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FOREST FIRE-DANGER MEASUREMENT

IN THE

EASTERN UNITED STATES

By

GEORGE M. JEMISON, Silviculturist, A. W. LINDENMUTH, Forester,
and J. J. KEETCH, Forester, Forest Service

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CONTENTS

INTRODUCTION

Is today a bad fire day, only moderately bad, or just an average day for the season? The fire-danger[1] rating system described in this publication answers that question daily at 413 locations in the 24 States in the East from Maine to Texas (fig. 1).

Fire-danger ratings are reliable because of the careful research and experience applied in developing the system and the accurate information used in the daily computations. Several times a day measurements of fuel moisture and wind velocity are made at each danger

[1] "Fire danger" is a general term expressing the sum total of both the constant and the variable factors which determine whether fires will start, spread, and do damage, and that determine their difficulty of control. In this publication "fire danger" is used narrowly and refers only to the variable aspects of fire danger such as weather and fuel moisture. Complete definitions of other common fire-control terms may be found in Glossary of Terms Used in Forest Fire Control (*22*) (see Literature Cited, p. 34).

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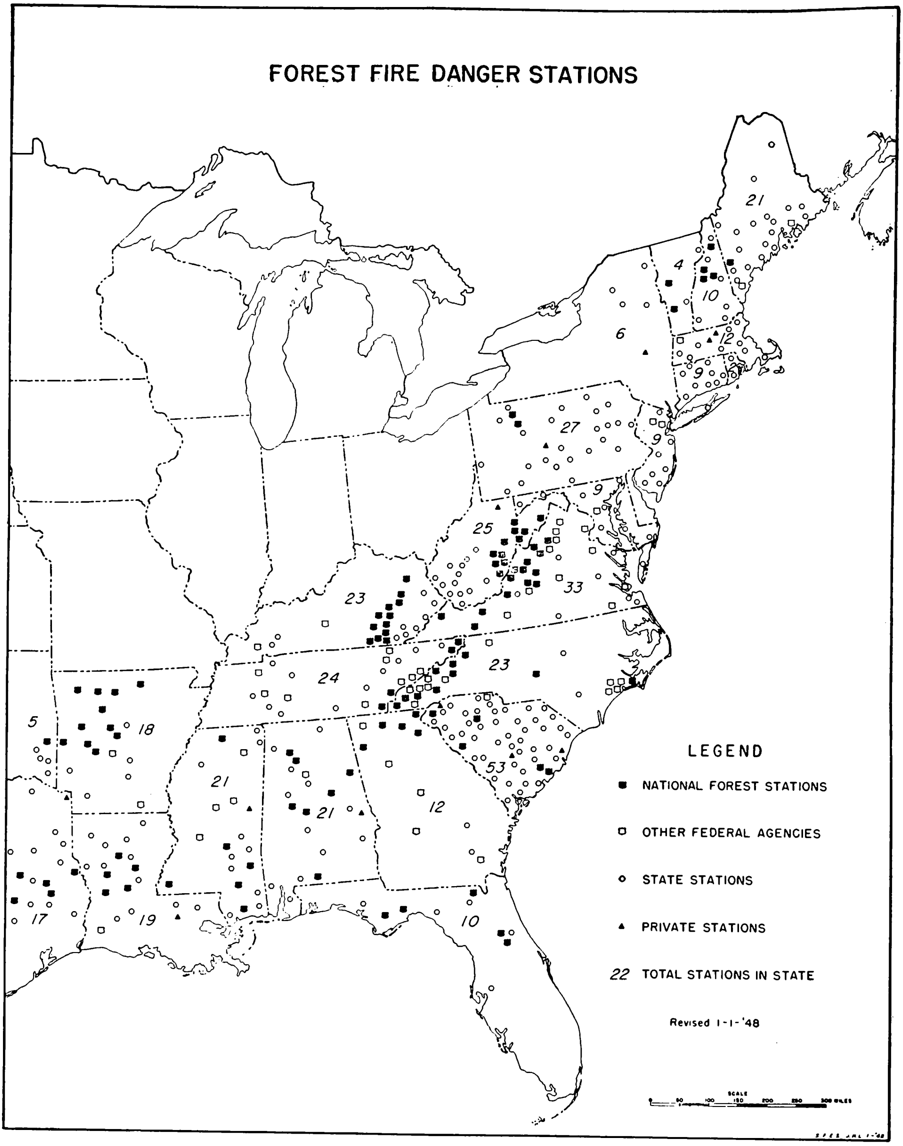

