Appendix D

Wind Vector Plotting

Wind vector plots are used to determine the lateral limits of fallout, the effective downwind direction, and the effective wind speed. These plots are prepared by the NBCC on receipt of upper-air wind data. Each is prepared on overlay paper, oriented to grid north, and drawn to a convenient scale. Each plot consists of a series of vectors representing wind layers between the surface of the earth and the height at which upper air wind data are obtained.

The vectors are plotted head to tail; and each vector represents the distance and direction a nominal-sized particle travels over the earth while falling through the wind layers. A nominal-sized particle is a spherical particle, 143 microns in diameter, that requires three hours to fall from a height of 11,000 meters to the ground. The wind vector plot represents a series of points on the ground where these nominal-sized particles are expected to land.

Upper-Air Wind Data

Upper-air wind data for fallout prediction by tactical units normally are obtained from division field artillery meteorological sections. These sections forward meteorological information to fire direction centers (FDCs) and to appropriate fire support elements (FSEs).

The network of field artillery meteorological sections provides all FDCs and FSEs within the corps with upper air wind data. This includes data up to 30,000 meters or to the bursting height of the balloon, whichever comes first. Minimum acceptable height is 14,000 meters. This information is provided four times daily; on or about 0600Z, 1200Z, 1800Z, and 2400Z. The upper-air wind data provided consists of—

- Average wind speed in knots for each 2,000-meter layer above the mean datum plane of the reporting meteorological section.
- Wind direction to the nearest 10 mils from which the winds are blowing for each 2,000-meter layer above the mean datum plane of the reporting MET section.

Note: Special data (pressures, temperatures, and relative humidities) at significant levels are furnished only when specifically requested. A significant level is defined as any level in the atmosphere where a significant weather change occurs.

The above wind data are sent to the NBCC in a fallout meteorological (FOMET) message by established communication nets. Division and corps FSEs monitor this net to obtain data directly. The FSE relays the upper-air wind data to the NBCC if required.

If Army field artillery wind observations are not available, upper air wind data for fallout prediction may be obtained from other sources. This data must provide wind speeds and directions for consecutive wind layers above the observing station or altitude layers above mean sea level. For example, wind direction to the nearest 10 degrees from true north and wind speed to the nearest knot may be obtained from air weather service (AWS) detachments.

The primary source for upper air wind data in the continental United States is the US Weather Bureau, which reports wind direction to the nearest 10 degrees from the directions from which the wind is coming and wind speed to the nearest knot. Wind direction is the direction from which the wind is blowing. If current wind data are not given to the required height, the latest available data from previous reports for the higher levels are used to extend the plot.

Up-to-date wind data that has been obtained from a source as close as possible to the actual or expected GZ should be used. Data from other sources, listing wind direction, speed, and height in units other than mils, knots, and kilometers, may be converted by using conversion tables D-16 and D-17, page D-13.

Army field artillery upper-air wind data are preferable to wind data from other sources. But it should be obtained from an observation point not more than one and one-half times as far from the actual or expected GZ as the data from other sources is from GZ.

Procedures

There are basically two methods for preparing the wind vector plot—the manual method and the plotting scale method. In the manual method, the plotter uses a compass and protractor to place the wind data on overlay paper. It can be used with any available wind data. In the plotting scale method, the plotter uses the ML556/UM plotting scale to place the wind data on overlay paper. It is quicker than the manual method, but can only be used with field artillery wind data or AWS data.

Regardless of the procedure used, the resulting wind vector plot must contain the following minimum information—

- A labeled GZ point.
- The plot of vectors for each wind layer, starting from the surface and proceeding upward consecutively to the highest observed wind level. Each vector must represent the distance in kilometers and direction that a nominal-size particle would travel over the surface while falling through the layer.
- Identification of each wind layer by designating the height levels, in thousands of feet or meters, of the top and bottom of the wind layer on the vector plot.
- Scale of the wind vector plot (map margin information).
- A GN line.

The procedure for plotting the wind data is essentially the same for both the manual and the plotting scale method. The plotting scale method is easier to use because you do not have to convert the raw wind data. Both methods yield similar results. Prepare the wind vector plot one factor at a time, starting with the lowest height level and working upward. The direction of each vector is the same as the wind direction for that layer. The length of the vector is the product of the wind speed and a weighting factor. Each vector represents the average fallout particle and its location. The example in Figure D-1 shows a 0-to-2,000-meter layer vector.

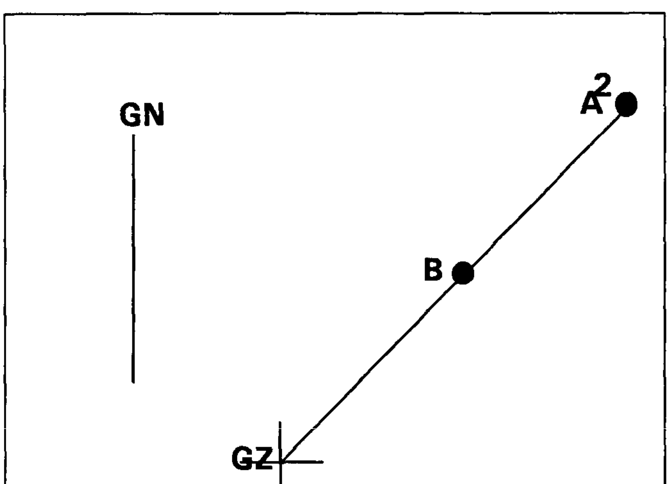


Figure D-1. Example of plotted 0-to-2,000-meter layer vector.

A fallout particle that starts at the 2,000-meter level will land at point A. A particle that starts at the 1,000-meter level will land at point B.

To better explain how to prepare wind vector plots, the following seven examples will be worked:

- Field artillery wind data—manual method.
- Field artillery wind data-plotting scale method.
- Ballistic met message.
- Computer met message.
- Air Weather Service wind data-plotting scale method.
- Air Weather Service constant pressure data-plotting scale method.
- Other wind data—manual method.

Field Artillery Wind Data —Manual Method

There are three standard field artillery meteorological messages applicable (or usable) for fallout prediction:

- Fallout met message.
- Ballistic met message.
- Computer met message.

The fallout met message contains only wind data in 2,000-meter layers from the surface to 30,000 meters. This data may be obtained in 5,000-foot levels, if requested from the field artillery. These data are used by the chemical section (NBCC) at division and/or corps level to develop the fallout winds messages (EDM and NBC 3), which predict the location of fallout particles if nuclear weapons are employed. Other NATO nations and the ANBACIS program refer to the EDM as EDR, or effective downwind report.

Assume that the field artillery upper air wind data shown in Figure D-2 (next page) have been received by the NBCC.

Line 00 of the message is surface winds and normally is not used. Line 01 contains the wind data for the 0-to-2,000-meter wind layer (124009). Reading from the left, the wind direction is 1240 mils, and the wind speed is 9 knots. Each line of the wind data message (representing different wind layers) can be separated into wind direction and wind speed (see Table D-1, next page).

