as heavy in accordance with ¶ 3233 are classified moderate.

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

3300. SQUALLS

3310. A squall is a strong wind that increases suddenly in speed, maintains a peak speed of 19 mph or more over a period of two or more minutes, and decreases in speed; similar fluctuations will occur at succeeding intervals. The occurrence of squalls is indicative of turbulence near the surface. The essential difference between squalls and gusts is the duration of the peak wind speed (see ¶ 8310). Although squalls are classified as an atmospheric phenomenon, instructions for reporting them will be found in ¶ 8450, 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.

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 one 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. Under such conditions the precipitation does not always cease, and when it is showery, the precipitation increases and decreases suddenly in intensity as the showers abruptly begin and end. Only the predominating character will be reported in an observation.

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

3432. At stations equipped with recording gages, determine the rate of accumulation, and select the corresponding intensity from Table 5. This table is applicable to all forms of precipitation except drizzle, provided solid forms are converted to water equivalent (see also ¶ 3434 and 3435).

Table 5. Criteria for determining intensity of precipitation on rate-of-fall basis

Very Light	Scattered drops or flakes that do not completely wet or cover an exposed surface, regardless of duration.
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. At stations not having recording gages, determine the intensity of rain from the guides indicated in Table 6, and estimate the intensity of other forms from the water equivalent of the amount accumulating on the ground.

Table 6. Guides for approximating intensity of rain

Very Light	Scattered drops that do not completely wet an exposed surface, regardless of duration.
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 1/4 to 1/2 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 1/2 full; visibility is greatly reduced; sound on roofs resembles roll of drums or distinct roar.

3434. When drizzle occurs in combination with other hydrometeors and lithometeors, estimate the rate of accumulation and select the corresponding intensity from Table 7.

Table 7. Intensity of drizzle on rate-of-fall basis

Very Light	Scattered drops that do not completely wet an exposed surface, regardless of duration.
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. When drizzle or snow (including snow pellets and snow grains) occurs alone, determine the intensity in accordance with Table 8.

Table 8. Intensity of drizzle and snow with visibility as criteria

Very Light	Scattered flakes or droplets that do not completely cover or wet an exposed surface, regardless of duration.
Light (Slight)	Visibility 1100 yards or more (5/8 statute mile).
Moderate	Visibility less than 1100 yards but not less than 550 yards.
Heavy	Visibility less than 550 yards (5/16 statute mile).

3440. Types of Precipitation.--For purposes of these instructions, precipitation is divided into liquid, freezing, and frozen types. These types are discussed in ¶ 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.--Drops of water (in the liquid state) falling from clouds; 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 may appear to float while following air currents. Unlike fog droplets, drizzle falls to the ground. It 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 ¶ 3442.1) is classified as freezing drizzle.

3443. Frozen Precipitation.--Solid precipitation is classified in accordance with the criteria in ¶ 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 temperature 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. (See ¶ 3432 and 3433 for intensity specifications.)

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. Although fog seldom forms when the difference between the air temperature and the temperature of the dew point is greater than 4.0°F, it should be reported when observed regardless of the temperature-dew point difference.

3502. Ground Fog.--If fog is not contiguous with the base of clouds that may be above it, and if it conceals less than 0.6 of the sky, i.e., the sky condition above an angle of 33° (see Table 2, Chapter 1) is observable, it will be reported as ground fog, rather than fog.

3503. Shallow Fog.--Low-lying fog that does not obstruct horizontal visibility at a level six 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.

3509. Drifting Snow.--Snow raised from the surface by the wind to a height less than six feet above the surface. Drifting snow is not regarded as an obstruction to vision (see ¶ 3920), since it does not restrict visibility at six feet or more above the surface. When snow is raised six feet or more above the surface, it is classified as blowing snow.

3510. Blowing Snow. --Snow lifted from the surface by wind to a height six feet or more above the surface and blown about in such quantities that the horizontal visibility is restricted at and above that height.

3512. Blowing Spray.--Spray lifted from the sea surface by the wind and blown about in such quantities that the horizontal visibility is restricted.

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.

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

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.

3900. ENTRIES ON WBAN-10

3910. Weather and Obstructions to Vision (Col. 5).--Enter precipitation and obstructions to vision in accordance with the symbols in Tables 8a and 8b. Use + after precipitation symbols to indicate heavy intensity, - to indicate light, and -- to indicate very light; the absence of a sign indicates moderate intensity. Precipitation will be entered in this column only if actually occurring at the time of the observation. (See ¶ 3920 for entry of remarks concerning intermittent precipitation.) 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 order of decreasing intensity

(4) Freezing precipitation, in order of decreasing intensity

(5) Frozen precipitation, in order of decreasing intensity

(6) Obstructions to vision, in order of decreasing predominance if discernible

3911. Omit entry of obstructions to vision in column 5 whenever the visibility recorded in column 4 is seven miles or more. If the visibility is less than seven miles, weather or obstructions to vision must be reported either in column 5 or column 13 (see ¶ 3920). If the visibility is reduced by phenomena not occurring at the station, enter an explanatory note in remarks, e.g., "GF BANK N".

Table 8a. Symbols for weather
TORDADO or WATERSPOUT (always written out in full) followed by direction from station.

T+	Heavy Thunderstorm	EW	Sleet Showers
T	Thunderstorm	S	Snow
R	Rain	SW	Snow Showers
RW	Rain Showers	SP	Snow Pellets
L	Drizzle	SG	Snow Grains
ZR	Freezing Rain	IC	Ice Crystals
ZL	Freezing Drizzle	A	Hail
E	Sleet	AP	Small Hail

Table 8b. Symbols for obstructions to vision

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

3920. Remarks (Col. 13). --Enter data pertaining to weather and obstructions to vision as follows:

Observed	Instructions for Entry
(1) Tornado and waterspout (see ¶ 9132.4)	
(a) Observed from station (still in progress)	Enter direction toward which it is moving (e.g., TORNADO MOVG NEWD) in all observations until it ends or disappears from sight.
(b) Observed from station (has ended or disappears from sight)	Enter time of occurrence (or time of beginning and ending), peak speed of gusts, and direction of movement (e.g., TORNADO 1155E G120 MOVD NE) in all observations until it has been transmitted in a record observation.
(c) Reported by public	Enter 1) location with respect to a nearby weather-reporting station, city, or town, 2) direction toward which it was moving, and 3) time tornado was observed, e.g., UNCONFIRMED TORNADO 15MI W DCA MOVG N 1600E. Repeat this remark until it has been transmitted in a record observation.
(2) Thunderstorm	
(a) In progress at station	Enter direction, if observable: (1) with respect to station (2) direction toward which storm is moving, e.g., T OVHD MOVG EWD or T SW MOVMT VRBL (omit remark concerning movement if movement unknown)

(b) Heavy thunderstorm began following the most recent record observation, but not occurring during current observation. (Enter this remark for all observations up to and including the next record observation, even though the phenomenon was previously reported in a special observation. See ¶ 9180.)	Enter the time of beginning and ending, peak speed of gusts and direction of movement, e.g., T+ B34E50 G45 MOVD N
(3) Lightning, with or without audible thunder	Enter if observable: (1) Frequency (2) Type (cloud to cloud, etc.) (3) Direction from station Use authorized abbreviations, e.g. OCNL LTGCG, FQT LTGIC NW, etc.
†(4) Precipitation	
(a) Hail	Enter diameter in inches of largest hailstones, e.g., HLSTO 1-1/4
(b) Intermittent and showery	Enter abbreviation for intermittent, followed by type of precipitation (e.g., INTMT R-), if intermittent precipitation has occurred within the previous 15 minutes. This entry will be made to report intermittent precipitation regardless of whether precipitation is entered in Col. 5 (see ¶ 3910). Enter "OCNL RW", etc. if showers have occurred within the previous 15 minutes and are not reported in Col. 5.
(c) Wet snow	Enter WET SNW

† In reporting data pertaining to snow, snow showers, or sleet in remarks, use the symbols S, SW, and E only when there is no possibility of their being confused with points of the compass. Otherwise, use established English abbreviations (SNW, SNW SHWRS, etc.).

(d) Snow depth increase	Enter abbreviation SNOINCR, followed by average depth of snow accumulated during the past hour, to the nearest whole inch (e.g., SNOINCR 5). This remark will be used only if average snow depth has increased during past hour by two or more inches.
(e) Variation of intensity	Enter appropriate abbreviations, e.g., R- OCNLY R+
(f) Precipitation at a distance but not at station	Enter form and intensity of precipitation if known and direction with respect to station. Use "U" following precipitation symbols to indicate unknown intensity, e.g., RU OVR RDG N or PCPN W INTSTY UNKN
(g) Times of beginning or ending of precipitation	Enter remarks in the next record observation to report the time of beginning or ending of types (i.e., liquid, freezing, or frozen) or separate periods of precipitation, when the time is within one hour of the reference time appearing at the head of the collection, unless: a) this time is apparent from a transmitted special observation (see ¶ 9132.6 and 9180), or b) for endings or beginnings pertaining to the cessation and recommencement of precipitation (of the same or different types), the interval between them is 15 minutes or less, or it appears likely that precipitation will recommence within this time (see example 4). Use the symbol appropriate to the type of precipitation, without regard for intensity or changes in

(g) Times of beginning or ending of precipitation (continued from page 51)

character (e.g., S for S- or S+, or S changing to SW+.) Suffix each precipitation symbol with the symbol "E" followed by the local standard time in minutes past the hour to signify the time of ending, and the symbol "B" similarly to signify the time of beginning.

Examples

1. RW- reported in 1228 obs; RW- ended at 1305. Enter remark in 1328 obs: "RWE05".

2. No precipitation reported in 1228 obs; S- began at 1235 and continued through 1330. Enter remark in 1328 obs: "SB35".

3. No precipitation reported in 1228 obs; S began at 1240 ended 1255; began 1305 and ended at 1315. Enter remark in 1328 obs: SB40E15"

4. RW- began 0515 E and ended 0620E; no precipitation falling at actual time of 0628E observation, but recommencement within 15 minutes of 0620E appeared probable at time of observation. Enter remarks:

   (a) In 0628E obs: "OCNL RW" (Note that time of ending of RW not reported since recommencement within 15 minutes of 0620E appeared probable).

   (b) In 0728E obs: None (Note that, since precipitation did not resume within 15 minutes of 0620E as previously expected and more than an hour elapsed between actual time of ending and 0728E obs., time of ending not reported).

(5) Obstructions to vision	
(a) Fog dissipating (or increasing)	Enter F DSIPTG (or F INCRG)
(b) Smoke drifting over field	Enter K DRFTG OVR FLD
(c) Shallow ground fog (height less than 6')	Enter SHLW GFDEP 4
(d) Drifting snow (height less than 6')	Enter DRFTG SNW (omit if "BS" is reported)
(e) Dust devils	Enter DUST DEVILS, followed by direction from station.
(f) Obstructions that restrict visibility at a level below the usual point of observation (see ¶ 2010).	Enter appropriate phrase contractions or plain words, e.g., "PATCH GF W".

NOTE: Report in remarks obstructions to vision for which symbols have not been established by means of authorized contractions or plain language.

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. No allowance is made for loss from evaporation. 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; less than 0.005 inch is called a trace. The actual depth of solid forms is expressed to the nearest 0.1 inch, and less than 0.05 inch 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 available the gage appearing highest on the following list will be used.

(1) Weighing gage equipped with 24-, 12-, or 6-hour gears; with other gears, treat as (5) below.

(2) Eight-inch gage.

(5) All other types.

4040. Measurement of Rain.--If a weighing gage is used, read the amount from the chart (see sec. A4300). If an 8-inch gage is used, 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.

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. All gages except the weighing gage will be emptied at each 6-hourly and midnight observation.

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 ¶ 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 ¶ 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 ¶ 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 two 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 ¶ 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, ten inches of snow correspond to one 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 melting, evaporation, and run-off. If several snow showers occur between observations and each melts before the following one occurs, the total snowfall for the period will be the sum of the maximum depths (measured or estimated) for each occurrence.

4300. ENTRIES ON WBAN-10

4310. Precipitation (Col. 44).--Enter in the 6-hourly spaces the total precipitation (water equivalent), in inches and hundredths, occurring during the six hours ending with the observation.* On the line captioned "Mid" 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 "Mid to" enter the amount that has occurred between midnight and the following 6-hourly observation. (Note that the entry for the first 6-hourly observation after midnight is the sum of the entries opposite "Mid" (for the preceding day) and "Mid to". Enter "T" for trace (see ¶ 4020) and "0" if no precipitation has fallen.

4311. If no precipitation has fallen during the six hours preceding the time of measurement of precipitation for the 6-hourly observation, but begins shortly thereafter and before the coded additive data group is filed, enter "T" in column 44. This procedure will be followed even though a measurable amount may have fallen.

4340. Twenty-Four Hour Precipitation (Col. 68).--Enter the total precipitation (water equivalent in inches and hundredths) for the 24 hours ending at midnight†. Enter "T" for trace (see ¶ 4020), and "0" if none has fallen. The sum of any number of "T" observations will be regarded as a trace unless recording gages indicate the total is .005 inch or more. (Note that the entry in this column is the sum of the entries in column 44, exclusive of the first 6-hourly observation of the day, provided a midnight observation is taken and, where a recording gage is used, no traces have been recorded.) Entries may be omitted in this column if the equivalent value is available by summation of the entries in column 44 of the forms constituting the day's record (see ¶ 11001.1).

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† For purposes of entries on WBAN-10, the midnight observation will be considered as the last observation of the day; e.g., a midnight observation taken at 0000 LST on the 15th will be entered on WBAN-10 for the 14th.

4350. Twenty-Four Hour Snowfall (Col. 69).--Enter to inches and tenths the total amount (unmelted) of frozen precipitation that has fallen during the twenty-four hours ending at midnight†. Determine this value as specified in ¶ 4230. Entries for hail will be followed by an asterisk and "*Hail" entered in column 90. Enter "T" for trace, and "0" if none has fallen. When precipitation melts as it falls, enter "T" with a note "Melted as it fell" in column 90.

4360. Snow Depth (Col. 70).--Enter the depth of frozen precipitation (see ¶ 3443) and ice on the ground at 1230 GCT to the nearest inch. Entries for hail will be followed by an asterisk and "*Hail" recorded in column 90. Enter "T" for amounts less than 0.5 inch and "0" when none is on the ground in exposed areas, even though snow is still present in surrounding forested or otherwise protected areas. If snow melts as it falls and there is no visible accumulation on the ground, enter "0". Where personnel are not on duty at 1230 GCT, enter the depth as measured at a time as close as practicable to 1230 GCT, and indicate the time in column 90.

A4100. D100, NON-RECORDING GAGE (EIGHT-INCH STANDARD) FIG. A4-1

A4110. General.--This gage consists of three parts: a receiver assembly, a measuring tube, and an overflow container. The receiver assembly consists of a circular (eight-inch inside diameter) collector ring and funnel. The inside cross-section area of the collector ring is ten times that of the measuring tube. The measuring stick used with this tube has a scale expanded in the same ratio Therefore, one linear inch of rain in the measuring tube is read as ten-hundredths (0.10) of an inch on the scale. The measuring stick is graduated over a range of 2.40 inches of rainfall in increments of 0.01 inch.

A4120. Winter Operation.--When freezing temperatures or solid forms of precipitation are likely to occur, remove the receiver and the measuring tube, leaving the overflow can to catch any precipitation (see ¶ 4041 and 4050).

A4140. Installation.--The box in which the gage is shipped also serves as a support for the gage. Remove the lid of the box, which is fastened by screws, and, after removing the gage, lower the lid to the level of the screw holes in the sides about ten inches above the bottom of the box. Fasten the lid in position with the shipping screws. The box should be mounted on metal or wooden stakes (purchased locally

† See footnote on preceding page.

if not available from the Weather Bureau regional supply depot) so that the bottom of the box is at least four to six inches above the ground (see ¶ A4410).

A4141. Wooden stakes or posts should be treated with a rot- and termite-resistant preservative prior to painting, unless creosote is used as a preservative, in which case painting is unnecessary.

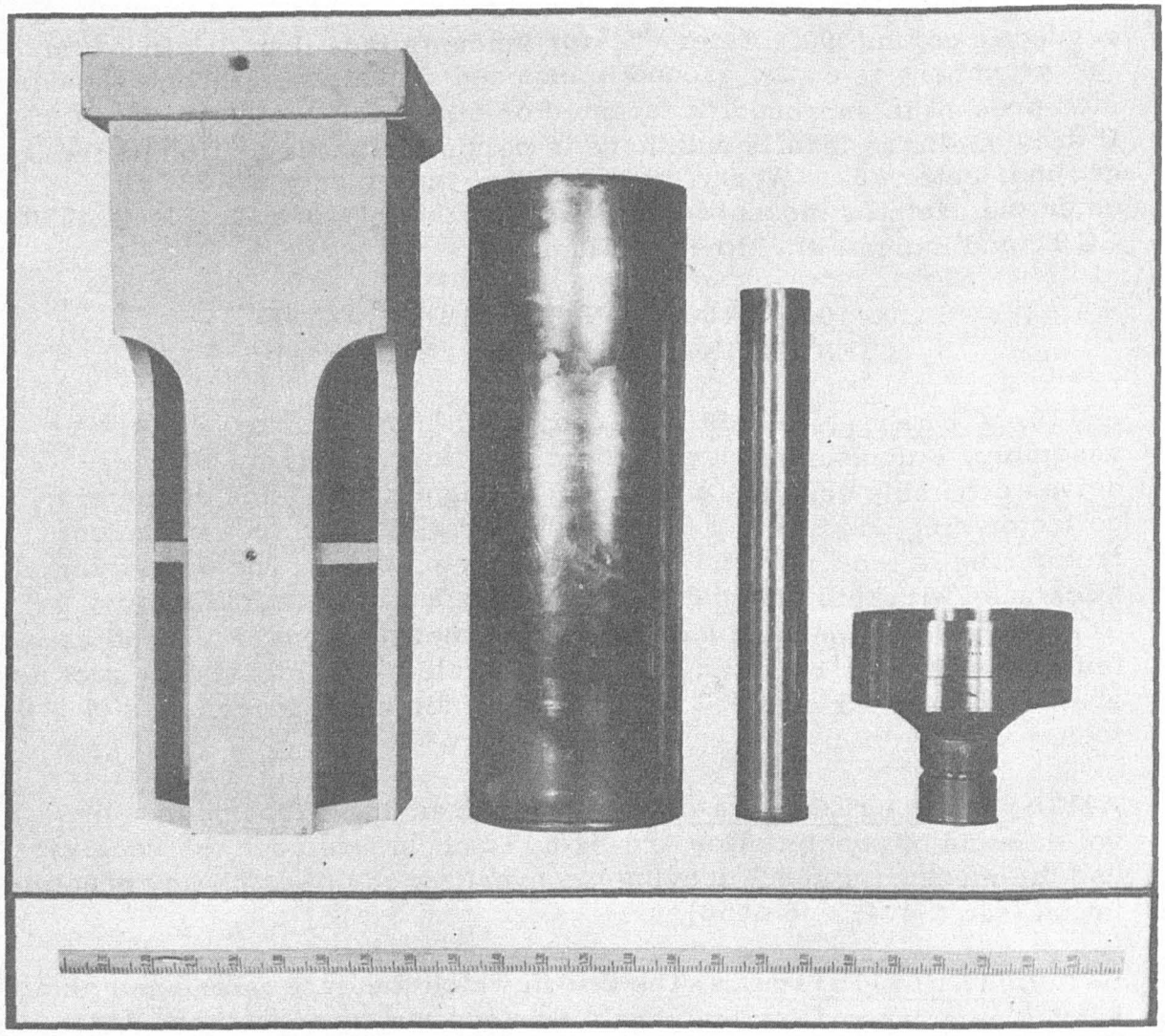


Fig. A4-1. D100, non-recording (eight-inch) precipitation gage. Left to right: wooden box support, overflow container, measuring tube, and receiver assembly. Below: measuring stick.

A4300. D110A OR B, WEIGHING GAGE (FIG. A4-5)

A4310. General.--The universal-type of weighing gage consists of a collector assembly, and a storage bucket mounted on a recording, weighing mechanism. The collector consists of an eight-inch (inside diameter) collector ring and a removable funnel. In addition, some gages are provided with a snow ring that operates as an extension of the collector ring for use when snow is expected. The weight of the accumulated precipitation is converted to equivalent inches of precipitation that is recorded in ink as a continuous trace on a chart. The amount of accumulated precipitation that may be recorded depends upon whether the pen linkage permits single or double traverse of the pen over the chart. The pen records on its ascent in the single-traverse type, and on its ascent and descent in the double-traverse type. Form 1028C, a 24-hour chart, is used on either the single- or dual-traverse gages. Stick measurements are not made of the precipitation accumulated in this gage. For ease of reading, the base of the gage should be at least 12 inches above the ground; preferably 18 to 24 inches, provided the foundation is firm enough to prevent normal vibration from disturbing the trace.

A4320. Routine operating procedure.

(1) When the gage is not charged with calcium chloride, empty the bucket whenever the chart is changed and as often between changes as necessary to avoid exceeding the single-traverse capacity of the gage.

(2) During periods of freezing temperatures and expected sleet and snow, remove the funnel in the bottom of the receiver, and on D110B, gages, install the snow ring (if available) on the collector ring. With the empty bucket in position and the pen set at zero, charge the gage with antifreeze by placing in the bucket one quart of commercial anhydrous calcium chloride dissolved in one quart of water. Do not use a more concentrated solution. If the calcium chloride has not been packaged with oil added, cover the solution with a small amount of low viscosity motor oil (SAE 10) to prevent evaporation. Do not adjust the pen after the solution has been placed in the bucket. Empty and recharge the gage (a) whenever the gross accumulation (initial charge plus subsequent precipitation) dilutes the charge to such an extent that there is a danger of damaging the bucket from solid freezing of the mixture, and (b) before the gross accumulation exceeds the single traverse capacity of the gage.

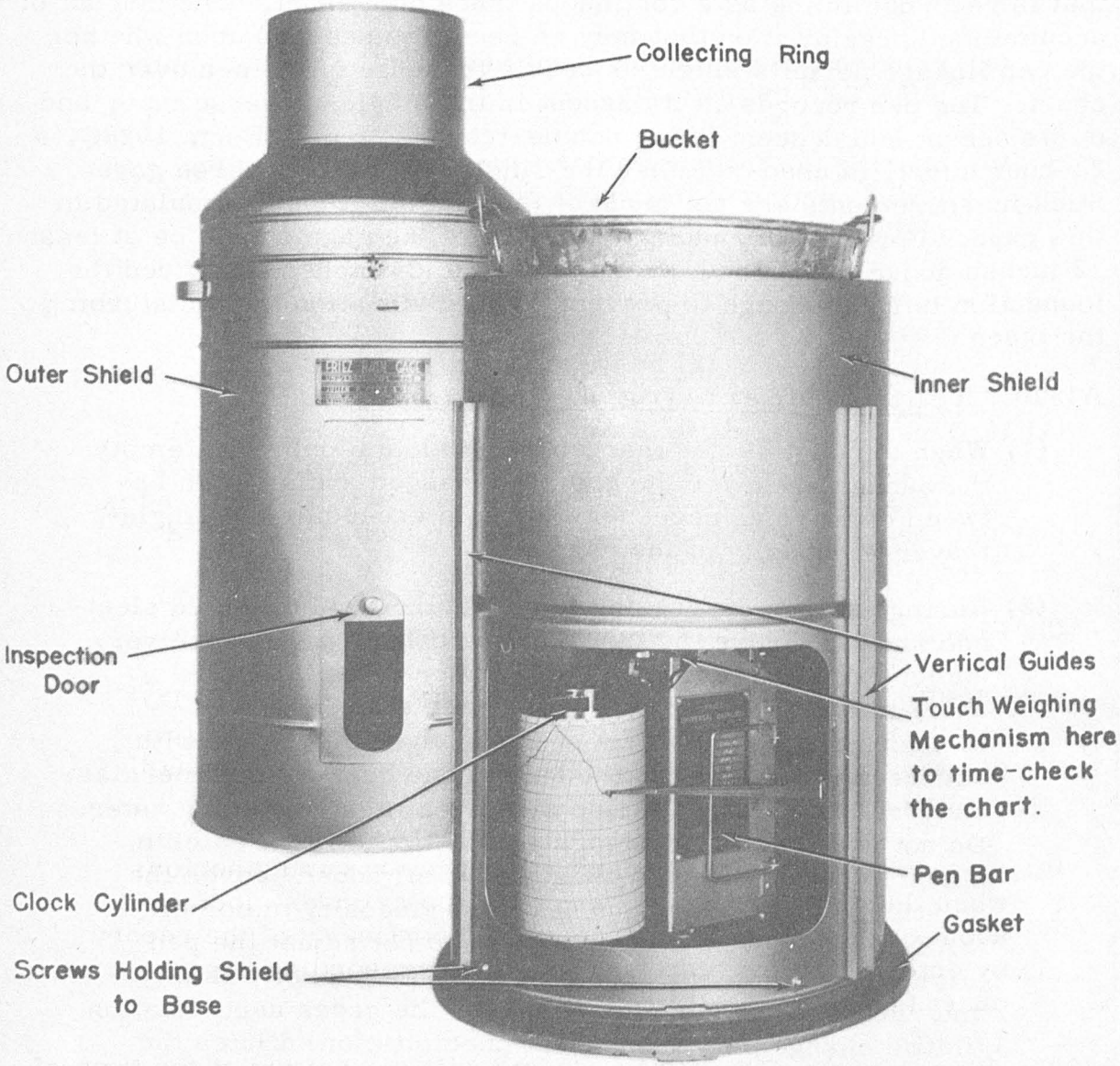


Fig. A4-5. D110A, weighing type of precipitation gage.

(3) At each observation inspect the mechanism to determine that the clock is running and the pen is recording. Make a time-check line at the time of the six-hourly observation when precipitation is occurring or has occurred during the preceding six hours and the precipitation record for the station is obtained from the weighing gage. The check line, approximately two ordinates in length, is made either by:

(a) removing the collector, and touching the bucket gently to elevate the pen; or,

(b) opening the inspection door and gently touching the lower portion of the weighing-bucket platform to elevate the pen; or,

(c) opening the inspection door and depressing the pen several ordinates. Do not elevate the pen except as specified in (a) or (b).

(4) If vibration or continuous repetition of the trace over the same ordinate causes the pen line to appear too wide for accurate evaluation of small amounts of precipitation, adjust the pen upward approximately 1/4 inch (linear) and make a notation to this effect on the chart.

(5) Check the condition of the bucket and remove any loose dirt or sediment each time the bucket is emptied. If additional cleaning is indicated, use soap and water. Do not use alcohol or a petroleum-base solvent owing to the deleterious action of the solvent on the protective asphalt coating.

(6) At each 6-hourly and midnight observation during periods when the clock is inoperative, turn the cylinder clockwise about one-half inch and maintain the continuity of the record by entering measurements from a non-recording gage on a chart (see ¶ A4321.2(2(b)).

A4321. Replacing Charts.--Charts will be changed at the time of the 1830 GCT six-hourly observation, or as soon as possible thereafter:

(1) On the first of the month and on each Monday, Wednesday, and Friday.

(2) Daily whenever sustained vibration produces a blurred trace corresponding to more than 0.04 inch of precipitation.

(3) Each Friday when the clock is inoperative (see ¶ A4320(6)).

A4321.1. In handling and storing completed charts, avoid smearing damp portions of the trace.

A4321.2. To change a chart:

(1) Remove the collector ring and bucket, and either remove the cylindrical shield or lift it until it can be turned so that its vertical guides rest on the matching guides attached to the inner shield. When the shield has two thumb-levers, located near the inside top of the outer shield, they must be depressed to release the shield.

(2) (a) Make a time check on the chart by touching the bucket lightly, etc. (see ¶ A4320(3)).

(b) If the clock is stopped and precipitation occurred during the interval that the clock was not functioning, carefully turn the cylinder slightly to the right and to the left to identify the top of the precipitation trace in the event that vibration of the pen has lengthened the trace. Label the point "Clock Stopped."

(c) If the pen is not operating, mark the position of the pen on the chart with a dot and enclose the dot in a circle. Label the entry "Pen Dry."

(3) Lift the pen from the chart with the pen holder.

(4) Empty and replace the bucket, except that when the bucket is charged with antifreeze, it will be emptied in accordance with ¶ A4320(2).

(5) Remove the chart cylinder from the gage by lifting the cylinder until it is entirely clear of the spindle and then tilting it until it can be removed through the opening in the inner shield.

(6) Remove the chart from the cylinder after withdrawing the flat, spring-type retaining clip.

(7) Wind the clock, being careful not to wind it too tightly.

(8) Fit the unused chart snugly to the cylinder and replace the retaining clip. When properly fitted, the bottom of the chart rests on the flange and the horizontal lines coincide where the right end of the chart overlaps the left end.

(9) Replace the cylinder on its spindle and lower it carefully until the gears have meshed.

(10) Adjust the cylinder for time (see ¶ A4326).

(11) Fill the pen about 3/4 full of ink and replace it on the chart.

(12) If the bucket is emptied, adjust the pen to the zero ordinate on the chart (see ¶ A4325).

(13) Check for satisfactory operation of the pen and clock and make a time check on the new chart by touching the bucket lightly, etc. (see ¶ A 4320(3)).

(14) Replace the outer shield and collector ring.

A4322. Annotating Charts.-- (See Fig. A4-6.) Enter the data listed below in ink.

(1) Before placing the chart on the gage, enter the station name, date and time (to minutes), and the local time zone designator (see Table 17).

(2) After the chart is removed from the gage, enter:

(a) The date, the time of removal, and the time zone designator; and,

(b) where applicable, suitable notations (see ¶ A4320(4) and A4321.2 (2(b and c)) to identify points where the clock stopped, pen was found dry, missing record, accumulation of sand and other foreign matter in the bucket during wind storms, etc.

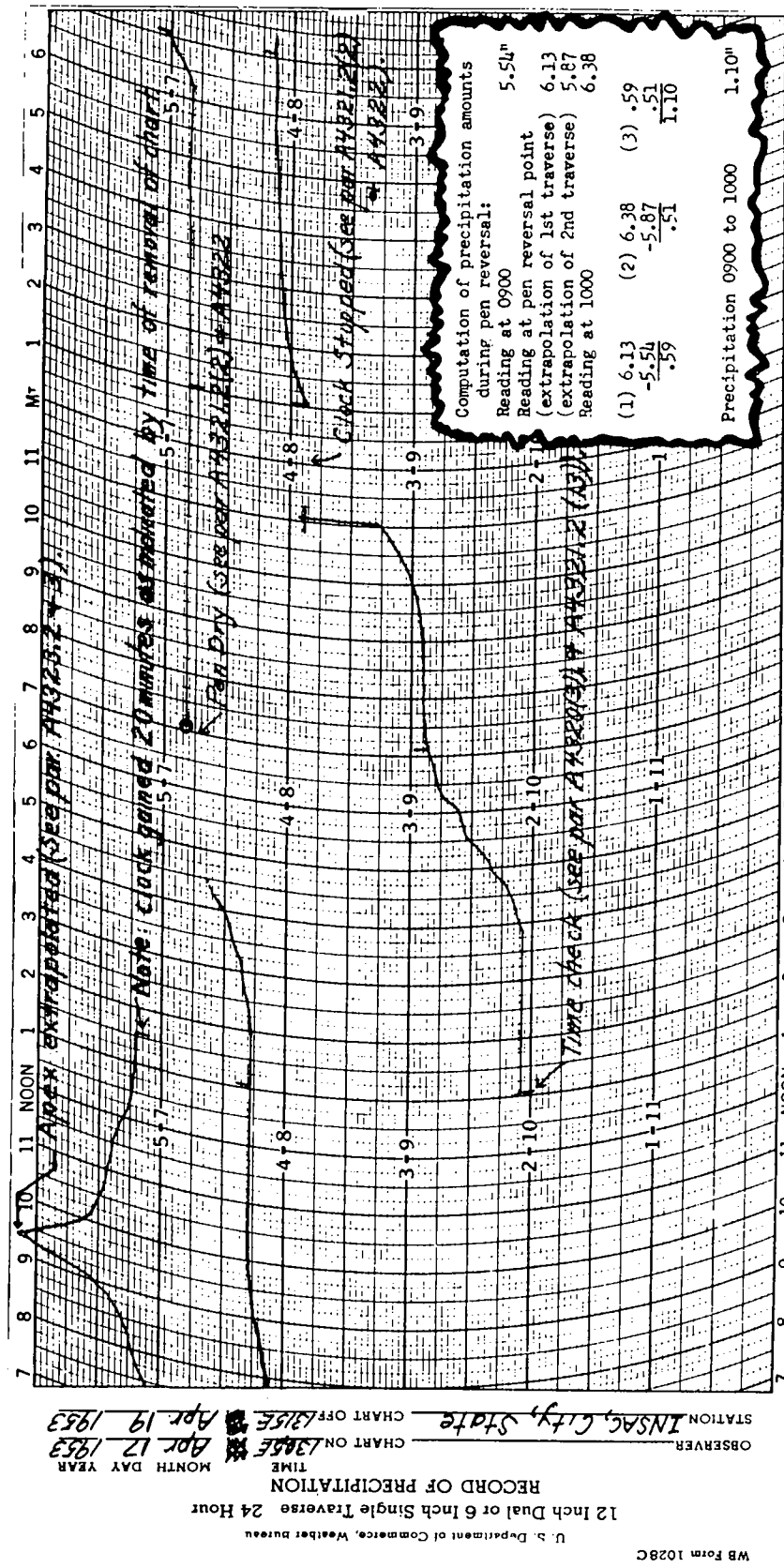
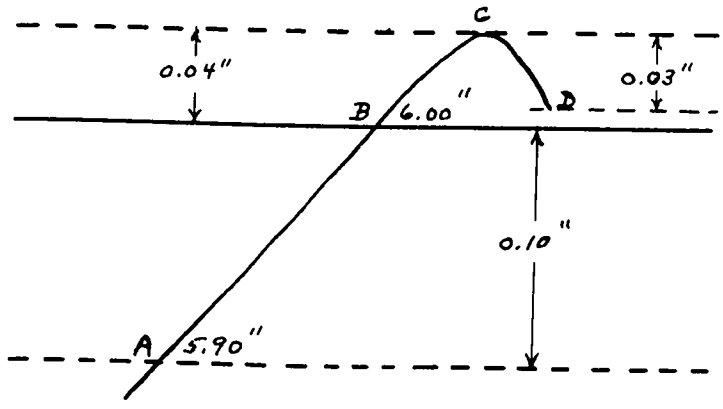


Fig. A4-6. Annotation of WB Form 1028C, weighing-type precipitation gage chart.

A4323. Evaluating Charts.

A4323.2. Evaluating Charts.--Unless the pen reverses exactly at the uppermost ordinate of the chart (the 6.00-inch line of this type of dual traverse gage), indicated readings for the second traverse as taken from the 6 - 12 inch scale are in error. Therefore, when the pen traverse has reversed during the observation period at a point above or below the 6.00-inch line, computation of the precipitation for the period is facilitated by taking the sum of the precipitation equivalent of the segments of the trace obtained during the period (see the following example).

EXAMPLE



In this illustration, the reading from the 0 - 6-inch scale at the beginning of the observation period is 5.90 inches at point A; B is the point of intersection of the first traverse with the 6.00-inch line; C is the point of reversal of the trace; D is the end of the trace at the end of the observation period. The total precipitation for the period, ABCD, is as follows:

(1) The difference between readings at points A and B is 6.00 minus 5.90 or 0.10 inch,

(2) The precipitation equivalent of the height of point C above the 6.00-inch line is 0.04 inch.

(3) The precipitation equivalent of the difference in height between points C and D is 0.03 inch.

(4) The sum of segments AB, BC, and CD is the sum of 0.10 plus 0.04 plus 0.03, or 0.17 inch, the precipitation during the time interval between points A and D.

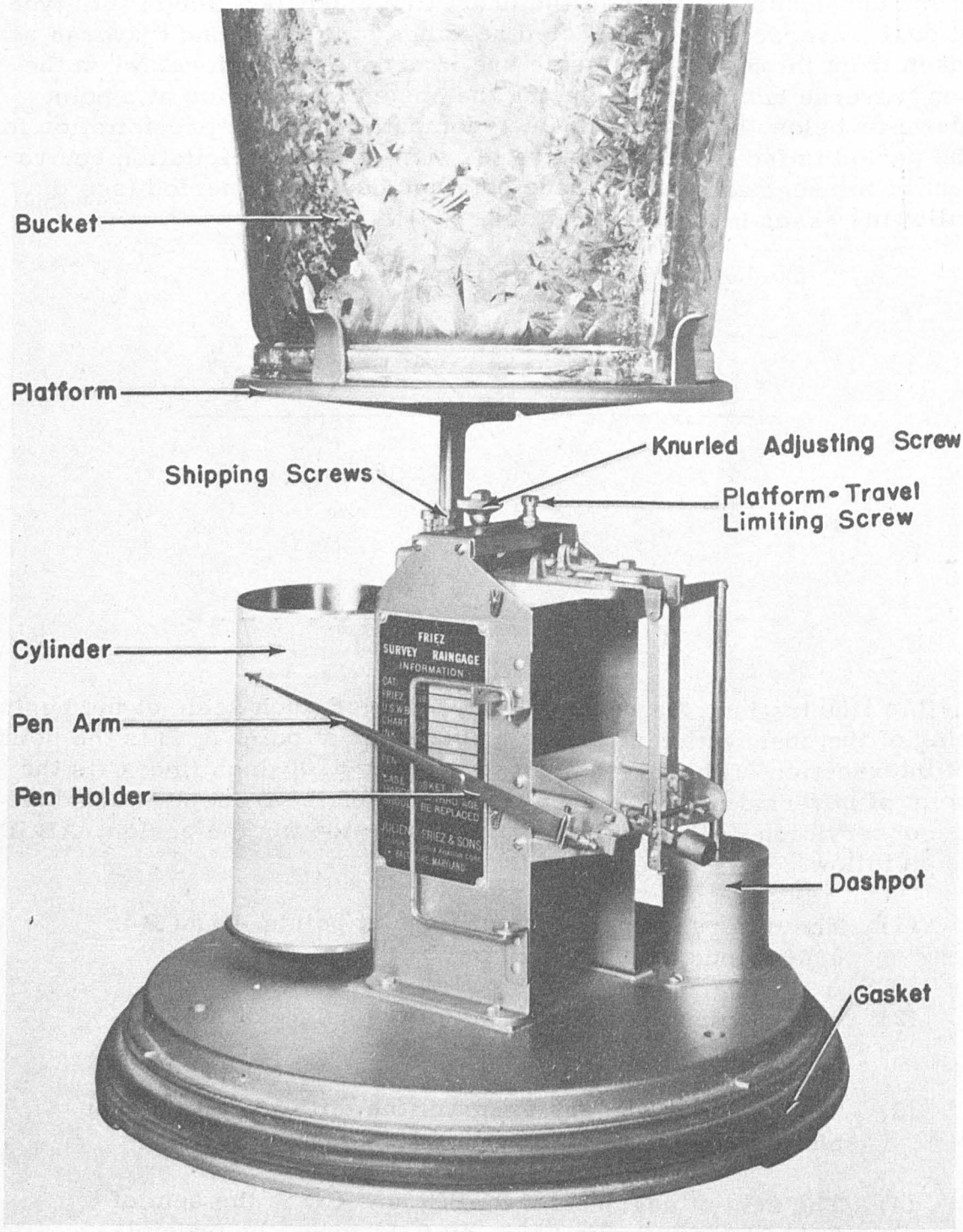


Fig. A4-7. Weighing mechanism.

A4323.3. If the pen reversed during heavy precipitation and the rainfall was recorded as a flat trace during reversal owing to loose linkage, extrapolate the ascending and descending portions of the curve to an appropriate apex.

A4324. Disposition of Charts.--Forward the charts for the week each Saturday to the WRPC's with the WBAN-10 forms.

A4325. Zero Adjustment.--The gages are provided with a knurled, zero-adjustment nut located above the frame that supports the linkage mechanism (see Fig. A4-7). Turn the nut clockwise to lower the pen and counterclockwise to raise the pen. Adjust the pen to the zero line (lowest horizontal line) on the form only when the bucket is empty and in place on the weighing platform. Be careful not to change the three platform-travel-limiting and shipping screws adjacent to the zero-adjustment nut.

A4326. Time Adjustment.--To adjust the chart for time, turn the cylinder counterclockwise as viewed from above until the correct local standard time is indicated by the position of the pen with respect to the labeled time lines. The heaviest lines are labeled to indicate the beginning of each hour (LST). Additional lines are provided at 15-minute intervals. The cylinder should be adjusted to indicate the time to the nearest minute.

A4331. Dashpots.--If necessary to prevent loss of ink from the pen, and to minimize irregularities in the trace resulting from vibration and wind gusts, fill the dashpots with etheleyne glycol (Prestone, etc.), petroleum oil, or a similar fluid. Either keep the dashpot filled to a level approximately 3/8' from the top, or keep the dashpot entirely empty. This is important to prevent erroneous readings resulting from the effect of surface tension on the dasher. After filling the dashpot, move the weighing platform up and down several times to remove any air bubbles trapped under the dasher, and then check the level of fluid. Do not mix dashpot fluids, i.e., a glycerin-base type with an oil-base type fluid.

A4332. Clocks.--If the clock gains more than about two minutes a day, adjust the timing regulator. If the clock is mounted in the record cylinder, open the small inspection plate in the top cover of the clock compartment (inside the cylinder as viewed from the top (see Fig. A7-7) for access to the adjusting lever. If the clock is mounted on the

spindle, the adjusting screw is mounted on the bottom of the plastic-covered escapement mechanism (see Fig. A4-8). Adjust the index toward "F" (Fast) if the clock is losing time, or toward "S" (Slow) if it is gaining time. It is preferable that such adjustments be made at the time of changing the chart in order to preserve the continuity of the record.