Figure 1.—Location of stations in eastern United States.

station in the woods. Precipitation is also recorded. These measurements, combined with season of year and condition of vegetation, form the basis for rating the day's fire danger. By using a fire-danger meter, which automatically gives the key factors their proper weight, the operator of a danger station can determine the type of fire day quickly, accurately, and without personal bias. The ratings are expressed in numerical classes having definite meaning and calling for definite action.

Before this system was developed, fire control officers tried to estimate the day's burning conditions according to certain rough rules of thumb. Wind velocity was estimated from the movement of trees or smoke drift. The extent to which a pine needle would bend without breaking or the ease with which hardwood leaves would crush in the hand are examples of various attempts to find some basis for an opinion of burning conditions. These rules were derived from popular experience and were highly useful to an experienced man in an area familiar to him.

From such observations and from work on going fires, the experienced old-time forester could estimate the peak periods of danger in a limited area. He could not tell what the conditions were in remote areas, nor could he refine his observations to judge the wide range of burning conditions that exist between the times when the woods are relatively safe or extremely hazardous.

Today the forester measures the amount of moisture and wind velocity with instruments, and he includes other important factors not considered by the old-timer. Observers will report to him periodically from several points on the forest, and he has a picture of forest-wide conditions at intervals during each day. He can be sure that the reports from all stations are comparable, and that any individual record is not affected by the observer's opinion on that day, or his past experience in fire control, or lack of it.

The idea of measuring forest fire danger originated about 15 years ago in the Northern Rocky Mountains when Gisborne (*8*)[2] constructed a fire-danger meter that expressed the degree of danger in numerical classes, based on measurements of certain fuel, weather, and other factors. Considerable study of individual weather factors and their relation to inflammability preceded or accompanied the development of the first fire-danger rating system (*6*, *7*, *9*, *10*, *15*, *16*, *17*, *19*, and *21*). During the 1930's almost every Forest Service region was testing fire-danger measurement.

Fire-danger ratings are a useful tool in the job of prevention and control and represent a tremendous advance over the informal and uninformed methods of guessing at danger, common a decade or two ago. Even so, there are many ways in which future study can improve the present ratings. Danger measurements aid but do not replace experienced judgment. The fire-danger rating system for the eastern United States[3] described in this publication has been developed and tested over a 10-year period. Its usefulness as a tool in fire control has become well established. If properly used, the results can be adopted as a practical guide in fire control planning with full assurance that the most important variables affecting fire danger from the weather standpoint are accounted for.

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[2] Numbers in italics refer to Literature Cited, p. 34.

[3] For the purpose of this discussion, "eastern United States" includes the Northeastern States, the Cumberland and Allegheny plateaus and adjacent lowlands, the Appalachian mountain system, the Piedmont plateau, and adjacent Coastal Plain. It includes portions of the deep South, but none of the Lake States or Central States.

THE PRINCIPLES OF MEASURING FOREST FIRE DANGER

In the eastern United States the danger-rating system has been developed as an index of forest inflammability, i. e., the relative ease with which fuels ignite and burn. Two closely related systems are in use—one for the Northeastern States and plateau and mountainous sections, which are primarily hardwood-covered, and the other for the adjacent Coastal Plain and Piedmont pineland sections of the South and Southeast (exclusive of the longleaf-slash pine forest type) (*1*).

THE KEY FIRE-DANGER FACTORS

Four key factors have been found to determine fire danger in the mountains and three in the Coastal Plain. These are (1) fuel moisture content determined from wood sticks and number of days since rain, (2) wind, (3) condition of vegetation, and (4) season of year; the latter factor being relatively unimportant in the Coastal Plain.