Follow steps 1 through 7 to prepare the fallout wind vector plot.

Step 1. Adjust the wind data. The wind directions reported in upper air wind data are the directions from which the winds are blowing. Using the reported direction, obtain the direction toward which the fallout particles are being blown while falling through a wind layer. Do this by adding or subtracting 3,200 mils-add 3,200 mils if the

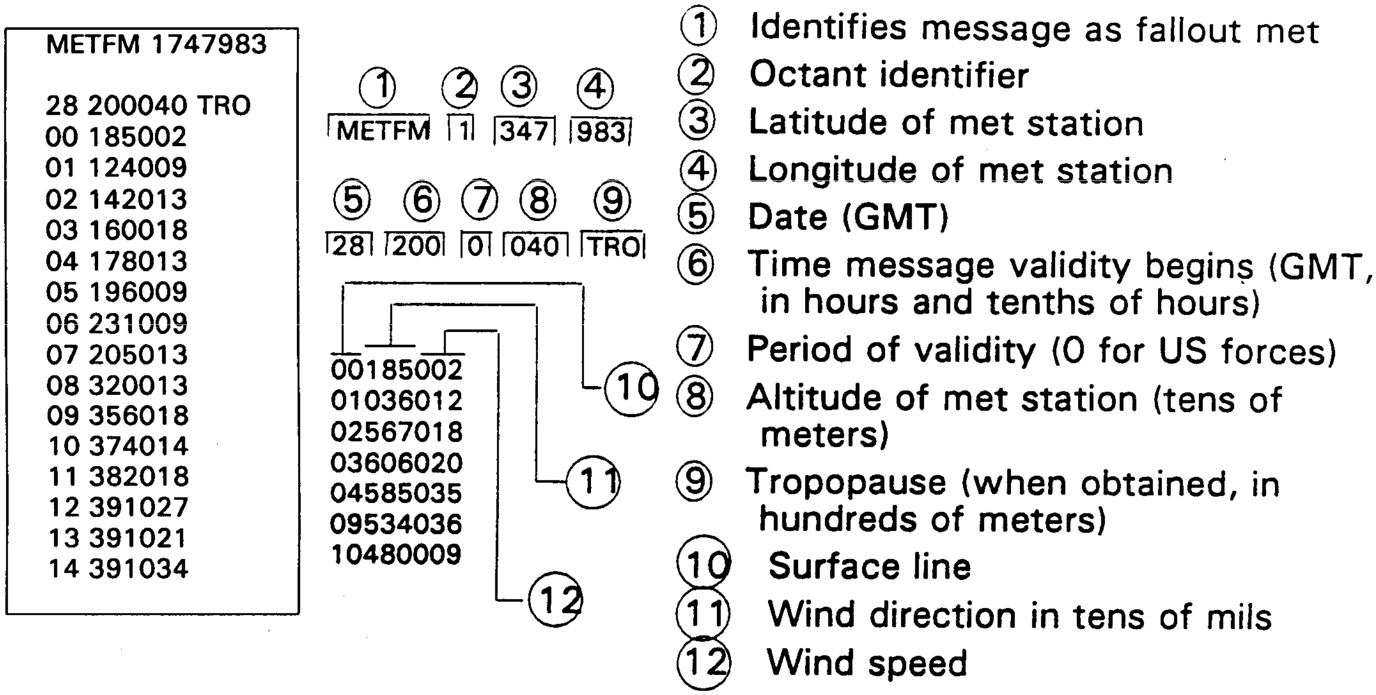


Figure D-2. Example of field artillery meteorological message containing upper air wind data (left) and breakdown of message format (right).

reported direction is less than 3,200 mils; subtract if it is more than 3,200 mils. To convert mils to degrees, divide the back azimuth in mils by 17.8.

Obtain the horizontal distance in kilometers traveled by a fallout particle while falling through a wind layer. Do this by multiplying the reported wind speed (in knots) for the layer by the appropriate weighting factor from Table D-2 (next page). Round the answer to the nearest tenth of a kilometer. Table D-3 (page D-5) shows a completed work sheet for this step.

The fallout met message provides wind data for nuclear weapons yields up to 6 megatons. Fallout met message format and breakdown is shown in Figure D-2.

Step 2. Attach overlay paper to a piece of graph paper, a map, firing chart, or any other paper with parallel lines that can serve as north-south grid lines. Select and mark a point that represents GZ, and draw in and label a GN line. Also record the date and time in which the winds were measured.

Step 3. Select and record a map scale. (In this example, a map scale of 1:500,000 is used.)

Step 4. Plot the wind direction and vector length for each wind layer, starting with the lowest layer.

Plot the vector for the lowest (0-to-2,000-meter) wind layer. Note that the wind speed is 9 knots, blowing from 1,240 mils. From GZ, plot an 11.3- kilometer line toward 4,440 mils. This distance (11.3 kms) came from Table D-3. It is the product of the reported wind speed of 9 knots at the 0-2,000-meter level multiplied by the weighting

Table D-1. Wind data from Figure D-2, separated into columns on worksheet.

Wind Layer (10^3 meters)	Wind Direction (mils)	Wind Speed (knots)
0--2	1240	9
2--4	1420	13
4--6	1600	18
6--8	1780	13
8--10	1960	9
10--12	2310	9
12--14	2050	13
14--16	3200	13
16--18	3560	18
18--20	3740	14
20--22	3820	18
22--24	3910	27
24--26	3910	26
26--28	3910	34
30 (balloon burst)		

factor of 1.26. Mark the end of this vector with the number 2. This indicates the 2,000-meter height (see Figure D-3, Part 1, below).

Starting at the point where the first vector ended, plot the second vector for the 2,000-4,000-meter layer. This represents a wind speed of 13 knots, blowing from 1,420 mils. The vector is plotted 14.2 kilometers toward 4,620 mils. Mark the end of this vector with the number 4. This indicates the 4,000-meter height (see Figure D-3, Part 2, below).

Starting at the point where the second vector ended, plot the third vector for the 4,000-6,000-meter layer. This represents a wind with a speed of 18 knots blowing from 1,600 mils. This vector is plotted 17.3 kilometers toward 4,800 mils. Mark the end of this vector with the number 6. This indicates the 6,000-meter height.

Plot the remaining vectors in the same manner, and label the end of each vector with the height it represents. The completed wind vector plot is shown in Figure D-3, Part 3 (next page).

Table D-2. Weighting factors for 2,000-meter wind layers. (To be used with Army field artillery wind data.)