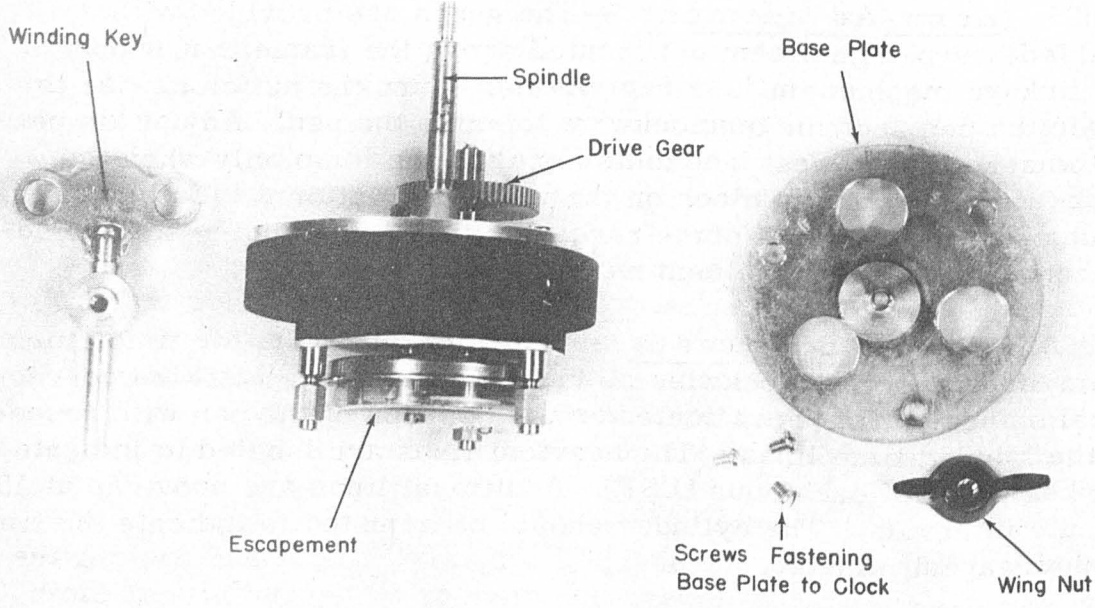


Fig. A4-8. D110-11, Macnick clock.

A4332.1. When a clock gains or loses more than ten minutes a day, another clock should be requested.

A4332.2. The gear on replacement clocks of the type mounted in the chart cylinder have a number stamped on them, and they will generally mesh satisfactorily with a gear-type spindle of the same number. If they do not mesh satisfactorily, adjust the position of the pinion slightly after loosening the three screws near the periphery of the base of the cylinder. The spindle screws into the base of the gage, and in some cases may be further secured by a wing nut. If accessory items, such as spindle, gear, pinion, washer and wing nut, are received with a replacement clock, the equivalent items should be returned with the used clock.

A4332.21. The gear-type spindles are provided with a small horizontal hole in the shaft to facilitate its removal with a spindle wrench or a short rod, such as a nail. Ordinarily, the friction between the gear and the shaft is ample to permit initial loosening and final tightening of the spindle by hand. The leverage afforded by the spindle itself should then be sufficient to permit removal or replacement by hand. Do not use pliers or other metal tools on the shaft or gear. If the threads do not mesh readily, request a replacement spindle.

A4332.22. The gear should not be free to turn after the spindle is tightened. Be sure that the outer, bevelled edge of the washer faces downward between the gear and the base of the gage. Center the washer when the spindle is tightened in order that the gear will be properly secured between the washer and the shoulder of the spindle.

A4333. Pens.--Clean the pen if sediment (dried ink, etc.) accumulates in it. To clean the pen, wash it thoroughly in water or, preferably, in alcohol. Scrape residual dried ink from the pen with a suitable sharp-edged instrument. Clean the nibs by pulling a piece of clean, hard-finish paper or cellophane between the nibs, and rewash the pen. Sharpen or replace the pen if it will no longer make a clearly legible trace.

A4333.1. The pen may be sharpened by inverting it and rubbing the edges gently over a fine-grain whetstone or a sheet of crocus cloth. After the point has been sharpened, rub it very lightly several times over the abrasive surface to remove any burrs that might catch on the chart and cause an erratic trace. A spare pen should be kept on hand for replacement purposes.

A4333.2. The pen is secured to the pen arm by a friction clamp. Avoid bending or otherwise damaging the pen-arm linkage when removing the pen. If the pen is not easily removed, use a knife edge or similar wedge to loosen the prongs that hold the pen to the arm.

A4334.1. Bucket.--If, at any time, the contents of the bucket freeze solid, examine the bucket carefully for evidence of damage, e.g., bulging of the bottom, slow leaks, etc. Report damaged buckets to the Weather Bureau regional office.

A4400. EXPOSURE AND SHIELDS

A4410. Exposure.--Precipitation gages should be located on a level plot of ground, at a distance from any object (including the instrument shelter) of at least two, and preferably four, times the height of the object above the top of the gage. All types of gages must be exposed with the rim of the receiver in a horizontal plane and at a level well above the average level of snow surfaces. Gages should not be installed on a roof without prior authorization by the Weather Bureau Central Office.

A4420. Shields.--Stations where snowfall and strong wind frequently occur together will be furnished with approved shields (see Fig. A4-9). However, where two or more gages are installed, only one will be shielded, preferably the weighing gage.

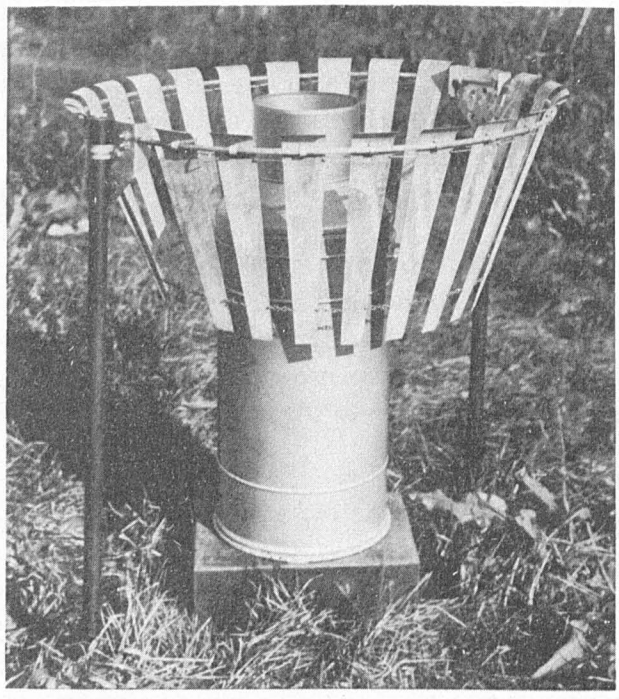


Fig. A4-9. D110A, weighing gage with a D131 Alter-type shield

A4421. Alter-type shields (D131) are installed with the circular ring horizontal and the top of the blades approximately 1/2 to 3/4 inch above the level of the top of the receiver. The blades are suspended from the ring. They are free to pivot at the point of suspension within

the limits imposed by the chain linking together the bottoms of the blades. The blades on the windward side of the gage deflect the wind downward and thereby increase the efficiency of the gage.

A4500. WATER EQUIVALENT OF FROZEN PRECIPITATION

A4540. Transmission.--Designated stations will transmit water equivalent of snow on the ground (see ¶ 4053) on Service A in the 1228 GCT report on Tuesday and Friday immediately following group "$985s_ps_p$" (snow depth). Use a slant to separate these data from the $985s_ps_p$ group, e.g.:

98505/50 - snow depth 5", water equivalent 0.50".

98502/9 - snow depth 2", water equivalent 0.09".

98511/110 - snow depth 11", water equivalent 1.10".

A4541. Additional reports of water-equivalent data may be transmitted in accordance with emergency requests received from the Weather Bureau Area Engineer or the Weather Bureau River District Office.

A4540.1. Where personnel are not on duty at 1230 GCT, omit water-equivalent observations.

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CHAPTER 5. TEMPERATURE

5000. GENERAL

5010. Scale.--Temperatures, as used in these instructions, refer to the Fahrenheit scale.

5020. Types of Thermometers.--The Fahrenheit thermometers in general use include the following types.

5020.1. Nonrecording mercurial or spirit-filled thermometers.

(1) Dry bulb (exposed).

(2) Wet bulb (with wick-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.

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. When frost forms on the thermometer, remove it by a warm cloth and allow sufficient time for the dissipation of extraneous heat before reading the thermometer.

5130. Wet-Bulb Temperature.--The wet-bulb temperature is the lowest temperature to be secured by evaporating water from the wick-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 dry-bulb 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 dry-bulb temperature is above freezing, near, or below freezing, and according as the relative humidity is high or low.

5131.1. Moisten the wet bulb just prior to ventilating the psychrometer. If, however, the temperature is high and the relative humidity is low, or it is expected that the final temperature of the wet bulb will be 32° or less, moisten the wet bulb thoroughly several minutes before taking a reading so that a drop of water will have formed on the end of the bulb. This will reduce the temperature of the wet bulb without prolonged ventilation and the consequent danger of the wick's drying out before the temperature of the wet bulb will have reached its lowest point.

5131.2. In areas where the temperature is high and the humidity low, it may be necessary to use precooled water for moistening the wet bulb

to avert premature drying of the wick. Water can be precooled for this purpose by storing it in a porous jug. Sufficient water will seep through the jug to cool it by evaporation. To avoid altering moisture conditions in the shelter, do not keep this jug in the shelter. If this method should not be effective, the wick may be extended from the wet bulb to an open container of water. Between observations, the end of the wick should remain immersed in the water. Continuous evaporation will maintain the thermometer close to the wet-bulb temperature. When the psychrometer is ventilated, the wick must be removed from the water until the wet-bulb thermometer has been read. Regardless of the method used, the psychrometer must always be ventilated in accordance with ¶ 5150 before determining the wet-bulb temperature.

5131.3. At dry-bulb temperatures of 37°F. or below, use water that has been kept at room temperature in order to melt completely any accumulation of ice on the wet bulb. Moisten the bulb thoroughly, at least fifteen minutes before ventilating the psychrometer, and longer if necessary to permit the latent heat, released if the water freezes, to be dissipated before ventilation is begun. Do not allow excess water to remain on the wet bulb, since a thin, thoroughly cooled coating is necessary for accurate data.

5140. Corrections.--Instrumental calibration corrections, which are listed on a correction card, will be applied to all thermometer readings under conditions (1) and (2). An additional correction factor will be applied to all wet-bulb thermometer readings under condition (3).

(1) Whenever the temperature indicated by the thermometer is above 42°F., and the instrumental correction is $\pm$0.3°F. or more in the case of mercurial thermometers, or $\pm$0.5°F. or more in the case of spirit-filled thermometers.

(2) Whenever the temperature indicated by the thermometer is 42°F. or less.

(3) Whenever the wet-bulb thermometer has an indicated reading higher than that of the dry-bulb thermometer. If the reading of the wet-bulb thermometer, after the correction has been applied, remains higher than the dry-bulb reading, disregard it and use the dry-bulb value for both temperatures. (See ¶ 6110.1.)

5141. Corrections are furnished for intervals not greater than 20°. Add the appropriate correction algebraically to the reading of the thermometer.

Examples:	°F.
Reading of the thermometer	62.1
Correction to be applied	-0.5
Corrected reading	61.6
Reading of the thermometer	-8.2
Correction to be applied	-1.2
Corrected reading	-9.4
Reading of the thermometer	+0.4
Correction to be applied	-1.2
Corrected reading	-0.8

5142. For an observed reading between the temperatures for which corrections are given, an interpolated value of the correction will be used whenever necessary. Tables for the purpose may be prepared locally.

5150. Psychrometer.--Psychrometers are designed to secure ventilation by means of a fan, a whirling apparatus, or a sling apparatus. The psychrometer should be so ventilated that the minimum speed of air passing over the thermometer bulbs is at least fifteen feet per second. This is approximately equal to one rps (revolution per second) of the geared (2 to 1 ratio) whirling psychrometer crank, 2 rps of the sling psychrometer, and 3-1/2 rps of the crank of the psychrometer fan or rotor (direct drive) whirling psychrometer. Psychrometric tables and calculators 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 ¶ 5110 - 30 and the following instructions.

5151.1. Saturate the wick of the wet-bulb thermometer with clean water even though the humidity is high or the wick already appears wet.

5151.2. After ventilating the psychrometer for about ten 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 rises between two successive readings, remoisten the wick and repeat the process of ventilation. Before commencing for a second time, permit the wet bulb to assume as low a temperature as possible.

5151.3. When the wet-bulb temperature is below 32°F. and the wick is not obviously frozen or ice covered, it should be brought to the latter state by touching it with clean ice, snow, or some other object whose temperature is approximately the same as, or less than, that of the dry bulb.

5151.4. 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.

5151.5. Read the dry- and wet-bulb temperatures at the time of the lowest wet-bulb reading. (See ¶ 5120.1.)

5151.6. Apply corrections, if necessary, in accordance with ¶ 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. If the readings of the dry-bulb and maximum thermometer disagree, check the thermometers for the source of error in accordance with maintenance instructions. Lock the thermometer in place on the support. Reset the maximum thermometer at each 6-hourly and midnight observation.

5163. If the maximum thermometer is broken or the reading is known to be in error, 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 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 and the reading is the same as the dry-bulb temperature. If the readings of the minimum and dry-bulb thermometer disagree, check the thermometers for the possible source of error in accordance with ¶ 5172 or separate maintenance instructions. Return the thermometer to its correct position. Reset the minimum thermometer at each 6-hourly and midnight observation.

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 is broken or the reading is known to be erroneous, use the lowest corrected temperature observed within the observation 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.

5500. ENTRIES ON WBAN-10

5510. Temperature (Col. 7).--Enter the dry-bulb temperature to the nearest whole degree Fahrenheit. Prefix a minus sign to temperatures below zero.

5530. Dry-Bulb (Col. 18).--Enter the dry-bulb temperature to the nearest degree and tenth, Fahrenheit, prefixing minus signs as required.

5540. Wet-Bulb (Col. 19).--Enter the temperature of the wet-bulb to the nearest degree and tenth, prefixing minus signs as required.

5550. Maximum and Minimum Temperatures (Cols. 47 and 48).--Enter these data only at stations equipped with maximum and minimum thermometers. Enter the maximum and minimum temperatures to whole degrees for the six hours ending with the observation. Note that these temperatures must be as high and low respectively as any temperature recorded in the preceding six hours, including the current temperature. If the hourly temperatures are inconsistent with the maximum and minimum readings, assume that the hourly readings are correct and adjust the maximum and minimum readings accordingly. On the line captioned "Mid" enter the maximum and minimum temperatures occurring between midnight and the preceding 6-hourly observation.† On the line captioned "Mid 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 not taking midnight observations, omit entry on the lines captioned "Mid" and "Mid to".

† See footnote to ¶ 4310.

5580. Maximum and Minimum Temperatures (Cols. 66 - 67).--Enter these data in whole degrees. Note that the maximum and minimum temperatures must be at least as high and low, respectively, as any temperature recorded through the day. Entries may be omitted in these columns if the equivalent values are available by summation of the entries in columns 66 and 67 respectively of the forms constituting the day's record (see ¶ 11001.1).

A5000. LIQUID-IN-GLASS THERMOMETERS

A5010. General.--The range of thermometers in use at a station should exceed any expected maximum and minimum temperatures. During periods when temperatures below -38°F. may be expected, substitute an alcohol-filled (spirit-filled) dry-bulb thermometer for the mercury-filled dry-bulb thermometer (see ¶ 5130).

A5020. Psychrometers.--(See Figs. A5-2 and A5-3.) Methods for ventilating psychrometers vary with the type of mounting. If the psychrometer is to be ventilated with a hand-powered fan (H030) mounted in a shelter (see Fig. A5-1), it is suspended, bulb end down, with both bulbs in front of the fan and about midway between the center of the fan and its periphery. When used in a medium-sized shelter (P300), the fan and its supporting frame are installed with the crankshaft housing projecting through the louvered side. The bottom of the supporting frame in front of the fan should be approximately 2-1/2 inches above the bottom of the shelter. A hook to hold the psychrometer is screwed into the face of the instrument-mounting board about seven inches from the right end of the board, and at a height such that the wet-bulb of the suspended psychrometer is five inches above the bottom of the shelter.

A5021. Maintenance.--Once a week, check the condition of the thermometers, change the wick on the wet bulb, and clean the thermometers if foreign matter (crystalline mineral deposits on wet bulb, etc.) has accumulated. Deposits of foreign matter on the wicks will cause erroneous wet-bulb readings. In some localities, it may be necessary to replace wicks more frequently than once a week to prevent their becoming badly soiled. A solution of vinegar and water will usually prove effective in removing mineral deposits on the glass bulbs.

A5021.1. Once a week, clean the gear teeth and exposed surfaces of the whirling psychrometer (H010) by removing dirty grease, oil, and loose dirt. Lubricate the bearings with a few drops of viscous motor oil (SAE 30 or higher) or, in the case of gear teeth and worn bearings, with a thin film of light grease (vaseline, etc.).

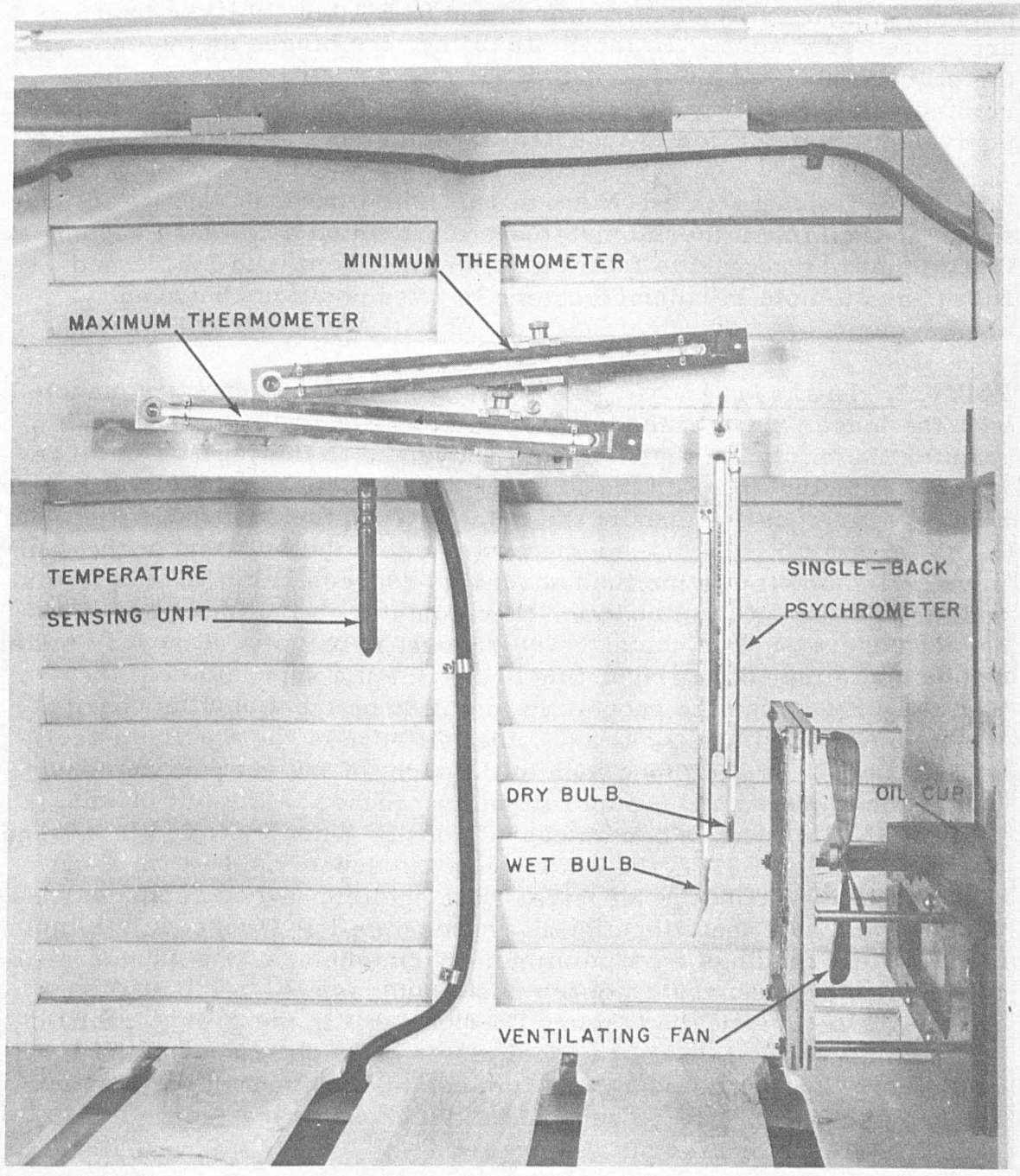

Fig. A5-1. Fan-ventilated, single-back psychrometer mounted in medium shelter with maximum and minimum thermometers and the temperature-sensing unit of the telethermoscope.

A5021.2. Oil the bearings of psychrometer fans (H030) at least once a month with one or two drops of light oil, such as anemometer oil if the bearings are only slightly worn, and SAE 10 or 20 if the bearings are more badly worn. To facilitate oiling, the hinges on the caps of the oil cups should face the rear of the shelter. The cups can be rotated with a pair of pliers if a No. 1 drill (.228 inch diameter) or equivalent diameter rod is inserted in each cup to prevent crushing it.

A5030. Maximum and Minimum Thermometers.--A maximum and minimum thermometer are mounted on a common support (P020) that is designed to facilitate resetting them (see ¶ 5162 and 5171), and to hold the thermometers in fixed positions between observations.

A5030.1. Installation.--The base plate of the support is mounted with the longer sides of the support vertical, and with the supporting stud for the minimum thermometer above and to the right of the maximum thermometer stud (see Fig. A5-4). The thermometer backs are held by clamps on the ends of the studs. When the support is installed in this manner and the thermometers are set, the bulb end of the minimum thermometer is inclined about five degrees below the horizontal, and the bulb end of the maximum thermometer is inclined about five degrees above the horizontal. The support is mounted at approximately eye-level, either on the mounting board or on a separate post (see Fig. A5-18). When the support is installed on the mounting board of the medium-sized shelter (P300), the left edge of the thermometer support should be about one inch to the right of the vertical centerline of the shelter, and not more than two inches to the left of this position if it is installed on a separate post. When installed in a large shelter (P310 or P311), the left edge of the support should be about nineteen inches from the left side of the shelter. When comparative readings indicate that vibration is responsible for erroneous minimum temperature readings from minimum thermometers, the support will be mounted on a separate wooden post, such as a 4" x 4", or other corrective action will be taken. The post, set in the ground, should extend through the floor of the shelter to, or slightly above, the level of the top of the cross board and immediately in front of the location specified for mounting the support on the cross board (see ¶ A5510). It should not touch any part of the shelter.

A5030.2. Maintenance.--Once a month, place a drop of SAE 10 or anemometer oil in the oil hole of the longer stud.

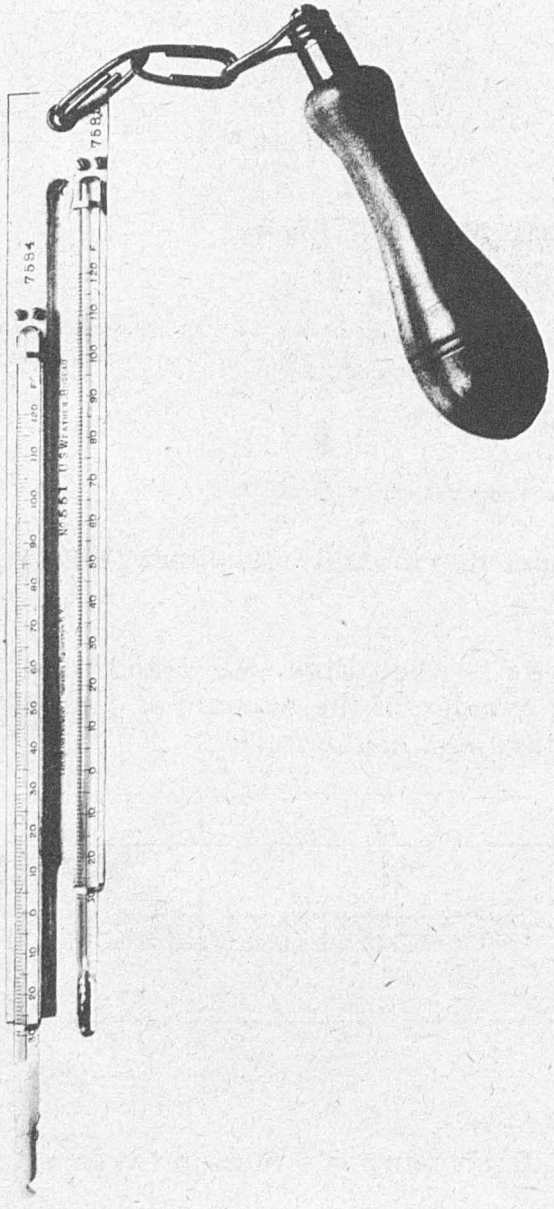

Fig. A5-2.
Sling psychrometer (H000)

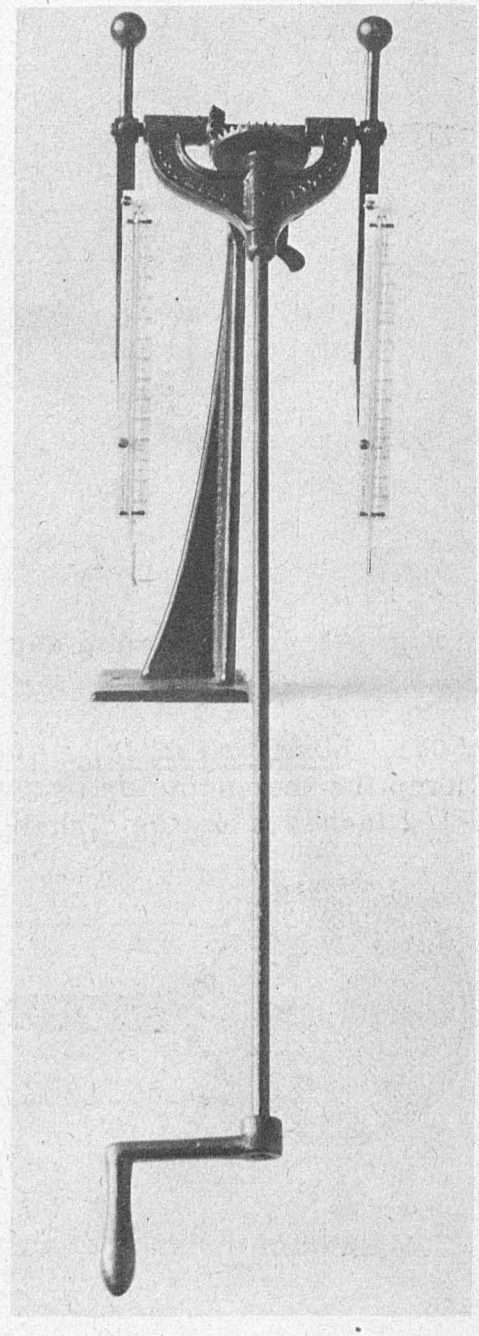

Fig. A5-3.
Whirling psychrometer (H010)

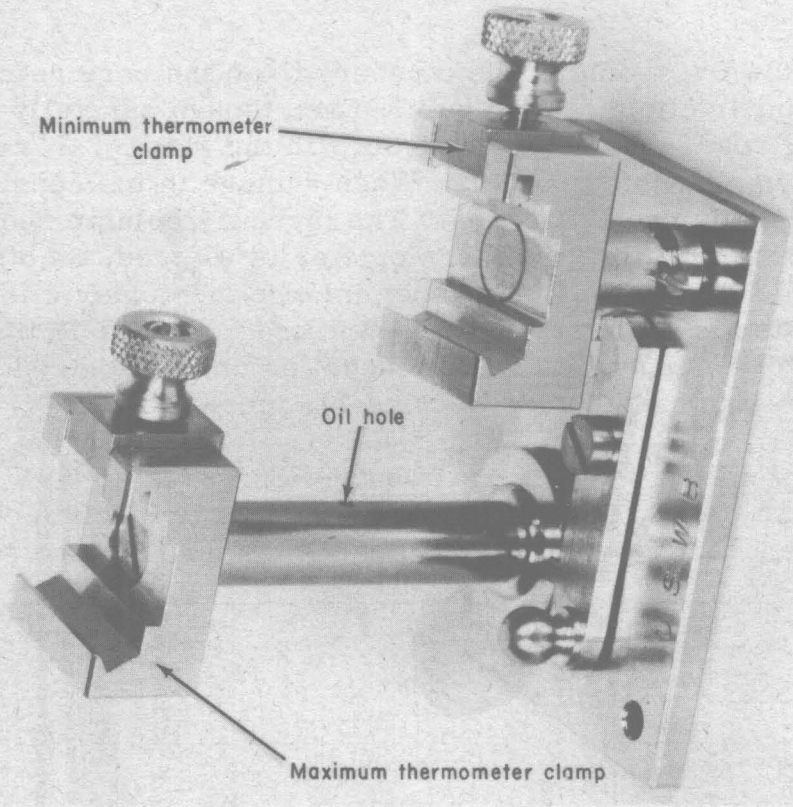

Fig. A5-4. Maximum and minimum thermometer support (P020)

A5031. Maximum Thermometer.--(See Figs. A5-1 and A5-5.) Clamp the thermometer in the lower carrier of the support at a point 3-1/2 inches from the high-temperature end of the back.

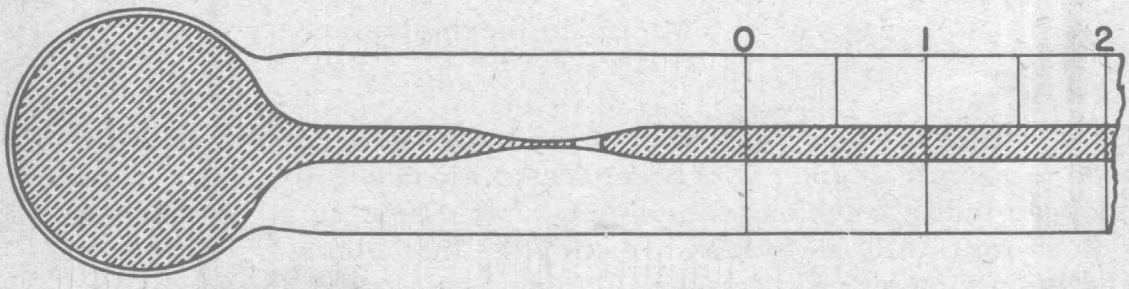

Fig. A5-5.
Maximum thermometer, bulb end, showing restriction in bore.

A5031.1. Maintenance.--A defective maximum thermometer is termed a "retreater" when the constriction is so large that, as the

temperature lowers, some of the mercury from the bore retreats through the constriction into the bulb. Even though carefully lowered prior to being read, some of the mercury in the stem of a "retreater" will pass through the constriction. When damage to the constriction occurs it is usually upon resetting. The mercury column should rest on this constriction before the thermometer is whirled, as otherwise the violent impact of the mercury may enlarge the constriction. When the thermometer is examined in reflected light, damage to the constriction will often appear as an iridescent patch. A "retreater" should be replaced immediately with a serviceable thermometer.

A5032. Minimum Thermometer.--(See Fig. A5-6.) Clamp the back near its midpoint (slightly less than half its length from the high-temperature end) into the upper carrier of the thermometer support.

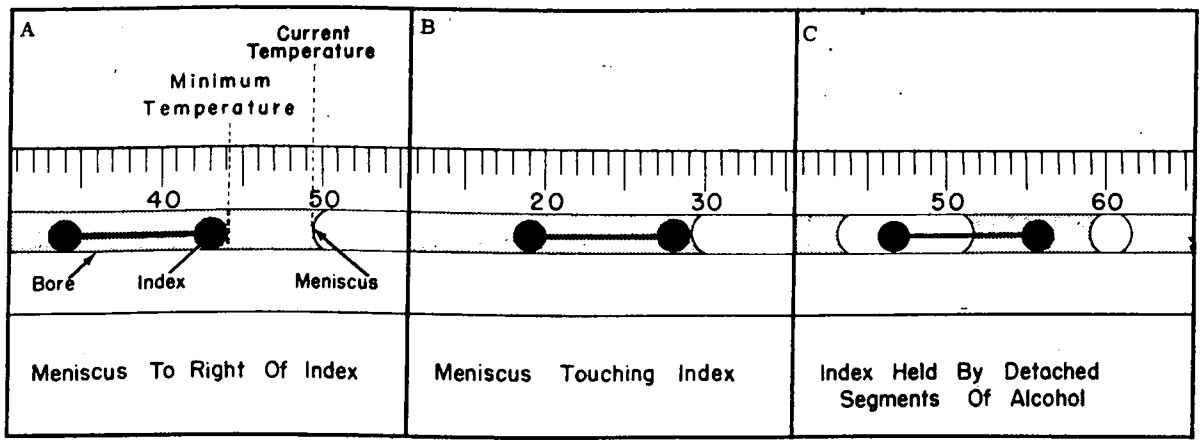

Fig. A5-6. Minimum thermometer.

A5032.1. Maintenance.--One of the methods described below will be used to reunite segments of a separated alcohol column, or to return a dislodged index to the united column. Avoid continuing any process so long or so forcefully as to risk breaking the thermometer. The same corrective action should be taken if condensed alcohol has formed a bubble in the upper end of the bore. If repeated attempts fail to unite the segments, replace the thermometer.

(1) Either attach a sling psychrometer handle to the back of the thermometer or tie a strong cord to it, and whirl the thermometer rapidly.

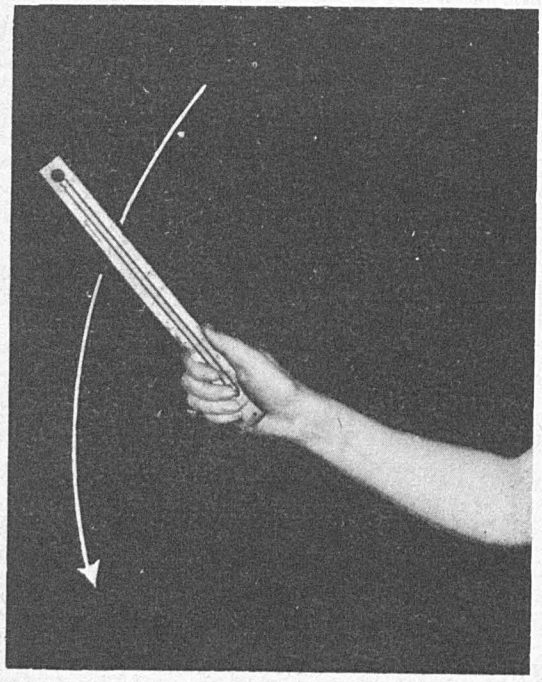

Fig. A5-7.

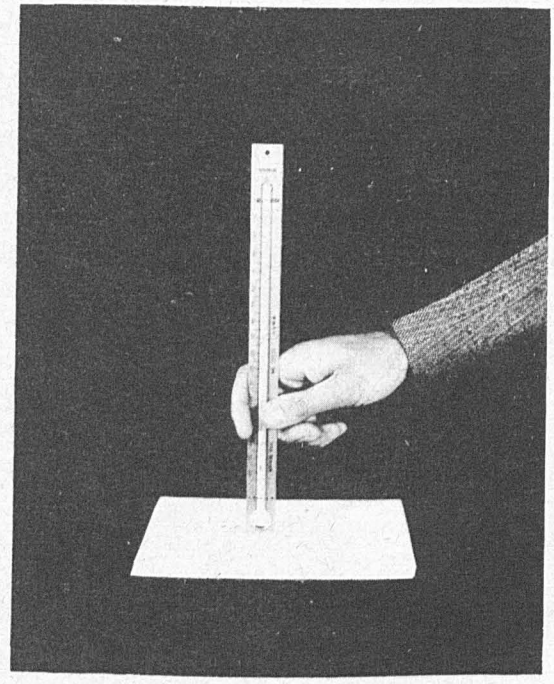

Fig. A5-8.

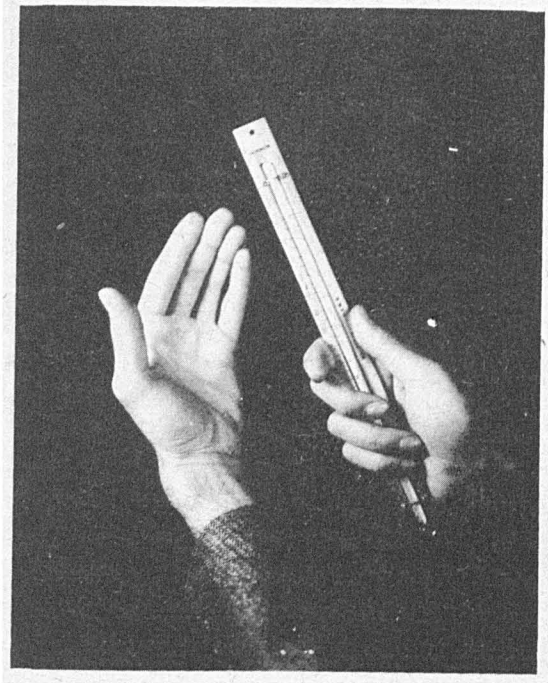

Fig. A5-9.

Fig. A5-7. Reuniting alcohol column of minimum thermometer by centrifugal force.

Fig. A5-8. Reuniting alcohol column of minimum thermometer by striking thermometer against firm object.

Fig. A5-9. Reuniting alcohol column of minimum thermometer by striking thermometer against palm of hand.

(2) Hold the thermometer with the bulb end extended away from the body and with the metal back of the thermometer held vertically. Quickly swing the thermometer downward through an arc of three or four feet (see Fig. A5-7). Stop the motion suddenly but without striking the thermometer against other objects.

(3) Hold the thermometer lightly between the thum and fingers with the bulb end down. Tap the lower end of the metal back against the top of a table or other firm object covered with sponge rubber, or with several thicknesses of cloth or paper to prevent the impact from damaging the thermometer (see Fig. A5-8). Gradually increase the striking force until the defect is corrected.

(4) Grasp the thermometer securely with the bulb end extended downward, and sharply strike the edge of the metal back, at a point adjacent to the broken column, against the palm of the hand (see Fig. A5-9).

A5032.11. After correcting a defect in a thermometer by one of the foregoing methods, allow the thermometer to remain at rest with the bulb end down for at least an hour before resetting it. Store spare minimum thermometers with the bulb end down.

A5100. TELETHERMOSCOPE

A5110. General.--(See Fig. A5-10.) The telethermoscope is an electrical resistance thermometer for remote indication of air temperature. It consists essentially of a temperature-sensing element (C400) - a coil of nickel wire sealed in a brass tube - and an indicating device (C530). The indicating apparatus is a modified Wheatstone bridge having a galvanometer and a variable resistance attached to a dial with a scale graduated in degrees Fahrenheit. The temperature-sensing element, the resistance of which varies with temperature, completes the circuit. Temperature is read from the scale after the galvanometer has been adjusted to indicate a balanced circuit. The temperature scale, in one-degree intervals, extends from -40° or -50° to 120°F.

A5120. Installation.--Locate the temperature-sensing unit as close to the center of the shelter as practicable (see Fig. A5-1). Suspend it vertically from the back of the mounting board by clamping the cable to the board about one or two inches from the end of the tube. The

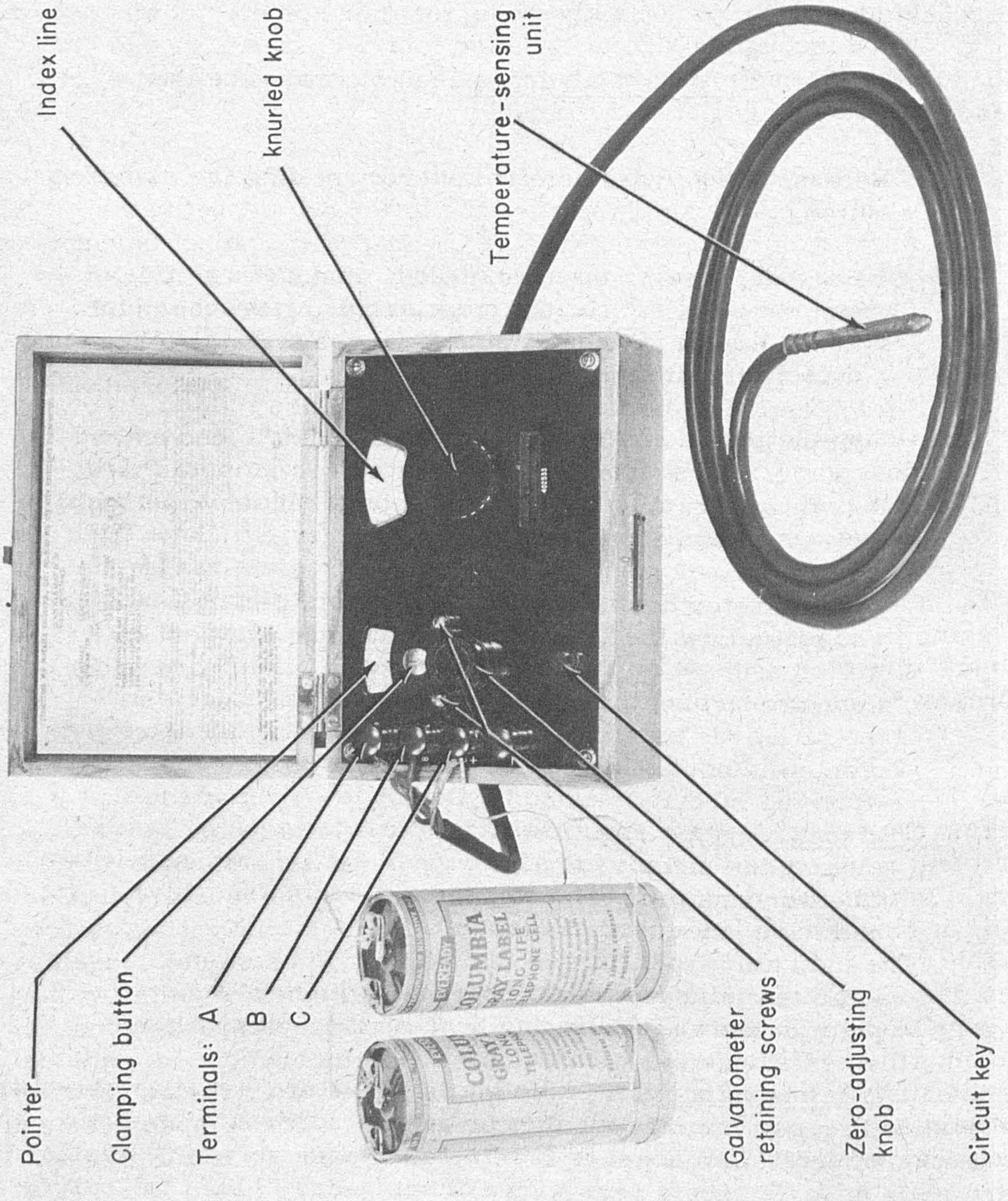

Fig. A5-10. Telethermoscope.

tube should not touch any surrounding objects. The indicator is either panel-mounted in an instrument cabinet, or mounted in a case designed for desk use.

A5130. Observational Routine.--To obtain a temperature reading:

(1) Release the galvanometer pointer by sliding the clamping button.

(2) Before depressing the circuit key, check the setting of the pointer to see that the open circuit reference point is at or near a zero reading. If it is not, loosen the screw on the side of the adjusting knob and turn the knob until the pointer stands at zero, then tighten the screw.

(3) Set the temperature scale to the approximate outside air temperature before closing the circuit. Close the circuit only momentarily until the deflection of the galvanometer pointer has been reduced to less than $\pm$10 by turning the temperature scale adjusting knob.