FUEL MOISTURE CONTENT

Moisture content of fuels, a controlling fire-danger factor, is particularly important in lightweight material such as dead grass, hardwood leaves, weeds, and pine needles. Fire brands ignite this material first and it burns most rapidly.

The moisture content of these lightweight fuels changes rapidly as weather fluctuates, but the relation is so complex that moistures cannot easily or accurately be determined from measurement of atmospheric factors such as humidity, temperature, and evaporation. Experience has proved that even the most experienced men cannot sense changes of a few percent in fuel moisture content which may make considerable difference in inflammability.

One simple and inexpensive way to measure fuel moisture is by means of fuel-moisture indicator sticks. Different sizes, shapes, and kinds of indicators are used in the United States, but flat slats 18 inches long, made of basswood, have been found to work best in the East. These sticks, when exposed under typical forest conditions, reveal the *effect*, in one simple measurement, of all controls (the *causes*) of moisture content, such as precipitation, humidity, temperature, evaporation, solar radiation, and wind. The fuel-moisture sticks do not always indicate the exact moisture content of natural fuel, but the relation between indicated and actual moisture is relatively constant. In general, the sticks dry out slightly faster than natural fuel after a rain and thus give some forewarning of approaching dangerous conditions.

The method of determining fuel moisture consists essentially of exposing under natural conditions a set of three numbered basswood sticks, for which the oven-dry weight has been predetermined, and weighing them currently on a specially constructed scale. This scale shows average moisture content directly.

Although the wood sticks provide excellent measures of current changes in the light fuels, they do not reflect the cumulative build-up of inflammable conditions in heavier fuels, denser "rough," and deeper layers of hardwood leaves, resulting from several days of dry weather. When these classes of fuel become dry, fires burn hotter, are harder to control, and require more mop-up work. But here, also, a means of appraising inflammability has been determined. It has been found that the number of days elapsed since rains of different amounts is a useful index of cumulative drying. The effect of showers (less than 0.25 inch) is adequately measured by the fuel-moisture sticks. Hence, the build-up of danger is indicated by days since rains of 0.25 inch or more.

Because of differences between mountain hardwoods and Coastal Plain pine-woods fuel types, this factor is of less importance in the Coastal Plain regions, particularly in the winter and spring seasons. Although time since rain is an easy and practical way to evaluate cumulative drying, it is not an exact measure. Considerable study will be required to improve the measurement of this factor.

WIND

Measurements of wind velocity are important because wind velocity is difficult to estimate and is of first importance in affecting rate of spread if fuels are dry enough to burn. Measurements of velocity can be made with any one of a number of buzzer-type anemometers. Because Coastal Plain fuels (principally dead grass) are finely divided and exposed to the air, wind velocity must be given more weight in the flatwoods than in mountain forests.

CONDITION OF VEGETATION

The state of the physiological activity of plants, varying with latitude, elevation, and aspect, is another factor which contributes to the degree of fire danger. For example, grasses, weeds, and shrubs tend to retard the rate of spread of fire as long as they are succulent and transpire large quantities of moisture; but when they are dry their effect on fire behavior is reversed. This difference in inflammability resulting from physiological condition is outstanding in the pine forests in the lower country where grass is a primary fuel.

Transition periods, when vegetation is coming up in the spring or when it is curing in the fall, are intermediate in their effect on fire danger. In some sections of the eastern United States this transition is very gradual in the fall; in others it is very abrupt, owing to sudden, heavy autumn frosts.

SEASON OF THE YEAR

The intensity of solar radiation obviously determines the drying rate of forest fuels, and since it varies with the calendar, the season of the year becomes an important fire-danger factor. This is particularly true in mountainous or hilly country where the movement of the sun towards the zenith as spring and summer approach causes more rapid and complete drying on north slopes. In fall and winter, north slopes often act as good firebreaks because sunlight reaches the ground for only a few hours each day or perhaps not at all (*3*). In the flat country such effects do not exist, of course, and season of the year is not important.