Wind Layer (10^3 meters)	Time In Layer (hours)	Weighting Factor
0--2	0.68	1.26
2--4	0.59	1.09
4--6	0.52	0.96
6--8	0.50	0.93
8--10	0.48	0.89
10--12	0.45	0.83
12--14	0.42	0.78
14--16	0.40	0.74
16--18	0.39	0.72
18--20	0.38	0.70
20--22	0.37	0.69
22--24	0.36	0.67
24--26	0.36	0.67
26--28	0.35	0.65
28--30	0.34	0.63
30--32	0.34	0.63
32--34	0.33	0.61
34--36	0.33	0.61
36--38	0.32	0.59
38--40	0.31	0.57
40--42	0.31	0.57
42--44	0.30	0.55
44--46	0.30	0.55
46--48	0.29	0.54
48--50	0.29	0.54

Note: 1. Multiply wind speed in knots by weighting factor to get kilometers.
2. Weighing factors remain constant for each layer regardless of the wind speed at that layer.

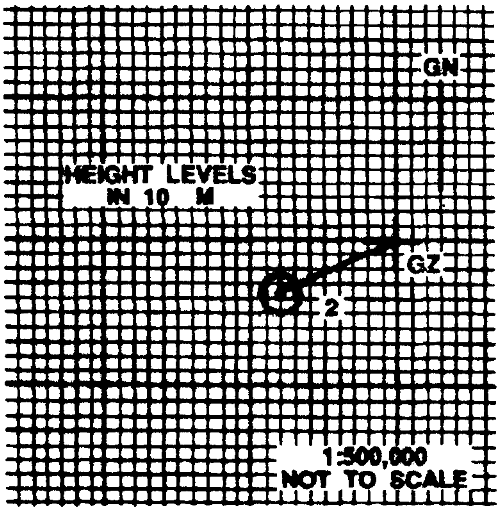


Figure D-3, Part 1. Vector for 0-to-2,000-meter wind layer.

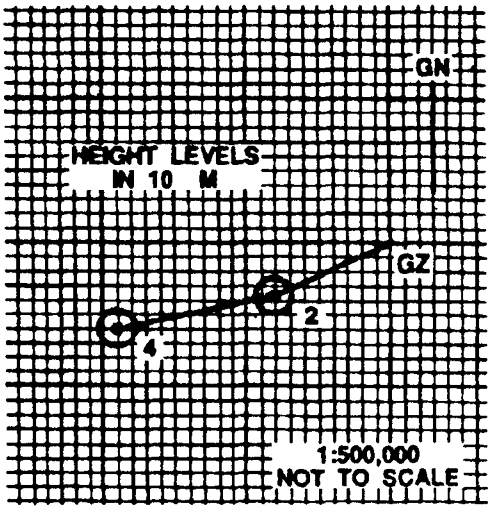


Figure D-3, Part 2. Vector for 2,000-4,000-meter wind layer.

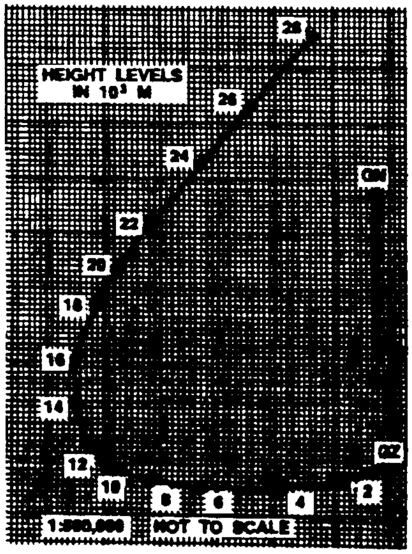


Figure D-3, Part 3. Completed wind vector plot.

Field Artillery Wind DataPlotting Scale Method

As seen in the first example, there are several steps in plotting each wind vector. A plotting scale makes this plotting easier, and it reduces the number of steps involved. The conversion of the direction from which the winds are blowing to the direction toward which they are blowing and the calculation of the vector length are eliminated with the plotting scale. The ML556/UM fallout prediction plotting scale (shown in Figure D-4, page D-6) lets you plot the wind vectors directly from field artillery or Air Weather Service upper-air wind data. The plotting scale is constructed of clear plastic and consists of two main parts:

- An azimuth dial with an inner scale in degrees and an outer scale in hundreds of mils.
- A series of 11 slots representing various wind layers (altitude zones) with wind speeds graduated in knots along each slot. These wind speeds are color-coded for use with different scale maps. Note the color representing the map scale you are using. The weighting factors in Table D-4 (page D-7) have been used to convert wind speeds in knots (nautical miles per hour) to vector lengths in kilometers on the scale.

Plot field artillery upper-air wind data with the plotting scale as shown in these six steps:

Step 1. Attach overlay paper to a piece of graph paper, a map, a firing chart, or any other paper with parallel lines that can serve as north-south grid lines. Mark GZ, scale, and GN line on the overlay paper.

Step 2. Lay the plotting scale on the chart so that the pin hole at the end of the 0-2 slot lies over the starting point (GZ).

Step 3. Secure the scale to the chart by inserting a sharpened instrument (hard lead pencil, compass point, or a pin) through the hole. Rotate the scale so that the line on the azimuth dial representing the wind direction (in mils) for the (0-2,000-meter) wind layer runs parallel to the north-south grid lines and is oriented with the azimuth representing the wind direction pointing north. Read the

Table D-3. Completed worksheet for upper-air wind data.

Wind Layer (10^3 m)	Wind Direction (mils)		Wind Speed x Factor = Vector Length		
	From (ML556)	To	Wind Speed (knots) (ML556)	Factor (from Table D-2)	Vector Length (km)*
0--2	1240	4440	9	1.26	11.3
2--4	1420	4620	13	1.09	14.2
4--6	1600	4800	18	.96	17.3
6--8	1780	4980	13	.93	12.1
8--10	1960	5160	9	.89	8.0
10--12	2310	5510	9	.83	7.5
12--14	2050	6050	13	.78	10.1
14--16	3200	6400	13	.74	9.6
16--18	3560	360	18	.72	13.0
18--20	3740	540	14	.70	9.8
20--22	3820	620	18	.69	12.4
22--24	3910	710	27	.67	18.1
24--26	3910	710	21	.67	17.4
26--28	3910	710	34	.65	22.1
30 (balloon burst)					

* Round off to nearest tenth of a kilometer.

wind direction directly from the field artillery upper air wind data.

Step 4. Holding the scale firmly, insert pencil in the 0-2 slot, and draw a line to the point which represents the wind speed in knots for the 0-2,000-meter layer. (Read the wind speed directly from the field artillery upper-air wind data). Be sure to read the correct wind speed (color-coded) for the map scale you are using. Lift the scale and mark this point with the number 2 to indicate the top of the layer it represents (2,000 meters).

Step 5. Move the scale so that the hole at the end of the 2-4 slot lies over the outer end of the wind vector just plotted. Orient the scale as described in Step 3. But, this time use the wind direction for the 2,000-4,000-meter layer. Using the 2-4 slot, draw a line to the point representing the wind speed in the 2,000-4,000-meter layer. Lift the scale and mark this point with the number 4.

Step 6. Repeat Step 5 for each wind layer until the plot is completed. Be sure to use the appropriate slot for each wind layer being plotted. Remember, the wind speeds are color-coded. Note that starting with the 16-18 slot, each slot is used to plot several vectors.