(4) Continue to turn the temperature adjusting knob until the circuit is balanced; i.e., until the galvanometer pointer is not deflected from its open-circuit position when the circuit is closed. Do not leave the circuit closed longer than necessary to take a reading, since closing the circuit for a prolonged period may result in erroneous temperature readings from excessive heating of the thermal element.

(5) Read the temperature to degrees and tenths at the point on the scale directly beneath the index line.

A5140. Maintenance.--Clean the temperature-sensing tube once a week with a soft cloth or, if dirt or grease adheres to the tube, with a cloth dampened in alcohol or a petroleum-base solvent. Replace the dry cells at least once a year with Columbia Grey Label (size 6) or the equivalent quality of heavy-duty dry cell. Order replacement cells from the Weather Bureau regional office not later than the expiration date on the cells in use. With proper care, the telethermoscope will

seldom get out of order. Table A5-1 will be used as a guide in locating and correcting malfunctioning of the equipment. When a defective cable is suspected, examine the exposed portions of the leads. Breaks should be carefully cleaned, twisted together, soldered, and taped. Identify the cable leads before disconnecting them. To connect the leads correctly when they are erroneously marked or are unidentified, transpose them successively until the circuit can be balanced.

Table A5-1
Trouble-Correction Guide for the Telethermoscope (C530)

Symptom	Procedure
(1) When the circuit key is depressed, the galvanometer pointer is deflected violently regardless of the temperature scale adjustment.	Test for an open circuit in the leads to the "A" and "B" binding posts.
(2) No deflection of galvanometer pointer (circuit closed) regardless of setting of temperature scale.	Test for a dead or disconnected power supply.
(3) Erratic movement of galvanometer pointer; impossible to make an exact balance.	Test leads for defective insulation or a poor connection at the binding posts.
(4) Sudden deflection of the pointer when the circuit is opened.	Test for defective insulation.
(5) Sluggish action of galvanometer pointer, or magnitude of deflection slight; impossible to make an exact balance.	Test the battery. If the battery is satisfactory, the galvanometer may be defective. As a further check on the galvanometer, disconnect the cable leads to indicator terminals A, B, and C, and replace them with the test coil (see Fig. A5-11). The circuit should then balance at a temperature setting of -20 degrees.

A5141. Use of Volt-Ohmmeter.--The continuity of the cable and the condition of the temperature-sensing coil may be tested with a volt-ohmmeter. Disconnect the leads from the indicator and measure the resistance between each pair of leads. The resistance between the ends of leads A and B, or A and C, should be between 80 and 110 ohms. If the resistance between the ends of leads B and C is not infinite, these leads may be assumed to be satisfactory. Infinite resistance between the ends of any pair of leads is indicative of an open circuit.

A5142. Defective Galvanometer.--When it it determined that the galvanometer is defective, order a replacement (see Foreword). Upon receipt, remove the defective galvanometer from the indicator by loosening the screws fastening it to the plate, and return it to the Weather Bureau regional office unless otherwise instructed. When other defects cannot be corrected locally inform the Weather Bureau regional office.

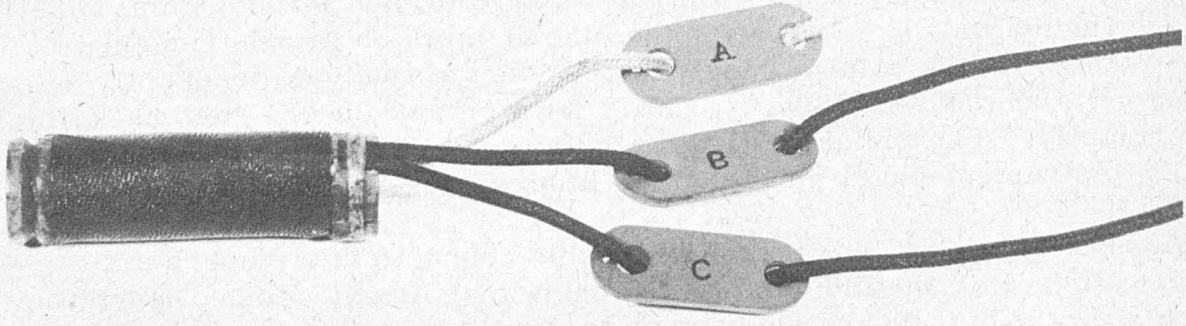

Fig. A5-11. Telethermoscope test coil.

A5200. TELETHERMOMETER

A5210. General.--The telethermometer is an electrical-resistance thermometer similar in principle of operation to the telethermoscope. It consists of a temperature-sensing element (C400) and a ratio-bridge type of indicator (C531). This indicator is self-balancing, and temperatures are read directly from it.

A5220. Temperature-Sensing Unit.--The temperature-sensing units used for both the telethermometer and the telethermoscope are interchangeable, although they differ in appearance. The unit, which is provided with a mounting bracket for attachment to a 3/4 to 7/8-inch board, will be installed as near the center of the shelter as practicable. When installation is made in a medium-sized shelter (P300), attach the unit, with the cable end uppermost, to the cross board at a point one or two inches to the left of the vertical center line of the shelter, or three to four inches from the center post if one is used (see Fig. A5-18). When installation is made in a large shelter (P310 or P311), install the unit either vertically with the cable end up, by attaching the bracket to the cross board, or horizontally with the tube pointed toward the back, by attaching the bracket to the vertical support for the cross board about twelve to fifteen inches above the bottom of the shelter.

A5230. Indicator.-- (See Fig. A5-12.) The indicator (C531) is powered from a 117-volt, a-c power supply. The scale of the meter is graduated in one-degree increments from -50°F. to 120°F. Voltage fluctuations between 95 and 120 volts should not reduce the overall accuracy of the indications. The power-supply voltage should be measured across the power input to the instrument under varying load conditions (changes in weather, night to day, etc.) until the normal voltage fluctuations are known for the circuit to which the instrument is attached. If the voltage supply is observed to fluctuate frequently below 95 volts and above 120 volts, notify the Weather Bureau regional office promptly. The indicator is mounted either in a standard 19-inch, size E, instrument-panel mounting, or in an enclosed metal case for desk use.

A5240. Wiring.--A three-wire cable connects the temperature-sensing unit to the indicator. The cable may be any desired length (up to about 5000 feet) and size, provided that the resistance of any lead does not exceed five ohms. The resistance of the three leads must be equal. Solder and tape all joints carefully. Wrap the joints first with rubber tape and then with friction tape. Be careful not to attach the 117-volt, a-c power supply to terminals A, B, or C. Attach the red or green lead of the temperature- sensing unit to terminal A. The black and the white leads are interchangeable between terminals B and C.

A5250. Observational Routine.--Tap the indicator before each observation if periodic checks indicate that the pointer is subject to sticking. Note: The pointer on the indicator does not return to zero when the power is off.

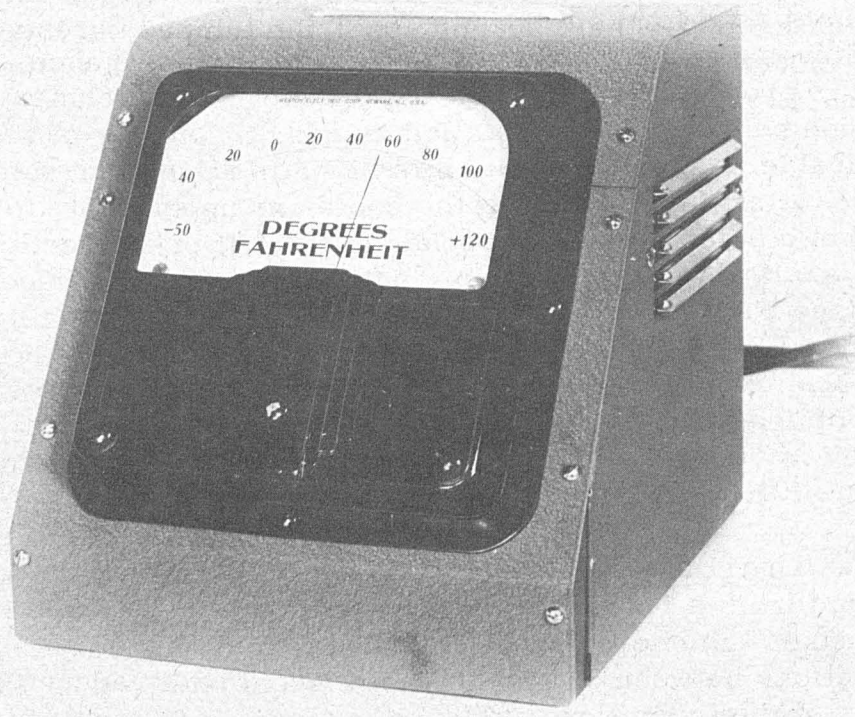

Fig. A5-12. Telethermometer.

A5260. Maintenance.--The temperature-sensing tube of the telethermometer should be cleaned weekly with a soft cloth, dampened in alcohol if necessary, to prevent an accumulation of dirt. If the indicator is known to be defective, order a replacement (see Foreword). If the source of the trouble is in the temperature tube or cable, or the source is unknown, notify the Weather Bureau regional office of the nature of the trouble.

A5500. INSTRUMENT SHELTERS AND EXPOSURES

A5510. Instrument Shelters.--The instrument shelter may be either the medium-sized type (P300 - see Fig. A5-17), or the large (P310 or P311) type. Both types have louvered sides with a double top to protect the temperature-sensing units from precipitation, condensation, and radiation, while at the same time exposing them freely to the flow of air surrounding the shelter. In general, and unless otherwise specified in this chapter, temperature-sensing units will be mounted as close to the center of the shelter as practicable, and in a

position where the operation of one instrument will not interfere with the operation of another. In any case, the temperature-sensing units will be mounted more than four inches from the sides, top, and bottom of the shelter.

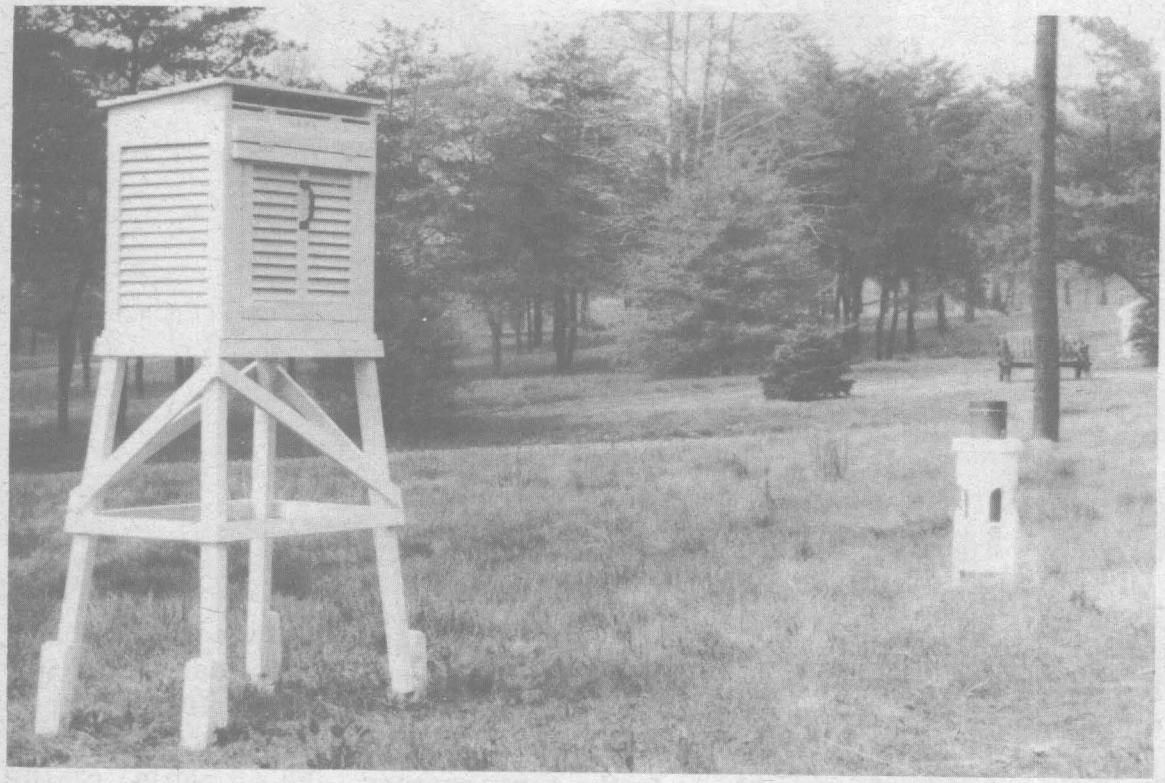

Fig. A5-17. Medium (cotton region) shelter with 8-inch gage.

A5520. Exposures.--(See Fig. A5-17.) Wherever possible, shelters will be installed over earth or sod at least 100 feet from any concrete or other hard-surfaced area, and not closer to any other object than four times the height of the object above the floor of the instrument shelter. Avoid roof installations if practicable. However, if it is necessary to locate the shelter on a roof, it should not be closer than 30 feet to any large, vertical reflecting surface (walls, etc.), exhaust fans, or cooling towers. The floor of the shelter should be approximately four feet above the ground or roof, except that, if the shelter is mounted above a roof, the height may be greater than four

feet in order to minimize radiation effects from the roof. To afford the interior of the shelter the greatest protection from direct solar radiation while the door is open, orient the shelter with the door facing north (in the Northern Hemisphere). Keep the shelter door closed when the instruments are not being read.

A5521. Illumination.--Use electric lamps rated at a total of not more than 30 watts in the shelter. Keep the lamps as far as practicable (at least ten inches) from any temperature-sensing element. Do not leave the lamps turned on any longer than is necessary to read the instruments.

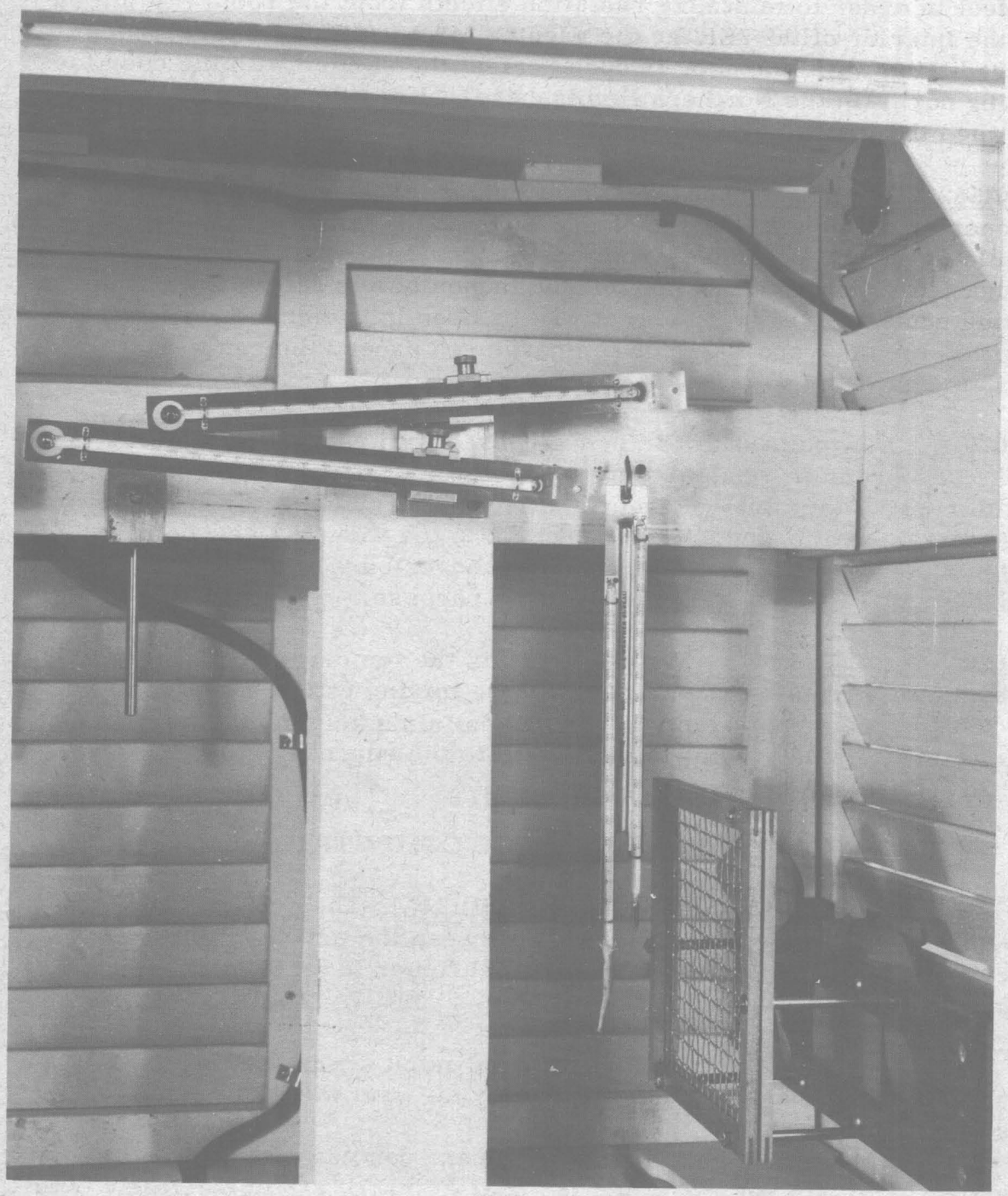

Fig. A5-18. Medium shelter - inside view. Illustrated are maximum and minimum thermometers mounted on separate (vertical) post, telethermometer sensing element, single-back psychrometer and ventilation fan.

CHAPTER 6. HUMIDITY MEASUREMENT

6000. DEFINITIONS

6010. General.--These instructions are concerned with the expression of humidity in terms of dew point. These data are calculated with psychrometric tables or calculators based on atmospheric pressures of 23, 25, 27, 28, 29, and 30 inches of mercury. If a psychrometric calculator is available, it will be used in preference to the tables unless the dry- and wet-bulb temperatures exceed the range of the calculator.

6010.1. Dew-point data can be expressed with respect to ice or water. The psychrometric calculator expresses dew point at all temperatures with respect to water. Psychrometric tables numbered WB 235 express values of dew point with respect to ice when the dew point is less than 32°. These values must be converted to their water equivalent, and Table 9 is 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† and barometric pressure remain constant, in order to attain saturation†† with respect to water. The dew point is expressed to the nearest whole degree Fahrenheit.

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 psychrometric tables and calculators to make dew-point computations.

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† 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.

†† 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.

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 temperature of the dew point will be regarded as the same as that of the wet bulb. If the wet bulb is covered with ice and a depression cannot be obtained, the dew point will be converted to its water equivalent (see ¶ 6131.1), unless liquid fog is present at the station. In this latter instance, the dew point will be regarded as the same as the dry-bulb temperature.

6120. Psychrometric Calculator.--Use the calculator based on the barometric pressure nearest the normal station pressure (see ¶ 6010). Instructions for use of the calculator are printed on it. Note that different scales of the calculator will be used according as the wet bulb is covered with ice or water at the time of the observation (see ¶ 5151.3).

A6121. Psychrometric Calculator.--(See Fig. A6-1) When the wet-bulb temperature is 32° or more, use the high temperature range (Form 1183) of the calculator; when the wet-bulb temperature is less than 32°, use the low temperature range (Form 1184). In the latter case, disregard instruction 1(a) on the scale, since the wick will be brought to a frozen state as indicated in ¶ 5151.3. The dew point is always read from the T_wDP scale. On the high temperature range (Form 1183), note that the T_wDP scale from -10° to 32° is on the periphery of the calculator.

A6122. Psychrometric Calculator - Maintenance.--When not in use, the calculator must be kept in an envelope or drawer, or otherwise protected. Keep it out of direct sunlight and away from radiators or other objects with relatively high temperatures.

A6122.1. Clean the calculator monthly with a damp blotter. If a more thorough cleaning is necessary, disassemble it and wash it with soap and water, then rinse and dry it. Do not use acetone, benzene, lacquer thinners or other solvents. Care should be taken to reassemble the calculator with spacing washers between each moving part, and with the rotor disks on the proper faces of the base. Do not lubricate the pivot assembly, since oil may cause discoloration of the vinylite.

A6122.2. Four sets of reference marks are printed near the extremities of two mutually perpendicular diameters of the calculator. On the base, each reference mark consists of three short parallel lines, while on the disk, each consists of a single line. To check the centering of the disks, align a reference mark on one of the disks with the center line of a reference mark on the base. The other reference marks on the disk should then lie within the limits of the outer lines of corresponding reference marks on the base. Repeat this test for all four positions of the disk's reference marks with relation to the marks on the base. If each position does not satisfy the conditions of the test, do not use the calculator for official psychrometric computations. This check is required (a) upon receipt of the calculator, (b) after reassembling the device, and (c) periodically to prevent misalignment due to pivot wear.

6130. Psychrometric Tables.--Use the tables based on the barometric pressure nearest the normal station pressure (see ¶ 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 data are given as tabular values on correspondingly captioned pages.

6131. The dew point is 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 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.

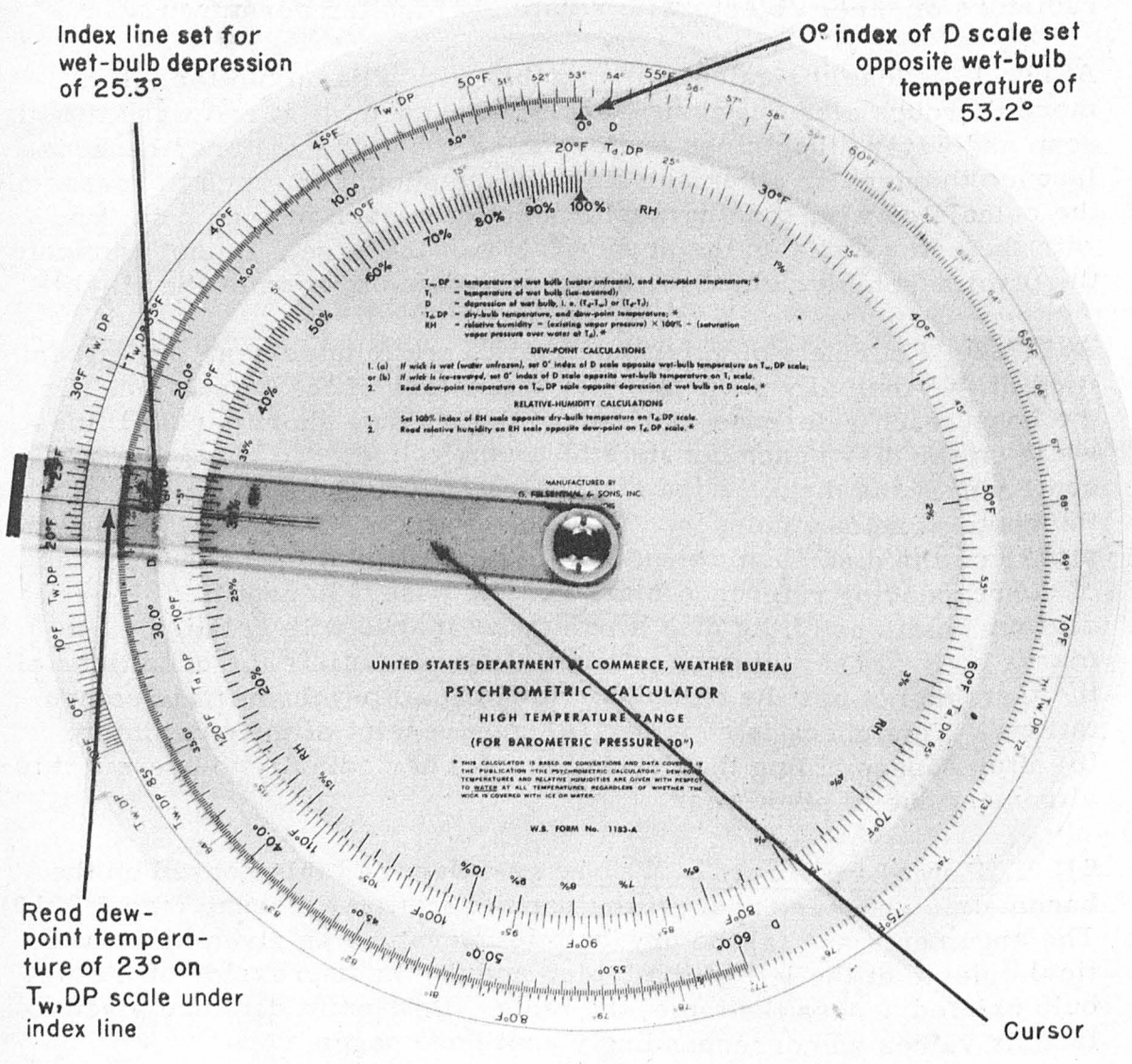


Fig. A6-1. Psychrometric calculator.

(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 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 ¶ 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 dew-point temperature, to the nearest tenth of a degree, 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.

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

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)	−16.2°	−18.3°		−18.0°
Dew point temperature (water) (See Table 9)	−21°	−24°	38°	−23°

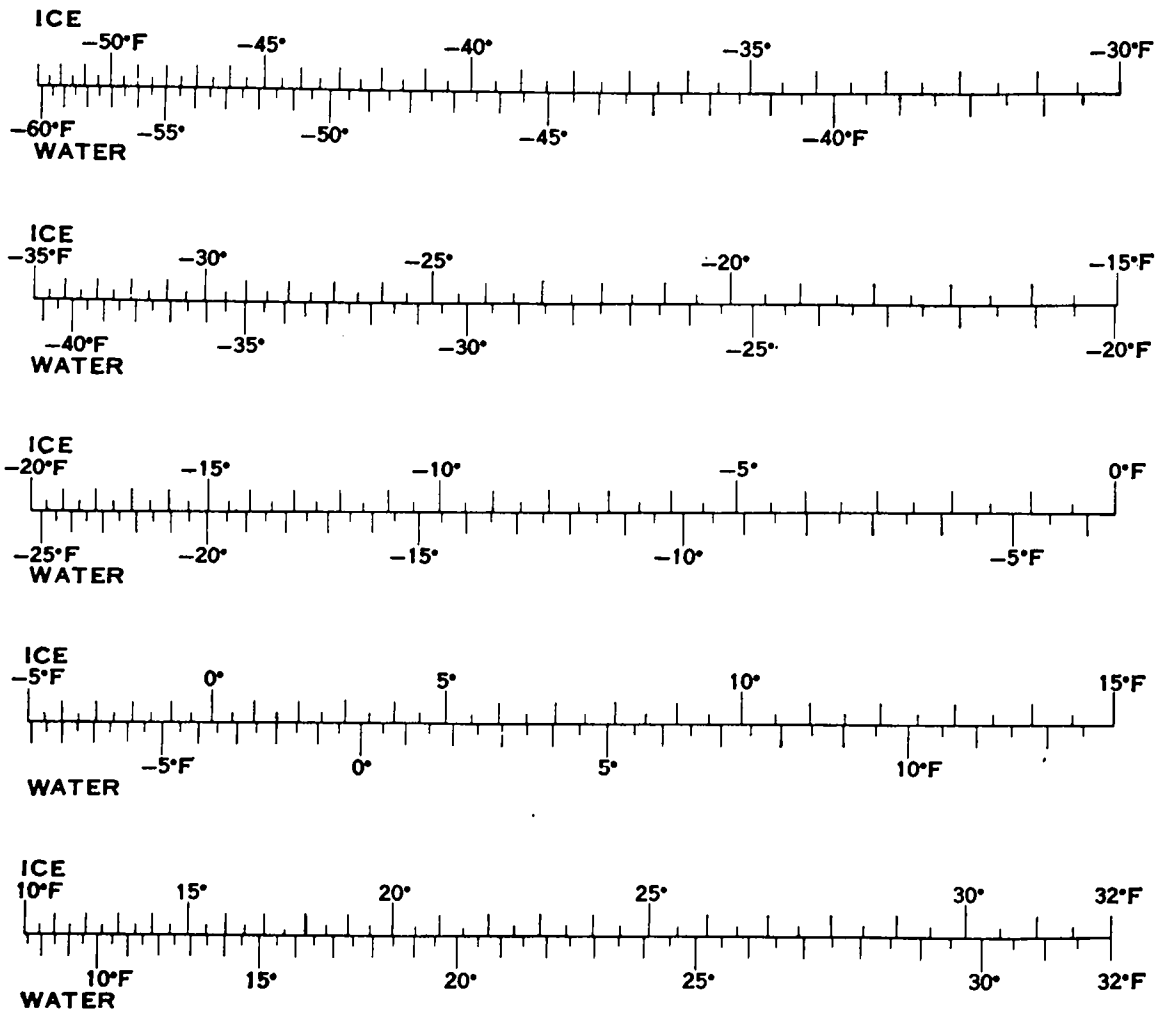
(Note that the dew point for temperatures below freezing in this example are with respect to ice and must be converted to their water equivalents.)

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

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.]

6400. ENTRIES ON WBAN-10

6410. Dew Point (Col. 8).--Enter the dew-point temperature to the nearest whole degree. Prefix a minus sign to dew-point temperatures below zero. For air temperatures below -35°F. see ¶ 5130 and 11010.

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 and microbarographs.

(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.

7011. At stations having two or more of the above types, observe the following priority in selecting the instrument to be used for hourly or 6-hourly pressure observations:

Hourly observations	6-hourly observations
(1) Precision aneroid barometer	(1) Precision aneroid barometer
(2) Altimeter-setting indicator	(2) Altimeter-setting indicator
(3) Microbarograph	(3) Mercurial barometer
(4) Mercurial barometer	

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 1/4 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 Fig. 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).

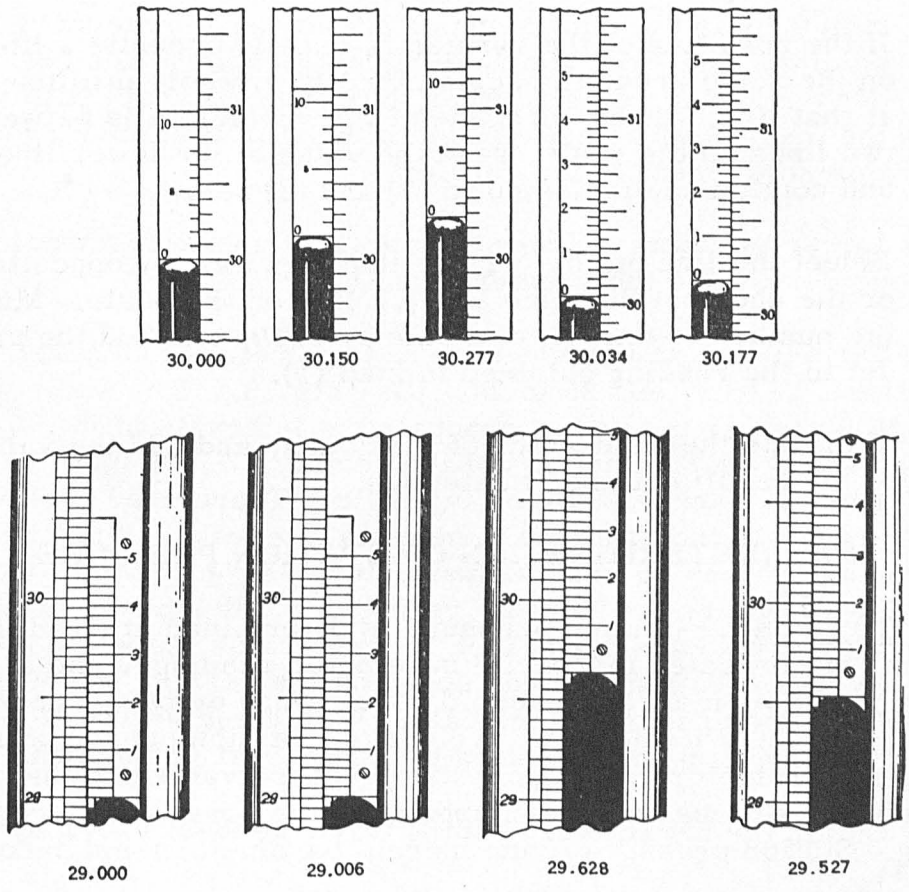


Fig. 3. Barometer verniers.

7120. Fixed-Cistern Barometers.--The Bowen fixed-cistern barometer is calibrated to give pressure readings in millibars; the attached thermometer is in the Celsius (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 ten spaces on the vernier are equal in length to 19 millibar spaces on the scale. That is, the length of one 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 ¶ 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 Celsius (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 2-1/2 to 1 open-scale microbarograph is magnified, or opened, so that a pressure difference of one inch of mercury is represented on the chart by a linear distance of 2-1/2 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 one inch of mercury is represented on the chart by a linear distance of one 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 ¶ 7242.

7242. A barograph will not be used for original determination of pressure unless a correction is established every six hours by comparison with the station pressure determined from the mercurial or precision aneroid barometer or altimeter setting indicator. Determine to the nearest 0.005 inch or 0.1 millibar the correction necessary to make the barograph reading agree with the station pressure computed from the barometer reading. If this correction exceeds 0.05 inch, the barograph should be reset at the time the barometer reading is made (see ¶ 7245.12). 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 by entry on

WBAN-10 (see ¶ 7787) and, if necessary, on a separate indicator 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. (See ¶ A7211.) 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. (See Fig. 4.)

7245. Charts.--The elevation range of the barograph is indicated on the nameplate. Select the chart to conform with the elevation of the barometer in accordance with Table 10c.

Table 10c. Barograph Charts (2-1/2 to 1 scale)

Elevation of Station Barometer (ft.)	Midway Isobar Pressure (inches)	Elevation of Station Barometer (ft.)	Midway Isobar Pressure (inches)	Elevation of Station Barometer (ft.)	Midway Isobar Pressure (inches)
0-30	30.25†	2361-2860	27.25†	6111-6710	23.75††
0-30	29.75††	2861-3370	26.75††	6711-7310	23.25†
31-490	29.75††	3371-3890	26.25†	7311-7920	22.75††
491-950	29.25†	3891-4420	25.75††	7921-8540	22.25†
951-1415	28.75††	4421-4970	25.25†	8541-9165	21.75††
1416-1880	28.25†	4971-5530	24.75††	9166-9790	21.25†
1881-2360	27.75††	5531-6110	24.25†	9791-10420	20.75††

† Use WB Form 1068C
††Use WB Form 1068D

7245.1. Changing Charts.--Charts will be changed on 4-day barographs on the 1st, 5th, 9th, 13th, 17th, 21st, 25th, and 29th of the month, and on weekly barographs on the 1st, 8th, 15th, 22nd, and 29th. The charts should be changed at the standard synoptic hour (0030 GCT, 0630 GCT, etc.) nearest to noon, LST. If for any reason the chart is not changed at the usual time, it will not be changed before the following 3-hourly pressure-tendency observation at stations where these data are observed, since an unbroken record is desirable for this observation; at stations not observing pressure tendency, the charts will be changed as soon as practicable.

7245.11. Before placing a chart on the barograph, use a typewriter, rubber stamp, or pen and ink to enter the following data:

(1) In the upper left-hand corner, or in spaces provided, enter the name of the station and the type (i.e., CAA), meridian of local standard time, and, on the first of the month, the time † that the pen is touched.

(2) Across the top of the chart on each noon line or in the spaces provided, enter the date of the day's record.

(3) Immediately preceding the printed figures along the first and last time arcs, enter the appropriate figures to indicate the range and calibration of the chart (e.g., 28 preceding the printed "00" on the 28.00-inch line of charts graduated in inches of mercury).

(4) Near the point where the trace will begin, enter "ON", the time †, and the current station pressure ††.

7245.12. To replace the chart, remove the pen from the chart by means of the lever mechanism, and lift the cylinder vertically until it is free of the spindle. Remove the cylinder and loosen the clip holding the chart to the cylinder, and remove the chart. Avoid storing or handling charts in a manner that might smear the trace before it is dry. Fit the replacement chart smoothly and tightly on the cylinder, with the bottom edge of the chart uniformly in contact with the flange at the bottom of the cylinder, and replace the clip. Inaccurately-cut charts should be trimmed along a line parallel to and 1/4 inch below the lower,

† Enter the local standard time to minutes.

†† Enter the current station pressure (before rounding) as obtained from the mercurial or precision-aneroid barometer, or the altimeter setting indicator.

horizontal boundary ordinate. Wind the clock and lower the cylinder gently over the center spindle until the gears have fully meshed, holding the cylinder by the top and bottom to avoid disturbing the position of the chart. Fill the pen with ink and return it almost to the surface of the chart. Adjust the pen, if necessary, for pressure and time (see ¶ 7245.2. and 7245.3). Return the pen to the surface of the chart and check the inking action of the pen.

7245.13. After adjustment or removal of a completed barogram:

(1) Enter the time † of each adjustment, and an arrow to indicate the point of adjustment.

(2) Near the end of the trace, enter the time of removal † and the current station pressure ††.

(4) When adjustment for pressure is made, enter the current station pressure †† and corrections applying to both the preceding and following record, e.g., -055/0, above the break in the trace (see Fig. 4).

7245.14. Forward completed barograms for the month (including the record up to the time of changing the chart on the first of the following month) to the station to which WBAN-10 is forwarded, not later than the second working day of the following month.

7245.2. Adjustment for Pressure.--To adjust the position of the pen, turn the knurled, pressure-adjusting knob at the top of the cylindrical pressure-element housing until the pen is at the correct station pressure. Tap the case or chassis lightly to overcome any sticking in the linkage mechanism before checking the adjustment of the pen. (See ¶ 7242 and 7245.12 for conditions under which adjustment for pressure is required.)

7245.3. Adjustment for Time.--To adjust the cylinder for time, turn it counterclockwise until all slack motion in the drive mechanism is removed. If the pen position does not bear the proper relationship to the time-ordinate lines after the slack has been removed, continue to turn the cylinder counterclockwise with sufficient force to override the friction drive until the timing error is eliminated. Adjust the instrument promptly if, at any time, the record trace is in error by more than one-quarter of the smallest time interval printed on the chart.

† Enter the local standard time to minutes.

†† Enter the current station pressure (before rounding) as obtained from the mercurial or precision-aneroid barometer, or the altimeter setting indicator.

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 the correction of an aneroid barometer becomes erratic, for example, +0.01 inch (+0.3 mb.) at one mercurial barometer comparison, +0.04 inch at the next, and a -0.02 inch at a third (see ¶ A7221.4 & .5), report it to the Weather Bureau regional office. 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 ¶ 7252.

7252. Corrections to be applied to precision-type aneroid barometers will be determined in accordance with instructions issued to the station 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.

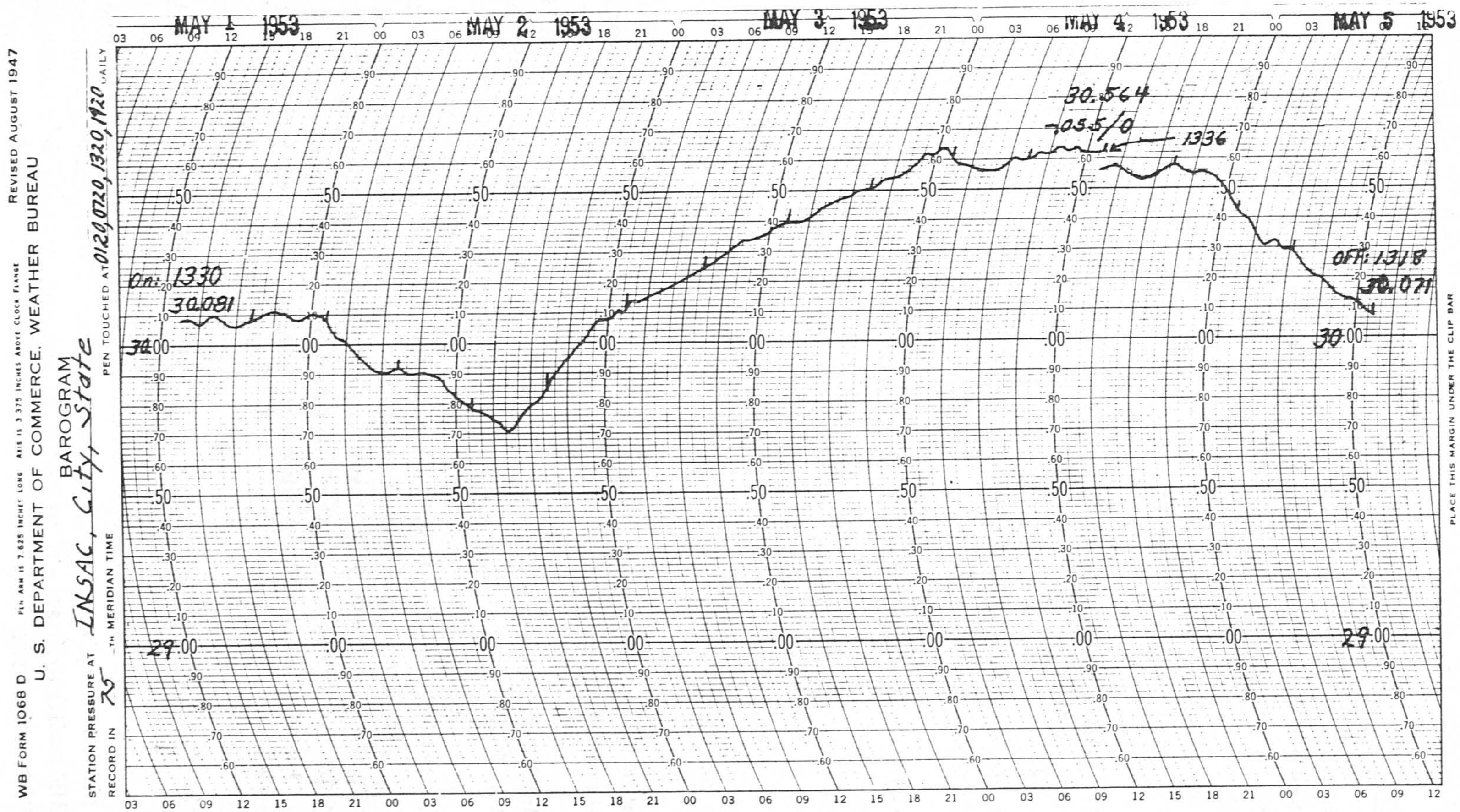


Fig. 4. Barogram
(Note: Corrections are not entered at CAA stations)

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 0.005 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 interpolating to the nearest 0.005 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 generally 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.

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 (Tables 10d - k), or by means of arithmetical interpolation.

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 table necessary for evaluation of the example is reproduced following ¶ 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 ¶ 7322. In the example, the difference between successive temperature arguments is 2°; therefore, proportional parts Table 10d 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 0.007.

(11) Using proportional parts Table 10g, 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), and interpolated value of pressure using Table 10d = 0.007.
(c) From (11), an interpolated value of pressure using Table 10g = 0.084.
(d) From (12) a sum that equals the sea-level pressure = 30.801.
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 (Tables 10d - k). In all operations, values as they appear in the tables will be carried forward to the final computation before disposing of the final digit.