Season of the year is also a direct measure of length of day. During summer months the days are long, and with more hours of sunlight, fuels tend toward low moisture levels for *longer periods*. In the summer, shade of a hardwood overstory somewhat reduces the effect of long days because dead ground fuels are not exposed to sunlight at all. Length of day is a factor during the leafless seasons, however. Long, cool, humid nights at this time of year create more favorable conditions, of course, and the burning day is considerably shorter. This is particularly true at northern latitudes, where the length of day may change 7 or 8 hours in the course of the year. Even in the southernmost part of the Appalachian region, length of day changes 4 to 5 hours from winter to summer.

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Figure 2.—A typical fire-danger station where fuel moisture and wind velocity are measured. Precipitation is measured in the open, away from sheltering trees.

SYSTEMATIC MEASUREMENT OF THE KEY FACTORS

Fire danger is ordinarily determined from measurements taken several times a day at a network of stations so located as to sample major variations in fire weather caused by topography and other physical features. A complete description of the selection of fire-danger station locations is given on pages 19 to 21. A typical fire-danger station consists of a fuel-moisture scale housed in a weighing shelter, a set of fuel-moisture indicator sticks, an anemometer, and a rain gage as basic equipment (fig. 2). A complete itemized list of all miscellaneous equipment and materials is included in the Appendix.

Measurements of fuel moisture and wind velocity, two or three times a day, and of rain once a day provide the data necessary to follow the development of critical conditions as well as to obtain an accurate average daily danger rating. A towerman, guard, or weather observer can read the instruments and record the observations in about 5 minutes. (See pp. 38 to 44 for explanation of the procedure.) Some agencies prefer to follow the changes in danger more closely and require observers to take as many as six readings a day during critical periods.

INTEGRATION OF MEASUREMENTS OF THE KEY FACTORS

Current measurements of the key fire-danger factors are integrated into numerical classes or index numbers by means of two danger meters, one for the mountain region, the other for the Coastal Plain. The mountain meter (type 5–W; fig. 3) is made in the form of a circular slide rule, and the Coastal Plain meter (type 7; fig. 4) consists of an envelope and movable slide. Both meters rate fire danger in 5 numerical classes, but the mountain meter also gives equivalent numerical ratings on a 100-point scale. The 100-point scale has been named "basic burning index" because it expresses relative inflammability which is basic to fire occurrence and fire behavior. As figure 3 illustrates, the 5-point scale and the 100-point index are side by side on the meter and one can be translated directly into terms of the other.

In 1937, when plans for developing a fire-danger rating system were being made, many experienced fire control men felt that only two danger classes could be recognized. This feeling was summed up as, "The woods will either burn or they won't burn." After a 5-point scale had been devised and used for several years, however, experience showed that there were even more than five recognizable classes of danger. There were more than five separate and distinct steps that could be taken to organize for conditions ranging from "safe" to the very worst. Protection men talked of "low class 3," "high class 2," or "middle class 4."

It was this demand for a greater refinement in expressing danger that led to the development of a 100-point scale. This scale shows the gradual build-up of serious danger more effectively than the 5-point scale, as is illustrated by the following tabulation for the period May 2 to 12, 1947, at the Trout Run Station, George Washington National Forest, Va.

	Rating	
	5-point scale (class)	*100-point scale (burning index)*
1947, May:		
2	1	2
3	2	11
4	3	13
5	3	17
6	3	25
7	3	15
8	4	40
9	4	40
10	4	40
11	4	45
12	4	75