Sample Situation

Assume that the field artillery upper-air wind data shown in Table D-5 (page D-7) have been received by the NBCC.

Sample Plotting Actions

Using the fallout prediction plotting scale, prepare the fallout wind vector plot as follows:

Step 1. Attach overlay paper to a piece of graph paper, a map, firing chart, or any other paper with parallel lines that can serve as north-south grid lines. Mark GZ, scale, height dimensions, and GN on the overlay paper. Lay the plotting scale on the chart so that the pinhole at the end of. the 0-2 slot lies over the point marked GZ. Insert a pin, sharp pencil, or compass point through the pinhole to secure the chart on GZ. Rotate the plotting scale until the 1,240-mil line on the azimuth dial (the outer scale) is parallel to any north-south line and directed toward GN. Insert a pencil in the 0-2 slot and draw a line to 9 (9 knots) at the selected map scale. Read this data directly from the field artillery upper air wind data. Mark the end of this vector with the number 2 to indicate 2,000-meter height.

Step 2. Lay the pinhole at the end of the 2-4 slot at the end of the vector just plotted. Insert a pin, sharp pencil, or compass point through the hole to secure the pinhole. Rotate the plotting scale until the 1,420-mil line on the azimuth dial is parallel to any north-south line and directed toward GN. Draw a line in the 2-4 slot to 13 (13 knots) at the selected map scale. Mark the end of this vector with the number 4 to indicate 4,000-meter height.

Step 3. Lay the pinhole at the end of the 4-6 slot at the end of the second vector. Insert a pin, sharp pencil, or compass point through the hole.. Rotate the plotting scale until the 1,600-mil line on the azimuth dial is parallel to

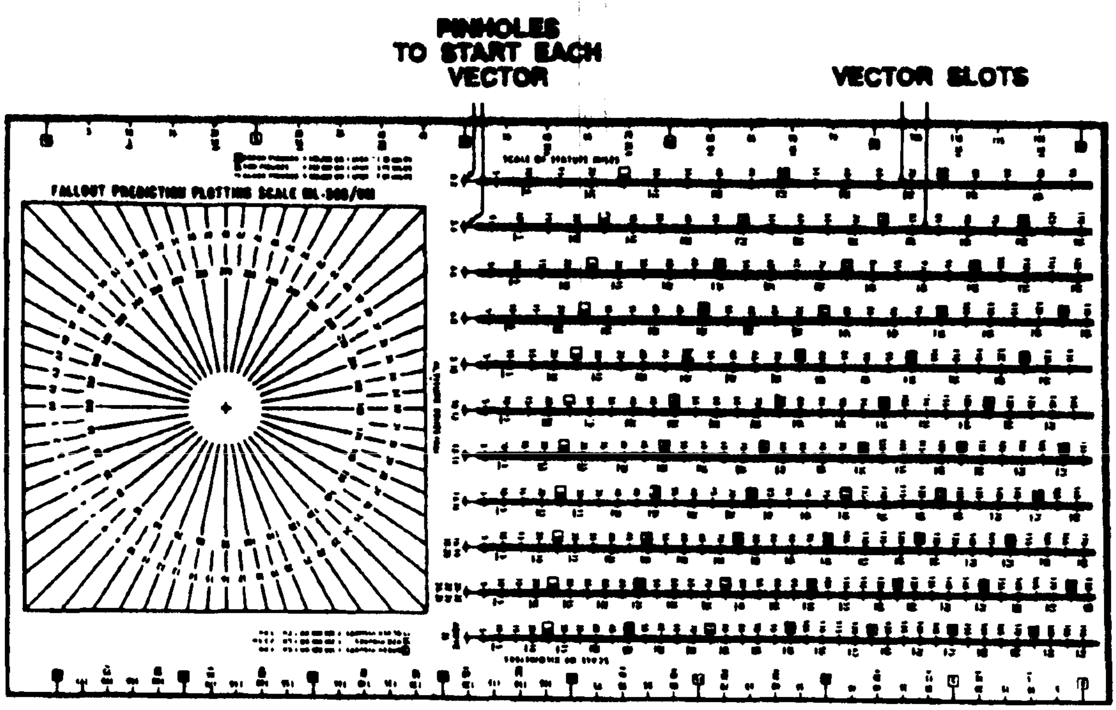


Figure D-4. ML556/UM fallout prediction plotting scale.

any north-south grid line and directed toward GN. Draw a line in the 4-6 slot to 18 (18 knots) at the selected map scale. Mark the end of this vector with the number 6 to indicate 6,000-meter height.

Step 4. Plot the remaining vectors in the same manner and label the end of each vector with the height it represents. The resulting plot will look like the one in Figure D-3, Part 3 (page D-5), since the same data were used for both the manual and plotting scale methods.

Table D-4. Weighting factors and plotting scale data for 5,000-foot wind layers. (For use with Air Weather Service

Wind Layer (10^3 feet)	Time In Layer (hours)	Weighting Factor [1]	Plotting Scale Slot (Use with wind layer indicated)	Adjustment Factor [2]
0--5	.51	.94	6-8	1
5--10	.46	.85	10-12	1
10--15	.43	.80	12-14	1
15--20	.41	.76	14-16	1
20--25	.39	.72	16-18	1
25--30	.37	.68	20-22	1
30--35	.35	.65	26-28	1
35--40	.34	.62	28-30	1
40--45	.32	.59	28-30	1
45--50	.31	.56	2-4	½
50--55	.30	.56	2-4	½
55--60	.30	.56	2-4	½
60--65	.29	.54	2-4	½
65--70	.28	.52	2-4	½
70--75	.28	.52	2-4	½
75--80	.27	.50	4-6	½
80--85	.27	.50	4-6	½
85--90	.27	.50	4-6	½
90--95	.27	.50	4-6	½
95--100	.26	.48	4-6	½
100--105	.24	.44	6-8	½
105--110	.24	.44	6-8	½
110--115	.24	.44	6-8	½
115--120	.23	.43	6-8	½
120--125	.23	.43	6-8	½
125--130	.23	.43	6-8	½
130--135	.22	.41	8-10	½
135--140	.22	.41	8-10	½
140--145	.22	.41	8-10	½
145--150	.21	.39	12-14	½
150--155	.21	.39	12-14	½
155--160	.21	.39	12-14	½

1. Multiply wind speed in knots by this factor to get kilometers.
2. Multiply reported wind speed by this factor before plotting.

Ballistic Met Message

The ballistic met message is a coded message containing information about current atmospheric conditions. The two types of ballistic met messages provided for artillery fire are Type 2 messages, which are used in air defense artillery, and Type 3 messages, which are used by field artillery cannon units and by rocket units for firing at surface targets. Ballistic met message format is shown in Figure D-5 (next page).

The introduction of the ballistic met message consists of four six-character groups.

Group 1. The first three letters (MET) in Group 1 identify the transmission as a meteorological message. The next letter (B) indicates that it is a ballistic met message. The first digit (3) indicates the type of met message. The last digit (1) designates the octant of the earth in which the met station is located. In this case, 1 indicates that the met station is between 90 degrees west and 180 degrees west longitude, and that it is north of the equator (north latitude). Specific octant codes are listed in Figure D-6, page D-10.