PORTION OF A SEA-LEVEL REDUCTION TABLE

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

Tables of Proportional Parts for Reduction of Pressure to Sea Level

Table 10d. Table of proportional parts for use with sea-level reduction tables having increments of 2° in temperature and 0.10 inch in pressure.

Temperature Increments °F	Vertical Tabular Differences (inch)			
	.01	.02	.03	.04
0.0	.000	.000	.000	.000
0.1	.001	.001	.002	.002
0.2	.001	.002	.003	.004
0.3	.002	.003	.005	.006
0.4	.002	.004	.006	.008
0.5	.003	.005	.008	.010
0.6	.003	.006	.009	.012
0.7	.004	.007	.011	.014
0.8	.004	.008	.012	.016
0.9	.005	.009	.014	.018
1.0	.005	.010	.015	.020
1.1	.006	.011	.017	.022
1.2	.006	.012	.018	.024
1.3	.007	.013	.020	.026
1.4	.007	.014	.021	.028
1.5	.008	.015	.023	.030
1.6	.008	.016	.024	.032
1.7	.009	.017	.026	.034
1.8	.009	.018	.027	.036
1.9	.010	.019	.029	.038
2.0	.010	.020	.030	.040

Table 10e. Table of proportional parts for use with sea-level reduction tables having increments of 5° in temperature and 0.10 inch in pressure.

Temperature Increments °F	Vertical Tabular Differences (inch)			
	.01	.02	.03	.04
0.0	.000	.000	.000	.000
0.1	.000	.000	.001	.001
0.2	.000	.001	.001	.002
0.3	.001	.001	.002	.002
0.4	.001	.002	.002	.003
0.5	.001	.002	.003	.004
0.6	.001	.002	.004	.005
0.7	.001	.003	.004	.006
0.8	.002	.003	.005	.006
0.9	.002	.004	.005	.007
1.0	.002	.004	.006	.008
2.0	.004	.008	.012	.016
3.0	.006	.012	.018	.024
4.0	.008	.016	.024	.032
5.0	.010	.020	.030	.040

Tables of Proportional Parts for Reduction of Pressure to Sea Level

Table 10f. Table of proportional parts for use with sea-level reduction tables having increments of 10° in temperature and 0.10 inch in pressure.

Temperature Increments °F	Vertical Tabular Differences (inch)			
	.01	.02	.03	.04
0.0	.000	.000	.000	.000
0.1	.000	.000	.000	.000
0.2	.000	.000	.001	.001
0.3	.000	.001	.001	.001
0.4	.000	.001	.001	.002
0.5	.001	.001	.002	.002
0.6	.001	.001	.002	.002
0.7	.001	.001	.002	.003
0.8	.001	.002	.002	.003
0.9	.001	.002	.003	.004
1.0	.001	.002	.003	.004
2.0	.002	.004	.006	.008
3.0	.003	.006	.009	.012
4.0	.004	.008	.012	.016
5.0	.005	.010	.015	.020
6.0	.006	.012	.018	.024
7.0	.007	.014	.021	.028
8.0	.008	.016	.024	.032
9.0	.009	.018	.027	.036
10.0	.010	.020	.030	.040

Table 10g. Table of proportional parts for use with all sea-level reduction tables in inches.

Pressure Increments (inch)	Horizontal Tabular Differences (inch)					
	.10	.11	.12	.13	.14	.15
0.00	.000	.000	.000	.000	.000	.000
0.01	.010	.011	.012	.013	.014	.015
0.02	.020	.022	.024	.026	.028	.030
0.03	.030	.033	.036	.039	.042	.045
0.04	.040	.044	.048	.052	.056	.060
0.05	.050	.055	.060	.065	.070	.075
0.06	.060	.066	.072	.078	.084	.090
0.07	.070	.077	.084	.091	.098	.105
0.08	.080	.088	.096	.104	.112	.120
0.09	.090	.099	.108	.117	.126	.135
0.10	.100	.110	.120	.130	.140	.150

Table 10h. Proportional parts for use with sea-level reduction tables, in millibars, having increments of 2° F. and 0.10 inch. Tabular values are tenths of millibars.

Temperature Increments (°F)	Vertical Tabular Differences														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.1	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
0.2	0	0	0	0	1	1	1	1	1	1	1	1	1	1	2
0.3	0	0	0	1	1	1	1	1	1	2	2	2	2	2	2
0.4	0	0	1	1	1	1	1	2	2	2	2	2	3	3	3
0.5	0	1	1	1	1	2	2	2	2	3	3	3	3	4	4
0.6	0	1	1	1	2	2	2	2	3	3	3	4	4	4	5
0.7	0	1	1	1	2	2	2	3	3	4	4	4	5	5	5
0.8	0	1	1	2	2	2	3	3	4	4	4	5	5	6	6
0.9	0	1	1	2	2	3	3	4	4	5	5	5	6	6	7
1.0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8
1.1	1	1	2	2	3	3	4	4	5	6	6	7	7	8	8
1.2	1	1	2	2	3	4	4	5	5	6	7	7	8	8	9
1.3	1	1	2	3	3	4	5	5	6	7	7	8	8	9	10
1.4	1	1	2	3	4	4	5	6	6	7	8	8	9	10	11
1.5	1	2	2	3	4	5	5	6	7	8	8	9	10	11	11
1.6	1	2	2	3	4	5	6	6	7	8	9	10	10	11	12
1.7	1	2	3	3	4	5	6	7	8	9	9	10	11	12	13
1.8	1	2	3	4	5	5	6	7	8	9	10	11	12	13	14
1.9	1	2	3	4	5	6	7	8	9	10	10	11	12	13	14
2.0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Table 10i. Proportional parts for use with sea-level reduction tables, in millibars, having increments of 5° F. and 0.10 inch. Tabular values are tenths of millibars.

Temperature Increments (°F)	Vertical Tabular Differences														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.2	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
0.3	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1
0.4	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1
0.5	0	0	0	0	1	1	1	1	1	1	1	1	1	1	2
0.6	0	0	0	0	1	1	1	1	1	1	1	1	2	2	2
0.7	0	0	0	1	1	1	1	1	1	1	2	2	2	2	2
0.8	0	0	0	1	1	1	1	1	1	2	2	2	2	2	2
0.9	0	0	1	1	1	1	1	1	2	2	2	2	2	3	3
1.0	0	0	1	1	1	1	1	2	2	2	2	2	3	3	3
2.0	0	1	1	2	2	2	3	3	4	4	4	5	5	6	6
3.0	1	1	2	2	3	4	4	5	5	6	7	7	8	8	9
4.0	1	2	2	3	4	5	6	6	7	8	9	10	10	11	12
5.0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Table 10j. Proportional parts for use with sea-level reduction tables, in millibars, having increments of 10° F. and 0.10 inch. Tabular values are tenths of millibars.

Temperature Increments (°F)	Vertical Tabular Differences														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.4	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
0.5	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
0.6	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1
0.7	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
0.8	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1
0.9	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1
1.0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	2
2.0	0	0	1	1	1	1	1	2	2	2	2	2	3	3	3
3.0	0	1	1	1	2	2	2	2	3	3	3	4	4	4	5
4.0	0	1	1	2	2	2	3	3	4	4	4	5	5	6	6
5.0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8
6.0	1	1	2	2	3	4	4	5	5	6	7	7	8	8	9
7.0	1	1	2	3	4	4	5	6	6	7	8	8	9	10	11
8.0	1	2	2	3	4	5	6	6	7	8	9	10	10	11	12
9.0	1	2	3	4	5	5	6	7	8	9	10	11	12	13	14
10.0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Table 10k. Proportional parts for use with all sea-level reduction tables in millibars. Tabular values are tenths of millibars.

Pressure Increments (inch)	Horizontal Tabular Differences																				
	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.01	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	5	5	5	5	5	5
0.02	6	6	6	7	7	7	7	7	8	8	8	8	8	9	9	9	9	9	10	10	10
0.03	9	9	10	10	10	11	11	11	11	12	12	12	13	13	13	14	14	14	14	15	15
0.04	12	12	13	13	14	14	14	15	15	16	16	16	17	17	18	18	18	19	19	20	20
0.05	15	16	16	17	17	18	18	19	19	20	20	21	21	22	22	23	23	24	24	25	25
0.06	18	19	19	20	20	21	22	22	23	23	24	25	25	26	26	27	28	28	29	29	30
0.07	21	22	22	23	24	25	25	26	27	27	28	29	29	30	31	32	32	33	34	34	35
0.08	24	25	26	26	27	28	29	30	30	31	32	33	34	34	35	36	37	38	38	39	40
0.09	27	28	29	30	31	32	32	33	34	35	36	37	38	39	40	41	41	42	43	44	45
0.10	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50

PROPORTIONAL PARTS TABLE

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

7410. Description of Diagrams.--The height in geopotential feet (gpft.) of the 850-millibar surface (25.10 inches of mercury) 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 gpft. 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 gpft. 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 2350 to 9500 feet for use with all diagrams listed in ¶ 7410. A kilometer scale is printed on the right in a range equivalent to the range of the gpft. scale. The station elevation in gpft. 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 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 1081:

(1) Current temperature.

(2) Current temperature.

(3) Temperature 6 hours previously.

(4) Algebraic 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). (See Table A7-2.)

(7) Algebraic sum of (5) and (6).

Only one copy of Form 1081 will be prepared unless additional copies are required locally. Completed copies may be destroyed after 90 days.

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 ¶ 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 gpft. scale on the hypsometric diagram so that height in gpft. 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 gpft. 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 gpft..... 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, 5290, 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 gpft.). Height equals 4810 gpft.

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. 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. Altimeter settings determined at the time of the 6-hourly observation will be furnished to local operations desiring them immediately after determination. These readings are required for comparative purposes, and are in addition to those normally transmitted in observations to local operations.

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.

EXAMPLE

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.....28.83

Value from table found in column headed .03.....29.62

(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 in ¶ A7230.

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. No allowance will be made for diurnal changes in determing these data.

7620. Pressure tendencies will be determined only at stations equipped with a barograph. Determine the characteristic from the trace for the full 3-hour period preceding the actual time of observation, and, at stations computing 850-millibar data, 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, the pressure 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. When the tendency of the observed trace is incompatible with the sign of the net change, select the tendency that is most nearly representative and still compatible with this sign. Classify barometric tendencies in accordance with Table 10m and ¶ 7621 and 7622.

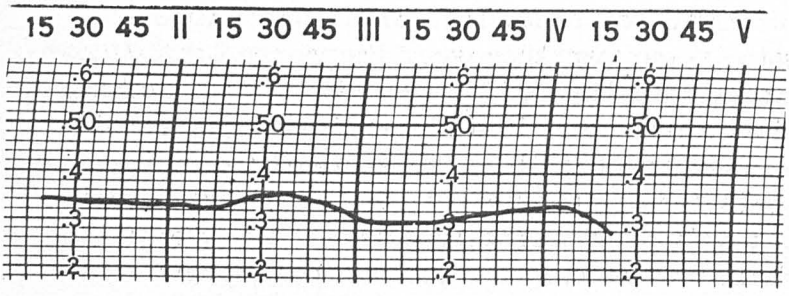
Table 10m. Pressure Tendencies

Code figure	Observed trace	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.	

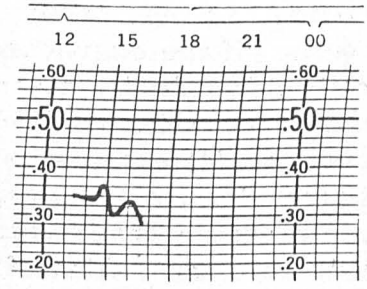
7621. Classify tendencies as 2 or 7 only if the difference in height between adjacent troughs and crests in two or more instances (such as between two adjacent crests and the intervening trough), equals or exceeds the distance represented by 0.02 inch of mercury (approximately 0.7 mb.) on the chart (see example A).

EXAMPLE A

12-hour chart



4-day chart

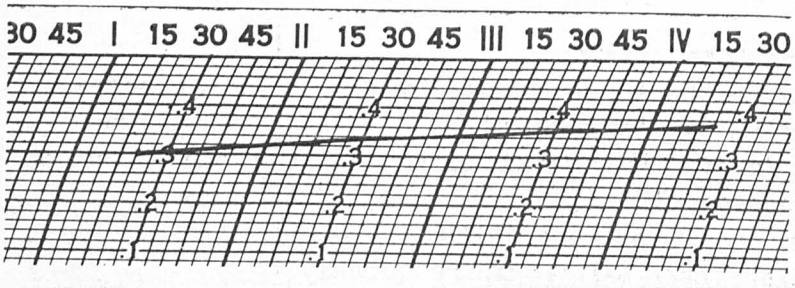


This tendency should be classified as 7 because the amplitude of the pressure changes between the two crests and the intervening troughs are equal to 0.02 inch or more.

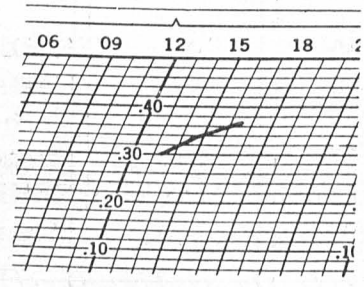
7621.1. Classify tendencies as 3 or 8 only if the trace contains no points of discontinuity (see example B). A point of discontinuity is defined as a point at which the predominant slope of the latter part of the trace represents a change from the predominant slope of the earlier part of 0.02 inch of mercury per hour or more.

EXAMPLE B

12-hour chart



4-day chart

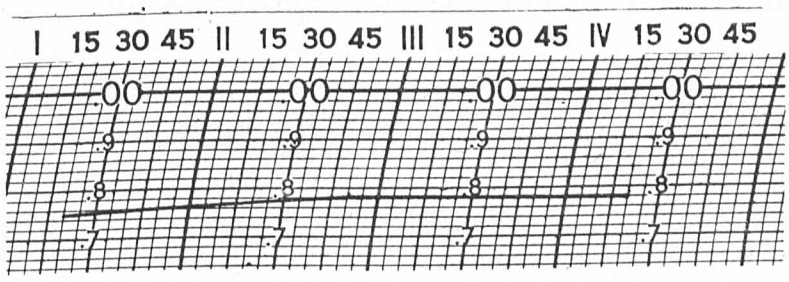


This tendency should be classified as 3 because the change in slope at discontinuity is less than 0.02 inch per hour.

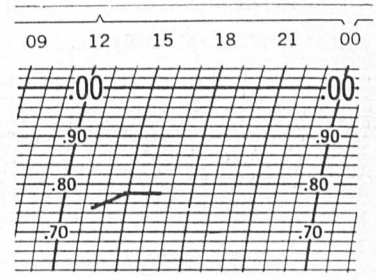
7621.2. Classify tendencies as "0", "1", "4", "5", or "9" according to the general criteria in Table 10d and the additional instructions in ¶ 7622 when neither of the criteria in ¶ 7621 and 7621.1 applies (see example C).

EXAMPLE C

12-hour chart



4-day chart

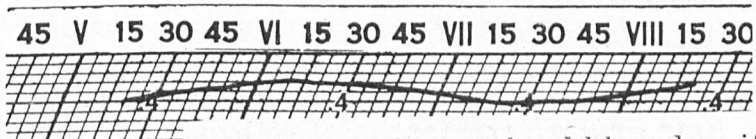


This tendency should be classified as 1 because the predominant slope of of the latter part of the trace differs from the predominant slope of the earlier part by more than 0.02 inch of mercury per hour.

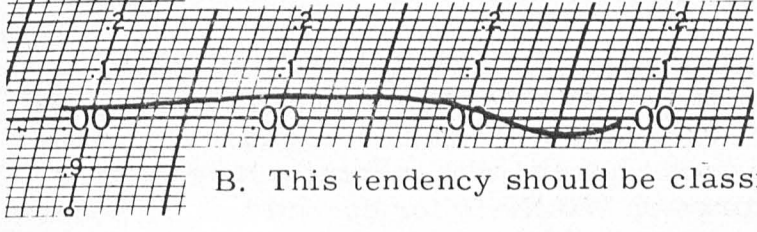
7622. When two or more characteristics apply, select the tendency that is representative of the latter portion of the trace (see examples A and B below), unless this tendency is not compatible with the net amount of change in the past three hours. In this latter case, select the tendency that is most descriptive of the entire 3-hour period and is also compatible with the net 3-hour change. (See examples C and D below.)

EXAMPLES

12-hour chart

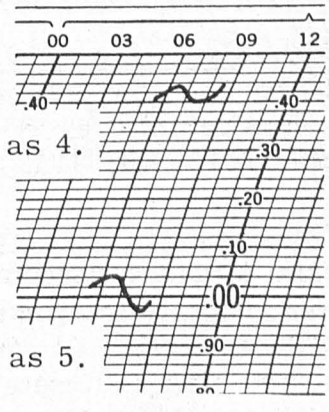


A. This tendency should be classified as 4.



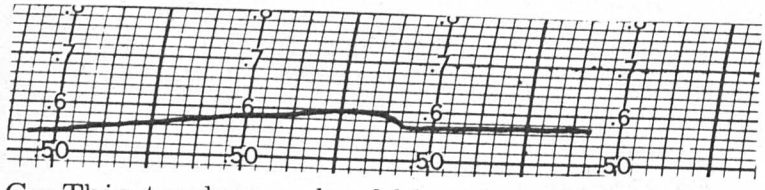
B. This tendency should be classified as 5.

4-day chart

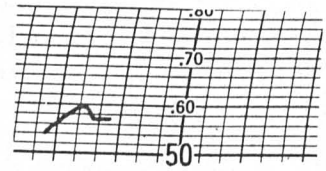


EXAMPLES

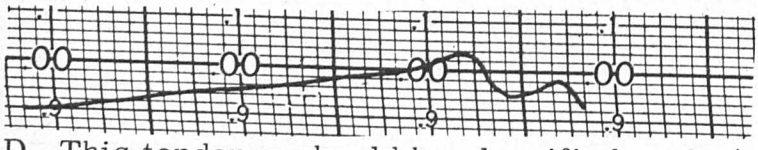
12-hour chart

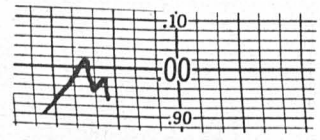


4-day chart



C. This tendency should be classified as 0. (Although numeral 6 of the tendency code is more representative of the latter portion of the period, it is not compatible with the positive sign of the net 3-hour change.)





D. This tendency should be classified as 0. (Although numeral 7 of the tendency code is more representative of the latter portion of of the period, it is not compatible with the positive sign of the net 3-hour change.)

7630. To find the amount of change, determine to the nearest 0.005 inch the net change over the interval by subtracting corresponding entries in column 17. If an observation was not taken three hours previously, determine the change from the barogram.

7640. When the barogram indicates a rapid fall in pressure followed by an abrupt rise, with both rise and fall at the rate of 0.06 inch per hour or more, the lowest pressure in the "V" will be noted and converted to sea-level pressure for reporting in accordance with ¶ 7730. The mean temperature used in the reduction will be the mean of the temperature at the preceding observation and at a time twelve hours previously.

7700. ENTRIES ON WBAN-10

7710. Sea-Level Pressure (Col. 6). --Omit the initial "9" or "10" of the sea-level pressure and enter it as three figures (without a decimal point) representing tens, units, and tenths of millibars; e.g., enter 1013.2 as "132".

7720. Altimeter Setting (Col. 12). --Omit the initial "2" or "3" of the altimeter setting and enter it as three figures (without a decimal point) representing units, tenths, and hundredths of inches; e.g., enter 29.94 as "994". At stations not equipped with mercurial barometers but requiring altimeter settings on WBAN-10 for operational purposes, prefix an "E" to the entry.

7730. Remarks (Col. 13).--Enter pressure data in column 13 as follows:

Observed	Entry
(1) Pressure rising or falling at rate of .06 inch per hour or more.	PRESRR or PRESFR
(2) Barogram "V" (see ¶ 7640).	Enter in the next record observation the lowest sea-level pressure in tens, units, and tenths of millibars, and time of occurrence LST; e.g., "LOWEST PRES 631 1745C".
(3) Pressure unsteady, as shown on the barogram by sharp troughs or crests that depart at least .03 inch from the mean trend.	PRES UNSTDY

7740. Station Pressure (Col. 17).--Enter station pressure to the nearest .005 inch determined from the instrument appearing highest in the priority list in ¶ 7011. Omit entry if a mercurial barometer is not used for periodic comparisons with other pressure-measuring instruments. (Entries in this column will be used in determining sea-level pressure and altimeter setting, after being rounded to the nearest .01 inch.)

7780. Station Pressure Computations (Lines 59 - 65).--Enter station pressure computations for the 6-hourly observations as specified below.

7781. 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.)

7782. Attached Thermometer (Line 60).--Enter the temperature of the thermometer attached to the mercurial barometer to the nearest 0.5° Fahrenheit or Celsius (centigrade). Omit entries when the pressure readings are taken from precision aneroid barometers or altimeter-setting indicators.

7783. Observed Barometer (Line 61).--Enter the uncorrected observed reading of the mercurial barometer to the nearest .001 inch or .05 millibar; or of the precision aneroid barometer to the nearest .005 inch or .1 millibar. Omit entry if an altimeter-setting indicator is being used to determine station pressure (see ¶ 7011).

7784. Total Correction (Line 62). --Enter the sum of all corrections required to reduce the observed reading to station pressure. Omit entry if an altimeter-setting indicator is being used to determine station pressure.

7785. Station Pressure (Line 63). --Enter to the nearest .001 inch or .05 millibar for mercurial barometer reading; to the nearest .005 inch or 1 millibar for precision aneroid or altimeter-setting indicator readings.

7786. Barograph Reading (Line 64). --Enter to the nearest .005 inch or .2 millibar according as the barogram is graduated in millibars or inches. When the barogram is changed at the time of the 6-hourly observation, take the barograph reading from the new barogram.

7787. Barograph Correction (Line 65). --Enter the the nearest .005 inch or .1 millibar with proper sign, the difference between the entries in lines 63 and 64, that is, line 63 minus line 64. 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 line 65 preceding the correction established at the time of the 6-hourly observation.

A7000. PRESSURE-SENSING INSTRUMENTS

A7030. Exposure. --Select exposure sites where the instrument will not be subjected to rapid fluctuations of temperature or to jarring and continuous vibration. Avoid exposing the instruments to direct sunlight and radiant heaters, and to direct drafts, such as from open windows and doors. When an installation is regarded as unsatisfactory, or when contemplated changes in the office (air-conditioning, renovation, etc.), are considered likely to affect the exposure adversely, notify the Weather Bureau regional office.

A7031. Aneroid barometers should, under ordinary circumstances, be mounted with the dial in a vertical position at a convenient level for reading. Aneroid barometers and altimeter-setting indicators will operate satisfactorily in other than a vertical position. However, since a change in position may result in a change in the indicated reading, the instrument should be carefully checked against a mercurial barometer whenever a change in position is made. Instruments designed for connection to a static head system should be installed in a location where the connections can be made. Dial-type instruments are frequently provided with a detachable case or flange to be used when the instrument is wall mounted. Remove the case or flange when the instrument is to be flush mounted in an instrument panel or rack.

A7100. MERCURIAL BAROMETERS

A7110. General.--Where two mercurial barometers are maintained side by side, the instrument regularly used is designated as the "station barometer," and the other as the "station extra." These designations will not be changed without authorization from the Weather Bureau Central Office. The station extra is to be used for emergency and reference purposes only. Do not use barometer lamps of more than 25 watts, or leave the lamp burning longer than required for the actual observation. Mercurial barometers, especially barometers of the adjustable cistern type, are very fragile.

A7112. Cistern Rings.--As an aid in maintaining adjustable-cistern barometers in a vertical position, a ring is attached to the mounting board to encircle without touching the cistern when the barometer is freely suspended. Adjust the suspension of the barometer, or the position of the cistern ring, to prevent the freely suspended barometer from touching the ring. An improved style of ring is provided with three set screws that clamp the cistern lightly in a vertical position, thereby facilitating rapid and accurate adjustment of the cistern without disturbing the vertical alignment of the instrument.

A7112.1. To adjust the cistern where the non-clamping type ring is used, steady the cistern against the side of the ring in a manner indicated in Fig. A7-3; i.e., by swinging the cistern end of the barometer in a direction such that the cistern touches the ring at a point where the line (AB) through the center of the cistern and the point of contact is at right angles to the line through the center of the cistern and the ivory point (I). When this is done properly, the mercury level with respect to the tip of the ivory point will not be changed when the barometer is released and returns to its vertical position.

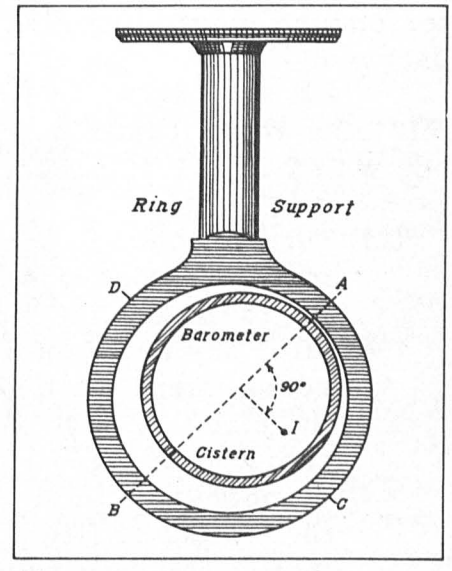


Fig. A7-3. Cistern ring.

A7120. Relocation of Mercurial Barometers.--Mercurial barometers will not be moved by station personnel, except in an emergency to protect the instrument from shock or other conditions likely to damage it. The circumstances will be reported immediately to the Weather Bureau regional office.

A7120.2. When a barometer is moved in an emergency, it should be removed to and stored in a protected location in accordance with ¶ A7121.

A7121. Moving a G010, Adjustable-Cistern, Fortin-Type Barometer.--(See Fig. A7-4.) The adjustable cistern barometer must be handled carefully. Avoid any rapid accelerating or decelerating movement of the instrument, especially in a lengthwise direction; i.e., along the center line of the tube and cistern.

A7121.1. When the barometer is to be relocated, it may be moved by hand without adjustment of the cistern provided it is:

(1) Hand-held in a vertical position with the cistern end down throughout the move.

(2) Not subjected to shock or to sufficient vertical acceleration or deceleration to cause noticeable pumping of the mercury; i.e., rise and fall of the mercury in the tube.

When the barometer cistern is maintained in a fixed position by a clamping type cistern ring, the supporting board or box and the barometer may be moved intact so long as these provisions are carefully observed.

A7121.2. When it is impractical to transport the barometer in accordance with ¶ A7121.1, prepare the instrument for removal as follows:

(1) Turn the cistern screw clockwise until the top of the mercury column is lifted just above the top of the opening in the tubular metal shield. Do not force the screw after any decrease in the freedom of its movement is noted, since the mercury may have reached the top of the tube. At high altitude stations where the atmospheric pressure is relatively low (less than 26.50 inches of mercury), incline the barometer about 45 degrees after the cistern is filled with mercury and before filling the tube. This will reduce the risk of damage from the hydrostatic pressure involved.

(2) Remove the barometer from its support and incline it slowly until the cistern end is above the horizontal.

(3) Unscrew the cistern screw approximately one turn.

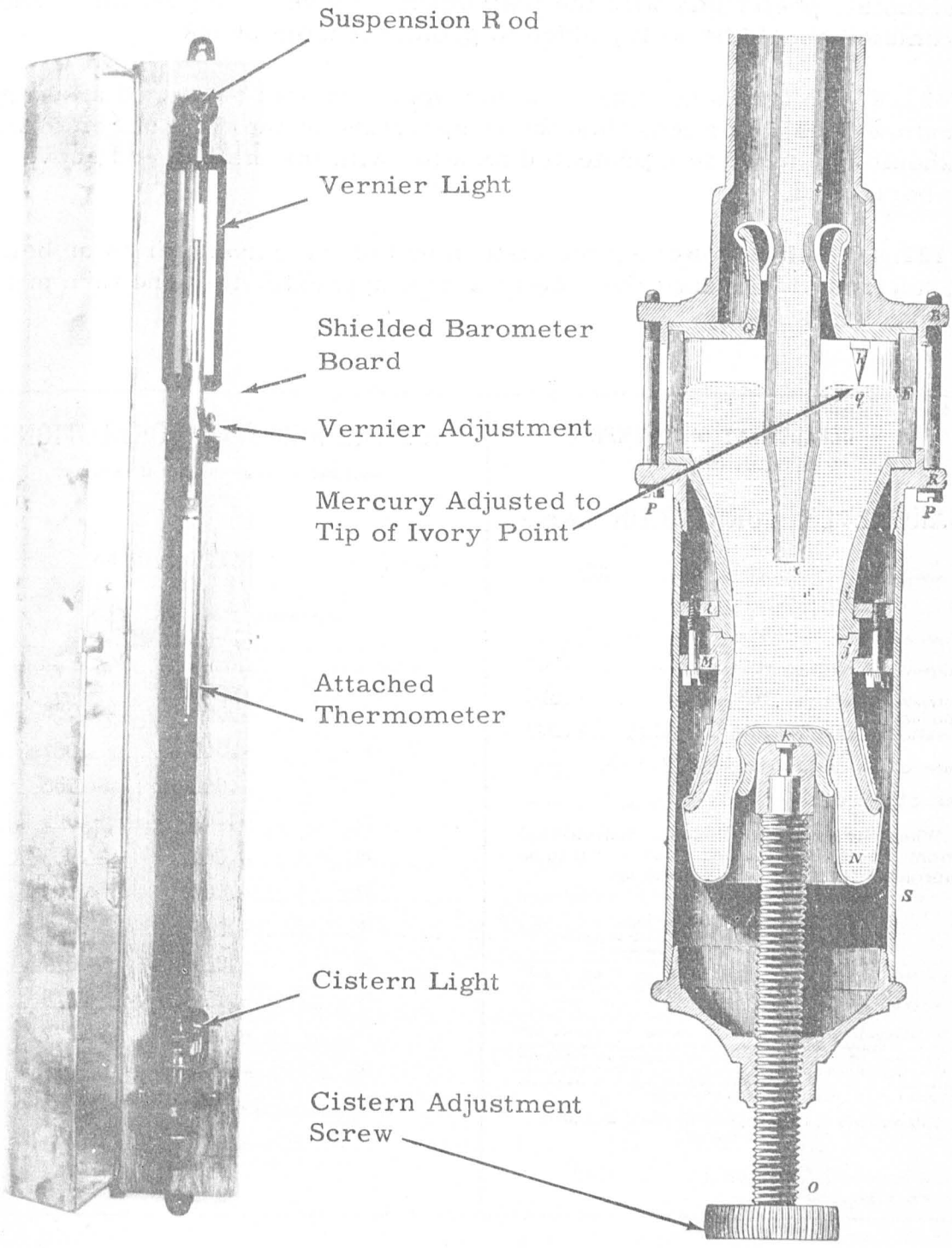


Fig. A7-4. Adjustable cistern, Fortin-type barometer, G010.

A7121.21. Transport the barometer with the cistern end above the horizontal, preferably with the instrument in a vertical position. The barometer should be well padded to protect it from shock.

A7121.3. So far as possible, the barometer should be stored at a temperature equal to or less than the temperature at the time of removal. It should be stored in a protected location with the cistern end above the horizontal.

A7121.4. Before lowering the cistern end of the barometer to or below the horizontal, advance the cistern screw approximately one turn provided it turns freely.

WB Form 1059

U. S. DEPARTMENT OF COMMERCE
WEATHER BUREAU

BAROMETER CORRECTION CARD

Station ..... Barometer No. 823

at Milford, Utah

Mean An. Temp., 49° Mean Pres., 24.94"

Correction for scale errors and capillarity .... .000

Correction for local gravity { Latitude 38° 25' ; -.015
Actual elevation 5033.119 ; -.007

Correction to station elevation 5097.1 ; ---

See other side Sum of corrections .. ---

When the total correction for instrumental errors is + it is to be added, when — it is to be subtracted from the observed reading.

Attached thermometer No. .....
Correction in degrees Fahrenheit to reduce to standard air thermometer.

Scale r'd'g	32°	42°	52°	62°	72°	82°	92°
Correction	—0.	—0.	—0.	—0.	—0.	—0.	—0.

The attached thermometer will be read to the nearest half degree. Whenever the corrections to reduce to the standard air thermometer are 0.5 degree, or more, the appropriate correction will be applied to the observed temperature and the reading thus corrected will be entered on forms and employed in taking out the correction for temperature of the barometer.

This card will be kept conspicuously posted adjacent to its barometer.

Card issued October 7, 1947

(WB—3-12-48—3.000) 67

SPECIAL REMOVAL CORRECTIONS

(Required for large changes of elevation)

Station Milford, Utah

Barometer No. 823

Temperature	Removal correction	Sum of corrections
—20	-.066	-.088
—10	-.065	-.087
0	-.064	-.086
+ 10	-.063	-.085
20	-.061	-.083
30	-.060	-.082
40	-.059	-.081
50	-.057	-.079
60	-.056	-.078
70	-.055	-.077
80	-.054	-.076
90	-.052	-.074
100	-.051	-.073

Fig. A7-5. Form 1059

A7200. ANEROID-TYPE INSTRUMENTS

A7210. Aneroid Barograph, G210.--(See Fig. A7-6) This barograph has a 2-1/2 to 1 scale.

A7211. Maintenance.--Whenever a barograph is initially placed in operation, and whenever any adjustment of the pen or linkage mechanism has been made, check the relationship between the time-arc lines on the chart and the arc described by the pen between the top and bottom pressure-ordinate lines. To check this, adjust the pen to the lowest pressure-ordinate line by means of the adjusting knob, and lift the pen gently to the highest pressure-ordinate line (never depress the pen except by means of the adjusting knob). The relationship is correct if the pen point is equidistant from the nearest time line at both the top and bottom of the chart, and at any third point near the middle of the chart. If the distance separating the pen and the time line differs between the top and bottom of the chart, it is likely that the chart is poorly fitted to the cylinder. If the distances at the top and bottom of the chart are in agreement, but differ from the distance at or near the middle of the chart, the pen arm length requires adjustment (see ¶ A7211.21).

A7211.1. Dashpots.--Dashpot fluid should be used if continuing vibration or artificial pressure changes (such as those caused by slamming doors and gusts of wind through open doors and windows) cause an unsteady trace. Before filling the dashpot, remove the connecting-rod screw that links the connecting rod of the dasher to the overhead slot in the rocker arm, and remove the dasher. Fill the dashpot to within 1/4 inch of the top. However, when it becomes necessary to add fluid to the dashpot, drain, clean and refill it, particularly if there is doubt as to the nature of the fluid. Do not mix differing types of fluids, such as an oil-type fluid with one having a glycerine base. Replace the dasher, and before connecting it to the rocker arm, raise and lower it in the fluid several times to dislodge any air bubbles present beneath the dasher. The level of the liquid must be kept above the upper limit of travel of the dasher in order to eliminate surface-tension errors. After replacement of the connecting-rod screw, the connecting rod should be freely suspended from the screw and should have noticeable side-to-side play between the sides of the slot in the rocker arm.

A7211.11. After filling the dashpot, check the operation of the instrument by depressing the pen to the bottom pressure-ordinate line by

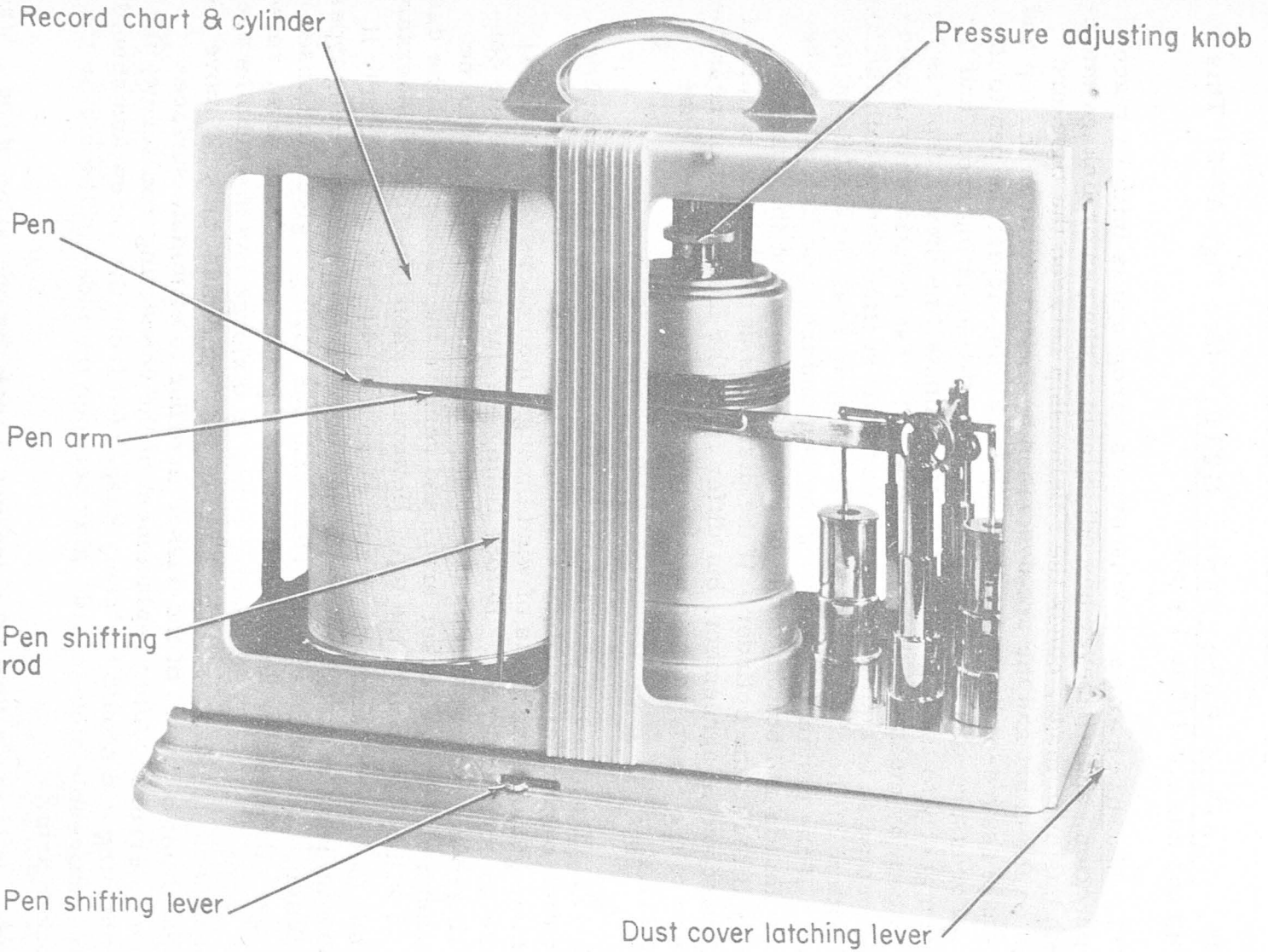


Fig. A7-6. Aneroid Barograph (2-1/2 to 1 scale), G210.

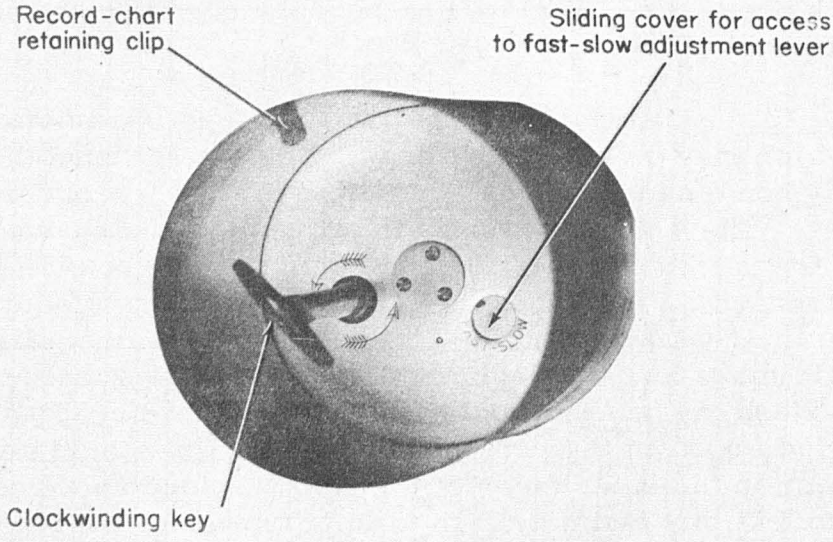
means of the pressure-adjustment knob, then lift the pen gently to the uppermost pressure ordinate and release it. The pen should begin its return rapidly and should decelerate uniformly until it comes to rest. If the return is non-uniform, it may be caused by (1) a sharp pen catching on the face of the form, (2) improperly functioning dashpots, or (3) tight spots in the linkage mechanism. Adjust the pressure trace, and check the pressure adjustment at intervals of two to three hours over several cycles of increasing and decreasing pressure. Whenever the correlation between the indicated pressure and the station pressure obtained from the mercurial barometer is erratic or otherwise abnormal, (1) repeat the procedure described in ¶ A7211.1 to eliminate air bubbles, and (2) check the level of the dashpot fluid. Even with damping fluid in the dashpots, tapping the case of the instrument lightly several times should be sufficient to remove any error resulting from sticking of the linkage. Whenever the effect of sticking is observed to be consistently or frequently more than 0.02 inch of mercury, and if the condition is not corrected by any of the foregoing procedures or by changing the pen (see ¶ A7211.2), report the condition to the Weather Bureau regional office.

A7211.2. Pen.--Whenever the pen fails to feed ink automatically, the flow of ink may be started by drawing a piece of smooth, lint-free (preferably bond) paper between the nibs of the pen in order to wet the inner faces. The wetting action is improved and the chance of retaining paper fragments or other foreign particles between the nibs of the pen is decreased, if the paper is withdrawn with a motion directed away from the reservoir and toward the nibs of the pen. If the pen still fails to make a fine, clear line, remove it from the pen arm and clean it. Wash the pen thoroughly in water or, preferably in alcohol. Scrape dried ink from the pen and rewash it. Ink should not be allowed to collect on the outer faces of the points, since an excess of ink tends to collect dirt and may lead to interruption of the record. Replace any pen that becomes so worn that it no longer makes a fine, clear record.

A7211.21. The pen is secured by a friction clamp to the tapered point of the pen arm. To remove the pen, loosen it carefully to avoid bending the pen or pen arm, or otherwise damaging the linkage mechanism. If the pen is not easily removed by a light pull, use a knife edge to loosen the prongs that secure it to the pen arm. The effective pen arm length of 7.625 inches (the distance from the pen point to the axis of rotation of the arm) must be maintained when the pen is replaced.

A7211.22. If a faint or otherwise unsatisfactory record is obtained because of ink dilution, refill the pen with undiluted ink. Keep the reserve supply of ink well stopped to prevent dilution by absorption of water vapor.