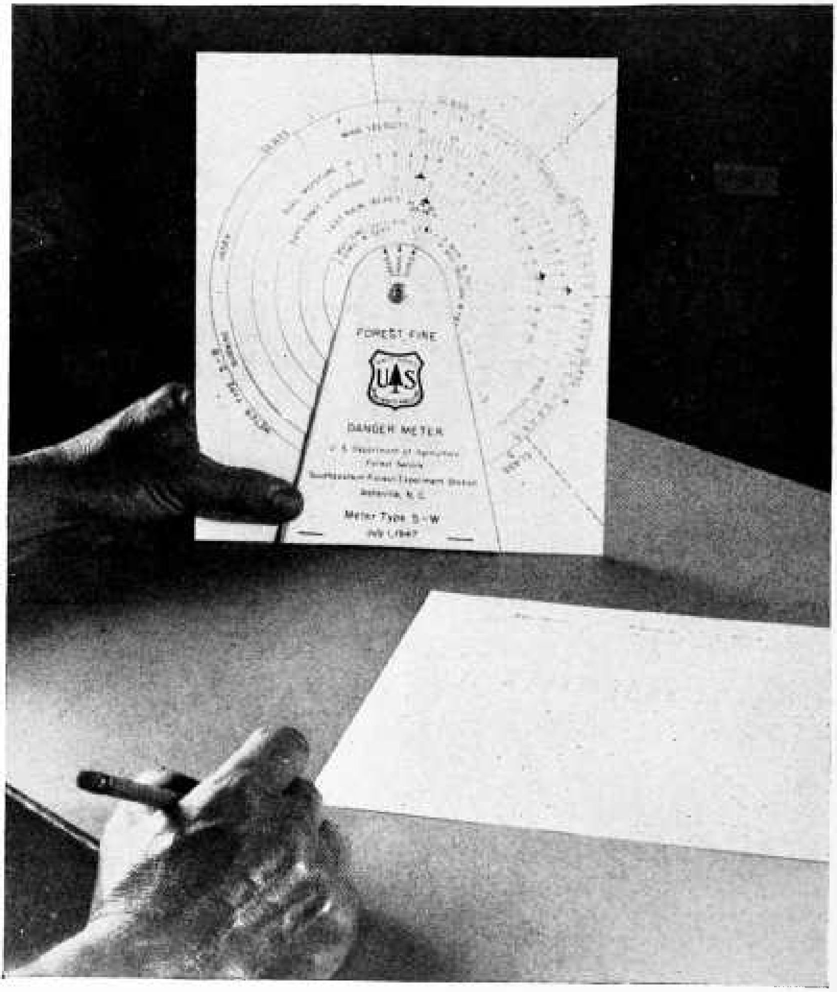

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Figure 3.—The mountain meter, a circular slide rule for integrating fuel moisture and weather measurements into numerical danger classes.

Note how the basic burning index for class-3 days ranged from 13 to 25 and for class-4 days showed a build-up from 40 to 75.

The 100-point basic burning index as used on the mountain meter has another advantage over the 5-point scale in that it bears a straight-line relation to relative inflammability when fire occurrence is used as a measure of inflammability (fig. 5). Note that on a class-3 day (fig. 5, *A*) the relative number of fires is 6.6. Thus, a burning index of 21 (fig. 5, *B*) is the equivalent of a class 3 because it also shows 6.6 fires. The relation between class of day and burning index is given below, with the midpoints rounded to the closest unit of 5 points.

5-point scale	100-point scale (Meter 5-W) Burning Index	
Class:	*Approximate midpoint*	*Range*
1	1	1 to 2
2	5	3 to 11
3	20	12 to 35
4	65	40 to 95
5	100	100+

A basic burning index of 40 represents conditions twice as bad as one of 20. A day rating an index of 10 is only half as bad as one rating 20. But a class 4 on the 5-point scale is not twice as bad as a class-2 rating. It is approximately 13 times a class 2 if fire occurrence in figure 5 is used as the basis of comparison. The advantages of the straight-line relation of the basic burning index to inflammability will be explained further in the discussion of summarizing danger ratings (see p. 31).

The straight-line, or proportional, relationship between the rated inflammability of forest fuels and the number of fires likely to occur is a highly important relationship in the value of the danger ratings. But it must not be misconstrued. If, for example, 50 careless smokers were discarding the same number of lighted matches into exactly the same forest fuels at similar locations over a period of several days or weeks, the number of fires that would start each day and that would require control action by the fire organization would vary in proportion to the variations in the burning-index rating for the day, as in figure 5, *B*. If on the average 1 fire resulted at a rating of 20, 2 fires could be expected at a rating of 40, 3 at 60, etc. However, from the tabulation above, if class-1 conditions under such circumstances resulted in 1 fire on the average, 5 fires could be expected under a class-2 rating, and 20 under a class-3 rating.