Group 2. Group 2 designates the center of the area in which the message is valid. This is expressed in tens, units, and tenths of degrees of latitude and longitude (345 = 34.5 degrees = 30 degrees 30 minutes north latitude; and 982 = 98.2 degrees = 98 degrees 2 minutes west longitude). When number 9 is

Table D-5. Example of field artillery upper-air wind data.

Wind Layer (10^3 meters)	Wind Direction (mils)	Wind Speed (knots)
0-2	1240	9
2-4	1420	13
4-6	1600	18
6-8	1780	13
8-10	1960	9
10-12	2310	9
12-14	2850	13
14-16	3200	13
16-18	3560	18
18-20	3740	14
20-22	3820	18
22-24	3910	27
24-26	3910	21
26-28	3910	34
30 (balloon burst)		

used to designate the octant, the six digits or letters represent the coded location of the met station that produced the message.

Group 3. The first two digits (27) in Group 3 represent the day of the month the message is valid. The next three digits (095) indicate the hour in tens, units, and tenths of hours (095 = 9.5 hours = 0930 hours) the message becomes valid. The hours refer to Greenwich mean time. The last digit (0) in Group 3 indicates the number of hours the message will remain valid. The United States does not attempt to predict the length of time a met message will remain valid. Instead, during combat the United States normally obtains new met data every 2 hours. Therefore, the last digit in Group 3 of a ballistic met message produced by the United States will always be 0. Some allied nations predict the length of time a met message will remain valid. These predictions vary from 1 to 8 hours. The **number 9 here indicates 12 hours.**

Table D-6. Ballistic met message height conversions.

Zone Height (meters)	Line Number ZZ
Surface	00
200	01
500	02
1,000	03
1,500	04
2,000	05
3,000	06
4,000	07
5,000	08
6,000	09
8,000	10
10,000	11
12,000	12
14,000	13
16,000	14
18,000	15

Group 4. The first three digits (037) of Group 4 indicate the altitude of the met station (meteorological datum plan) above mean sea level in multiples of 10 meters (037 = 370 meters). The next three digits (991) indicate the atmospheric pressure at the station, expressed as a percentage (to the nearest 0.1 percent) of the International Civil Aviation Organization (ICAO) standard atmospheric pressure at mean sea level (991 = 99.1 percent). When a value is equal to or greater than 100 percent, the initial digit 1 is omitted (000 = 100 percent).

The body of the met message can consist of 16 lines (00 through 15). Each line consists of two six-digit groups. Each line contains the ballistic data for a particular altitude zone. Ballistic data are the weighted averages of the conditions that exist from the surface up through the altitude zone indicated by the line number and back to the surface.

The first two digits of the first group of the line identify the altitude zone (00 [surface] through 15 [18,000 meters]).

The next two digits (21) of the first group indicate from which direction the wind is blowing expressed in hundreds of mils true north (01 = 100 mils).

The last two digits (07) of the first group indicate the speed of the ballistic wind in knots (05 = 5 knots).

The first three digits (029) of the second group on the line indicate the ballistic air temperature expressed as a percentage (to the nearest 0.1 percent) of the ICAO standard temperature (003 = 100.3 percent). When a value is equal to or greater than 100 percent for temperature or pressure, the initial digit 1 is omitted.

The last three digits (957) of the second group indicate the ballistic air density expressed as a percentage (to the nearest 0.1).

Ballistic met message data may be plotted manually by allpying these six steps:

Step 1. Determine the height in meters for each line number, using Table D-6.

Step 2. Convert wind directions “from” to wind direction "to."

Step 3. Determine the time of fall (hours) for each layer, using Figure D-10 (page D-14).

Step 4. Convert wind speed in knots to wind speed in kilometers per hour by multiplying by 1.853.

Introduction

METB31 (Group 1) 345982 (Group 2)
270950 (Group 3) 037991 (Group 4)

Body

002107	029957
012208	029954
022309	033953
032410	037954
042610	039953

METB31347983
082000040957
Identifies message as a met message
B for ballistic message
3 for Type 3 message (surface-to-surface)
Octant identifier
Latitude of met station
Longitude of met station
Date (GMT)
Time message validity begins (GMT)
Period of validity (0 for US forces)
Altitude of met station (MDP)
Met datum plane (MDP) pressure, percent of standard

Figure D-5. Sample ballistic met message and breakdown of format.

Step 5. Multiply wind speed in kmph by the time in layer (Step 3) to obtain vector length in kilometers.

Step 6. Plot converted data.

The ballistic met message provides wind data for nuclear weapons yields up to 350-kiloton.

Computer Met Message

The computer met message, like the ballistic met message, is a coded message that reports the atmospheric conditions in selected layers, starting at the surface and extending to an altitude that normally includes the maximum ordinate of field artillery weapons that use these data. Unlike the ballistic met message used in the manual computations (where the weather conditions existing in one layer or zone are weighted against the conditions in lower layers and reported as percentages of the standard), the computer met reports actual average wind speed, air temperature, and pressure in each layer. The computer met message is used by BVCS, BCS, and TACFIRE computers in computing equations in the computer's program.

The introduction of the computer met message consists of four six-character groups:

Group 1. The first five letters (METCM) identify the transmission as a computer met message. The last figure (1) is the designation of the octant of the earth in which the station is located. The octant code key is the same as the key for the ballistic met message.

Groups 2 and 3. These groups in the computer met message are the same as Groups 2 and 3 in the ballistic met message.

Group 4. The first three digits of Group 4 indicate the altitude of the met station above mean sea level in tens of meters. The last three digits indicate the atmospheric pressure, in millibars, at the met station. When the value is greater than 99.9, the first digit (1) is omitted (for example, 009 = 100.9).

The body of the met message consists of 27 met message lines (00 through 26). Each line consists of two 8-number groups. Each line contains the actual average weather data for a particular altitude zone.

The first two digits of the first group indicate the met line number that identifies the zone. The lines are numbered in sequence from 00 (surface conditions) through 26. Line 00 is used as an example.

The next three digits (260) indicate the direction from which the wind is blowing, expressed in tens of mils (2,600) true azimuth.

Table D-7. Computer met message height conversions.

Zone Height (meters)	Line Number ZZ
Surface	00
200	01
500	02
1,000	03
1,500	04
2,000	05
2,500	06
3,000	07
3,500	08
4,000	09
4,500	10
5,000	11
6,000	12
7,000	13
8,000	14
9,000	15
10,000	16
11,000	17
12,000	18
13,000	19
14,000	20
15,000	21
16,000	22
17,000	23
18,000	24
19,000	25
20,000	26

The last three digits (018) indicate the wind speed expressed in knots (18 knots).

The first four digits (2698) of the second group indicate the actual air temperature, expressed in degrees Kelvin to the nearest tenth of a degree (269.8 degrees Kelvin).