A7211.3. Clock Adjustment.--To adjust a clock that consistently gains or loses time, open the small inspection plate in the top cover of the clock compartment (inside the cylinder as viewed from the top - see Fig. A7-7). Carefully move the small index slightly toward "F" (Fast) if the clock is losing time, or toward "S" (Slow) if the clock is gaining time. It is preferable that timing adjustments be made at the time of changing the form to preserve continuity of the record.



A7212. Exposure.--Barographs will be exposed in accordance with instructions in ¶ A7030.

A7220. Aneroid Barometers - Precision Type.--(See Fig. A7-9.) The range of aneroid barometers is indicated by the graduated scale on the dial. The pressure scale should extend to at least 1.3 inches of mercury (approximately 45 mb.) higher, and 1.5 inches of mercury (approximately 50 mb.) lower, than the mean station pressure as taken from Form 1059 (see Fig. A7-5).

WB FORM 455 7
(Formerly 1025 B)

UNITED STATES DEPARTMENT OF COMMERCE, WEATHER BUREAU

BAROMETER COMPARISONS

(Comparison of altimeter setting indicators or aneroid barometers with mercurial barometers.)

Station: INSAC, City, State

Month and Year: July 1953

Mercurial Barometer No. 976

Aneroid Barometer (X) or Altimeter Setting Indicator ( ); Serial No. 5716

Elevation of Indicator in Feet Above Mean Sea Level: —

Day of Month	Time (LST)	Temperature Attached Thermometer	Mercurial Barometer: Uncorrected Reading	Mercurial Barometer: Station Pressure	Mercurial Barometer: Altimeter Setting	Aneroid Barometer: Uncorrected Reading	Aneroid Barometer: Differences and Means	Aneroid Barometer: Applied Correction	Aneroid Barometer: Elevation Scale Reading (feet)	Remarks
1	2	3	4	5	6	7	8	9	10	11
12	1340	67.5	29.016	982.6		982.8	-0.2			
13	1610	72.5	29.001	982.1		982.2	-0.1			
14	2045	70.0	29.047	983.6		983.8	-0.2			
15	2140	77.5	29.132	986.6		986.8	-0.2			
16	2035	74.5	29.063	984.2		984.3	-0.1			
17	1415	68.5	29.004	982.2		982.2	± 0.0			
18	1055	75.5	28.886	978.2		978.1	+0.1			
						TOTAL:	-0.7			
						MEAN:	-0.1			
19	1312	71.0	28.880	978.0		978.0	+0.1	-0.1		
20	1540	69.0	29.073	984.5		984.6	± 0.0	-0.1		

See instructions on reverse side.

WB FORM 455-7

Fig. A7-8. Form 455-7, record of aneroid-mercurial barometer comparative readings.

A7221. Comparative Readings.--Comparative data from concurrent readings of the precision aneroid barometer and a mercurial barometer will be obtained as described below and entered on Form 455-7 in accordance with instructions on the back of the form (see Fig. A7-8). Unless otherwise specified below, the form will be disposed of in accordance with instructions printed on the back of it. Concurrent readings taken within periods of several consecutive months should include readings taken during the occurrence of relatively high and low pressure.

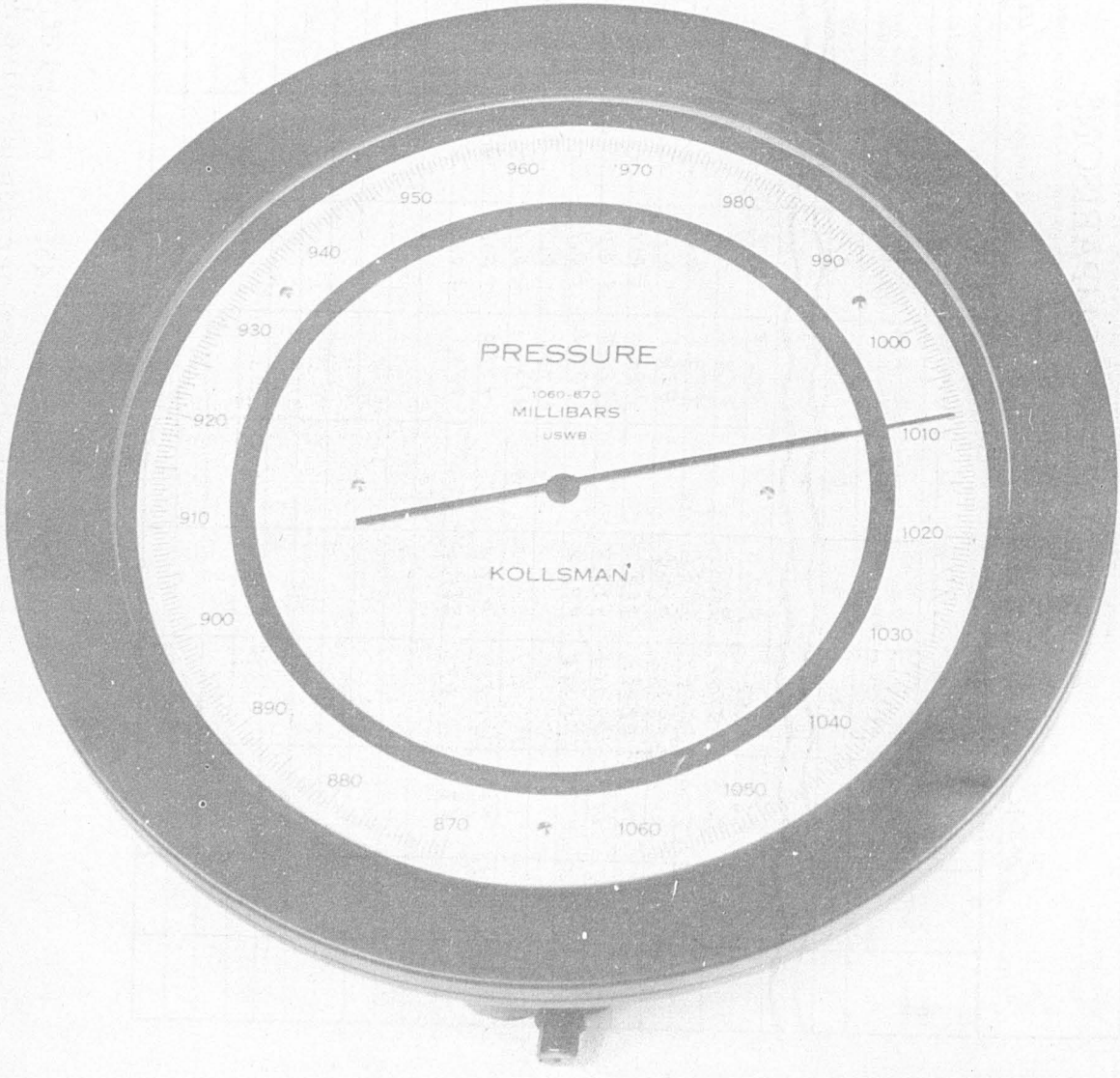


Fig. A7-9. Precision aneroid barometer (Kollsman), G121A-1.

A7221.1. After the aneroid barometer has been installed, comparative readings will be taken as follows:

(1) Take concurrent readings of the barometers once each day at various times, but preferably in the afternoon. Compute the station pressure, using the mercurial barometer reading (see Sec. 7200), and determine the difference between the two barometers by subtracting the uncorrected reading of the aneroid barometer from this station-pressure value.

(2) After the differences for seven days have been determined, compute the algebraic mean of the differences. This mean will be added algebraically, as a correction, to subsequent uncorrected readings of the aneroid barometer to provide values of station pressure for purposes of Form 455-7 only. This correction will be applied, (see ¶ 7252) until revised, to subsequent comparative barometer readings.

(3) Determine each day the difference obtained by subtracting the corrected aneroid readings obtained as in (2) from the station pressure based on readings of the mercurial barometer. After fourteen consecutive days in which none of these differences exceeds ± 0.3 mb., the corrected aneroid readings may be used as the station pressure for observational purposes.

(4) Continue to take concurrent daily readings at least 14 days longer, and to compute the difference between station pressure and the corrected readings of the aneroid barometer.

(5) After comparative readings have been taken daily for at least eight weeks, and after 14 consecutive days in which none of the differences in (4) have exceeded ± 0.3 mb., comparisons will be made once every seven days.

A7221.2. Whenever the difference between station pressure and a corrected reading of the aneroid barometer exceeds 0.3 mb., the difference will be verified immediately, preferably by another observer. If the verified difference:

(1) Does not exceed 0.3 mb., disregard the first value and proceed as specified in ¶ A7221.1, item (3) - (5).

(2) Exceeds 0.3 mb. but not 0.6 mb., compute the algebraic mean of the two differences and post the mean value as a revised correction applicable until the next day (see ¶ A7221.4).

(3) Exceeds 0.6 mb., discontinue use of the aneroid barometer and notify the Weather Bureau Central Office through the Weather Bureau regional office.

A7221.3. After adjustment of the precision aneroid barometer to a correction of zero (by an inspector or technician), take a comparative reading one hour later and another two hours later. Compute the differences. If neither difference exceeds 0.3 mb., determine the algebraic mean of the two differences, and post this mean value as the correction applicable until the next day (see ¶ A7221.4). If either difference exceeds 0.3 mb., proceed in accordance with ¶ A7221.2, items (2) and (3).

A7221.4. Whenever a posted correction has been redetermined as specified in ¶ A7221.2 or A7221.3, proceed as follows:

(1) Take comparative readings daily, determine their difference, and compute the cumulative sum of the differences. Use the posted correction determined as specified above as the first difference in the sum. Compute the algebraic mean value. Post each mean value as the correction applicable until the following day.

(2) Compute the posted correction as in (1) until it has been redetermined for seven consecutive days. If the difference between the station pressure and the corrected aneroid barometer exceeds 0.3 mb., repeat the procedure of ¶ A7221.2 (see also (3) and (4) below). The mean value obtained on the seventh day will be posted as the correction applicable until either the difference between comparative readings exceeds 0.3 mb. or the aneroid barometer is adjusted to zero.

(3) Whenever the requirements of ¶ A7221.1 have not been satisfied since the aneroid barometer was installed, and a posted correction has been redetermined as in (2), resume comparisons as in ¶ A7221.1(3). Whenever redeterminations occur so frequently that the re-

quirements of ¶ A7221.1 cannot be satisfied within three months, discontinue use of the instrument and notify the Weather Bureau Central Office through the Weather Bureau regional office.

(4) Whenever redetermination of the posted correction is required after weekly comparisons have been initiated in accordance with ¶ A7221.1(5), resume daily comparisons for at least fourteen days. Whenever subsequent redeterminations are required before the foregoing procedure is completed, and weekly comparisons cannot be resumed within four weeks, discontinue use of the instrument and forward the comparison data on Form 455-7 to the Weather Bureau Central Office through the Weather Bureau regional office.

A7221.5. Whenever the aneroid barometer is used for observational purposes, and there are indications that its readings are inaccurate, a series of five comparative readings will be taken approximately one hour apart. If the differences in station pressure between the aneroid and mercurial barometer vary over a range of more than 0.3 mb., discontinue use of the aneroid barometer and forward the data on Form 455-7 to the Weather Bureau Central Office through the Weather Bureau regional office.

A7230. Altimeter-Setting Indicator.--Altimeter-setting indicators are provided with two scales - a pressure, or primary scale, and an elevation, or secondary, scale (see Fig. A7-11 and -12). Indicators are designed for operation within the elevation range specified on the dial. Station personnel should not attempt to adjust the pressure-scale index independently of the position of the elevation scale.

A7231. Station Pressure.--The altimeter-setting indicator may be used for the determination of station pressure in accordance with ¶ 7260, provided satisfactory comparisons are obtained periodically in accordance with ¶ A7233.

A7232. Adjusting Elevation Scale.--The position of the elevation scale and the related position of the pressure-scale pointer are adjusted by the elevation-scale adjusting screw, which on some instruments projects through a hole in the cover glass (see Fig. A7-12). The Kollsman type of instrument has a plug screw and washer in the back side of the case (near the bottom) to provide access to the adjusting screw. Care should be taken not to damage the washer, which prevents leakage at the plug screw. Turn the adjusting screw until the

pointer of the pressure scale indicates the correct altimetter setting as obtained from the mercurial barometer (see Sec. 7500). Do not adjust the scale during periods of rapidly changing pressure or high wind speeds (see ¶ A7010). If at any time after adjusting the elevation scale to indicate the correct altimeter setting, the corresponding elevation-scale reading is not within ±100 feet of the actual altitude of the indicator above mean sea level, discontinue use of the instrument and notify the Weather Bureau Central Office through the Weather Bureau regional office. Normal aging usually results in a progressively increasing negative correction or decreasing positive correction. During the first year of operation it is likely that readjustment of the elevation scale will be necessary to provide readings of the required accuracy (see ¶ A7233).

A7233. Comparative Readings.--Comparative data from concurrent readings of the altimeter-setting indicator and a mercurial barometer will be obtained as described below and entered on Form 455-7 in accordance with instructions on the back of the form (see Fig. A7-10). Concurrent readings taken within periods of several consecutive months should include readings taken during the occurrence of relatively high and low pressure.

A7233.1. When the altimeter-setting indicator has been installed, adjust the elevation scale (see ¶ A7232) so that the pressure scale reading corresponds to the altimeter setting computed from a concurrent reading of a mercurial barometer. Make the comparative readings as follows:

(1) Take concurrent readings of the altimeter-setting indicator and a mercurial barometer once a day at various times, preferably in the afternoon. Obtain the altimeter setting (see Sec. 7500), and determine the difference by subtracting the uncorrected reading of the indicator from the altimeter setting. A difference that exceeds ±0.020 inch will be verified immediately. If the second difference does not exceed ±0.020 inch, disregard the first; otherwise, adjust the indicator (see ¶ A7232) to reduce the verified difference (mean of the two differences if they are not the same) to zero.

(2) After each period of seven consecutive days of comparative readings taken with the same elevation-scale adjustment of the indicator, compute the algebraic mean of the differences for the period.

WB FORM 455 7
(Formerly 1027 B)

UNITED STATES DEPARTMENT OF COMMERCE, WEATHER BUREAU

BAROMETER COMPARISONS

(Comparison of altimeter setting indicators or aneroid barometers with mercurial barometers.)

Station: INSAC, City, State

Month and Year: Sept. - Oct. 1953

Mercurial Barometer No. 1217

Aneroid Barometer ( ) or Altimeter Setting Indicator (X); Serial No. 435

Elevation of Indicator in Feet Above Mean Sea Level: 167

Day of Month	Time (LST)	Temperature Attached Thermometer	Uncorrected Reading	Station Pressure	Altimeter Setting	Uncorrected Reading	Differences and Means	Applied Correction	Elevation Scale Reading (feet)	Remarks
1	2	3	4	5	6	7	8	9	10	11
			EXAMPLE A: Readings taken during a period of comparisons as specified in par. A7233.2							
15	1055	68.5	29.073	28.973	29.133	29.145	-0.012		144	
16	1610	67.5	29.184	29.086	29.246	29.270	-0.024		144	Difference excessive -
16	2045	68.0	29.186	29.087	29.247	29.270	-0.023		144	Adjusted for zero difference
17	1415	72.5	29.223	29.112	29.272	29.261	+0.011	Applied for 7-day Mean	121	
18	1737	75.0	29.249	29.131	29.291	29.293	-0.002		121	
19	2250	70.0	29.250	29.145	29.305	29.301	+0.004		121	
20	2021	75.0	29.132	29.014	29.174	29.167	+0.007		121	
21	1312	77.5	29.071	28.948	29.108	29.099	+0.009		121	
22	0411	78.0	29.058	28.934	29.094	29.091	+0.003		121	
23	0917	74.5	29.117	29.002	29.162	29.157	+0.005		121	
					7-Day	Total:	+0.037			
						Mean:	+0.005			
			EXAMPLE B: Readings taken during a period of comparisons as specified in par. A7233.3							
30	1155	70.0	29.228	29.123	29.283	29.274	+0.009		121	
7	1207	72.5	29.252	29.141	29.301	29.285	+0.016		121	
14	0705	68.0	29.378	29.278	29.438	29.404	+0.034		121	Difference excessive -
14	0707	68.5	29.377	29.276	29.436	29.406	+0.030	+0.032	121	Daily comparisons
15	1147	75.5	29.245	29.126	29.286	29.275	+0.011	+0.022	121	resumed.
16	1010	72.0	29.127	29.018	29.178	29.161	+0.017	+0.020	121	
17	1512	71.0	29.042	28.936	29.096	29.111	-0.015		121	Difference excessive -
17	1515	71.0	29.041	28.935	29.095	29.106	-0.011		121	Use for altimeter
18	0210	69.0	29.211	29.109	29.269	29.272	-0.005		109	settings discontinued.
19	0705	68.0	29.263	29.164	29.324	29.326	-0.002		109	

WB FORM 455-7

Fig. A7-10. Form 455-7, record of altimeter-setting indicator - mercurial-barometer comparative readings.

(3) When neither seven-day mean difference of two consecutive seven-day periods has exceeded ±0.010 inch, uncorrected readings of the indicator may be used as altimeter settings and for obtaining station pressure. However, when a mean difference exceeds ±0.010 inch, adjust the instrument to reduce this difference to zero. Resume daily comparisons until these requirements have been satisfied.

A7233.2. When the indicator is placed in use, continue daily comparative readings, computing the difference between the altimeter setting and the uncorrected reading of the indicator for 14 days more. If during these 14 days a difference, or a seven-day mean difference, exceeds the respective limits in ¶ A7233.1, adjust the indicator to reduce the verified difference or mean difference to zero, and resume daily comparisons until these limits have not been exceeded for 14 consecutive days.

A7233.3. After the conditions in ¶ A7233.2 have been satisfied and daily readings have been taken for at least eight weeks, comparisons will be made once every seven days unless a verified difference is obtained that exceeds the limits in ¶ A7233.1. When these limits are exceeded, adjust the indicator to reduce the verified difference or mean difference to zero and:

(1) Determine the difference between the altimeter setting and the uncorrected reading of the indicator. Post this difference as the correction (see ¶ 7530), and apply it to uncorrected indicator readings to obtain altimeter settings until a new correction is determined on the following day.

(2) On subsequent days, compute and post the value of the cumulative mean of the daily differences.

(3) After seven days in which none of the daily differences departs from the correction computed on the preceding day by more than ±0.020 inch, and the cumulative mean does not exceed ±0.010 inch, resume comparisons at seven-day intervals. However, if either of these values is exceeded within seven days, adjust the indicator to zero difference, and discontinue its use for observational purposes. Repeat the procedures in ¶ A7233.1 - .2.

A7233.4. When more than four adjustments of the elevation scale are necessary within three months, discontinue use of the indicator and notify the Weather Bureau Central Office through the Weather Bureau regional office.

A7233.5. Whenever the altimeter-setting indicator is used for observational purposes, and there are indications that its reading are inaccurate a series of five readings will be taken approximately one hour apart. If the differences between the uncorrected readings and the concurrent altimeter settings vary over a range of more than 0.020 inch, discontinue use of the indicator and forward the data on a copy of Form 455-7 to the Weather Bureau Central Office through the Weather Bureau regional office.

A7233.6. Ascertain whether the altimeter-setting indicator is sufficiently stable to satisfy the following conditions:

(1) The range of the last seven weekly comparisons is 0.030 inch or less.

(2) The mean difference between the altimeter-setting indicator and the altimeter setting for the last seven weekly comparisons exceeds $\pm$0.005.

If both conditions are satisfied, adjust the altimeter-setting indicator in the amount of the mean difference referred to in (2).

A7234. Disposition of Form 455-7.--Completed Forms 455-7 will be retained at the station as specified on the back of the form.

A7300. SEA-LEVEL PRESSURE

A7310. Sea-Level Reduction Tables.--Officials in charge desiring to change their sea-level pressure reduction tables, so that tabular values will be in millibars instead of inches of mercury, may compute the tables by a simple process of successive addition. The basic data and instructions may be secured upon request in accordance with the Foreword. The technique permits extension of tables so that results may be readily obtained for station pressure arguments having intervals of 0.01 inch of mercury.

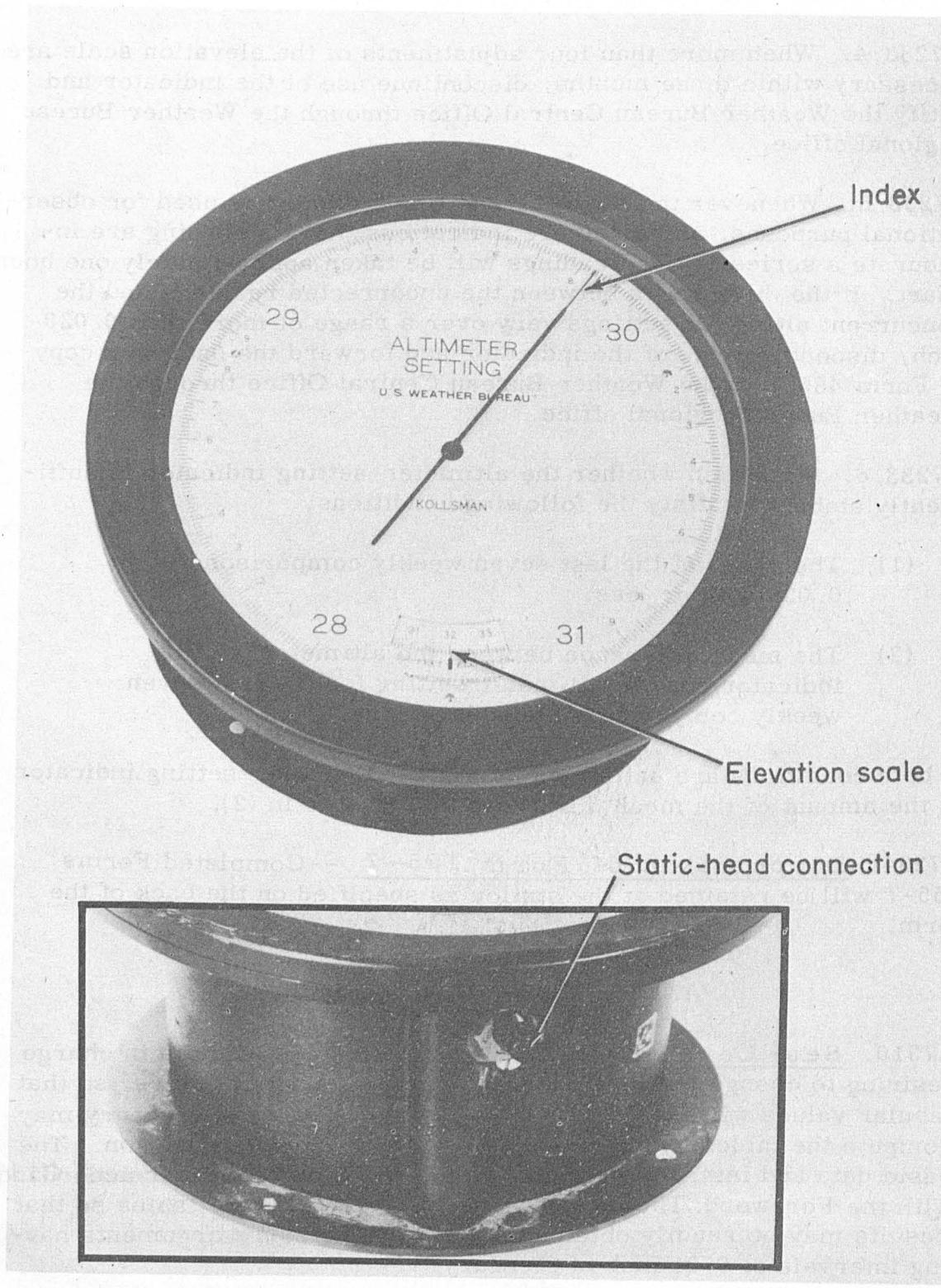


Fig. A7-11. Altimeter-setting indicator (Kollsman), G110B-1.

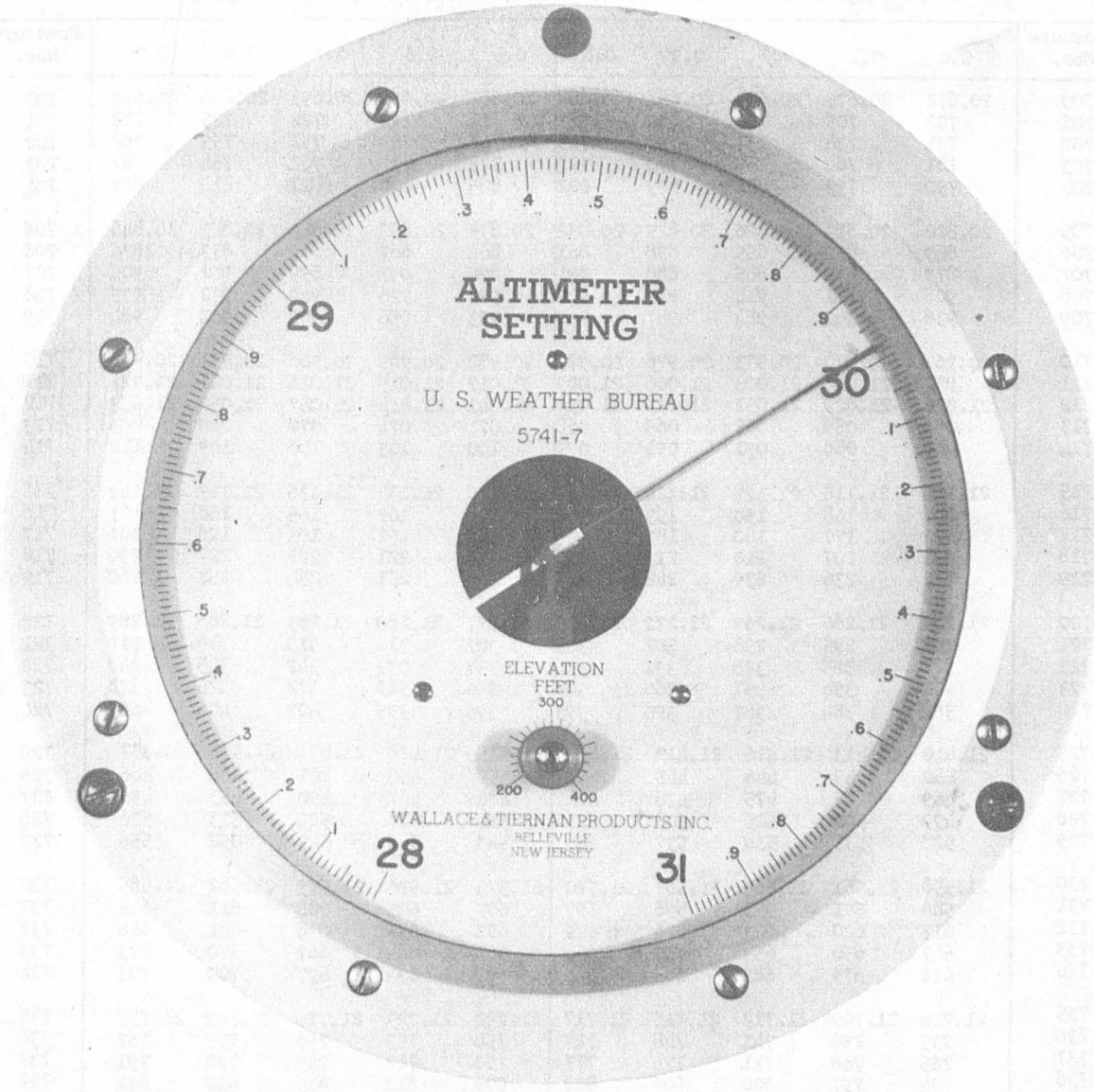


Fig. A7-12. Altimeter-setting indicator (Wallace & Tiernan), G110.

TABLE A7-1. PRESSURE CONVERSION, Mb. to $In._{45}$

1 $In._{45}$ Hg. (1 inch of Mercury at Lat. 45°, m.s.l.) = 33.8621 Millibars.

Pressure Mbs.	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	Pressure Mbs.
700	20.672	20.675	20.678	20.681	20.684	20.687	20.690	20.693	20.696	20.699	700
701	702	705	708	710	713	716	719	722	725	728	701
702	731	734	737	740	743	746	749	752	755	758	702
703	761	764	767	770	772	775	778	781	784	787	703
704	790	793	796	799	802	805	808	811	814	817	704
705	20.820	20.823	20.826	20.829	20.832	20.835	20.837	20.840	20.843	20.846	705
706	849	852	855	858	861	864	867	870	873	876	706
707	879	882	885	888	891	894	897	899	902	905	707
708	908	911	914	917	920	923	926	929	932	935	708
709	938	941	944	947	950	953	956	959	961	964	709
710	20.967	20.970	20.973	20.976	20.979	20.982	20.985	20.988	20.991	20.994	710
711	997	21.000	21.003	21.006	21.009	21.012	21.015	21.018	21.021	21.024	711
712	21.026	21.029	21.032	21.035	21.038	21.041	21.044	21.047	21.050	21.053	712
713	056	059	062	065	068	071	074	077	080	083	713
714	086	088	091	094	097	100	103	106	109	112	714
715	21.115	21.118	21.121	21.124	21.127	21.130	21.133	21.136	21.139	21.142	715
716	145	148	150	153	156	159	162	165	168	171	716
717	174	177	180	183	186	189	192	195	198	201	717
718	204	207	210	213	215	218	221	224	227	230	718
719	233	236	239	242	245	248	251	254	257	260	719
720	21.263	21.266	21.269	21.272	21.275	21.277	21.280	21.283	21.286	21.289	720
721	292	295	298	301	304	307	310	313	316	319	721
722	322	325	328	331	334	337	339	342	345	348	722
723	351	354	357	360	363	366	369	372	375	378	723
724	381	384	387	390	393	396	399	402	404	407	724
725	21.410	21.413	21.416	21.419	21.422	21.425	21.428	21.431	21.434	21.437	725
726	440	443	446	449	452	455	458	461	464	466	726
727	469	472	475	478	481	484	487	490	493	496	727
728	499	502	505	508	511	514	517	520	523	526	728
729	528	531	534	537	540	543	546	549	552	555	729
730	21.558	21.561	21.564	21.567	21.570	21.573	21.576	21.579	21.582	21.585	730
731	588	591	593	596	599	602	605	608	611	614	731
732	617	620	623	626	629	632	635	638	641	644	732
733	647	650	653	655	658	661	664	667	670	673	733
734	676	679	682	685	688	691	694	697	700	703	734
735	21.706	21.709	21.712	21.715	21.717	21.720	21.723	21.726	21.729	21.732	735
736	735	738	741	744	747	750	753	756	759	762	736
737	765	768	771	774	777	780	782	785	788	791	737
738	794	797	800	803	806	809	812	815	818	821	738
739	824	827	830	833	836	839	842	844	847	850	739
740	21.853	21.856	21.859	21.862	21.865	21.868	21.871	21.874	21.877	21.880	740
741	883	886	889	892	895	898	901	904	906	909	741
742	912	915	918	921	924	927	930	933	936	939	742
743	942	945	948	951	954	957	960	963	966	969	743
744	971	974	977	980	983	986	989	992	995	998	744
745	22.001	22.004	22.007	22.010	22.013	22.016	22.019	22.022	22.025	22.028	745
746	031	033	036	039	042	045	048	051	054	057	746
747	060	063	066	069	072	075	078	081	084	087	747
748	090	093	095	098	101	104	107	110	113	116	748
749	119	122	125	128	131	134	137	140	143	146	749

TABLE A7-1. PRESSURE CONVERSION, Mb. to $In._{45}$

1 $In._{45}$ Hg. (1 inch of Mercury at Lat. 45°, m.s.l.) = 33.8621 Millibars.

Pressure Mbs.	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	Pressure Mbs.
750	22.149	22.152	22.155	22.158	22.160	22.163	22.166	22.169	22.172	22.175	750
751	178	181	184	187	190	193	196	199	202	205	751
752	208	211	214	217	220	222	225	228	231	234	752
753	237	240	243	246	249	252	255	258	261	264	753
754	267	270	273	276	279	282	285	287	290	293	754
755	22.296	22.299	22.302	22.305	22.308	22.311	22.314	22.317	22.320	22.323	755
756	326	329	332	335	338	341	344	347	349	352	756
757	355	358	361	364	367	370	373	376	379	382	757
758	385	388	391	394	397	400	403	406	409	411	758
759	414	417	420	423	426	429	432	435	438	441	759
760	22.444	22.447	22.450	22.453	22.456	22.459	22.462	22.465	22.468	22.471	760
761	474	476	479	482	485	488	491	494	497	500	761
762	503	506	509	512	515	518	521	524	527	530	762
763	533	536	538	541	544	547	550	553	556	559	763
764	562	565	568	571	574	577	580	583	586	589	764
765	22.592	22.595	22.598	22.600	22.603	22.606	22.609	22.612	22.615	22.618	765
766	621	624	627	630	633	636	639	642	645	648	766
767	651	654	657	660	663	665	668	671	674	677	767
768	680	683	686	689	692	695	698	701	704	707	768
769	710	713	716	719	722	725	727	730	733	736	769
770	22.739	22.742	22.745	22.748	22.751	22.754	22.757	22.760	22.763	22.766	770
771	769	772	775	778	781	784	787	789	792	795	771
772	798	801	804	807	810	813	816	819	822	825	772
773	828	831	834	837	840	843	846	849	852	854	773
774	857	860	863	866	869	872	875	878	881	884	774
775	22.887	22.890	22.893	22.896	22.899	22.902	22.905	22.908	22.911	22.914	775
776	916	919	922	925	928	931	934	937	940	943	776
777	946	949	952	955	958	961	964	967	970	973	777
778	976	978	981	984	987	990	993	996	999	23.002	778
779	23.005	23.008	23.011	23.014	23.017	23.020	23.023	23.026	23.029	23.032	779
780	23.035	23.038	23.041	23.043	23.046	23.049	23.052	23.055	23.058	23.061	780
781	064	067	070	073	076	079	082	085	088	091	781
782	094	097	100	103	105	108	111	114	117	120	782
783	123	126	129	132	135	138	141	144	147	150	783
784	153	156	159	162	165	167	170	173	176	179	784
785	23.182	23.185	23.188	23.191	23.194	23.197	23.200	23.203	23.206	23.209	785
786	212	215	218	221	224	227	230	232	235	238	786
787	241	244	247	250	253	256	259	262	265	268	787
788	271	274	277	280	283	286	289	292	294	297	788
789	300	303	306	309	312	315	318	321	324	327	789
790	23.330	23.333	23.336	23.339	23.342	23.345	23.348	23.351	23.354	23.356	790
791	359	362	365	368	371	374	377	380	383	386	791
792	389	392	395	398	401	404	407	410	413	416	792
793	419	421	424	427	430	433	436	439	442	445	793
794	448	451	454	457	460	463	466	469	472	475	794
795	23.478	23.481	23.483	23.486	23.489	23.492	23.495	23.498	23.501	23.504	795
796	507	510	513	516	519	522	525	528	531	534	796
797	537	540	543	545	548	551	554	557	560	563	797
798	566	569	572	575	578	581	584	587	590	593	798
799	596	599	602	605	608	610	613	616	619	622	799

TABLE A7-1. PRESSURE CONVERSION, Mb. to $In._{45}$

1 $In._{45}$ Hg. (1 inch of Mercury at Lat. 45°, m.s.l.) = 33.8621 Millibars.

Pressure Mbs.	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	Pressure Mbs.
800	23.625	23.628	23.631	23.634	23.637	23.640	23.643	23.646	23.649	23.652	800
801	655	658	661	664	667	670	672	675	678	681	801
802	684	687	690	693	696	699	702	705	708	711	802
803	714	717	720	723	726	729	732	734	737	740	803
804	743	746	749	752	755	758	761	764	767	770	804
805	23.773	23.776	23.779	23.782	23.785	23.788	23.791	23.794	23.797	23.799	805
806	802	805	808	811	814	817	820	823	826	829	806
807	832	835	838	841	844	847	850	853	856	859	807
808	861	864	867	870	873	876	879	882	885	888	808
809	891	894	897	900	903	906	909	912	915	918	809
810	23.921	23.924	23.926	23.929	23.932	23.935	23.938	23.941	23.944	23.947	810
811	950	953	956	959	962	965	968	971	974	977	811
812	980	983	986	988	991	994	997	24.000	24.003	24.006	812
813	24.009	24.012	24.015	24.018	24.021	24.024	24.027	24.030	24.033	24.036	813
814	039	042	045	048	050	053	056	059	062	065	814
815	24.068	24.071	24.074	24.077	24.080	24.083	24.086	24.089	24.092	24.095	815
816	098	101	104	107	110	113	115	118	121	124	816
817	127	130	133	136	139	142	145	148	151	154	817
818	157	160	163	166	169	172	175	177	180	183	818
819	186	189	192	195	198	201	204	207	210	213	819
820	24.216	24.219	24.222	24.225	24.228	24.231	24.234	24.237	24.239	24.242	820
821	245	248	251	254	257	260	263	266	269	272	821
822	275	278	281	284	287	290	293	296	299	302	822
823	304	307	310	313	316	319	322	325	328	331	823
824	334	337	340	343	346	349	352	355	358	361	824
825	24.364	24.366	24.369	24.372	24.375	24.378	24.381	24.384	24.387	24.390	825
826	393	396	399	402	405	408	411	414	417	420	826
827	423	426	428	431	434	437	440	443	446	449	827
828	452	455	458	461	464	467	470	473	476	479	828
829	482	485	488	491	493	496	499	502	505	508	829
830	24.511	24.514	24.517	24.520	24.523	24.526	24.529	24.532	24.535	24.538	830
831	541	544	547	550	553	555	558	561	564	567	831
832	570	573	576	579	582	585	588	591	594	597	832
833	600	603	606	609	612	615	617	620	623	626	833
834	629	632	635	638	641	644	647	650	653	656	834
835	24.659	24.662	24.665	24.668	24.671	24.674	24.677	24.680	24.682	24.685	835
836	688	691	694	697	700	703	706	709	712	715	836
837	718	721	724	727	730	733	736	739	742	744	837
838	747	750	753	756	759	762	765	768	771	774	838
839	777	780	783	786	789	792	795	798	801	804	839
840	24.806	24.809	24.812	24.815	24.818	24.821	24.824	24.827	24.830	24.833	840
841	836	839	842	845	848	851	854	857	860	863	841
842	866	869	871	874	877	880	883	886	889	892	842
843	895	898	901	904	907	910	913	916	919	922	843
844	925	928	931	933	936	939	942	945	948	951	844
845	24.954	24.957	24.960	24.963	24.966	24.969	24.972	24.975	24.978	24.981	845
846	984	987	990	993	995	998	25.001	25.004	25.007	25.010	846
847	25.013	25.016	25.019	25.022	25.025	25.028	25.031	25.034	25.037	25.040	847
848	043	046	049	052	055	058	060	063	066	069	848
849	072	075	078	081	084	087	090	093	096	099	849

TABLE A7-1. PRESSURE CONVERSION, Mb. to $In._{45}$

1 $In._{45}$ Hg. (1 inch of Mercury at Lat. 45°, m.s.l.) = 33.8621 Millibars.

Pressure Mbs.	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	Pressure Mbs.
850	25.102	25.105	25.108	25.111	25.114	25.117	25.120	25.122	25.125	25.128	850
851	131	134	137	140	143	146	149	152	155	158	851
852	161	164	167	170	173	176	179	182	184	187	852
853	190	193	196	199	202	205	208	211	214	217	853
854	220	223	226	229	232	235	238	241	244	247	854
855	25.249	25.252	25.255	25.258	25.261	25.264	25.267	25.270	25.273	25.276	855
856	279	282	285	288	291	294	297	300	303	306	856
857	309	311	314	317	320	323	326	329	332	335	857
858	338	341	344	347	350	353	356	359	362	365	858
859	368	371	373	376	379	382	385	388	391	394	859
860	25.397	25.400	25.403	25.406	25.409	25.412	25.415	25.418	25.421	25.424	860
861	427	430	433	436	438	441	444	447	450	453	861
862	456	459	462	465	468	471	474	477	480	483	862
863	486	489	492	495	498	500	503	506	509	512	863
864	515	518	521	524	527	530	533	536	539	542	864
865	25.545	25.548	25.551	25.554	25.557	25.560	25.563	25.565	25.568	25.571	865
866	574	577	580	583	586	589	592	595	598	601	866
867	604	607	610	613	616	619	622	625	627	630	867
868	633	636	639	642	645	648	651	654	657	660	868
869	663	666	669	672	675	678	681	684	687	689	869
870	25.692	25.695	25.698	25.701	25.704	25.707	25.710	25.713	25.716	25.719	870
871	722	725	728	731	734	737	740	743	746	749	871
872	752	754	757	760	763	766	769	772	775	778	872
873	781	784	787	790	793	796	799	802	805	808	873
874	811	814	816	819	822	825	828	831	834	837	874
875	25.840	25.843	25.846	25.849	25.852	25.855	25.858	25.861	25.864	25.867	875
876	870	873	876	878	881	884	887	890	893	896	876
877	899	902	905	908	911	914	917	920	923	926	877
878	929	932	935	938	941	943	946	949	952	955	878
879	958	961	964	967	970	973	976	979	982	985	879
880	25.988	25.991	25.994	25.997	26.000	26.003	26.005	26.008	26.011	26.014	880
881	26.017	26.020	26.023	26.026	26.029	26.032	26.035	26.038	26.041	26.044	881
882	047	050	053	056	059	062	065	067	070	073	882
883	076	079	082	085	088	091	094	097	100	103	883
884	106	109	112	115	118	121	124	127	130	132	884
885	26.135	26.138	26.141	26.144	26.147	26.150	26.153	26.156	26.159	26.162	885
886	165	168	171	174	177	180	183	186	189	192	886
887	194	197	200	203	206	209	212	215	218	221	887
888	224	227	230	233	236	239	242	245	248	251	888
889	254	256	259	262	265	268	271	274	277	280	889
890	26.283	26.286	26.289	26.292	26.295	26.298	26.301	26.304	26.307	26.310	890
891	313	316	319	321	324	327	330	333	336	339	891
892	342	345	348	351	354	357	360	363	366	369	892
893	372	375	378	381	383	386	389	392	395	398	893
894	401	404	407	410	413	416	419	422	425	428	894
895	26.431	26.434	26.437	26.440	26.443	26.445	26.448	26.451	26.454	26.457	895
896	460	463	466	469	472	475	478	481	484	487	896
897	490	493	496	499	502	505	508	510	513	516	897
898	519	522	525	528	531	534	537	540	543	546	898
899	549	552	555	558	561	564	567	570	572	575	899

TABLE A7-1. PRESSURE CONVERSION, Mb. to $In._{45}$

1 $In._{45}$ Hg. (1 inch of Mercury at Lat. 45°, m.s.l.) = 33.8621 Millibars.