Such relationships hold only so long as the exposure of forest fuels to sources of fire remains the same. This is closely approached when the number of fires at various danger ratings are combined for very large areas, such as a group of States or a region, or are developed for a single protection unit over a long period. It will also be closely approached when the fire risk is constant in even small areas, such as along a railroad right-of-way, around a constantly operated refuse burner, and so on.

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The number of fires that may be maliciously set will naturally deviate from these trends for accidental fires, since they represent an erratic and independent source of risk. Consequently the time, place, and number must be anticipated by other criteria. Even so, the success of the incendiarist in getting a large number of sets to "take" and to spread rapidly enough to burn over sizeable areas before they

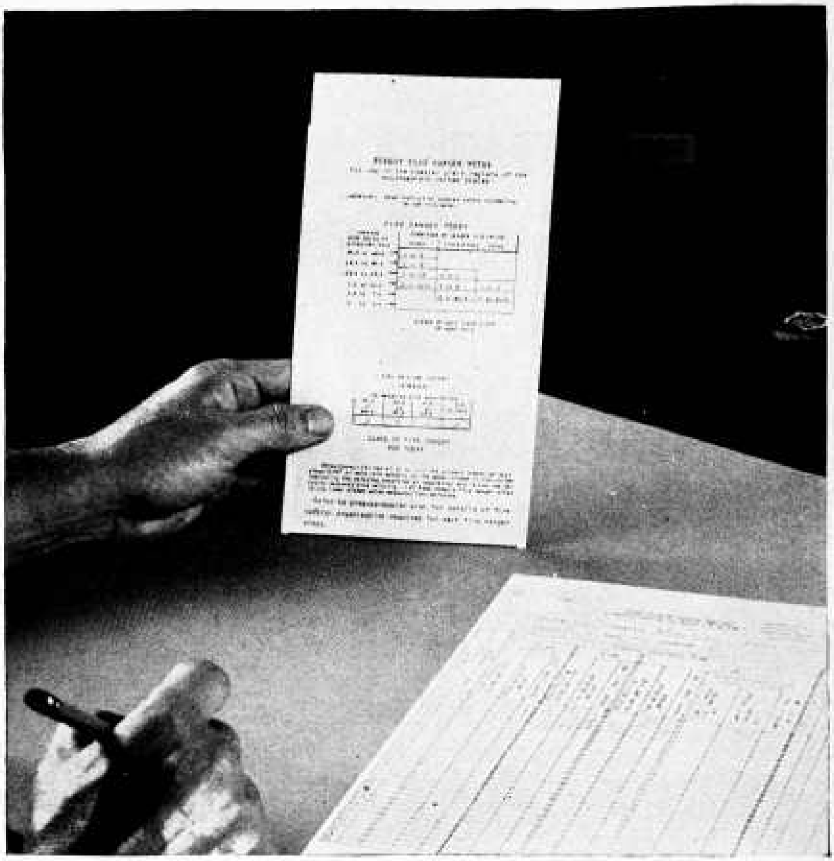

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Figure 4.—**The Coastal Plain danger meter is of regular slide-rule design. It integrates fuel moisture and weather data into five possible danger classes.**

can be controlled will depend on the burning conditions at the time and will closely reflect the burning index which expresses these conditions.

Lightning fires, which are important in only a few localities in the South, have somewhat similar relationships. Fire-setting lightning storms are usually erratic in occurrence, but the number and size of fires that result and the consequent size of the fire-fighting job will also be closely related to the burning conditions at the time they are started and until they are extinguished. Whether or not any will occur must also be determined by other criteria.

On a single protection unit, the fires to be expected from the normal and more or less constant sources of risk at different burning-index ratings can soon be established. From this as a base, both the success of prevention effort and the importance of new and variable sources of fire risk can be evaluated and used in the planning and management of the fire organization.