The last four digits of the second group indicate the actual air pressure, in millibars, to the nearest millibar.

Although not addressed in field manuals, a computer met message may be used to prepare a fallout wind vector plot in the same manner as described for ballistic met messages/ The height in meters for each line number uses different code definitions (see Table D-7).

Computer met messages provide wind data for nuclear yields up to 600 kiloton.

Octant Codes and Locations

All met messages use the octant codes and locations in Figure D-6 (page D-10).

Air Weather Service Wind Data —Plotting Scale Method

Plotting AWS upper-air wind data with the plotting scale is done in much the same way as for field artillery upper-air wind data, except that different slots are used for the wind layers. For heights above 45,000 feet, the vector is drawn to a point on the slot scale equal to one half of the reported wind speed. Table D-4 (page D-7) has weighting factors and plotting scale data to be used with AWS wind data. The next example problem illustrates the use of the plotting scale with AWS upper-air wind data.

Sample Situation

Assume the upper-air wind data in Table D-8 (next page) have been received by the NBCC from the AWS detachment.

Sample Plotting Actions

Prepare the fallout wind vector plot, according to the following three steps:

Step 1. Attach overlay paper to a piece of graph paper, a map, firing chart, or any other paper with parallel lines that can serve as north-south grid lines. Select and mark points that represent GZ and GN.

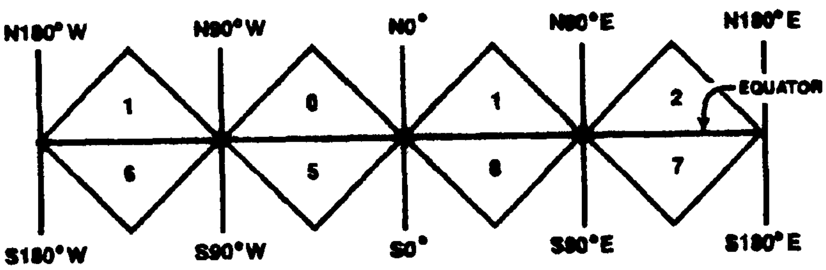
Step 2. Select and record a map scale. In this example, a map scale of 1:500,000 is

Table D-8. AWS upper-air wind data

Altitude Above Mean Sea Level of Reported Wind (10^3 feet)*	Representing Layer Above Local Mean Datum Plane (10^3 feet)	Wind Direction (degrees)	Wind Speed (knots)
5	0-5	180	9
10	5-10	190	9
15	10-15	210	13
20	15-20	210	17
25	20-25	230	17
30	25-30	250	13
35	30-35	260	26
40	35-40	310	20
45	40-45	310	17
50	45-50	320	18
55	50-55	320	18
60	55-60	320	10
65	60-65	320	10
70	65-70	320	18
75	70-75	340	18
80	75-80	320	24

* When local mean datum exceeds 5,000 feet above mean sea level, begin the plot with the 10,000-foot altitude of reported wind (column 1), and label vectors in 5,000-foot increments above the mean datum plane (subtract 5,000 feet from the figures listed in column 2).

used. Note the color on the scale representing the 1:500,000 map scale.



CODE NUMBER	OCTANT CODES
0	North latitude, 0° to 90° West longitude
1	North latitude, 90° to 180° West longitude
2	North latitude, 180° to 90° East longitude
3	North latitude, 90° to 0° East longitude
4	Not used
5	South latitude, 0° to 90° West longitude
6	South latitude, 90° to 180° West longitude
7	South latitude, 180° to 90°East longitude
8	South latitude, 90° to 0° East longitude
9	Used for coded identification

Figure D-6. Met station octant locations and codes.

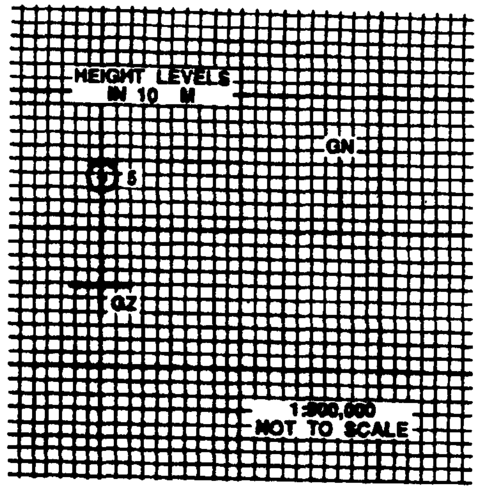


Figure D-7. Vector for the 0-5,000-foot wind layer.

Step 3. Using the plotting scale, plot the vector for each wind layer starting with the lowest layer. These vector are plotted in the same manner as the previous sample problems, except different slots are used for the various wind layers, and one-half of the reported wind speeds are used for wind layers above 45,000 feet. Table D-4 shows which plotting scale slot to use for the various wind layers.

Plot the 0-5,000-foot wind layer vector by placing the pinhole of the 6-8 slot over the GZ point. Rotate the plotting scale around the pinhole until the 180-degree line (the inner scale) is parallel with GN (the degree number points up). Draw a line in the slot to the number 9 (9 knots). Mark the downwind end of this vector 5 to indicate the 5,000-foot height (Figure D-7, above).

Continue this procedure through the 40,000-45,000-foot layers. Use the plotting scale slot for the various wind layers (Table D-4).

Plot the 45,000-50,000-foot wind layer vector by placing the pinhole of the 2-4 slot over the end point of the 40,000-45,000-foot layer vector just plotted. Rotate the plotting scale around the pinhole until the 320-degree line is parallel with GN (the degree number points up). Draw a line in the slot number 9 (representing one-half of the 18-knot wind speed for the layer). Mark the downwind end of this vector 50 to indicate the 50,000-foot height (Figure D-8. If the wind speed for any layer above the 40,000-5,000-foot level is an uneven number and dividing by one half produces a fraction, round it to the next higher number.

Plot the remaining vectors of the wind vector plot in the same manner, using the slot designated for each wind layer indicated in Table D-4. Label the end of each layer by the height it represents. Figure D-8 shows the completed vector.

Air Weather Service Constant Pressure Data—Plotting Scale Method

Assume that the AWS upper air wind data (constant pressure surfaces) shown in Table D-9 have been received by the NBCC.

Prepare the fallout wind vector plot by performing the following steps:

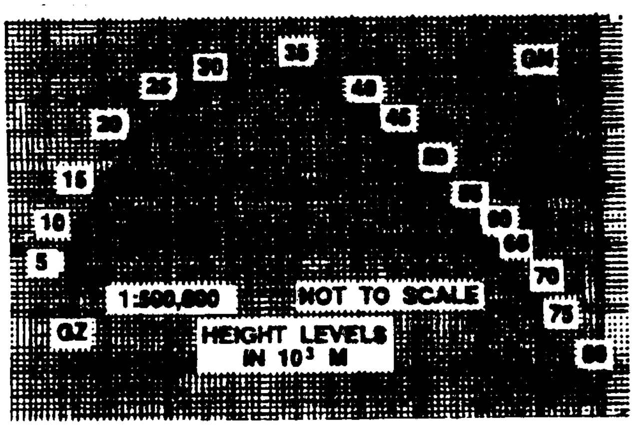


Figure D-8. Completed wind vector plot.