Pressure Mbs.	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	Pressure Mbs.
900	26.578	26.581	26.584	26.587	26.590	26.593	26.596	26.599	26.602	26.605	900
901	608	611	614	617	620	623	626	629	632	634	901
902	637	640	643	646	649	652	655	658	661	664	902
903	667	670	673	676	679	682	685	688	691	694	903
904	697	699	702	705	708	711	714	717	720	723	904
905	26.726	26.729	26.732	26.735	26.738	26.741	26.744	26.747	26.750	26.753	905
906	756	759	761	764	767	770	773	776	779	782	906
907	785	788	791	794	797	800	803	806	809	812	907
908	815	818	821	823	826	829	832	835	838	841	908
909	844	847	850	853	856	859	862	865	868	871	909
910	26.874	26.877	26.880	26.883	26.886	26.888	26.891	26.894	26.897	26.900	910
911	903	906	909	912	915	918	921	924	927	930	911
912	933	936	939	942	945	948	950	953	956	959	912
913	962	965	968	971	974	977	980	983	986	989	913
914	992	995	998	27.001	27.004	27.007	27.010	27.012	27.015	27.018	914
915	27.021	27.024	27.027	27.030	27.033	27.036	27.039	27.042	27.045	27.048	915
916	051	054	057	060	063	066	069	072	075	077	916
917	080	083	086	089	092	095	098	101	104	107	917
918	110	113	116	119	122	125	128	131	134	137	918
919	139	142	145	148	151	154	157	160	163	166	919
920	27.169	27.172	27.175	27.178	27.181	27.184	27.187	27.190	27.193	27.196	920
921	199	202	204	207	210	213	216	219	222	225	921
922	228	231	234	237	240	243	246	249	252	255	922
923	258	261	264	266	269	272	275	278	281	284	923
924	287	290	293	296	299	302	305	308	311	314	924
925	27.317	27.320	27.323	27.326	27.328	27.331	27.334	27.337	27.340	27.343	925
926	346	349	352	355	358	361	364	367	370	373	926
927	376	379	382	385	388	391	393	396	399	402	927
928	405	408	411	414	417	420	423	426	429	432	928
929	435	438	440	444	447	450	453	455	458	461	929
930	27.464	27.467	27.470	27.473	27.476	27.479	27.482	27.485	27.488	27.491	930
931	494	497	500	503	506	509	512	515	517	520	931
932	523	526	529	532	535	538	541	544	547	550	932
933	553	556	559	562	565	568	571	574	577	580	933
934	582	585	588	591	594	597	600	603	606	609	934
935	27.612	27.615	27.618	27.621	27.624	27.627	27.630	27.633	27.636	27.639	935
936	642	644	647	650	653	656	659	662	665	668	936
937	671	674	677	680	683	686	689	692	695	698	937
938	701	704	706	709	712	715	718	721	724	727	938
939	730	733	736	739	742	745	748	751	754	757	939
940	27.760	27.763	27.766	27.769	27.771	27.774	27.777	27.780	27.783	27.786	940
941	789	792	795	798	801	804	807	810	813	816	941
942	819	822	825	828	831	833	836	839	842	845	942
943	848	851	854	857	860	863	866	869	872	875	943
944	878	881	884	887	890	893	895	898	901	904	944
945	27.907	27.910	27.913	27.916	27.919	27.922	27.925	27.928	27.931	27.934	945
946	937	940	943	946	949	952	955	958	960	963	946
947	966	969	972	975	978	981	984	987	990	993	947
948	996	999	28.002	28.005	28.008	28.011	28.014	28.017	28.020	28.022	948
949	28.025	28.028	28.031	28.034	28.037	28.040	28.043	28.046	28.049	28.052	949

TABLE A7-1. PRESSURE CONVERSION, Mb. to $In._{45}$

1 $In._{45}$ Hg. (1 inch of Mercury at Lat. 45°, m.s.l.) = 33.8621 Millibars

Pressure Mbs.	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	Pressure Mbs.
950	28.055	28.058	28.061	28.064	28.067	28.070	28.073	28.076	28.079	28.082	950
951	084	087	090	093	096	099	102	105	108	111	951
952	114	117	120	123	126	129	132	135	138	141	952
953	144	147	149	152	155	158	161	164	167	170	953
954	173	176	179	182	185	188	191	194	197	200	954
955	28.203	28.206	28.209	28.211	28.214	28.217	28.220	28.223	28.226	28.229	955
956	232	235	238	241	244	247	250	253	256	259	956
957	262	265	268	271	273	276	279	282	285	288	957
958	291	294	297	300	303	306	309	312	315	318	958
959	321	324	327	330	333	336	338	341	344	347	959
960	28.350	28.353	28.356	28.359	28.362	28.365	28.368	28.371	28.374	28.377	960
961	380	383	386	389	392	395	398	400	403	406	961
962	409	412	415	418	421	424	427	430	433	436	962
963	439	442	445	448	451	454	457	460	462	465	963
964	468	471	474	477	480	483	486	489	492	495	964
965	28.498	28.501	28.504	28.507	28.510	28.513	28.516	28.519	28.522	28.525	965
966	527	530	533	536	539	542	545	548	551	554	966
967	557	560	563	566	569	572	575	578	581	584	967
968	587	589	592	595	598	601	604	607	610	613	968
969	616	619	622	625	628	631	634	637	640	643	969
970	28.646	28.649	28.652	28.654	28.657	28.660	28.663	28.666	28.669	28.672	970
971	675	678	681	684	687	690	693	696	699	702	971
972	705	708	711	714	716	719	722	725	728	731	972
973	734	737	740	743	746	749	752	755	758	761	973
974	764	767	770	773	776	778	781	784	787	790	974
975	28.793	28.796	28.799	28.802	28.805	28.808	28.811	28.814	28.817	28.820	975
976	823	826	829	832	835	838	841	843	846	849	976
977	852	855	858	861	864	867	870	873	876	879	977
978	882	885	888	891	894	897	900	903	905	908	978
979	911	914	917	920	923	926	929	932	935	938	979
980	28.941	28.944	28.947	28.950	28.953	28.956	28.959	28.962	28.965	28.967	980
981	970	973	976	979	982	985	988	991	994	997	981
982	29.000	29.003	29.006	29.009	29.012	29.015	29.018	29.021	29.024	29.027	982
983	030	032	035	038	041	044	047	050	053	056	983
984	059	062	065	068	071	074	077	080	083	086	984
985	29.089	29.092	29.094	29.097	29.100	29.103	29.106	29.109	29.112	29.115	985
986	118	121	124	127	130	133	136	139	142	145	986
987	148	151	154	156	159	162	165	168	171	174	987
988	177	180	183	186	189	192	195	198	201	204	988
989	207	210	213	216	219	221	224	227	230	233	989
990	29.236	29.239	29.242	29.245	29.248	29.251	29.254	29.257	29.260	29.263	990
991	266	269	272	275	278	281	283	286	289	292	991
992	295	298	301	304	307	310	313	316	319	322	992
993	325	328	331	334	337	340	343	345	348	351	993
994	354	357	360	363	366	369	372	375	378	381	994
995	29.384	29.387	29.390	29.393	29.396	29.399	29.402	29.405	29.408	29.410	995
996	413	416	419	422	425	428	431	434	437	440	996
997	443	446	449	452	455	458	461	464	467	470	997
998	472	475	478	481	484	487	490	493	496	499	998
999	502	505	508	511	514	517	520	523	526	529	999

TABLE A7-1. PRESSURE CONVERSION, Mb. to $In._{45}$

1 $In._{45}$ Hg. (1 inch of Mercury at Lat. 45°, m.s.l.) = 33.8621 Millibars.

Pressure Mbs.	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	Pressure Mbs.
1000	29.532	29.534	29.537	29.540	29.543	29.546	29.549	29.552	29.555	29.558	1000
1001	561	564	567	570	573	576	579	582	585	588	1001
1002	591	594	597	599	602	605	608	611	614	617	1002
1003	620	623	626	629	632	635	638	641	644	647	1003
1004	650	653	656	659	661	664	667	670	673	676	1004
1005	29.679	29.682	29.685	29.688	29.691	29.694	29.697	29.700	29.703	29.706	1005
1006	709	712	715	718	721	723	726	729	732	735	1006
1007	738	741	744	747	750	753	756	759	762	765	1007
1008	768	771	774	777	780	783	786	788	791	794	1008
1009	797	800	803	806	809	812	815	818	821	824	1009
1010	29.827	29.830	29.833	29.836	29.839	29.842	29.845	29.848	29.850	29.853	1010
1011	856	859	862	865	868	871	874	877	880	883	1011
1012	886	889	892	895	898	901	904	907	910	912	1012
1013	915	918	921	924	927	930	933	936	939	942	1013
1014	945	948	951	954	957	960	963	966	969	972	1014
1015	29.975	29.977	29.980	29.983	29.986	29.989	29.992	29.995	29.998	30.001	1015
1016	30.004	30.007	30.010	30.013	30.016	30.019	30.022	30.025	30.028	30.031	1016
1017	034	037	039	042	045	048	051	054	057	060	1017
1018	063	066	069	072	075	078	081	084	087	090	1018
1019	093	096	099	101	104	107	110	113	116	119	1019
1020	30.122	30.125	30.128	30.131	30.134	30.137	30.140	30.143	30.146	30.149	1020
1021	152	155	158	161	164	166	169	172	175	178	1021
1022	181	184	187	190	193	196	199	202	205	208	1022
1023	211	214	217	220	223	226	228	231	234	237	1023
1024	240	243	246	249	252	255	258	261	264	267	1024
1025	30.270	30.273	30.276	30.279	30.282	30.285	30.288	30.291	30.293	30.296	1025
1026	299	302	305	308	311	314	317	320	323	326	1026
1027	329	332	335	338	341	344	347	350	353	355	1027
1028	358	361	364	367	370	373	376	379	382	385	1028
1029	388	391	394	397	400	403	406	409	412	415	1029
1030	30.417	30.420	30.423	30.426	30.429	30.432	30.435	30.438	30.441	30.444	1030
1031	447	450	453	456	459	462	465	468	471	474	1031
1032	477	480	482	485	488	491	494	497	500	503	1032
1033	506	509	512	515	518	521	524	527	530	533	1033
1034	536	539	542	544	547	550	553	556	559	562	1034
1035	30.565	30.568	30.571	30.574	30.577	30.580	30.583	30.586	30.589	30.592	1035
1036	595	598	601	604	606	609	612	615	618	621	1036
1037	624	627	630	633	636	639	642	645	648	651	1037
1038	654	657	660	663	666	669	671	674	677	680	1038
1039	683	686	689	692	695	698	701	704	707	710	1039
1040	30.713	30.716	30.719	30.722	30.725	30.728	30.731	30.733	30.736	30.739	1040
1041	742	745	748	751	754	757	760	763	766	769	1041
1042	772	775	778	781	784	787	790	793	795	798	1042
1043	801	804	807	810	813	816	819	822	825	828	1043
1044	831	834	837	840	843	846	849	852	855	858	1044
1045	30.860	30.863	30.866	30.869	30.872	30.875	30.878	30.881	30.884	30.887	1045
1046	890	893	896	899	902	905	908	911	914	917	1046
1047	920	922	925	928	931	934	937	940	943	946	1047
1048	949	952	955	958	961	964	967	970	973	976	1048
1049	979	982	984	987	990	993	996	999	31.002	31.005	1049

TABLE A7-1. PRESSURE CONVERSION, Mb. to $In._{45}$

1 $In._{45}$ Hg. (1 inch of Mercury at Lat. 45°, m.s.l.) = 33.8621 Millibars.

Pressure Mbs.	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	Pressure Mbs.
1050	31.008	31.011	31.014	31.017	31.020	31.023	31.026	31.029	31.032	31.035	1050
1051	038	041	044	047	049	052	055	058	061	064	1051
1052	067	070	073	076	079	082	085	088	091	094	1052
1053	097	100	103	106	109	111	114	117	120	123	1053
1054	126	129	132	135	138	141	144	147	150	153	1054
1055	31.156	31.159	31.162	31.165	31.168	31.171	31.173	31.176	31.179	31.182	1055
1056	185	188	191	194	197	200	203	206	209	212	1056
1057	215	218	221	224	227	230	233	236	238	241	1057
1058	244	247	250	253	256	259	262	265	268	271	1058
1059	274	277	280	283	286	289	292	295	298	300	1059
1060	31.303	31.306	31.309	31.312	31.315	31.318	31.321	31.324	31.327	31.330	1060
1061	333	336	339	342	345	348	351	354	357	360	1061
1062	362	365	368	371	374	377	380	383	386	389	1062
1063	392	395	398	401	404	407	410	413	416	419	1063
1064	422	425	427	430	433	436	439	442	445	448	1064
1065	31.451	31.454	31.457	31.460	31.463	31.466	31.469	31.472	31.475	31.478	1065
1066	481	484	487	489	492	495	498	501	504	507	1066
1067	510	513	516	519	522	525	528	531	534	537	1067
1068	540	543	546	549	551	554	557	560	563	566	1068
1069	569	572	575	578	581	584	587	590	593	596	1069

Table A7-2. Correction for lapse rate and humidity (for use in computation of height of 850-millibar surface)

Station Pressure (Inches)	Temperature °F																Station Pressure (inches)
	-50	-45	-40	-35	-30	-25	-20	-15	-10	- 5	0	+ 5	+10	+15	+20	+25	
20.60	+6	+6	+6	+6	+6	+6	+6	+6	+7	+7	+7	+7	+7	+8	+8	+8	20.60
20.70	6	6	6	6	6	6	6	6	6	7	7	7	7	7	8	8	20.70
20.80	6	6	6	6	6	6	6	6	6	6	7	7	7	7	7	8	20.80
20.90	5	6	6	6	6	6	6	6	6	6	6	7	7	7	7	7	20.90
21.00	5	5	5	6	6	6	6	6	6	6	6	6	7	7	7	7	21.00
21.10	5	5	5	5	6	6	6	6	6	6	6	6	6	7	7	7	21.10
21.20	5	5	5	5	5	5	6	6	6	6	6	6	6	6	7	7	21.20
21.30	5	5	5	5	5	5	5	5	6	6	6	6	6	6	6	7	21.30
21.40	5	5	5	5	5	5	5	5	5	5	6	6	6	6	6	7	21.40
21.50	5	5	5	5	5	5	5	5	5	5	5	6	6	6	6	6	21.50
21.60	4	4	5	5	5	5	5	5	5	5	5	5	6	6	6	6	21.60
21.70	4	4	4	4	5	5	5	5	5	5	5	5	5	6	6	6	21.70
21.80	4	4	4	4	4	4	5	5	5	5	5	5	5	5	6	6	21.80
21.90	4	4	4	4	4	4	4	4	4	5	5	5	5	5	5	6	21.90
22.00	4	4	4	4	4	4	4	4	4	4	5	5	5	5	5	6	22.00
22.10	4	4	4	4	4	4	4	4	4	4	4	5	5	5	5	5	22.10
22.20	4	4	4	4	4	4	4	4	4	4	4	4	5	5	5	5	22.20
22.30	4	4	4	4	4	4	4	4	4	4	4	4	4	5	5	5	22.30
22.40	3	3	3	4	4	4	4	4	4	4	4	4	4	4	5	5	22.40
22.50	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	5	22.50
22.60	3	3	3	3	3	3	3	4	4	4	4	4	4	4	4	5	22.60
22.70	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	22.70
22.80	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	22.80
22.90	3	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	22.90
23.00	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	4	23.00
23.10	2	2	2	3	3	3	3	3	3	3	3	3	3	3	4	4	23.10
23.20	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	4	23.20
23.30	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	23.30
23.40	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	23.40
23.50	+2	+2	+2	+2	+2	+2	+2	+2	+2	+2	+2	+2	+3	+3	+3	+3	23.50

Table A7-2. Correction for lapse rate and humidity (for use in computation of height of 850-millibar surface) (continued)

Station Pressure (Inches)	Temperature °F															Station Pressure (Inches)
	+30	+35	+40	+45	+50	+55	+60	+65	+70	+75	+80	+85	+90	+95	+100	
20.60	+8	+9	+9	+10	+ 10	+11	+12	+12	+13	+14	+14	+14	+14	+14	+14	20.60
20.70	8	9	9	10	10	11	12	12	13	14	14	14	14	14	14	20.70
20.80	8	8	9	9	10	11	11	12	13	13	14	14	14	14	14	20.80
20.90	8	8	9	9	10	10	11	12	12	13	13	14	14	13	13	20.90
21.00	8	8	8	9	10	10	11	11	12	13	13	13	13	13	13	21.00
21.10	8	8	8	9	9	10	11	11	12	13	13	13	13	13	13	21.10
21.20	7	8	8	9	9	10	10	11	12	12	12	13	13	13	13	21.20
21.30	7	8	8	8	9	10	10	11	12	12	12	13	12	12	12	21.30
21.40	7	7	8	8	9	9	10	10	11	12	12	12	12	12	12	21.40
21.50	7	7	8	8	8	9	10	10	11	12	12	12	12	12	12	21.50
21.60	6	7	7	8	8	9	10	10	11	11	12	12	12	12	12	21.60
21.70	6	7	7	8	8	9	9	10	11	11	11	12	12	11	11	21.70
21.80	6	7	7	7	8	8	9	10	10	11	11	11	11	11	11	21.80
21.90	6	6	7	7	8	8	9	9	10	11	11	11	11	11	11	21.90
22.00	6	6	7	7	7	8	9	9	10	10	11	11	11	11	11	22.00
22.10	6	6	6	7	7	8	9	9	10	10	10	11	11	10	10	22.10
22.20	5	6	6	7	7	8	8	9	10	10	10	10	10	10	10	22.20
22.30	5	6	6	6	7	8	8	8	9	10	10	10	10	10	10	22.30
22.40	5	6	6	6	7	7	8	8	9	10	10	10	10	10	10	22.40
22.50	5	5	6	6	6	7	8	8	9	9	10	10	10	10	10	22.50
22.60	5	5	6	6	6	7	8	8	9	9	9	10	10	9	9	22.60
22.70	5	5	5	6	6	7	7	8	8	9	9	9	9	9	9	22.70
22.80	4	5	5	6	6	6	7	8	8	9	9	9	9	9	9	22.80
22.90	4	5	5	6	6	6	7	7	8	8	9	9	9	9	9	22.90
23.00	4	4	5	5	6	6	7	7	8	8	8	9	9	8	8	23.00
23.10	4	4	5	5	6	6	6	7	8	8	8	8	8	8	8	23.10
23.20	4	4	4	5	5	6	6	7	7	8	8	8	8	8	8	23.20
23.30	4	4	4	5	5	6	6	6	7	8	8	8	8	8	8	23.30
23.40	4	4	4	5	5	5	6	6	7	7	8	8	8	8	8	23.40
23.50	+3	+4	+4	+4	+5	+5	+6	+6	+7	+7	+7	+8	+8	+7	+7	23.50

Table A7-2. Correction for lapse rate and humidity (for use in computation of height of 850-millibar surface) (continued)

Station Pressure (Inches)	Temperature °F																Station Pressure (Inches)
	-50	-45	-40	-35	-30	-25	-20	-15	-10	- 5	0	+ 5	+10	+15	+20	+25	
23.60	+2	+2	+2	+2	+2	+2	+2	+2	+2	+2	+2	+2	+2	+3	+3	+3	23.60
23.70	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	23.70
23.80	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	23.80
23.90	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	23.90
24.00	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	24.00
24.10	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	24.10
24.20	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	24.20
24.30	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	24.30
24.40	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	24.40
24.50	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	24.50
24.60	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	24.60
24.70	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	24.70
24.80	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	24.80
24.90	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	24.90
25.00	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	25.00
25.10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+1	+1	25.10
25.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+1	25.20
25.30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25.30
25.40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25.40
25.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25.50
25.60	-1	-1	-1	-1	-1	-1	0	0	0	0	0	0	0	0	0	0	25.60
25.70	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	0	0	0	25.70
25.80	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	0	0	25.80
25.90	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	25.90
26.00	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	26.00
26.10	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	26.10
26.20	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	26.20
26.30	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	26.30
26.40	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-1	-1	-1	-1	26.40
26.50	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-1	-1	-1	26.50

Table A7-2. Correction for lapse rate and humidity (for use in computation of height of 850-millibar surface) (continued)

Station Pressure (Inches)	Temperature °F															Station Pressure (Inches)
	+30	+35	+40	+45	+50	+55	+60	+65	+70	+75	+80	+85	+90	+95	+100	
23.60	+3	+4	+4	+4	+5	+5	+6	+6	+7	+7	+7	+7	+7	+7	+7	23.60
23.70	3	3	4	4	4	5	6	6	6	7	7	7	7	7	7	23.70
23.80	3	3	4	4	4	5	5	6	6	7	7	7	7	7	7	23.80
23.90	3	3	3	4	4	4	5	5	6	6	6	7	7	7	7	23.90
24.00	3	3	3	4	4	4	5	5	6	6	6	6	6	6	6	24.00
24.10	2	3	3	3	4	4	5	5	6	6	6	6	6	6	6	24.10
24.20	2	3	3	3	4	4	4	5	5	6	6	6	6	6	6	24.20
24.30	2	2	3	3	3	4	4	5	5	6	6	6	6	6	6	24.30
24.40	2	2	2	3	3	4	4	4	5	5	6	6	6	5	5	24.40
24.50	2	2	2	3	3	3	4	4	5	5	5	6	5	5	5	24.50
24.60	2	2	2	2	3	3	4	4	5	5	5	5	5	5	5	24.60
24.70	1	2	2	2	3	3	4	4	4	5	5	5	5	5	5	24.70
24.80	1	2	2	2	2	3	3	4	4	5	5	5	5	5	5	24.80
24.90	1	2	2	2	2	3	3	4	4	4	4	5	5	4	4	24.90
25.00	1	1	2	2	2	2	3	3	4	4	4	4	4	4	4	25.00
25.10	1	1	1	2	2	2	3	3	4	4	4	4	4	4	4	25.10
25.20	1	1	1	2	2	2	3	3	4	4	4	4	4	4	4	25.20
25.30	1	1	1	1	2	2	3	3	3	4	4	4	4	4	4	25.30
25.40	0	1	1	1	2	2	2	3	3	4	4	4	4	4	4	25.40
25.50	0	1	1	1	1	2	2	2	3	3	4	4	4	3	3	25.50
25.60	0	0	1	1	1	2	2	2	3	3	3	4	3	3	3	25.60
25.70	0	0	0	1	1	2	2	2	3	3	3	3	3	3	3	25.70
25.80	0	0	0	1	1	1	2	2	2	3	3	3	3	3	3	25.80
25.90	0	0	0	0	1	1	2	2	2	3	3	3	3	3	3	25.90
26.00	0	0	0	0	1	1	1	2	2	2	3	3	3	2	2	26.00
26.10	-1	0	0	0	0	+1	1	2	2	2	2	2	2	2	2	26.10
26.20	-1	0	0	0	0	+1	1	1	2	2	2	2	2	2	2	26.20
26.30	-1	0	0	0	0	0	+1	1	2	2	2	2	2	2	2	26.30
26.40	-1	-1	0	0	0	0	+1	1	2	2	2	2	2	2	2	26.40
26.50	-1	-1	-1	0	0	0	+1	1	1	2	2	2	2	2	2	26.50

Table A7-2. Correction for lapse rate and humidity (for use in computation of height of 850-millibar surface) (continued)

Station Pressure (Inches)	Temperature °F																Station Pressure (Inches)
	-50	-45	-40	-35	-30	-25	-20	-15	-10	- 5	0	+ 5	+10	+15	+20	+25	
26.60	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-1	26.60
26.70	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	26.70
26.80	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	26.80
26.90	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	26.90
27.00	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	27.00
27.10	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	27.10
27.20	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	27.20
27.30	-2	-2	-2	-2	-3	-3	-2	-3	-3	-3	-3	-3	-2	-2	-2	-2	27.30
27.40	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-2	-2	27.40
27.50	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	27.50
27.60	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	27.60
27.70	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	27.70
27.80	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	27.80
27.90	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	27.90
28.00	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	28.00
28.10	-3	-3	-3	-3	-4	-4	-3	-4	-4	-4	-4	-4	-4	-3	-4	-3	28.10
28.20	-3	-3	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-3	28.20
28.30	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	28.30
28.40	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	28.40
28.50	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	28.50
28.60	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	28.60
28.70	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	28.70
28.80	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	28.80
28.90	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	28.90
29.00	-4	-4	-4	-4	-4	-4	-4	-4	-4	-5	-5	-5	-4	-5	-4	-4	29.00
29.10	-4	-4	-4	-4	-4	-5	-4	-5	-5	-5	-5	-5	-5	-5	-5	-5	29.10
29.20	-4	-4	-4	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	29.20
29.30	-4	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	29.30
29.40	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	29.40
29.50	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	29.50

Table A7-2. Correction for lapse rate and humidity (for use in computation of height of 850-millibar surface) (continued)

Station Pressure (Inches)	Temperature °F															Station Pressure Inches
	+30	+35	+40	+45	+50	+55	+60	+65	+70	+75	+80	+85	+90	+95	+100	
26.60	-1	-1	-1	-1	0	0	0	+1	+1	+2	+2	+2	+2	+1	+1	26.60
26.70	-1	-1	-1	-1	0	0	0	0	+1	1	1	2	1	1	1	26.70
26.80	-2	-1	-1	-1	-1	0	0	0	+1	1	1	1	1	1	1	26.80
26.90	-2	-1	-1	-1	-1	0	0	0	+1	1	1	1	1	1	1	26.90
27.00	-2	-2	-1	-1	-1	-1	0	0	0	+1	1	1	1	1	1	27.00
27.10	-2	-2	-2	-1	-1	-1	0	0	0	+1	1	1	1	0	0	27.10
27.20	-2	-2	-2	-1	-1	-1	0	0	0	0	0	+1	0	0	0	27.20
27.30	-2	-2	-2	-2	-1	-1	-1	0	0	0	0	0	0	0	0	27.30
27.40	-2	-2	-2	-2	-2	-1	-1	-1	0	0	0	0	0	0	0	27.40
27.50	-2	-2	-2	-2	-2	-1	-1	-1	0	0	0	0	0	0	0	27.50
27.60	-3	-2	-2	-2	-2	-2	-1	-1	0	0	0	0	0	0	0	27.60
27.70	-3	-2	-2	-2	-2	-2	-1	-1	-1	0	0	0	0	0	0	27.70
27.80	-3	-3	-2	-2	-2	-2	-1	-1	-1	-1	0	0	0	-1	-1	27.80
27.90	-3	-3	-3	-2	-2	-2	-2	-1	-1	-1	-1	-1	-1	-1	-1	27.90
28.00	-3	-3	-3	-2	-2	-2	-2	-2	-1	-1	-1	-1	-1	-1	-1	28.00
28.10	-3	-3	-3	-3	-2	-2	-2	-2	-1	-1	-1	-1	-1	-1	-1	28.10
28.20	-3	-3	-3	-3	-3	-2	-2	-2	-1	-1	-1	-1	-1	-1	-1	28.20
28.30	-4	-3	-3	-3	-3	-2	-2	-2	-2	-1	-1	-1	-1	-2	-2	28.30
28.40	-4	-3	-3	-3	-3	-3	-2	-2	-2	-2	-1	-1	-2	-2	-2	28.40
28.50	-4	-4	-3	-3	-3	-3	-2	-2	-2	-2	-2	-2	-2	-2	-2	28.50
28.60	-4	-4	-4	-3	-3	-3	-3	-2	-2	-2	-2	-2	-2	-2	-2	28.60
28.70	-4	-4	-4	-4	-3	-3	-3	-3	-2	-2	-2	-2	-2	-2	-2	28.70
28.80	-4	-4	-4	-4	-4	-3	-3	-3	-2	-2	-2	-2	-2	-2	-2	28.80
28.90	-4	-4	-4	-4	-4	-3	-3	-3	-2	-2	-2	-2	-2	-2	-2	28.90
29.00	-4	-4	-4	-4	-4	-4	-3	-3	-3	-2	-2	-2	-2	-3	-3	29.00
29.10	-4	-4	-4	-4	-4	-4	-3	-3	-3	-2	-3	-2	-3	-3	-3	29.10
29.20	-5	-4	-4	-4	-4	-4	-3	-3	-3	-3	-3	-3	-3	-3	-3	29.20
29.30	-5	-4	-4	-4	-4	-4	-4	-4	-3	-3	-3	-3	-3	-3	-3	29.30
29.40	-5	-5	-5	-4	-4	-4	-4	-4	-3	-3	-3	-3	-3	-3	-3	29.40
29.50	-5	-5	-5	-5	-4	-4	-4	-4	-3	-3	-3	-3	-3	-3	-3	29.50

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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 one-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-lamp (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 one-minute interval.

8200. DETERMINATION OF SPEED

8210. General.--Speed of the surface wind will be determined to the nearest statute mile per hour. So far as possible, average wind speed observations will not be taken during periods of extreme wind speeds - either high or low.

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 one-minute average speed will be made by one of the following methods. At stations having two or more types of equipment, observe the following priority in selecting the equipment to be used.

(1) Direct-reading equipment

(2) Condenser-discharge equipment.

(3) Nine-light indicator.

(5) Other.

8231. Using the 1/60 mile indicator, count the number of times the center lamp lights or the buzzer sounds during an exact 60-second interval. Apply the correction, from Table 14a appropriate to the type of anemometer in use.

Table 14b. Corrections to indicated wind speeds (1/60-mile anemometers).

Corrections in whole m.p.h.	Speed Indicated				Corrections in whole m.p.h.
	3-cup, F101 or F102, "S" type anemometer m.p.h.††	4-cup anemometer m.p.h.	Beaded, 4-cup anemometer m.p.h.	F103, "SA" type, small anemometer m.p.h. ††	
+1	†0-16	†0-8	†0-5	†0-35	+1
0	17-26	9-12	6-13	35-57	0
-1	27-35	13-16	14-20	(Correc-	-1
-2	36-44	17-20	21-27	tions for	-2
-3	45-52	21-24	28-34	higher	-3
-4	53-61	25-28	35-41	velocities	-4
-5	62-70	29-32	42-48	not deter-	-5
-6	71-79	33-36	49-55	mined; use	-6
-7	80-87	37-39	56-62	zero.)	-7
-8	88-96	40-43	63-69		-8
-9	97-105	44-47	70-75		-9
-10	106-114	48-51	76-82		-10
-11	115-122	52-54	83-89		-11
-12	123-132	55-58	90-96		-12
-13	133-139	59-62	97-103		-13
-14	140-149	63-65	104-110		-14
-15	150-157	66-69	111-117		-15
-16	158-166	70-73	118-124		-16
-17	167-174	74-77	125-131		-17
-18	175-184	78-80	132-138		-18
-19	185-192	81-84	139-145		-19
-20	193-200	85-88	146-152		-20
-21		89-91	153-158		-21
-22		92-95	159-165		-22
-23		96-99	166-171		-23
-24		100-103	172-178		-24
-25		104-106	179-185		-25
-26		107-110	186-192		-26
-27		111-114	193-200		-27
-28		115-117			-28
-29		118-121			-29
-30		122-125			-30
-31		126-128			-31
-32		129-132			-32
-33		133-136			-33
-34		137-140			-34
-35		141-143			-35

† Movement of anemometer cups observed.

†† When used with F210 or F222 (Gurley condenser-discharge type) indicators (see ¶ A8320), use correction Table 15.

8232. Condenser-discharge indicators give an uncorrected average 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 average 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)

F101 or F102 (Type "S") anemometer		F103 (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 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 for a one-minute period and determine an average value. Apply to the average value the correction furnished for the particular instrument. (See Table A8-1.)

8235. Assume zero correction for anemometers for which no correction tables have been furnished.

8236. Estimate the wind speed when it is less than the starting speed of the anemometer.

Table A8-1. Wind-Speed Corrections

Indicator or Wind System	Uncorrected Speed (m.p.h.)	Correction (m.p.h.)
F420 †	2.5 to 75	0
	5.0 to 150 (Double Range)	-3
F420A †	2.0 to 75	0
	4.0 to 150 (Double Range)	-2
F430 †	3 to 75	0
	6 to 150 (Double Range)	-3
F431 † (Bendix-Friez Windial)	0 to 10	+3
	11 to 20	+2
	21 to 25	+1
	26 to 60	0
	61 to 65	+1
	66 and above	+2

† Corrections are based on adjustment of the pointer, under calm conditions, to the lowest indicated speed given in this table for the type of indicator in use.

8300. CHARACTER OF WIND

8310. Gustiness.--Gustiness is characterized by sudden, intermittent increases in speed, with at least 10 mph variation (corrected) between peaks and lulls. The peak speed must reach at least 19 mph and the average time interval between peaks and lulls should usually not exceed twenty seconds. (See ¶ 3310.)

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. The peak gust is the highest speed momentarily

indicated, without regard to the duration of the gust. 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.

8330. Wind Shifts.--Wind shifts, as defined and used in this manual, are usually 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 counterclockwise in the Southern Hemisphere).

(2) Rapid drop in the dew point.

(3) Rapid drop in temperature.

(4) Rapid rise in pressure.

(5) In summer; lightning, 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.

8400. ENTRIES ON WBAN-10

8410. Wind Direction (Col. 9).--Enter the wind direction to sixteen points of the compass by means of one or two short arrows, as shown in Table 16. When the wind is calm, make no entry in this column.

Table 16. 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

8420. Wind Speed (Col. 10).--Enter wind speed in statute miles per hour. If the wind is estimated enter the letter E immediately following the speed. Enter C for calm.

8430. Gustiness (Col. 11).--Report gusts by the symbol "+" immediately after the one-minute wind speed. Enter the peak speed of gusts observed during the past 15 minutes immediately after this symbol. (See Fig. 6.) These data will be reported when they occur regardless of the type of wind equipment used. If estimated, enter E in accordance with ¶ 8420.

8440. Shifts (Col. 11).--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. Since the space provided in column 11 is not sufficient for wind-shift data, distribute all wind data evenly among columns 9, 10, 11; e.g., "↘25+40↖1614C" in these columns would indicate a wind shift from southeast to northwest at 1614 CST.

8450. Squalls (Col. 11).--Report squalls by the symbol "Q" immediately following the one-minute wind speed and preceding the peak speed of gusts observed during the past 15 minutes (see Fig. 6 and Sec. 3300).

A8000. MAGNETIC WIND DIRECTIONS

A8010. General.--Wind directions used for meteorological purposes are with reference to true north. Wind directions with reference to the magnetic north pole are sometimes required by CAA communications personnel providing air-ground communication service.

A8011. Evaluation.--Wind directions relative to true north are converted to wind directions, magnetic, in accordance with Table A8-1a

Table A8-1a. Conversion Between Magnetic and True Wind Directions.

True Dir.	Declination †							True Dir.
	East			11°E to 11°W same as True Direction	West			
	78°-57°	56°-34°	33°-12°		12°-33°	34°-56°	57°-78°	
N	WNW	NW	NNW	N	NNE	NE	ENE	N
NNE	NW	NNW	N	NNE	NE	ENE	E	NNE
NE	NNW	N	NNE	NE	ENE	E	ESE	NE
ENE	N	NNE	NE	ENE	E	ESE	SE	ENE
E	NNE	NE	ENE	E	ESE	SE	SSE	E
ESE	NE	ENE	E	ESE	SE	SSE	S	ESE
SE	ENE	E	ESE	SE	SSE	S	SSW	SE
SSE	E	ESE	SE	SSE	S	SSW	SW	SSE
S	ESE	SE	SSE	S	SSW	SW	WSW	S
SSW	SE	SSE	S	SSW	SW	WSW	W	SSW
SW	SSE	S	SSW	SW	WSW	W	WNW	SW
WSW	S	SSW	SW	WSW	W	WNW	NW	WSW
W	SSW	SW	WSW	W	WNW	NW	NNW	W
WNW	SW	WSW	W	WNW	NW	NNW	N	WNW
NW	WSW	W	WNW	NW	NNW	N	NNE	NW
NNW	W	WNW	NW	NNW	N	NNE	NE	NNW

† Note that the declination is East at all points West of the agonic line, and West at all points East of the line. Note that for declinations of 79-101, 102-123, 124-146, 147-168, and 169-180 degrees, the magnetic direction continues clockwise or counterclockwise from the true direction in the same sense and in the same increments shown above.

A8100. INSTRUMENTAL

A8110. Exposure and Related Maintenance.--So far as available sites permit, wind sensing equipment will be placed 30 to 35 feet above the ground on a freely exposed tower, and over terrain that is relatively level and free from obstructions to wind flow. In general, obstructions include hills or other objects whose height above the ground at the exposure site is not more than one-tenth their distance from the site. Avoid sites where topography or other obstructions are known to create appreciable up-or-down drafts, eddy currents, or jet-flow effects. When a compromise must be made, expose the sensing units at least 12 feet above any obstruction within 100 feet of them, and at least as high as any obstruction within 100 to 200 feet of them. Supporting towers should not be of such bulk or shape as to create an appreciable obstruction to the wind flow.

A8111. Vertical Alignment.--Report to the Weather Bureau regional office any evidence that the vertical (or horizontal) axis of an anemometer or wind vane is not in alignment.

A8120. General Maintenance.--Instructions in this Section for routine lubrication and cleaning are applicable to instruments operating under average conditions of exposure. More frequent lubrication and cleaning is required under severe operating conditions, such as those associated with exposures close to salt water, in an atmosphere polluted with industrial wastes, or in severe and frequent dust and sand storms. Squeaking bearings, scratches on bearing surfaces, and a noticeable accumulation of foreign matter (dirt, dirty oil film, corrosion, or moisture) on bearing surfaces, gear teeth, worm-gear threads, or within the instrument housing, indicate that more frequent cleaning and lubrication are required. Squeaking brushes in d-c generator-type anemometers should not be confused with squeaking bearings. Squeaking of the brushes usually decreases as the wind speed increases. In general, winter-type anemometer oil is satisfactory for use whenever anemometer lubrication is required. However, summer-type oil may be used at temperatures above 25°F. for lubricating F102 anemometers and other contact-type anemometers of similar general design that are also equipped with friction bearings at the upper end of the spindle. One or two drops of oil, applied with the end of a matchstick, are generally sufficient to oil each bearing surface. Other points of rolling or sliding friction, such as gear teeth, worm threads, sliding-contact surfaces, etc., should be oiled similarly. Carefully remove oil that spills or

accumulates on non-lubricated portions of the equipment, especially electrical insulation and contact points or brushes. Direct contact with oil will cause the breakdown of some insulating materials. Oil film between contact points acts as an insulating material that may cause the equipment to fail. Oil film adjacent to moving parts tends to collect abrasive material that may gradually work into the bearings. Polish electrical contacts sufficiently to remove pitting or corrosion.

A8130. Accuracy of Wind Direction Indications.--When there is evidence that indicated readings disagree with the position of the vane after it has been aligned in accordance with Section A8500, notify the Weather Bureau regional office.

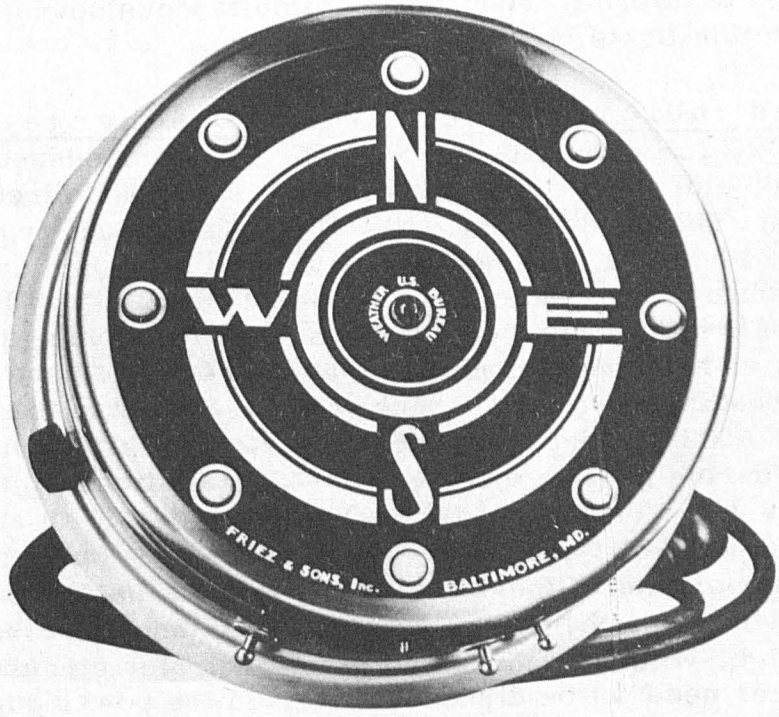


Fig. A8-3. Wind speed and direction indicator (9-light), F221A.

A8300. INDICATORS

A8310. Speed and Direction Indicators (9-Light), F221A, B and C.--These indicators are actuated by contact-type anemometers and contact- or commutator-type wind vanes. A buzzer or gong is sometimes used in lieu of a center light for wind speed indications. Once a month test the operation of the lamps and lamp circuits. Test the direction lamps and their circuits by rotating the wind

vane through several complete revolutions and observing whether all of the lamps operate in the proper sequence as the vane is revolved. As frequently as necessary, replace defective lamps with three-candle power, six- to eight-volt lamps. Some indicators use double-contact, bayonet-base (Mazda No. 64 or equivalent) lamps; other indicators use single-contact, miniature-bayonette-base (Mazda No. 44, 51, or equivalent) lamps. The Bendix-Friez-indicator lamps are located behind the dial. To remove the dial, pull outward on the bottom of the rim at the guide slot used to orient the dial with respect to the indicator housing and lamps. A transformer is used with the F221A indicator (see Fig. A8-3) to supply the required 6-8 volts when the indicator is to be powered from a 117-volt, a-c power supply. Some indicators are equipped with switches and variable resistors to control the intensity of the lights and to afford independent or simultaneous operation of the speed and direction lights.

A8320. Speed Indicator (Condenser-Discharge Type), F210 and F222.--(See Fig. A8-4.) The Gurley condenser-discharge wind-speed indicator F210 and combined wind speed and direction indicator F222 are designed for use with 1/60-mile contact-type anemometers. About 24 hours of continuous operation of these indicators is required to stabilize the readings. These instruments may be used for wind-speed observations after (a) three consecutive readings, taken approximately an hour apart, indicate that the readings have stabilized; and (b) these readings have been checked for accuracy in the manner described in ¶ A8322. Keep the indicator meter in operation continuously except during maintenance periods. Installations in which the anemometer is wired directly to the indicator operate with a potential of approximately 50 volts across the leads to the anemometer. Do not remove the anemometer of these installations until the indicator has been disconnected from the power source. If the anemometer circuit is of six- to eight-volts and connected to the indicator circuit through a relay, the meter need not be disconnected from the power supply when the anemometer is removed for servicing.

A8321. Pointer-Swing.--The pointer-swing of the indicator is equal numerically to the maximum speed at which the pointer returns to zero between impulses, e.g., when the pointer returns to zero between impulses at any wind speed below four mph, but does not drop to zero at higher speeds, four mph is termed the "swing" of the unit. If the swing exceeds five mph, notify the Weather Bureau regional office.

A8322. Accuracy Verification.--Before using the indicator readings for wind-speed observations, and at weekly intervals after the instrument is placed in service, check the accuracy of the instrument during a period of steady winds by counting the number of pulses of the pointer or the number of times that the main relay contacts close in a one-minute period (the number of relay-contact cycles per minute is equal to the mean one-minute wind speed). If the meter reading is steady during this period, the indicator reading should agree with the contact count within ± 1 mph. If the disagreement exceeds this value, the unit should be adjusted at the low-scale-adjustment speed of ten miles per hour in the manner described in the following paragraphs. After making the adjustment recheck the accuracy of the readings. If the indicator is correct at speeds near ten miles per hour after a low-scale adjustment, but becomes erroneous at higher speeds, notify the Weather Bureau regional office.

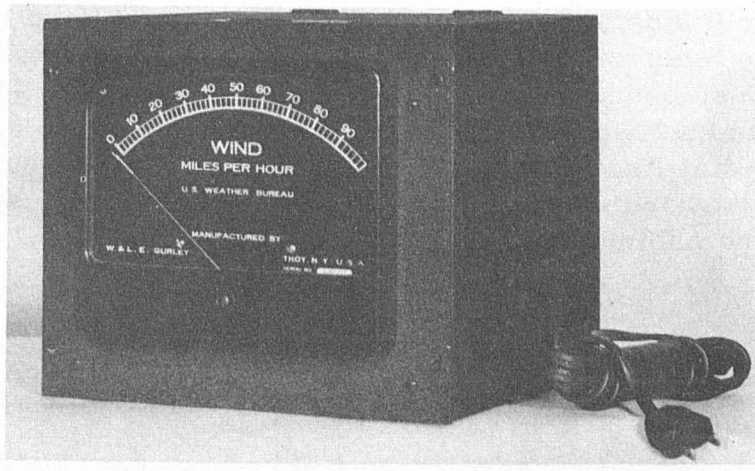


Fig. A8-4. Wind-speed indicator (condenser-discharge type), F210.

A8322.1. Low-Scale Adjustment.--Before adjusting the indicator, disconnect the anemometer from it. Establish momentary contact between terminals "1" and "2" at six-second intervals (10 contacts per minute). While this contact rate is being maintained, turn the zero-adjustment screw on the face of the meter until the up-scale swing of the pointer ends at the 10-miles-per-hour graduation each time contact is established between the terminals. An insulated wire, connected to one of the terminals, may be touched to the other terminal to establish the necessary contacts. After making this adjustment, turn the screw in the opposite direction by approximately one-half the total backlash movement of the screw. This latter adjustment, made to prevent

subsequent shock or vibration from altering the meter adjustment, must not be great enough to alter the preceding adjustment. Finally, recheck the accuracy and stability of the adjustment by maintaining the test rate of 10-contacts-per-minute for three or four minutes.

A8323. Static-Charge Errors.--The glass of the meter dial should not be touched with the fingers or rubbed with a dry cloth or other dry material, since such action is likely to generate a sufficient charge of static electricity on the glass to cause serious errors in the readings. Use a dampened cloth or paper towel for cleaning the glass.

A8330. Speed and Direction Indicator, F431-3 and -4.--(Windial - see Fig. A8-5.) The indicators are operated from a 12-20 volt d-c power source. Not more than two indicators should be attached to a transmitter. When the unit is energized from a 117-volt a-c power source (nominal), a power converter in the cabinet converts 117 volts a-c to approximately 15 volts d-c. The six-volt dial lamps are connected in series; therefore, if one lamp fails, both lights will go out. To locate a defective lamp, substitute a good lamp for first one and then the other of the two lamps. Use a 6-8 volt, 0.25 ampere, miniature-bayonet-base, single-contact lamp, Mazda No. 44 or the equivalent. The knob on the front of the cabinet is used to control the intensity of the dial lights, and to turn them off. The instrument is protected from power overloads by a 3-AG, two-ampere fuse located in the back of the cabinet.

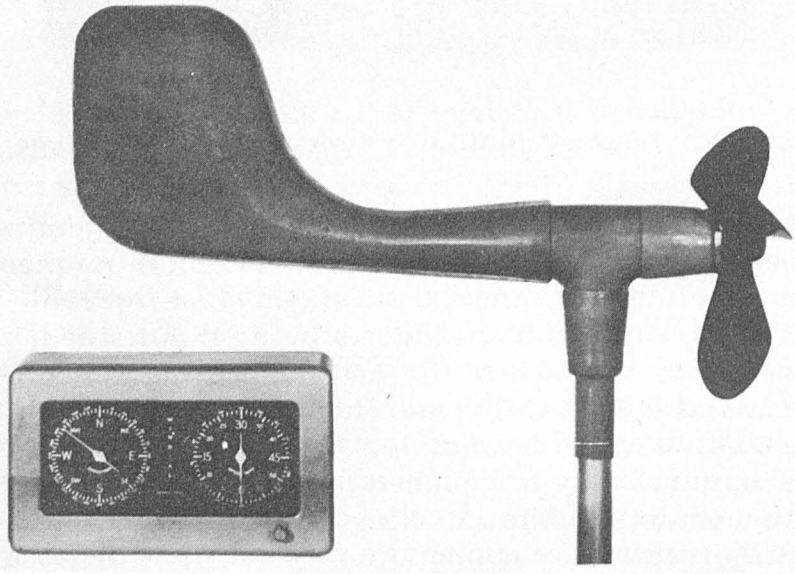


Fig. A8-5. Wind system (Windial), F431.

A8331. The direction indicator is graduated from 0 to 360 degrees, in increments of five degrees, and to eight compass points. The speed indicator continuously indicates through approximately two revolutions of the pointer. It is graduated from 0 to 60 mph in one-mile increments, and from 60 to 125 mph in five-mile increments. Wind speed is read on the 0 to 60 mph scale during the first revolution of the pointer, and on the 60 to 125 mph scale during the second revolution of the pointer. The rest position of the pointer is about 0 mph (uncorrected), and the starting speed of the anemometer is approximately 3 mph; i.e., a wind speed of 3 mph or more is required for indicated readings greater than zero. Check the indicator occasionally under calm conditions to see that the rest position of the pointer is correct.

A8340. Speed and Direction Indicators, F430-3.--(See Fig. A8-6.) The indicators are mounted on a 19" x 6-31/32" panel. A sub-panel assembly behind the panel contains components of the transmitter circuits. The intensity of the dial lights is controlled by a knob on the front of the panel. To replace a dial lamp, remove the lamp socket from the back of the indicator by pulling outward on the stem of the socket with a side-to-side motion. Replace defective lamps with Mazda No. 44 (or equivalent) single-contact, miniature-bayonet-base lamps. Replace defective fuses with 3-AG, one-ampere fuses. A total of five speed-indicators and a recorder can be attached to this wind system. The addition of each indicator requires the removal of a 1500-ohm resistor connected across the respective indicator terminals. The installation of a recorder requires the removal of a 3000-ohm resistor (see ¶ A8230). Conversely, the removal of a recorder or indicator requires the replacement of the corresponding resistor.

A8341. The wind-speed indicator is a d-c milliammeter type, graduated from 0 to 75 mph in increments of 1 mph; the wind-direction indicator is a 117-volt (nominal), 60-cycle, a-c selsyn-type indicator, graduated from 0 to 360 degrees in increments of five degrees, with compass points indicated. When the range switch (below the dial) is in the 0-75 mph position, the true wind speed is the same as the indicated wind speed and is read directly from the dial. When the switch is in the 0-150 mph position, the uncorrected wind speed is twice the indicated speed. The rest position of the pointer is set at 3 mph to compensate for operational characteristics of the anemometer transmitter. Check the indicator occasionally when the anemometer cups are at rest to see that the setting of the pointer is correct. When required, adjustments will be made by turning the set screw in the center of the cover glass.

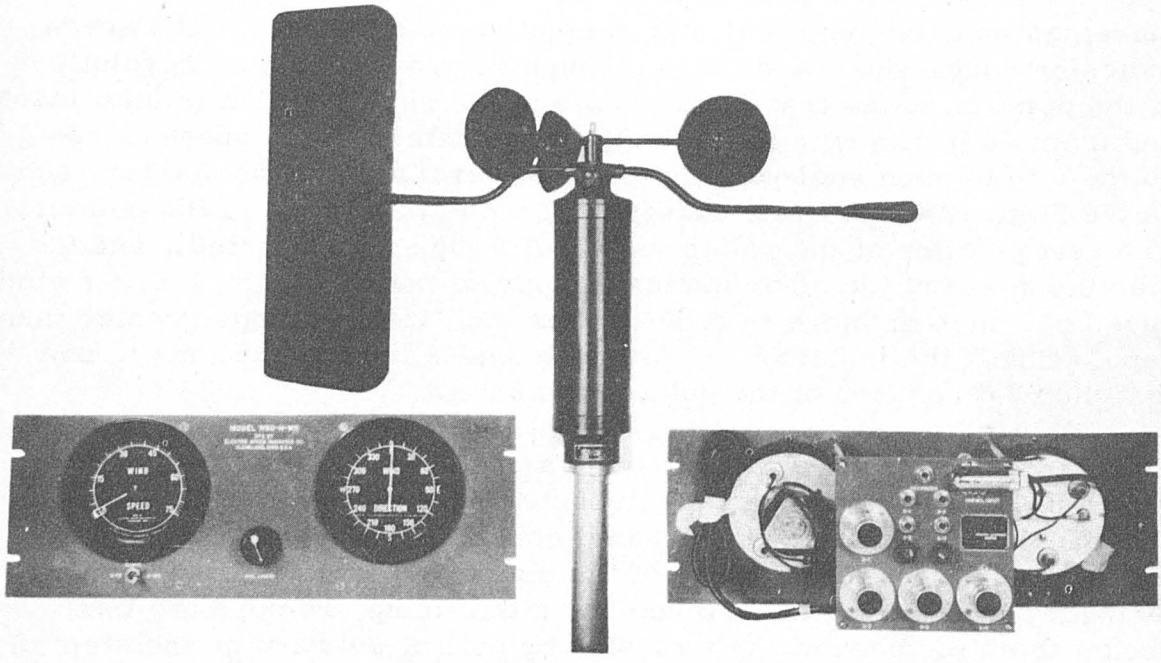


Fig. A8-6. Wind system, F430.

A8350. Speed and Direction Indicators, F420-8, F420-9.--(Electric Speed - see Fig. A8-7.) The indicators are mounted on a 19" x 6-31/32" panel. A sub-panel assembly behind the panel contains components of the transmitter circuits and a milliammeter. Read the milliammeter at least monthly, and notify the Weather Bureau regional office if the pointer does not remain within the red portion of the scale. To replace a dial lamp, remove the lamp socket by pulling outward on the stem of the socket with a side-to side motion. Replace defective lamps with Mazda No. 47, single-contact, miniature-bayonet-base lamps. A total of three speed-indicators and a recorder may be attached to this wind system. The circuit must be modified as each indicator or recorder is added to the original system (see ¶A8340).

A8351. The direction indicator is a 12-volt, d-c, selsyn type, graduated from 0 to 360 degrees in increments of five degrees, with compass points indicated. The wind-speed indicator is a d-c milliammeter type, graduated from 0 - 75 mph in increments of 1 mph. When the range switch (below the dial) is in the 0 - 75 mph position, the true wind speed is the same as the indicated wind speed and is read directly from the dial. When the switch is in the 0 - 150 mph position, the

uncorrected wind speed is twice the indicated wind speed (dial reading). The rest position of the pointer is set at 2.5 mph to compensate for operating characteristics of the transmitter. Check the indicator occasionally when the anemometer cups are at rest to see that the setting for the pointer has not been altered. When required, adjustments will be made by turning the set screw in the center of the cover glass.

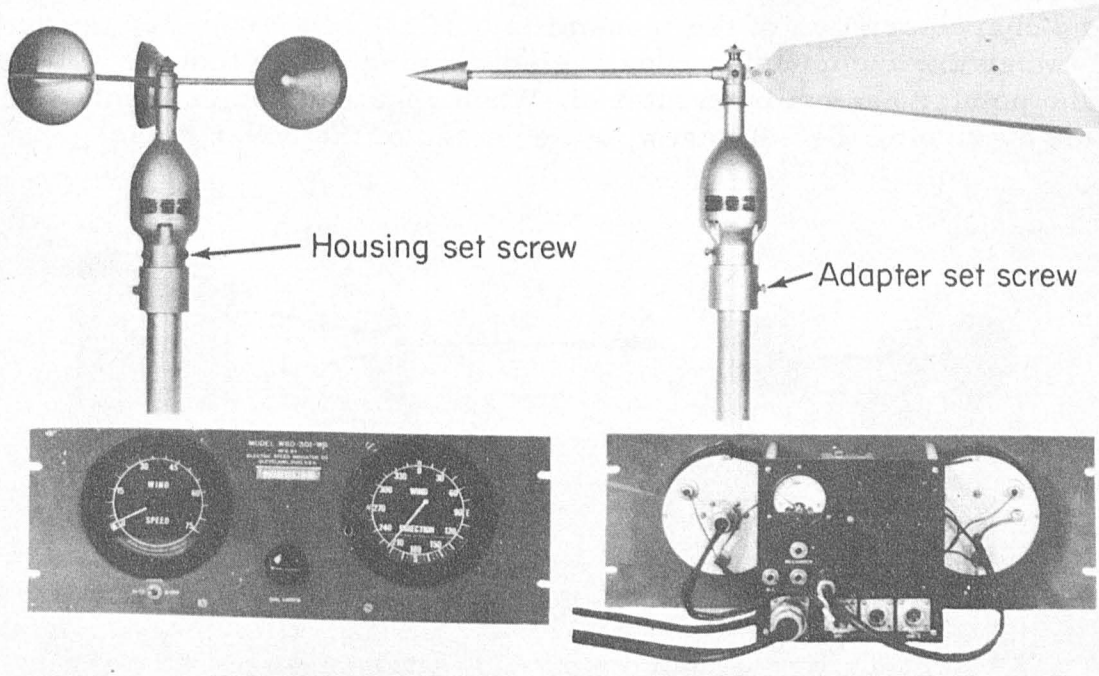
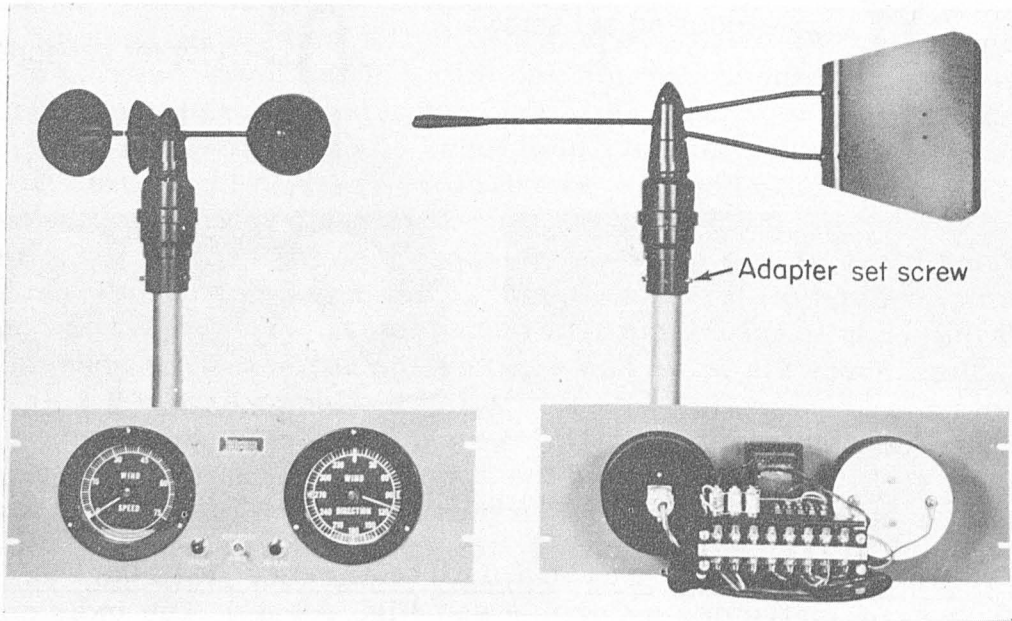


Fig. A8-7. Wind system (Electric Speed), F420.

A8360. Speed and Direction Indicators, F420A-8, F420A-9.--(Instruments Corp. - see Fig. A8-8.) The indicators with the speed-range-indicator lights and switch are mounted on a 19" x 6-31/32" panel. A sub-panel assembly behind the panel contains components of the transmitter circuits, the power supply, line fuse, and terminal connection block. To replace a range lamp, unscrew the jewel-type lens on the front of the panel. Press the lamp inward and turn it counterclockwise until the lamp is free to be removed from its socket. Replace the lamp with a Mazda No. 47 type, single-contact, miniature-bayonet-base lamp. Replace defective line fuses with 3-AG, two-ampere fuses. Three speed-indicators and a recorder may be operated in the circuit of this wind system; however, the circuit must be modified as each additional indicator or recorder is attached (see ¶ A8340).

A8361. The direction indicator is a 12-volt, d-c selsyn type, graduated from 0 to 360 degrees in increments of five degrees, with compass points indicated. The speed indicator is a d-c milliammeter type, graduated from 0 to 75 mph in increments of 1 mph. The indicator range in use is indicated by one of two lights flanking the range switch. When the 0 to 75 mph range lamp is lighted, the uncorrected wind speed is indicated directly on the dial. When the 0 to 150 mph range lamp is lighted, the uncorrected wind speed is twice the indicated wind speed. The rest position of the pointer is set at 2 mph to compensate for operating characteristics of the transmitter. Check the indicator occasionally when the anemometer cups are not turning to see that the setting of the pointer has not been altered. When required, adjustments will be made by turning the set screw in the center of the cover glass.



A8400. ANEMOMETERS

A8401. Maintenance.--The maintenance instructions for F102 anemometers are also generally applicable to F101 one-mile-contact-type, 3-cup anemometers, and to 4-cup anemometers. The one-mile-contact action of the F101 anemometer is similar to that of the F102 anemometer.

A8401.1. When lubrication is specified, frequent application of a small amount is preferable to liberal applications at infrequent intervals.

A8401.2. Where the polishing of electrical contacts is specified, use crocus cloth or fine sand paper. Never use emery cloth.

A8410. Anemometers, F102.--(3-Cup, WB Type - see Fig. A8-9.) The three-cup rotor mechanism of this anemometer drives a mechanical odometer through a gear train, and also actuates 1/60-mile and one-mile electrical contacts. The cups, the rotor, and the gear train are so designed that the passage of each 1/60 mile and one mile of wind causes the respective contacts to close momentarily.

A8412. Routine Maintenance.--The parenthetical letters in the following instructions refer to anemometer parts similarly identified in Fig. A8-9. An orifice is provided in the back of the housing of the anemometer for the inspection and oiling of the lower bearing of the spindle. Keep the orifice closed except during servicing operations to prevent the entrance of dust, moisture, or other foreign matter. At least once a week, check for satisfactory operation of the anemometer, and if the retaining nut (j) is not of the oil-reservoir type, remove the cups and place a drop of oil on the upper bearing (g). At least once a month clean and oil the anemometer. Before removing the anemometer, label the leads to insure correct replacement. To remove the anemometer, disconnect the leads and unscrew the set screw (l) several turns. Remove the anemometer with a twisting motion to loosen the fit between the pintle and the adapter at the lower end of the anemometer. Remove the cups and, after unscrewing the upper bearing with the anemometer wrench, remove the spindle. The pins in one end of the wrench are designed to fit the two holes in the top face of the bearing. It is not necessary to remove the lower bearing more frequently than once a year provided the reservoir (m) is kept filled and the oil remains clean. A screwdriver is required to unscrew or replace the lower bearing. The slotted head of the bearing assembly is reached through the pintle-adapter end (s) of the anemometer housing. When the lower bearing is removed, unscrew the collar (t) and remove the steel thrust washer (u). Remove the odometer cover (n) after unscrewing the two retaining screws in the face of the cover. At least once a year, and more frequently if visible amounts of dirt have accumulated on the graduated faces or between the teeth of the odometer dials, remove the retaining screw and dials, being careful not to bend the spring-mounted arm of the one-mile-contact points. Similarly, if visible amounts of dirt have

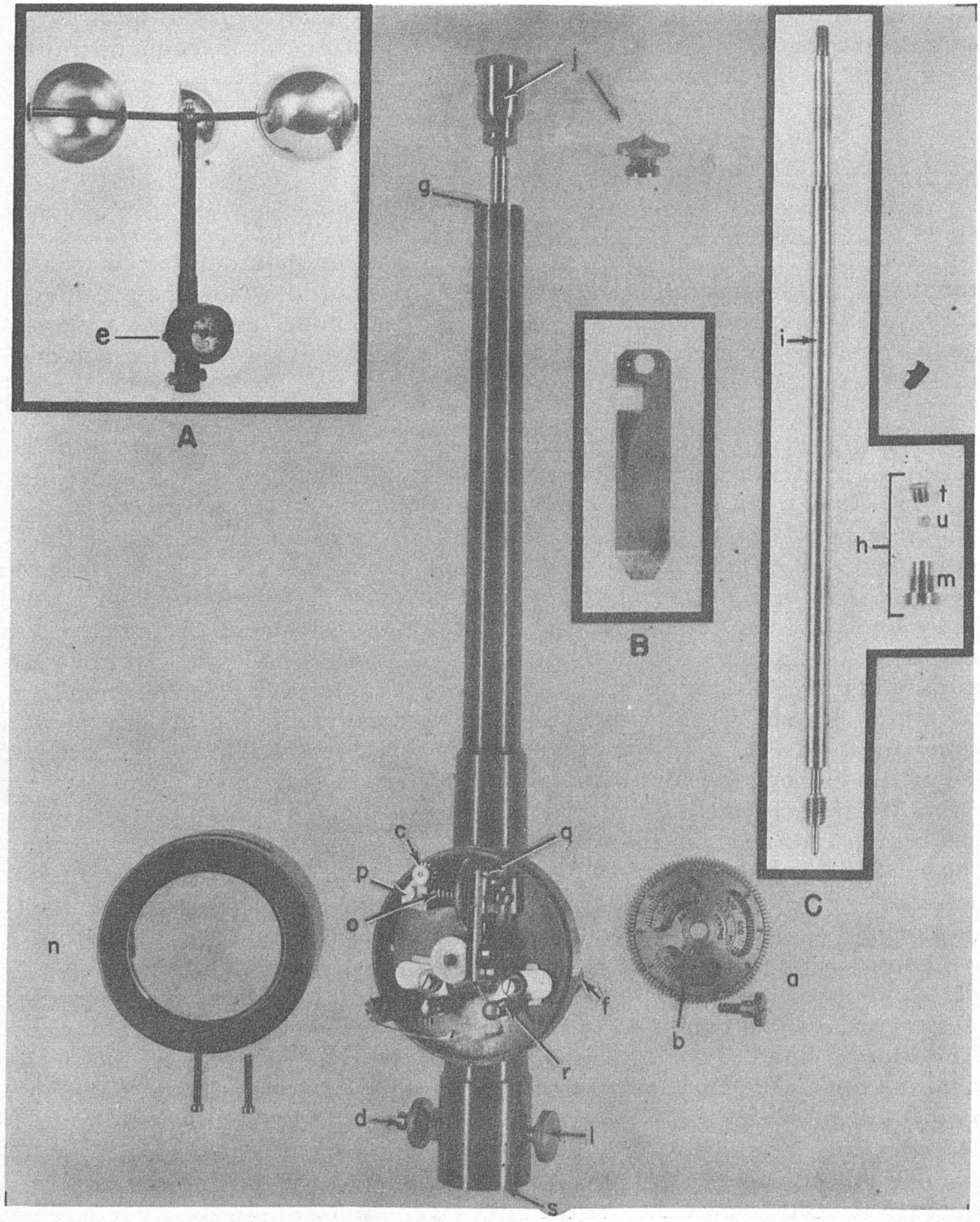


Fig. A8-9.
Three-cup anemometer, five-inch diameter cups,
1/60- and 1-mile contacts, F102.

accumulated on the worm- and pinion-gear assembly (p), unscrew the index (c); remove the pinion gear; unscrew the pillow-block bearing screw (p); and remove the bearing and worm-gear unit.

A8412.1. Clean the inside of the anemometer housing, being careful not to bend the movable arms of either the 1/60-mile or one-mile contacts. Wash the spindle, bearings, gears, and similar disassembled parts in Varsol, Stansol, or similar petroleum-base solvent (gasoline, especially leaded gasoline, which is very poisonous, should not be used). Dry the parts thoroughly with clean, soft cloth or tissue before reassembling the instrument. The bearings and teeth should not show appreciable scratches, flat spots, or other signs of neglect or wear. When the lower bearing (h) is removed for cleaning, check the condition of the thrust-bearing washer and the pivot end of the spindle. For satisfactory operation, the rounded end of the spindle should not be flattened appreciably, and the thrust-washer face should be smooth, flat, and without cupping in the center. After noticeable cupping occurs in one face of the washer, use the other face as the bearing surface. Unless the rounded end of the spindle has worn badly, the bright spot (contact area) in the center of the thrust washer should not be larger than the head of a pin. Clean and replenish the oil reservoir with oil sufficient to insure that the reservoir will be filled when the lower end of the spindle is replaced in the bearing. Lightly oil all other bearings, gear teeth, and sliding contact areas, except electrical contacts, before reassembling the instrument. If the anemometer is equipped with the oil-reservoir type of retaining nut (j), refill the reservoir and check the condition of the wick. Once a year, clean the oil reservoir and refill it with clean oil. Oil from the reservoir is fed with cotton wicking to a small drilled hole in the top of the shaft, and thence through a right-angle channel to the upper bearing. Cotton wicking may be made from size 8 to 20 unmercerized cotton thread. Coil several turns of wicking in the bottom of the reservoir, and insert about one inch of the free end of the wick into the hole in the spindle when the instrument is reassembled.

A8412.2. The 1/60-mile-contact screw (q) and the one-mile-contact screw (r) are used to adjust the contact clearances in order to obtain satisfactory opening and closing of the contacts. When bent spring arms of the movable contacts preclude satisfactory adjustment, rebend them until a satisfactory adjustment can be made. In adjusting either the movable or fixed contacts, secure definite electrical contact between them with as little friction as possible between the movable contact and the wheel pins that actuate it. The adjustment should be such

that the contacts are closed for as short a portion of each cycle as is necessary to operate satisfactorily the indicator or register to which the anemometer is connected. Be careful that the spring arms are not bent to the extent that the actuating pins touch the arm of the movable one-mile contact ahead of the sharp projection on the arm, or ahead of the rounded projection on the back of the 1/60-mile-contact arm. Polish the electrical contacts if necessary to remove pitting or corrosion.

A8412.3. Reassemble the anemometer and check it for freedom of rotation of the spindle. Replace the anemometer on the pintle with a slight twisting motion until the anemometer is tightly seated. Secure the anemometer by turning the set screw (1) clockwise by hand. Connect the ground lead to terminal (d) by means of the knurled nut; connect the 1/60-mile-contact lead to the left rear terminal (e) on the back of the anemometer housing; and connect the one-mile contact-lead to the right rear terminal (f). Determine that the operation of the odometer and the operation of the electrical contacts are satisfactory as evidenced by the operation of the indicators and registers connected to the anemometer.

A8420. Anemometer, F103.--(WB Airway Type - see Fig. A8-10.) The three-cup rotor mechanism of this anemometer closes an electrical circuit momentarily with the passage of each 1/60 mile of wind. Normally, the anemometer is connected to a 6- to 8-volt circuit.

A8421. Routine Maintenance.--In addition to the attention required by Section A8100, at least once a month loosen the spindle retaining screw and remove the spindle rotor, and rainshield assembly. Be careful not to lose the flat washer between the rainshield and the ball bearing on anemometers with a serial number between 2312-SA and 2511-SA. Oil the ball bearing under the rainshield, the worm threads of the rotor spindle, and the spindle journal at the lower end of the rotor spindle. Use one or two drops on each surface. Replace the spindle and cup assembly, and tighten the retaining screw.

A8421.1. At least once every month, remove the anemometer for cleaning and oiling. Label the leads to the anemometer before disconnecting them from the terminal posts. Unscrew the thumb-clamp screw several turns and remove the anemometer with a slight twisting motion. Loosen the spindle retaining screw and remove the spindle rotor, and rainshield assembly. If the cups are removed from the spindle, replace the cups for clockwise rotation as viewed from the

top (see Fig. A8-10). Remove the front name plate cover for access to the lower spindle bearing and the contact points. When difficulty is encountered in cleaning or adjusting the gear train and contact mechanism through the front cover opening, remove the back cover plate and then remove the mechanism from the housing. Be careful to replace the cover in such manner that the original alignment, which secures minimum friction between the spindle and the lower bearing, is not changed. The lower bearing for the spindle carries the thrust of the spindle shaft on a steel ball bearing. Do not disturb the lower bearing-adjustment screw. The bearing is adjusted at the factory to assure low starting speed and calibration accuracy.

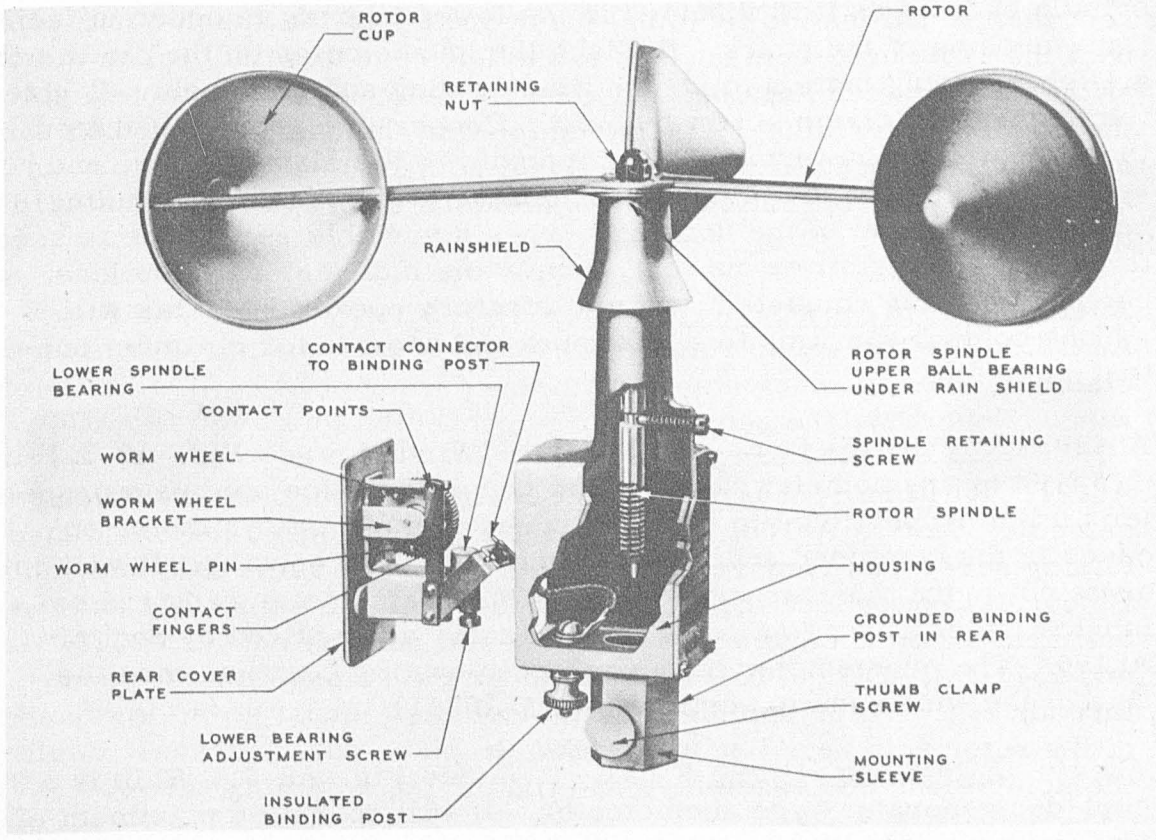


Fig. A8-10. Three-cup anemometer, 2-7/8-inch diameter cups, 1/60-mile contact, F103.

A8421.2. When the anemometer is cleaned, carefully check the condition and adjustment of the contacts. This is especially necessary when the anemometer operates on more than six to eight volts, as when it is connected directly to a condenser-discharge indicator. Adjust the position of the spring-mounted contact, either by means of an

adjusting screw, when one is provided, or by bending the spring until each contact of the rotating contact wheel successively makes a brief, but firm, sliding contact with the spring-mounted contact. The adjustment should be such that the contacts separate as rapidly and with as little arcing as possible. The maximum satisfactory contact clearance is approximately 0.02 inch. Blackened or pitted contacts indicate arcing (a source of radio interference). The adjustment that causes the least blackening of the contacts consistent with satisfactory operation should be maintained. Polish the contacts if necessary to remove pitting or corrosion.

A8421.3. When replacing the spindle and cup assembly, rotate the spindle by hand as it is inserted in the lower bearing in order to facilitate meshing of the gears. Replace the anemometer on the pintle with a slight twisting motion to insure firm seating and alignment. Tighten the thumb-type clamp screw by hand. Connect the ground lead from the indicator to the terminal post opposite to the clamp screw, and connect the 1/60-mile lead from the indicator to the insulated (binding) post on the bottom of the housing. When a variable resistance is used to limit the transmitter current, supply the indicator with the least current possible consistent with satisfactory operation. This will reduce contact sparking to a minimum and provide for optimum contact-point life.

A8430. Anemometer, F431-1.--(Windial - see Fig. A8-5.) In this type of anemometer, a magnetic coupling device applies a propeller torque proportional to the wind speed to a d-c selsyn motor encased in the combined anemometer and wind vane housing. It will operate not more than two indicators. This anemometer requires no lubrication or other routine attention except as required by Section A8100. The anemometer is in correct operating position when the axis of the wind vane is vertical (see ¶ A8111).

A8440. Anemometer, F430-1.--(See Fig. A8-6.) This is a 3-cup, d-c generator-type anemometer. It will operate a maximum of five indicators and a recorder. At least once every three months, unscrew the retaining nut and remove the anemometer cups. Oil the needle bearing with one drop of "winter" viscosity anemometer oil. For general instructions regarding maintenance and other attention, see Section A8100.

A8450. Anemometer, F420-1 (Electric Speed) and F420A-1 (Instruments Corp.).--(See Figs. A8-7 & A8-8.) These 3-cup, d-c generator-type anemometers will operate a maximum

of three indicators and one recorder. They require no routine lubrication. See Section A8100 regarding general maintenance and other attention.

A8500. WIND VANES

A8510. Wind Vane Transmitters, F003 and F004.--(Contact Types - see Fig. A8-11.) Once a month, lower the shield surrounding the switch assembly. The shield is held in place by three screws near its top edge. Lubricate the upper bearing of the spindle with several drops of oil (SAE 10 or anemometer oil). Inspect the condition of the switch, being careful not to disturb the adjustment of the contacts when lubricating the bearing. Test the operation of the switch, the indicator, and its associated wiring by noting whether the indicator follows, in proper sequence, the movement of the vane through each revolution. Make an approximate test of the orientation of the switch by moving the vane slowly through at least one switching point (see Table A8-2) and noting whether or not the change in indicated direction occurs when the vane passes through the correct bearing in azimuth.

A8511. Contact Adjustments.--When any set of contacts does not open or close at the proper wind-vane azimuth angle (see Table A8-2), check the vertical alignment of the contact arms and the condition and adjustment of the contacts. The contacts should open about 1/32 (0.03) inch when fully open. Adjustment of the contact-adjusting screws should secure the proper contact action. Straighten bent contact arms carefully and sufficiently to obtain the proper adjustment of the contacts. Polish the contacts to remove any pitting and corrosion. Erratic indicator action is usually a sympton of poor contact action likely to result in pitting of the contacts.

A8520. Wind Vane Transmitter, F005.--(Commutator Type - see Fig. A8-12.) Once a month, lower the outer and inner shields, which are held by set screws, as shown in Fig. A8-12. Lubricate the upper bearing with several drops of oil (SAE 10 or anemometer oil). Wipe the cummutator free of dirt, grease, etc. Test for the correct action and orientation of the commutator-type switch assembly in the manner specified in ¶ A8510.

A8530. Wind Vane, F431-1.--(Windial - see Fig. A8-5.) The wind vane and anemometer of this system are in a single housing. No lubrication or other attention is necessary, except as required by Sec. A8100. Orient the wind vane by turning the pipe that supports the

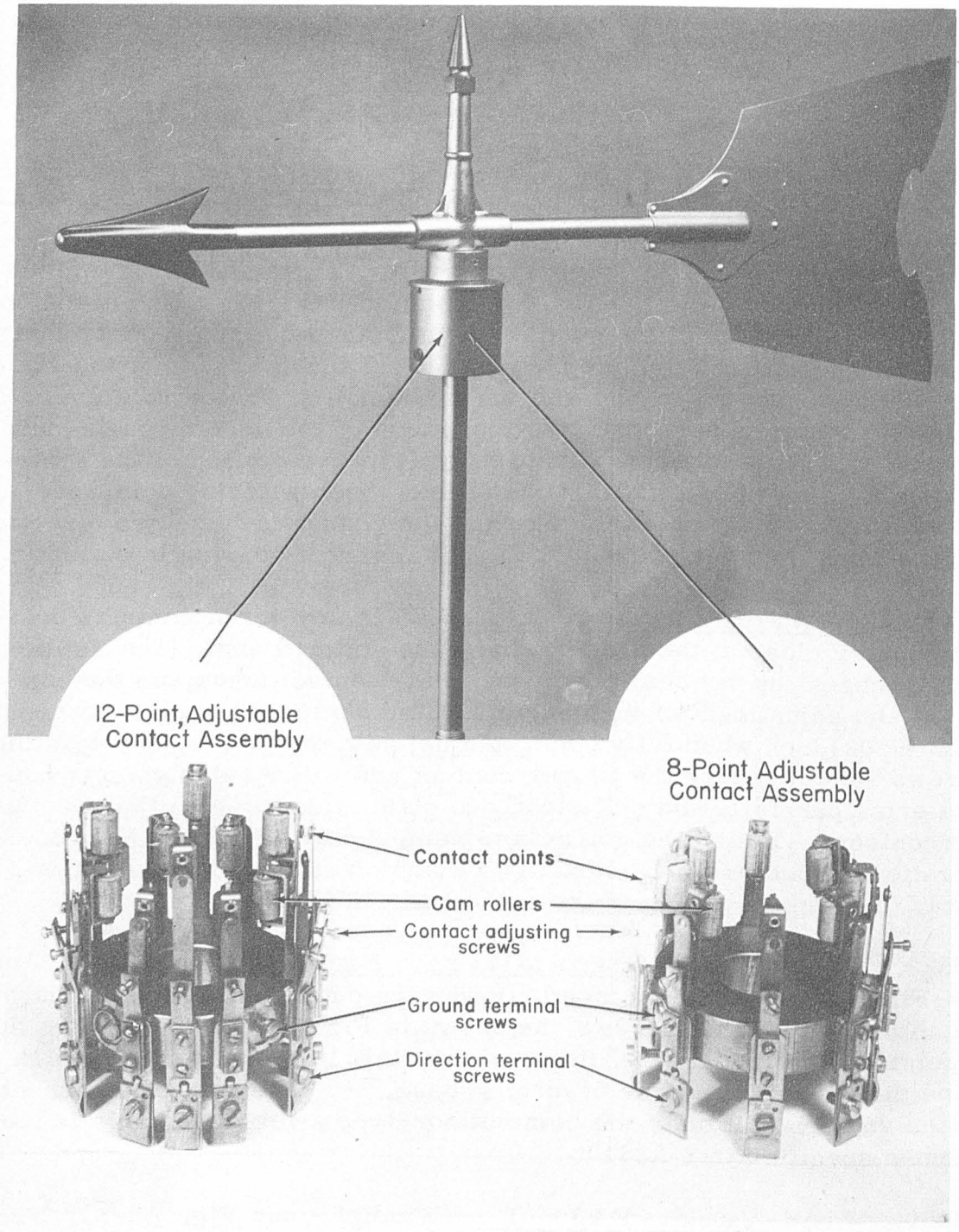


Fig. A8-11. Wind-direction transmitter, F003 or F004, and vane, F010. Either the F003-1 eight-point switch, or the F004-1 twelve-point switch, may be used in this type of installation.