Step 1. Plot the constant pressure surface wind data with the plotting scale in much the same way as in the previous example. But use different slots for the different wind layers; and draw the vector lengths to numbers on each slot corresponding to adjusted wind speeds for each layer. Table D-10, shows the required slot designation and wind speed adjustment factor for each layer. Table D-11 (next page) shows the completion of Step 1.

Step 2. Attach overlay paper to a piece of graph paper mark GZ, scale height dimensions, and GN on the overlay paper. Place the pinhole of the 6-8 slot of the plotting scale over the GZ point. Rotate the plotting scale around the pinhole until the 140-degree line of the azimuth dial (the inner scale) is parallel to GN (the degree number points up). Draw a line in the slot to the number 20 (representing the adjusted wind speed for the 0-5,000-foot wind layer). Mark the downwind end of this vector "5" to indicate the 5,000-foot height.

Place the pinhole of the 8-10 slot over the end point of the 0-5 vector just drawn. Align the plotting scale for a wind from 100 degrees, and draw the second vector, using an adjusted wind speed of 16 knots. Label the end point of this second vector "10." Repeat this procedure for the other wind layers. Figure D-9 shows the completed wind vector plot.

Other Wind Data-Manual Method

This method is used for wind data from sources other than field artillery or AWS, for which weighting factor tables are not available and the plotting scale cannot be used.

Sample Situation

Assume that the upper-air wind data shown in Table D-12 have been received by the NBCC.

Table D-9. AWS upper-air wind data (constant pressure surfaces) for sample plot.

Constant Pressure Surface (millibars)	Wind Direction (degrees)	Wind Speed (knots)
850	140	20
700	100	16
600	90	18
500	80	21
400	80	22
300	80	25
200	70	20
150	60	18
100	60	16

Table D-10. Weighting factors and plotting scale data (to be used with Air Weather Service constant pressure surface winds).

Constant Pressure (millibars)	Wind Layer (10^3 feet)	Weighting Factor (Multiply wind speed in knots by this factor to get kilometers)	Plotting Scale Slot (Use with the indicated wind layer)	Adjustment Factor (Multiply reported wind speed by this factor before plotting)
850	0-5	0.94	6-8	1
700	5-10	.85	8-10	1
600	10-14	.63	Above 26	1
500	14-18	.57	2-4	½
400	18-24	.82	10-12	1
300	24-30	.82	10-12	1
200	30-39	1.15	2-4	1
150	39-45	.74	14-16	1
100	45-53	.93	6-8	1

Sample Plotting Actions

Prepare the fallout wind vector plot, using the following steps:

Step 1. Covert the upper-air wind data to find the direction toward which the winds are blowing. To do this, add or subtract 3,200 mils (as applicable) for each wind layer. Add 3,200 mils if the reported direction is less than 3,200 mils, or subtract if it is more than 3,200 mils. Convert the wind speeds from meters per second to kilometers per hour. To do this, multiply the wind speed in meters per second by the correction factor of 3.6. A work sheet for Step 1 is shown in Table D-13.

Step 2. Determine the time the particle will spend in each layer. First, find the time it takes the particle to fall from each height to the surface (see Figure D-10, page D-14). Then subtract the time of fall to the ground from the bottom of the layer from the time of

Table D-12. Upper-air wind data from a source other than field artil-

Wind Layer (10^3 meters)	Wind Direction (mils)	Wind Speed (meters per second)
0-3	1200	5
3-6	1100	5
6-9	1000	7
9-12	800	8
12-15	600	10
15-20	500	10
20-25	500	12
25-30	400	8

Table D-11. Worksheet showing the completion of Step 1. AWS constant pressure, plotting scale.

Constant Pressure Surface (millibars)	Represents Wind Layer (10^3 feet)	Wind Direction (degrees)	Reported WS x Factor = Adjusted WS*			
			Wind Speed (knots)	Factor (from Table D-4)	Wind Speed (knots)	Plotting Scale Slot To Use
850	0-5	140	20	1	20	6-8
700	5-10	100	16	1	16	8-10
600	10-14	90	18	1	18	Above 26
500	14-18	80	21	½	11	2-4
400	18-24	80	22	1	22	10-12
300	24-30	80	25	1	25	10-12
200	30-39	70	20	1	20	2-4
150	39-45	60	18	1	18	14-16
100	45-53	60	16	1	16	6-8

*WS = wind speed

Table D-13. Work sheet showing the completion of Step 1. Other wind data, manual method

$$\frac{1m}{sec} \times \frac{1km}{10^3 m} \times \frac{3{,}600sec}{1hr} = 3.6kmph$$

Wind Layer (10^3 meters)	Wind Direction (mils)		Reported Wind Speed (m per sec)	Correction Factor	Adjusted Wind Speed (kmph) *
	From	To			
0-3	1200	4400	5	3.6	18
3-6	1100	4300	5	3.6	18
6-9	1000	4200	7	3.6	25
9-12	800	4000	8	3.6	29
12-15	600	3800	10	3.6	36
15-20	500	3700	10	3.6	36
20-25	500	3700	12	3.6	43
25-30	400	3600	8	3.6	29

* Round off to nearest kilometer per hour.

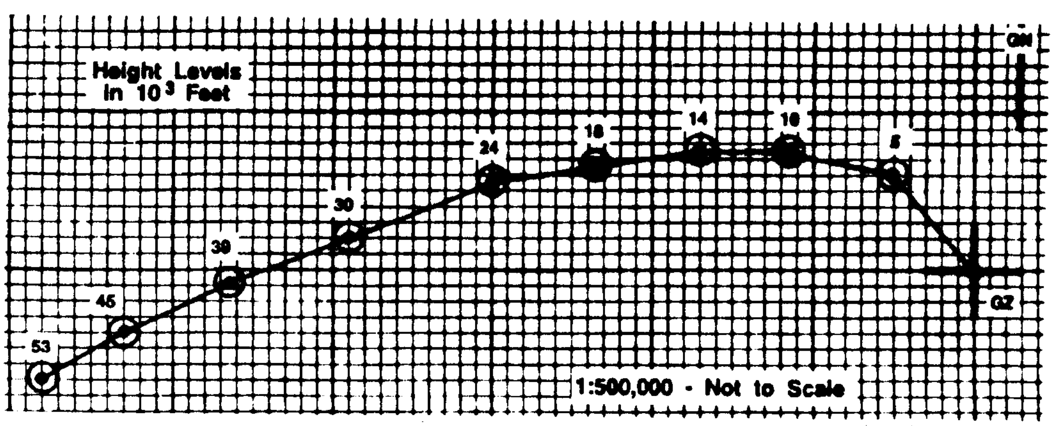


Figure D-9. Completed wind vector plot from AWS constant pressure surface data, using plotting scale.