Table A8-2
Relation of Azimuth Angle to Switching Action of Wind-Vane Switches

Azimuth angle (measured clockwise from true north in degrees)	Switching Action	
	For 8-position use	For 4-position use
11-1/4	NE closes	
22-1/2		E closes
33-3/4	N open	
56-1/4	E closes	
67-1/2		N opens
78-3/4	NE opens	
101-1/4	SE closes	
112-1/2		S closes
123-3/4	E opens	
146-1/4	S closes	
157-1/2		E opens
168-3/4	SE opens	
191-1/4	SW closes	
202-1/2		W closes
213-3/4	S opens	
236-1/4	W closes	
247-1/2		S opens
258-3/4	SW opens	
281-1/4	NW closes	
292-1/2		N closes
303-3/4	W opens	
326-1/4	N closes	
337-1/2		W opens
348-3/4	NW opens	

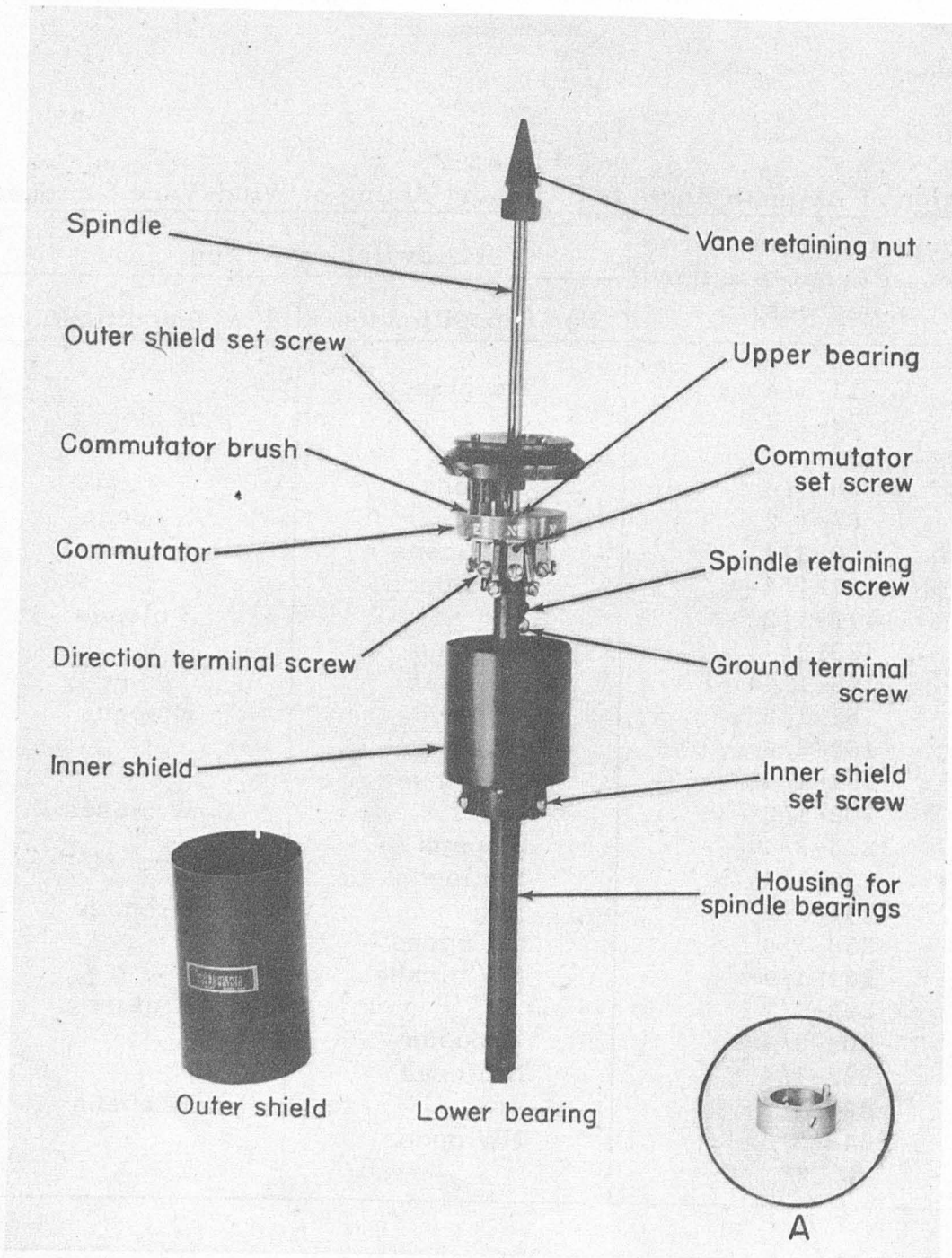


Fig. A8-12. Wind-direction transmitter (12-point commutator-type switch), F005. Inset A shows Adapter F005-1 which replaces recessed collar on metal vanes when used with F005 transmitter.

housing until the set screw located six inches below the top of the housing faces true south.

A8540. Wind Vane, F430-1.--(See Fig. A8-6.) The 117-volt (nominal) a-c, selsyn-type wind-vane portion of this combined anemometer and wind vane unit needs no lubrication or other routine attention, except as required by Section A8100. Orient the housing by loosening the adapter set screws (located at the bottom of the housing) and turning the adapter until the vertical line on the adapter faces true north. If the housing and adapter are properly assembled, the equivalent reference line on the housing will also face true north.

A8550. Wind Vane, F420-5.--(Electric Speed - see Fig. A8-7.) This 12-volt d-c, selsyn-type wind vane needs no lubrication or other routine attention, except as required by Section A8100. Orient the housing by loosening the adapter set screws and turning the adapter until the letter "N" on the transmitter housing faces true north. When the housing and adapter are assembled and secured by the housing set screw, the adapter is properly aligned with the transmitter housing.

A8560. Wind Vane, F420A-5.--(Instruments Corp. - see Fig. A8-8.) This 12-volt d-c, selsyn-type wind vane needs no lubrication or other routine attention, except as specified in Section A8100. Orient the housing by loosening the adapter set screws and turning the housing until the letter "N" on the adapter faces true north.

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CHAPTER 9. TYPES OF 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. All scheduled observations will be started just sufficiently in advance of the time of transmission to permit accurate evaluation of all the elements. 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

9100. AVIATION OBSERVATIONS

9110. General.--Aviation 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 ¶ 9142. The weather will be observed and the various elements evaluated between observations as often as is consistent with the condition of the weather. All elements reported in an aviation observation will have been observed within 15 minutes preceding the time of entry on WBAN-10. Changing weather situations that might require a special or local extra observation will be watched most closely to insure that an observation will be filed promptly after the change occurs.

9120. Record Observations.--A record observation is taken at scheduled hourly intervals and will be prepared for teletypewriter transmission at least two minutes and not more than five minutes prior to the time of entrance into the sequence in which it first appears.

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† In aviation observations, these items should be reviewed if practicable before filing the message to ensure that current data are being transmitted.

A9120.2. Omission of Observations.--Contractions will be transmitted as follows to indicate the expected or actual omission of a scheduled observation:

(3) FINO. When primary duties prevent taking an observation as scheduled (see Introduction), record and transmit "FINO" at the scheduled time. On WBAN-10, record type and scheduled time of omitted observations in columns 1 and 2, "FINO" in column 13, and initials in column 15. If time permits before the next scheduled or special observation, enter (on the next line below) a delayed observation for local control and broadcast purposes, in accordance with ¶ A11021.

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.--Special observations are taken to provide information on significant developments in meteorological conditions occurring at other than scheduled times. Special observations are taken even though there are no impending aircraft operations.

9131. 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) Wind shift or an increase in wind speed

9131.1. When a change in any other element satisfies the criteria for a special observation, the observation will include:

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

In all cases remarks will be added when appropriate.

9132. 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.

9132.1. Ceiling.--

(1) The ceiling decreases to less than 1500 feet, or increases to 1500 feet or more.

(2) The ceiling decreases to less than 1000 feet, or increases to 1000 feet or more.

(3) The ceiling decreases to less than 500 feet, or increases to 500 feet or more.

(4) A ceiling of less than 500 feet changes by 100 feet or more. †

(5) The ceiling decreases to less than the highest instrument minimum †† for the airport. †

(6) The ceiling increases to or above the highest instrument minimum †† for the airport. †

9132.2. Sky Condition.--Clouds are observed below:

(a) 1000 feet, and no clouds were previously reported below this altitude.

(b) The highest instrument minimum†† for the airport, and no clouds were previously reported below this altitude. †

† Effective only at stations having scheduled air-carrier operations.

†† These minimums are with reference to instrument minimums exclusive of ILS, GCA, or alternate minimums.

9132.3. Visibility.

(1) The visibility decreases to less than:

(a) 3 miles
(b) 1 mile
(c) 3/4 mile
(d) 1/2 mile
(e) 1/4 mile
} †

(2) The visibility increases to equal or exceed:

(a) 3 miles
(b) 1 mile
(c) 3/4 mile
(d) 1/2 mile
(e) 1/4 mile
} †

9132.4. Tornado.

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

9132.5. Thunderstorm.

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

(2) Increases in intensity.

(3) Ends (Special observation 15 minutes after thunder is last heard at station.)

9132.6. Precipitation.

(1) Hail begins, ends, or changes in intensity.

(2) Freezing precipitation other than very light begins, ends, or changes in intensity.

(3) Sleet begins, ends, or changes in intensity.

† Effective only at stations having scheduled air-carrier operations.

9132.7. Wind and Wind Shifts.

(1) Sudden doubling of speed (over a one-minute interval) to more than 30 miles per hour.

(2) Wind shift.

9132.9. 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 all stations, for local distribution only, under the circumstances specified in ¶ 9141 - 43. 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. Local extra observations will be taken at intervals not exceeding 15 minutes, beginning whenever there are known impending aircraft operations and

(1) the ceiling decreases to 500 feet or less, or
(2) the visibility decreases to one mile or less.

Observations will be discontinued when values above these minimums have been reported or when there are no impending aircraft operations. 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. 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, or to meet other local needs, will be taken and recorded, 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 of all elements ordinarily included in a record observation will be taken immediately following any aircraft accident or report of an aircraft in distress in the vicinity of the observing station. These observations are for record purposes only and need not be disseminated. The note "ACFT ACCIDENT" will be entered in column 13. If notification of an accident is not received immediately, the observation should nevertheless be taken immediately after notification, unless there has been an intervening observation. An explanatory note should be entered in column 90 of WBAN-10 whenever this observation has been delayed.

9150. Check Observations.--The most recent observation will serve as the check observation for broadcast purposes. Specifically, a check observation:

A. Will be taken:

(1) at all stations where scheduled aviation broadcasts of local weather are made, even though no significant changes in weather have occurred.

(2) within 20 minutes of the time of broadcast preferably as near that time as practicable, except when all personnel are engaged in duties authorized as paramount to the taking of check observations (e.g., the taking of a pilot-balloon observation). ††

† 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.

†† Note that special observations are still required in accordance with ¶ 9130.

B. Will not be taken:

(1) if an aviation has been taken within 20 minutes of broadcast time. ††

(2) if the broadcast cannot be made because of equipment failure. †††

C. Need not be recorded on WBAN-10 if all elements in the check observation remain unchanged from the immediately preceding record or special observations.

9150. Check Observations.--Check observations will be taken at all stations where scheduled aviation broadcasts of local weather are made even though no significant changes in weather have occurred. The local schedule of broadcasting will determine the time of taking them. Check observations will not be taken if a record, special or local extra observation has been taken within the previous 20 minutes. The check observation will be taken within 20 minutes of the scheduled time of local broadcast, preferably as near to the time of broadcast as practicable. 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
(8) Remarks (as appropriate)

9160. Grouping of Elements.--Aviation observations are disseminated in a code that consists of symbols and numerals arranged in relatively fixed positions. Word and phrase contractions or complete words are used in a specified manner to supplement the coded data. The letter symbol "M" is used to indicate missing data pertaining to an element normally included in a report. Elements regularly

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†† Note that special observations are still required in accordance with ¶ 9130.

††† A notation indicating the period of and reason for suspension of check observations will be entered on WBAN-10.

omitted are indicative of data not observed at a particular station. The elements of the observation are placed in groups as specified below, with slants and spaces used to separate numerical data that might otherwise be misinterpreted.

9161. Hourly Reports.--Data pertaining to record observations are coded in groups as follows: Station identification (space) ceiling, sky, visibility, weather, obstructions to vision (space) pressure (slant) temperature (slant) dew point, wind direction and speed (slant) altimeter setting (slant) and remarks. Additive data are separated by a slant and a space from the last element of the aviation observation. Except as stated in ¶ 11103.1, no specified sequence need be observed in appending these additional groups to the aviation observation.

Example: DCA E18V⊕12 271/74/58 ← ↙ 8/052/CIG 16V20/ 2002

9162. Other Reports.--Data pertaining to special, check, and local extra reports are grouped similarly to hourly observations insofar as the same data are transmitted (see ¶ 9131, 9141, and 9150). Spaces will be used following type of report and time of report, which are sent for all special observations and for local extra and check observations if they are transmitted on local teletypewriter circuits.

Example: DCA S8 1009E E18V⊕12 ← ↙ 8/CIG 16V20

9163. Corrected Reports.--A report correcting a previously transmitted report will be identified by the letters "COR" immediately following the station identification or the symbols required in accordance with ¶ 9172 in the case of special and record special observations. The report will include station identifier and time. If the observation to be corrected is a special, record-special, or local extra report, the correcting report will also include type of report. If an error in a record, or record-special observation is discovered within the hour after the observation has been transmitted on the teletypewriter, a correction 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 teletypewriter or local distribution, a correction will be filed. If an error is discovered in a check observation, a correction 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.

9163.1. A correction message may consist of a complete, corrected observation, or of a single element properly identified (e.g., COR 1328E ALSTG 969), whichever procedure is the shorter.

9170. Coding.--Instructions in Chapters 1 - 8 will be observed in coding individual elements of observations for teletypewriter and radio distribution. Instructions for the coding of station identification, type of report, and time are given in ¶ 9171 - 9173.

9171. Station Identification.--The station identification is a three-letter symbol assigned to the station for use in teletypewriter transmissions. These symbols are listed in the Civil Aeronautics Administration publication "Location Identifiers."

9172. Type.--Record observations are not identified by any symbol in teletypewriter transmission. Special and record-special reports are identified by the letter "S" followed by a serial number (see ¶ 11101). Local extra reports transmitted on local teletypewriter circuits are identified by the contraction "LCL."

9173. 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. Times will be included in corrected and special observations as specified in CAA communication manuals.

9174. Delayed Observations.--When an observation is not available for transmission at the scheduled time but will be available later, file the abbreviation "DLAD" at the time of the scheduled observation.

9180. Dissemination.--Record and special aviation observations will be transmitted by teletypewriter or radio where suitable facilities are available. When transmission is delayed until time for the next record or special observation, transmit only the latest observation and enter "FIBI" in column 13 of the observation not transmitted. When the observation not transmitted pertains to the phenomena listed in ¶ 9132.4 to 9132.7, enter in remarks of the next succeeding transmitted observation: (a) the time of the observation not transmitted, (b) weather, obstructions to vision, and wind reported in that observation. (This remark may be omitted or abridged insofar as it duplicates data pertaining to tornadoes, waterspouts, or heavy thunderstorms, entered in accordance with Item 1(b), 1(c), and 2(b) of ¶ 3920.)

EXAMPLES

S5 1437E M15@2RW+ ↘25Q55↑1432E (FIBI)

S6 1448E M20@6RW- ↘15/1437E RW+ ↘25Q55↑1432E.

9181. Local Distribution.--All observations will be distributed by a common airport communications system, when available, to local operational offices desiring them. If a single airport communications system is not available, observations will always be furnished to the tower, GCA units, and air-ground positions if desired by these units, and to other local operations if time and station work load permits.

A9182. Communications Failure.--During periods of teletypewriter service failure, aviation observations will be routed to an adjacent station where facilities have not failed, utilizing services still in operation, in accordance with the Federal Airway Manual of Operations. If all services have failed, the first record or special observation following the breadkown will be telephoned or telegraphed, prepaid (unless specifically instructed otherwise) to the nearest Weather Bureau or CAA station on the same circuit with facilities still functioning. At stations transmitting on more than one circuit, additional calls to other stations will be made as necessary to insure that the observation is entered on all circuits. Thereafter, record observations will be sent only at the times of 6-hourly observations, but all special observations will be telephoned or telegraphed promptly after they are taken. Station observational records will be kept as usual during this period.

A9182.2. Transmit these observations in accordance with CAA administrative instructions.

A9182.3. Stations outside the United States may be furnished separate instructions by the Weather Bureau regional office.

9300. MIDNIGHT OBSERVATION

9310. At midnight, local standard time, an observation of maximum and minimum temperatures and of precipitation will be taken at all stations having personnel available at that time. If no midnight observation is taken, omit all entries from WBAN-10 on the lines captioned "Mid" and "Mid to".

CHAPTER 10. PILOTS' REPORTS

10000. GENERAL

10010. Pilots' reports of meteorological phenomena encountered in flight are termed PIREPS. 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 to secure all available pilots' reports promptly.

10100. CODING

10110. General.--All reference to heights of phenomena encountered in flight will be expressed in hundreds of feet to the nearest hundred above mean sea level †. Authorized weather symbols, international cloud abbreviations, and word and phrase contractions will be used; or if they are lacking, complete words. All phenomena having an authorized symbol (see Tables 8a and 8b) 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.

10120. Arrangement of Elements.--Pireps will be coded in accordance with ¶ 10121 - 10127. In general, the order of coding will be:

(1) Station identification.

(2) Time (LST) that pilot report is prepared for transmission, and appropriate time, zone indicator (see Table 17).

† Note.- Pilot reports of cloud heights used as a ceiling in aviation observations will be converted to feet above the surface by the observer and coded in accordance with ¶ 1440.

(3) The term PIREP.

(4) Location or extent of phenomena with respect to an observing station or other well-known point. (If the original report by the pilot is with respect to a fan-marker or intersection point, it will be converted to the foregoing basis by the ground observer.)

(5) Time of pilot's observation, whenever known, and the time zone indicator, as in (2) above.

(6) Phenomena reported.

(7) Altitude of phenomena.

(8) Type of aircraft, in reports of turbulence, condensation trails, and icing only.

10121. Icing.--Use the contraction "ICG" with indication of intensity and type, if known. For example:

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

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, Ore., at 2000 feet MSL:

MFR 0715P PIREP 5-20 N EUG 0700P LGT ICG 20 STSN

The pilot of an F-51 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 10,000 (note that Air Force stations use GCT.):

SRF 1731Z PIREP MTNS N BUR 1725Z HVY ICG 100-115 F51

10122. 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 5000 feet MSL:

DCA 1629E PIREP 20 S DCA 1620E DISCHARGE 50

The pilot of a liaison aircraft 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 2500 feet MSL:

CHI 1535C PIREP 15 S JOT 1515C DISCHARGE 25

10123. Turbulence.--Use the contraction "TURBC" preceded 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 6000 feet MSL:

MKC 2335C PIREP 10 NE TYS 2330C HVY TURBC 60 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 PIREP OVR DONNER SUMMIT 1050P LGT TURBC 100 DC3

10124. Hail.--Use the authorized teletypewriter 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 pirep.

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 3500 feet MSL:

OMA 1619C PIREP 10 S OMA 1617C A 35

At 1628 CST the same pilot reports that he is flying in light hail and heavy rain, with heavy turbulence at 3000 feet MSL, 15 miles southwest of Omaha, and that at 5000 feet MSL his plane had experienced a discharge:

OMA 1635C PIREP 15 SW OMA 1628C HVY TURBC R+A- 30 DISCHARGE 50 DC4.

10125. Winds Aloft.

(1) Use the contraction "WND".

(2) Code true direction from which the wind is blowing in three figures representing the degrees of the compass, to the nearest 10 degrees.

(3) Use figures to code the wind speed in knots.

EXAMPLES:

At 0845 CST the pilot of a C-54 reports to Bismarck, N. Dak., that he is encountering an 82-knot wind west of Bismarck at 6000 feet MSL, wind direction 80 degrees:

BIS 0850C PIREP W BIS 0845C WND 080 82 KT 60

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 8500 feet MSL:

MSN 1225C PIREP 20 SE MSN 1215C WND 240 72 KT 85

10126. Bases and Tops of Clouds.--Select appropriate sky-cover symbol from Table 1a. Enter heights of bases preceding the symbol, and heights of tops † following the symbol, in hundreds of feet MSL. (Note - Intervals specified in ¶ 1440 for reporting cloud heights are not applicable to pilots' reports.)

EXAMPLES:

The pilot of a B-29 flying over Navasota, Texas, at 0613 CST reports to Houston that the top of the overcast is at 8500 feet MSL:

HOU 0618C PIREP OVR AVS 0613C ⊕85

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 PIREP 15 SE AVS 1613C ⊕85

The pilot of a DC-3 flying over Washington, D. C. reports at 1110 EST to Washington that the ceiling is 1500 feet MSL, and top of overcast 4500 feet MSL:

DCA 1118E PIREP OVR DCA 1110E 15 ⊕45

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

SHR 1850M PIREP 65 S SHR 140⊕

10127. Condensation Trails.--Use the term CONTRAILS, followed by altitude in hundreds of feet MSL at which pilot reports contrails occurred, and type of aircraft when available.

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† For traffic control purposes, pilots sometimes furnish reports such as "500 on top at 8000". Such reports merely indicate that the pilot is maintaining an altitude of at least 500 feet above all clouds, in accordance with his traffic clearance. It should not be inferred from this report that the top of the clouds is 7500 feet.

EXAMPLE:

A pilot of an F-86 30 miles south of Omaha, Nebraska, at 1425 CST reports contrails occurring at 45,000 feet MSL.

OMA 1428C PIREP 30 S OMA 1425C CONTRAILS 450 F86

10128. In addition to the elements indicated in ¶ 10121 - 10127, any other elements of meteorological or operational significance will be coded in the general form outlined in ¶ 10120.

10200. DISSEMINATION

10210. All pireps, including those pertaining to ceilings within 1-1/2 miles of any runway of the airport, will be disseminated in the same manner as special observations. (See ¶ 1444.1 for conditions under which pilots' reports of ceiling will also be incorporated into the current aviation observation.) If a pirep and a record or special observation are available for transmission at the same time, the pirep will be added as a remark to the record or special observation. Similarly, two or more pireps may be combined to avoid repetition of the station identifier or other identical items. When two or more pireps that contain substantially the same information are available for transmission at the same time, only the most recent one will be sent.

CHAPTER 11. ENTRIES ON FORM WBAN-10

11000. GENERAL

11001.1. WBAN-10 (CAA), will constitute the basic original record of surface observations at CAA stations. A new form will be started each day beginning with the first observation at or following 0000 local standard time. It will be prepared in duplicate. Enter data in columns 41 to 90 on the sheet in use at the time of observation.

11002. Instructions in this chapter relate primarily to entry of non-meteorological data. Instructions relating to meteorological elements will be found in the chapters pertaining to these elements.

11003. 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. Use a black-lead drawing pencil (Venus 2H or 3H or equivalent), employing sufficient pressure to ensure legible copies and ample contrast for photographic reproduction. Slants to separate data in the aviation code may be used as specified in Chapter 9.

11004. The name of the station and date will be entered in the spaces provided. If stamps are used, use black ink.

A11005. Disposition.

A11005.1. Disposition.--Original copies of completed WBAN-10 forms will be mailed to the WRPC:

(a) Each Saturday. This will include all forms for the week through Friday.

(b) By the second working day of each month. This mailing will include forms for the last several days of the previous month.

A11005.11. Carbon copies of completed WBAN-10 forms will be retained for ninety days, after which they may be destroyed.

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.

A11021. Late Observations.--When an observation is taken late and no appreciable changes have occurred since the scheduled time, the entire observation will be entered in black pencil and enclosed in parentheses. When conditions have changed appreciably since the scheduled time, estimate the conditions probable at the observation time, using recording instruments wherever possible, and enter the observation in red pencil. In either case, the observation will be used for local control and broadcast purposes, but it will not be transmitted on Service "A".

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 neatly erased from all copies 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 "COR (Time)" in red in column 13 of the erroneous observation. Carbon copies, if prepared will also be corrected in red.

11100. COLUMN ENTRIES ON WBAN-10

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.")

11102. Time Entries (Col. 2).--The time ascribed to an observation is that of the last entry on WBAN-10. Entries will be in local standard time to the nearest minute in terms of the 24-hour clock, unless use of GCT is specifically authorized. 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. The time based upon any of the standard time meridians can be converted to GCT by adding one hour for each 15° of longitude west of Greenwich. (See Table 17.)

Table 17. Meridians of standard time zones and conversion to GCT

Standard Time Zone	Letter Designator	Meridian	To Convert to GCT, add -
Atlantic Standard Time	- -	60°	4 hours.
Eastern Standard Time	E	75°	5 hours.
Central Standard Time	C	90°	6 hours.
Mountain Standard Time	M	105°	7 hours.
Pacific Standard Time	P	120°	8 hours.
Yukon Standard Time	Y	135°	9 hours.
Alaskan Standard Time	A	150°	10 hours.
Bering Standard Time	B	165°	11 hours.

11103. Remarks (Col. 13).--Enter remarks in symbols or abbreviations specified in the CAA publication "Contractions" whenever possible; otherwise, use plain English. If necessary, use additional lines; it is not intended that the physical dimensions of the column shall limit in any way the information to be reported. Enter also additive data groups. (See ¶ 11103.1.) Contractions pertaining to nonmeteorological data, such as notices to airmen concerning broadcast facilities, may also be entered in the column if desired.

11103.1. Additive Data.--Maximum additive data requirements are expressed below in symbolic form. These data will be added to hourly reports in accordance with ¶ 9161. The meaning of the symbols is specified in ¶ 11103.101 through 11103.106; items in parentheses will be omitted under the conditions specified in the appropriate paragraphs. Items not in parentheses will always be reported unless the

station has been specifically authorized to omit them.

3-hourly symbolic form (0328, 0928, 1528, and 2128 GCT):
app (99ppp) ($2h_{85}h_{85}h_{85}a_3$)

6-hourly symbolic form (0028, 0628, 1228, and 1828 GCT):
app(RR) (99ppp) (Precipitation - plain language)
($985s_ps_p$) $T_{n/x}T_{n/x}$ ($2h_{85}h_{85}h_{85}a_3$)

11103.101. Characteristic of Barograph Trace "a".--Select appropriate code figure from Table 10d. Transmit a slant (/) if the characteristic is missing.

11103.102. Amount of Barometric Tendency "pp" or "ppp". - - Select appropriate code figure from Table 41 corresponding to the net pressure change during the past three hours (see § 7630). Transmit slants (///) or (////), as appropriate, if the net change is missing. When the change equals or exceeds 9.9 mb., code "pp" as "99" and insert the "99ppp" group in the message following the "appRR" (or the "app" group, as appropriate).

In the "99ppp" group, "99" is the group identifier, "ppp" is the total change in tens, units, and tenths of millibars during the past three hours. E. G.: For a total change of 23.4 mb., the elements "pp" and "ppp" are coded "a99RR 99234"; for 9.9 mb. change, the elements are coded "a99RR 99099."

11103.103. Amount of Precipitation "RR" and Plain Language.--Report, as "RR", the tenths and hundredths figures of the total amount of precipitation entered in column 44. Report the figures to the left of the decimal in plain language, when the amount is 1.00 inch or more. Code "00" if "T" is entered in column 44; "11" if "M" is entered in column 44; and omit "RR" if "0" is entered in column 44.

EXAMPLES

(1) When a = 6, pp = 02, and RR = zero, the group is coded "602."

(2) When a = 6, pp = 02, and RR = TRACE, the group is coded "60200."

(3) When a = 6, pp = 9.9, and RR = zero, the groups are coded "699 99099."

TABLE 41

Symbols "pp" and "ppp." —*Amount of barometric change in the last 3 hours*

Amount of rise or fall											
pp						ppp					
Code figure	Inches of Mercury	Millibars	Code figure	Inches of Mercury	Millibars	Code figure	Inches of Mercury	Millibars	Code figure	Inches of Mercury	Millibars
00	0.000	0.0				100	0.295	10.0			
02	0.005	0.2	52	0.155	5.2	102	.300	10.2			
03	0.010	0.3	54	0.160	5.4						
05	0.015	0.5	56	0.165	5.6	103	.305	10.3	154	0.455	15.4
07	0.020	0.7	58	0.170	5.8	105	.310	10.5	156	.460	15.6
08	0.025	0.8	59	0.175	5.9	107	.315	10.7	157	.465	15.7
						108	.320	10.8	159	.470	15.9
10	0.030	1.0	61	0.180	6.1	110	.325	11.0	161	.475	16.1
12	0.035	1.2	63	0.185	6.3						
14	0.040	1.4	64	0.190	6.4	112	.330	11.2	163	.480	16.3
15	0.045	1.5	66	0.195	6.6	113	.335	11.3	164	.485	16.4
17	0.050	1.7	68	0.200	6.8	115	.340	11.5	166	.490	16.6
						117	.345	11.7	168	.495	16.8
19	0.055	1.9	69	0.205	6.9	119	.350	11.9	169	.500	16.9
20	0.060	2.0	71	0.210	7.1						
22	0.065	2.2	73	0.215	7.3	120	.355	12.0	171	.505	17.1
24	0.070	2.4	75	0.220	7.5	122	.360	12.2	173	.510	17.3
25	0.075	2.5	76	0.225	7.6	124	.365	12.4	174	.515	17.4
						125	.370	12.5	176	.520	17.6
27	0.080	2.7	78	0.230	7.8	127	.375	12.7	178	.525	17.8
29	0.085	2.9	80	0.235	8.0						
30	0.090	3.0	81	0.240	8.1	129	.380	12.9	179	.530	17.9
32	0.095	3.2	83	0.245	8.3	130	.385	13.0	181	.535	18.1
34	0.100	3.4	85	0.250	8.5	132	.390	13.2	183	.540	18.3
						134	.395	13.4	185	.545	18.5
36	0.105	3.6	86	0.255	8.6	135	.400	13.5	186	.550	18.6
37	0.110	3.7	88	0.260	8.8						
39	0.115	3.9	90	0.265	9.0	137	.405	13.7	188	.555	18.8
41	0.120	4.1	91	0.270	9.1	139	.410	13.9	190	.560	19.0
42	0.125	4.2	93	0.275	9.3	141	.415	14.1	191	.565	19.1
						142	.420	14.2	193	.570	19.3
44	0.130	4.4	95	0.280	9.5	144	.425	14.4	195	.575	19.5
46	0.135	4.6	97	0.285	9.7						
47	0.140	4.7	98	0.290	9.8	146	.430	14.6	196	.580	19.6
49	0.145	4.9		0.295	10.0	147	.435	14.7	198	.585	19.8
51	0.150	5.1	[1] 99	0.300	10.2	149	.440	14.9	200	.590	20.0
				etc.	etc.	151	.445	15.1	201	.595	20.1
						152	.450	15.2	203	.600	20.3

[1] When the amount of the barometric pressure change equals or exceeds 9.9 millibars, the group "99ppp" should be inserted in the message following the "$D_dv_da$pp" group. The "99" is the group identifier, and "ppp" is the total amount of the pressure change (in tens, units, and tenths of millibars) during the preceding 3 hours. When the group is inserted, "99" should be reported for "pp" in the "$D_dv_da$pp" group. *For example:* If the total amount of the pressure change is 13.4 millibars, the groups should be coded "D_dv_da99 99134." If the amount is 9.9 millibars, the groups are coded "D_dv_da99 99099." ("D_dv_da" should be given appropriate values.)

(4) When a = 6, pp = 10.2, and RR = 1.00, the groups are coded "69900 99102 ONE."

(5) When a = 6, pp = 3.4, and RR = 1.03, the groups are coded "63403 ONE."

(6) When a = missing, pp = missing, and RR = zero, the group is coded "///."

(7) When a = missing, pp = missing, and RR = 0.03, the group is coded "///03."

11103.104. Snow Depth "985$s_p s_p$".--One or more of these groups are used to report the actual depth of snow on the ground in increments of 100 inches or less to the nearest inch as follows:

(1) When the total depth is 99 inches or less, only one "985$s_p s_p$" group will be sent, and the actual depth will be coded as "$s_p s_p$", e.g., a snow depth of 34 inches would be coded as 98534.

(2) When the total depth is more than 99 inches, report each 100-inch increment by a group 98599, with the groups arranged in consecutive order; the tens and units values of the total precipitation will be coded as "$s_p s_p$" in a final group. E. g., 100 inches of snow on the ground would be coded 98599, 98500; 105 inches, 98599, 98505; 210 inches, 98599, 98599, 98510.

Snow depth is reported as follows:

(1) At 1228 GCT: When there is more than a TRACE of snow on the ground.

(2) At 1828, 0028, and 0628 GCT: When there is more than a TRACE of snow on the ground, provided more than a trace of precipitation has occurred during the past six hours.

11103.105. Maximum and Minimum Temperature "$T_{n/x}T_{n/x}$".--For the symbols "$T_{n/x}T_{n/x}$", code maximum and minimum temperatures as follows:

(1) At 0028 GCT, report the maximum temperature for the past 12 hours.

(2) At 0628 GCT, report the maximum temperature for the past 24 hours.

(3) At 1228 GCT, report the minimum temperature for the past 12 hours.

(4) At 1828 GCT, report the minimum temperature for the past 24 hours.

When the temperature to be reported is higher than 0°, code "$T_{n/x}T_{n/x}$" as the tens and units values, e.g., 1° as "01," 53° as "53," 100° as "00," and 105° as "05."

When the temperature is 0° or less, subtract the positive numerical value of the temperature from 100 and code the tens and units values of the remainder , e.g., code 0° as "00," -15° as "85," and -1° as "99" (i.e., 100 minus 1 = 99). Report slants (//) when the maximum or minimum temperature is missing. Omit the $T_{n/x}T_{n/x}$ group at stations not equipped with instruments for the determination of maximum and minimum temperatures (such as maximum and minimum thermometers).

11103.106. Height of the 850-Mb. Surface "$2h_{85}h_{85}h_{85}a_3$".--Unless otherwise authorized, the $2h_{85}h_{85}h_{85}a_3$ group will be reported by all stations whose elevations are between 2500 and 9500 feet. Code as "$h_{85}h_{85}h_{85}$" the computed height of the 850-mb. pressure surface above mean sea level in tens of geopotential feet, i.e., report the thousands, hundreds, and tens figures as $h_{85}h_{85}h_{85}$. (See Section 7400.) When for any reason, the height cannot be obtained, slants (///) will be reported.

Code the characteristic of the barograph trace for the three-hour period which ended three hours prior to the time of observation for symbol "a_3" in accordance with Section 7600. Code "a_3" as a slant (/) when the characteristic is missing.

11104. Observer's Initials (Col. 15).--Enter initials of observer taking the observation in this column.

11200. COLUMN ENTRIES ON WBAN-10

11202. Time (Cols. 41 and 42).--Entries in column 41 will be omitted. In column 42 in the block captioned "Mid to.....," enter the time of beginning of the first 6-hourly observation after 0000 LST. In the next four blocks below, enter, consecutively, the time of beginning of the 6-hourly observations. The entries will be to the nearest minute in terms of the 24-hour clock.

WBAN-10 (CAA)
(3-1-53)

U S DEPARTMENT OF COMMERCE, WEATHER BUREAU

SURFACE WEATHER OBSERVATIONS

(Abridged form for use at designated CAA stations)

STATION INSAC, City, State DATE Mar. 18, 1953

TYPE	TIME (LST)	SKY and CEILING (Hundreds of Feet)	VISIBILITY (Miles)	WEATHER and OBSTRUCTIONS TO VISION	SEA LEVEL PRESS (mb.)	TEMP (°F)	DEW PT (°F)	WIND DIRECTION	WIND SPEED (mph)	WIND CHARACTER AND SHIFTS	ALTIMETER SET (in.)	REMARKS AND SUPPLEMENTAL CODED DATA (Selected Circular N References)	STATION PRESSURE (in.)	DRY BULB (°F)	WET BULB (°F)	TOTAL SKY COVER	TOTAL OPAQUE SKY COVER	OBSERVERS INITIALS
R	1228	-X	4	GF	129	42	42	→ ↘	11		990	SFC VSBY 2 GFDEP 25 (1110, 2420(2))	29.885	42.2	42.0	2	2	ok
S1	1245	W2X	1/2	F				→ ↘	10			(9131, 9132.1 & .3)						ok
S2	1300	W2X	3/8	F				→ ↘	10			(9131, 9132.3)						ok
L	1314	W2X	3/8	F				→ ↘	10		990	(9110, 9141, 9150, 11101)						ok
R	1326	W2X	3/8	F	129	43	42	→ ↘	11		990	524 (1103.1)	29.890	42.8	42.2	10	10	ok
S3	1342	-X	3/4	F				→ ↘	10			VSBY N½ E½ WI (2420(1))						ok
S4	1401	-X	1/4	F				→ ↘	10		990	(9110, 9132.3, 9141)						ok
S5	1417	W2X	3/16V	F				→ ↘	10			VSBY OV3/8 FIBI (9180, 2420(3))						ok
R	1427	W2X	3/16	F	132	42	40	→ ↘	10		991		29.900	41.9	41.2	10	10	ok
S6	1443	-X	7/8	F				↘	10			CONS RPDLY VRBL (9132.1 & .3)						ok
S7	1458	M7⊕	2	F				↘	9		992	(9132.1 & .3, 9150)						ok
RS8	1526	M7V⊕	3	F	135	45	41	↘	10		992	CIG 5V8 (1520(8))	29.910	45.2	43.3	9	9	ok
✓	1607	E6⊕	3	F				↘	11		993	(9150)						RAA
S9	1618	A4⊕	3	F				↘	12			FIBI (1444.1, 9180)						RAA
RS10	1628	M5⊕90⊕	3	F	146	47	40	↘	14		995	419 47 (9132.1(4), 11103.1)	29.945	46.7	43.6	9	8	RAA
S11	1658	6-⊕90⊕	4	F				↘	22	+30	995	(8430, 9132.1(1))						RAA
R	1728	25⊕90⊕220⊕	5	F	146	45	38	↘	24	038	995	VSBY NW1½ BD (3911, 8450)	29.945	45.0	41.9	4	3	RAA
✓	1818	25⊕90⊕220⊕	6	F				↘	23	+34	995	BD ON FLD NW (3920(5))						RAA
R	1828	25⊕400M90⊕																RAA
		120⊕220⊕	6	H	146	44	36	↘	18	+27	995	(1510)	29.945	44.4	40.8	10	6	RAA
✓	1909	400⊕90⊕220-⊕	6	H				↘	17		995	(1410)						RAA
R	1928	220-⊕	7		146	45	37	↘	16		995	902 (11103.1)	29.940	44.9	41.2	10	4	RAA
✓	2010	220-⊕	8					↘	14		994							RAA
R	2028	30⊕220-⊕	10		139	44	39	→ ↘	17		993		29.915	44.4	41.8	10	4	RAA
✓	2108	30⊕220-⊕	12					→ ↘	16		991							RAA
R	2127	30⊕E200⊕	12		129	44	39	→ ↘	19	+24	990	OV⊕ (1520(7))	29.890	43.7	41.4	10	6	RAA
✓	2207	M34⊕150⊕	10	RW-				→ ↘	21	+28	986							RAA
R	2229	M34⊕120⊕	7	RW-	098	37	33	→ ↘	18		981	RWB48 74707 47 (3920(4,9), 11103.1)	29.800	37.1	35.3	10	10	RAA
✓	2308	150⊕M41⊕90⊕	9	RW-				↓ ↘	12		981							RAA
RS12	2327	150⊕M38⊕	7	2R-	095	30	23	↓ ↘	14		980	RWE15 (3920(4,9), 9132.6)	29.790	29.6	27.3	10	10	RAA
S13	2351	P8X	1	S-				↘	11			(9132.1 & .3)						RAA

TIME (G.C.T.)	TIME (LST)	NO	PRECIP (in.)	MAX TEMP (°F)	MIN TEMP (°F)
	MID TO	X			
		1			
		2			
	1604	3	0	47	40
	2207	4	.07	47	37
	MID	X	.12	37	28

STATION PRESSURE COMPUTATIONS

TIME (LST)		1615	2216
ATT. THERM.		75.0	74.0
OBSVD. BAR.		30.092	29.958
TOTAL CORR.		-.149	-.157
STA. PRESS.		29.943	29.801
BAROGRAPH		29.945	29.810
BAR. CORR.		*0	-.010

SUMMARY OF DAY (MIDNIGHT TO MIDNIGHT)

24-HR MAX. TEMP. (°F)	24-HR MIN. TEMP. (°F)	24-HR PRECIP. (in.)	24-HR SNOWFALL (in.)	SNOW DEPTH (in.)
			T	0

REMARKS, NOTES AND MISCELLANEOUS PHENOMENA

* -.005" (Cir. N 7787)

Fig. 6. Entries on WBAN-10 (CAA).

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INDEX

† This paragraph follows paragraph 11004
†† This paragraph follows paragraph 9120
††† This paragraph follows paragraph 11010

† These paragraphs follow paragraph 6120.

† These paragraphs follow paragraph 6120.

† This paragraph follows paragraph 2011.

Commerce-Weather Bureau, Washington, D. C.

Change No. → 1

FOR OFFICIAL USE ONLY

UNITED STATES DEPARTMENT OF COMMERCE • Sinclair Weeks, Secretary
WEATHER BUREAU • F. W. Reichelderfer, Chief

MANUAL OF
SURFACE OBSERVATIONS
ABRIDGED
(For CAA Stations)

FROM

CIRCULAR N
Sixth Edition
(Revised)

October 1, 1954

WASHINGTON, D. C.

Change No. 1 consists of the following:

Pen-and-ink changes:

1. Change "statute miles" or "miles" to read "nautical miles" in the following places:

   a. Page 5, par. 1431(3), line 3.

   b. Page 5, par. 1432, line 3.

   c. Page 6, par. 1436(3), line 3.

   d. Page 11, par. 1444, line 6.

   e. Page 12, par. 1446, line 6.

   f. Page 16, par. 1520(6,b), column captioned "Instructions for entry".

2. Page 49, par. 3920(1), under the caption "Instructions for Entry", in item (b), 3rd line, following "gusts," insert "in knots," and in item (c) add the sentence "Distances other than visibility will be reported in nautical miles."

3. Page 174, Table A8-1, in the two column headings captioned "....(m.p.h.)," add "or knots."

4. Page 183, par. A8341, add the footnote:

   "These units may be statute miles per hour or knots depending upon the calibration of the individual instrument."

5. Pages 185-186, par. A8351 and A8361, add the sentence:

   "See the footnote to par. A8341."

6. Page 187, par. A8410, 1st sentence, add "(statute miles)."

7. Page 190, par. A8420, 1st sentence, add "(statute miles)."

8. Page 209, par. 10110, following the caption "General," add "All distances will be expressed in nautical miles, except visibility will be in statute miles."

9. Page 215, par. 11004, add "In the caption to column 10, delete "(m.p.h.)" and add "(kts.)."

10. Page 217, par. 11103, add the sentence, "Enter all distances except visibility in nautical miles."

11. Page 223, Fig. 6, add "During the period Oct. 1 through Dec. 31, 1954, enter wind speeds in accordance with par. 8420."

Page changes consist of pages 175-176.

THIS PAGE MAY BE DISCARDED WHEN THE FOREGOING CHANGES HAVE BEEN MADE.

indicated, without regard to the duration of the gust. 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.

8330. Wind Shifts.--Wind shifts, as defined and used in this manual, are usually 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 counterclockwise in the Southern Hemisphere).

(2) Rapid drop in the dew point.

(3) Rapid drop in temperature.

(4) Rapid rise in pressure.

(5) In summer; lightning, 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.

8400. ENTRIES ON WBAN-10

8410. Wind Direction (Col. 9).--Enter the wind direction to sixteen points of the compass by means of one or two short arrows, as shown in Table 16. When the wind is calm, make no entry in this column.

Table 16. 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

***8420. Wind Speed (Cols. 10 & 11). --Enter wind speed in knots in col. 10, (see par. 11004). In col. 11, following any entry of gustiness, shifts or squalls (see par. 8430-50), enter the speed in statute miles per hour in red. Enter E immediately following estimated values of speed. Enter C for calm.**

* 8430. Gustiness (Col. 11). --Report gusts by the symbol "+" immediately following the one-minute wind speed. Enter the peak speed (in knots) of gusts observed during the past 15 minutes immediately following this symbol (see Fig. 6). These data will be reported when they occur regardless of the type of wind equipment used. If estimated, enter E in accordance with par. 8420.

8440. Shifts (Col. 11). --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. Since the space provided in column 11 is not sufficient for wind-shift data, distribute all wind data evenly among columns 9, 10, 11; e.g., "↘25+40↖1614C" in these columns would indicate a wind shift from southeast to northwest at 1614 CST.

8450. Squalls (Col. 11). --Report squalls by the symbol "Q" immediately following the one-minute wind speed and preceding the peak speed of gusts observed during the past 15 minutes (see Fig. 6 and Sec. 3300).

A8000. MAGNETIC WIND DIRECTIONS

A8010. General. --Wind directions used for meteorological purposes are with reference to true north. Wind directions with reference to the magnetic north pole are sometimes required by CAA communications personnel providing air-ground communication service.