Table D-14. Work sheet showing the completion of Step 2. Other wind data, manual method.

Height Level (10^3 meters)	Time of Fall to Surface (hr) (Figure D-10)	Wind Layer (10^3 meters)	Fall Time From Top (hr)	Fall Time From Bottom	Time In Layer (hr)
3	0.97	0-3	0.97	0.00	.97
6	1.78	3-6	1.78	0.97	.81
9	2.53	6-9	2.53	1.78	.75
12	3.20	9-12	3.20	2.53	.67
15	3.83	12-15	3.83	3.20	.63
20	4.82	15-20	4.82	3.83	.99
25	5.72	20-25	5.72	4.82	.90
30	6.60	25-30	6.60	5.72	.88

Table D-15. Work sheet showing the completion of Step 3. Other wind data, manual method.

Wind Layer (10^3 meters)	Wind Speed x Time in Layer = Vector Length*			Wind Direction To (mils)
	Wind Speed (kmph) (Step 1)	Time in Layer (Step 2)	Vector Length (km)*	
0-3	18	.97	17	4400
3-6	18	.81	15	4300
6-9	25	.75	19	4200
9-12	29	.67	12	4000
12-15	36	.63	23	3800
15-20	36	.99	36	3700
20-25	43	.90	39	3700
25-30	29	.88	26	3600

Table D-16. Mils-to-degrees conversions.

Mils	Degrees	Mils	Degrees
100	6	3,300	186
200	11	3,400	191
300	17	3,500	197
400	23	3,600	203
500	28	3,700	208
600	34	3,800	214
700	40	3,900	220
800	45	4,000	225
900	51	4,100	231
1,000	57	4,200	237
1,100	62	4,300	242
1,200	67	4,400	247
1,300	73	4,500	253
1,400	79	4,600	259
1,500	84	4,700	264
1,600	90	4,800	270
1,700	96	4,900	276
1,800	101	5,000	281
1,900	107	5,100	287
2,000	113	5,200	293
2,100	118	5,300	298
2,200	124	5,400	304
2,300	130	5,500	310
2,400	135	5,600	315
2,500	141	5,700	321
2,600	147	5,800	327
2,700	152	5,900	332
2,800	157	6,000	337
2,900	163	6,100	343
3,000	169	6,200	349
3,100	174	6,300	354
3,200	180	6,400	360

Table D-17. Distance conversions.

To Convert—	To—	Multiply By—
kilometers	miles	0.62
kilometers	nautical miles	0.54
miles	kilometers	1.61
miles	nautical miles	0.87
nautical miles	kilometers	1.84
nautical miles	miles	1.15

fall to the ground from the top of the layer. A work sheet showing the completion of this step is shown in Table D-14.

Step 3. Determine the vector length in kilometers for each wind layer. This is the distance in kilometers that the nominal size particle travels while falling through each layer. Do this by multiplying the wind speed in kilometers per hour (from step 1) by the time in layer in hours (from step 2). A work sheet showing Step 3 is in Table D-15.

Step 4. Prepare the wind vector plot. The procedures are the same as those for plotting field artillery wind reporting system and the plotting scale method.

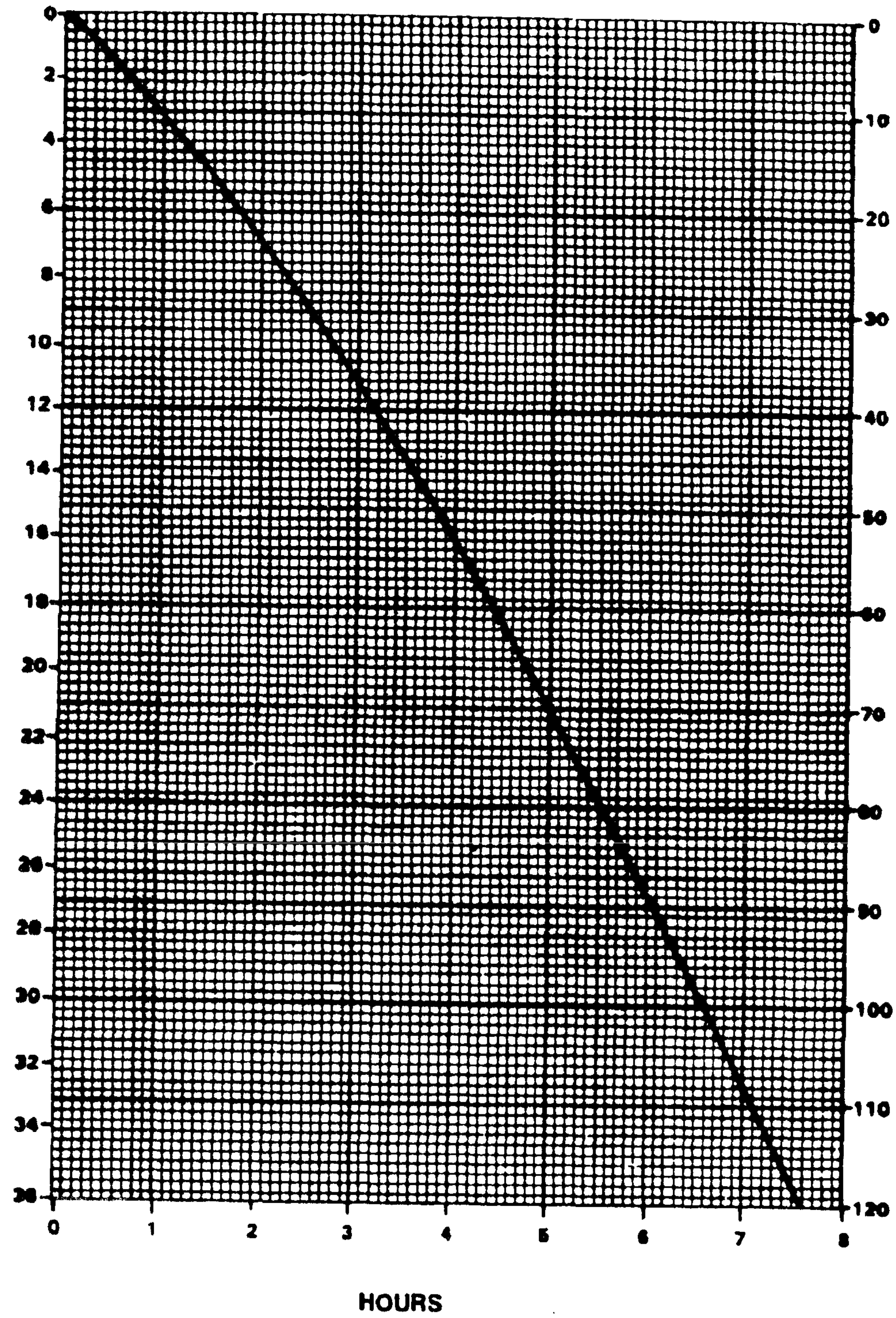


Figure D-10. Time of fall of a nominal-sized particle to the surface.