After additional study the 100-point scale will be adapted to the Coastal Plain meter. For this meter, the upper limit of the new scale, the 100-point, should be placed to represent more dangerous conditions than it does on the mountain meter. This is necessary because, in the pine forests of the flatwoods, the fuels dry out faster and are exposed to higher winds. The beneficial effects of rains are quickly dissipated. There is a need to be able to identify and evaluate the

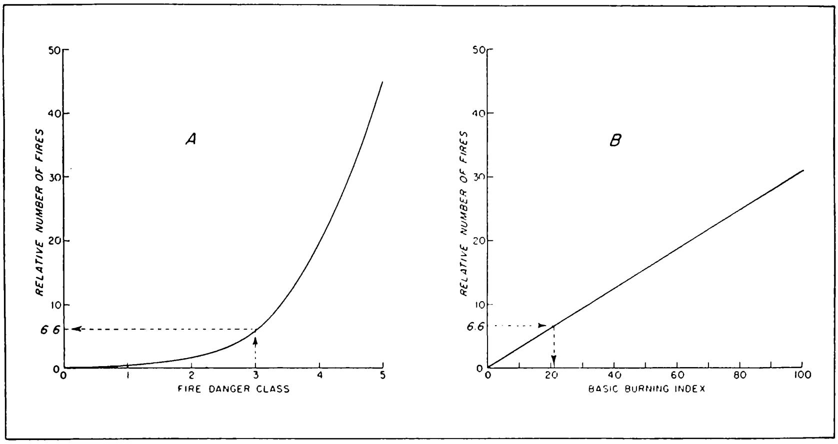

Figure 5.—**Relation between fire occurrence and fire danger expressed on (*A*) 5- and (*B*) 100-point scales. Based on records for 14 Northeastern States, 1942 to 1945.**

extreme conditions that occur more frequently than in the mountain hardwood forests.

The factors integrated into the danger classes or burning indexes by the mountain meter are (1) fuel moisture as indicated by wood sticks and days since last rain, (2) wind velocity, (3) condition of lesser vegetation, and (4) season of year. The "season of year" factor is not of sufficient importance to require consideration on the Coastal Plain meter; and because of regional variations in climate, latitude, elevation, and forest types, the other factors are given different weights on the two meters.

Predictions of fire danger for at least a 24-hour advance period are desirable because of the characteristic rapid and frequent fluctuations in danger that make it difficult for fire control men to estimate class of danger for the future. The first models of the danger meters included a device for forecasting "tomorrow's" fire danger, essentially by modifying current danger on the basis of predicted weather and wind. Extensive tests have shown that this feature could be relied upon to forecast danger with a satisfactory degree of accuracy in most parts of the Eastern States, but unfortunately the prediction required considerable local adjustment in the mountains. Because of this impracticability, the forecasting feature has been eliminated on the mountain danger meter but not on the Coastal Plain meter. Fire danger may still be predicted by an experienced man, however, using this meter with a forecast of wind and weather supplied by the Weather Bureau. Estimates of fuel moisture content are based upon such predictions and the local forester's intimate knowledge of the relation of fuel moisture to temperature, humidity, cloudiness, and other weather factors.

Recently two of the eastern offices of the Weather Bureau began experimental predictions of fuel moisture content. If forecasters study the relation of fuel moisture to weather and are equipped with the best available guides for estimating probable absolute humidities, radiation effects, and other phenomena, they may be in a better position than the forest officer to predict fuel moisture. The present tests have not run long enough to indicate whether or not fuel moisture predictions from a central Weather Bureau office are more or less reliable than on-the-ground estimates.

SPECIFIC USES OF FIRE-DANGER RATINGS

A danger rating based primarily on fuel moisture and wind is an accurate index of inflammability—the relative ease with which fuels ignite and burn. It can be used to indicate probable fire occurrence, fire behavior, difficulty of suppression, and damage. However, other factors not measured in the danger-rating system also affect these phenomena. Hence, considerable care and understanding are necessary in using fire-danger ratings [4] as a guide to fire protection activities. Some of the principal uses of danger ratings which are based on fuel moisture and wind are discussed on the following pages and their limitations pointed out.

APPLICATION IN FIRE PREVENTION

In the East, where 98 percent of the fires are man-caused, there is a definite relationship between occurrence and fire-danger ratings (table 1). Most debris burning, such as tobacco-bed burning or other clean-up connected with agriculture, is seasonal and is done in dry or moderately dry weather. Incendiarists tend to operate in dry weather too. Some fire-starting agencies, such as railroads and smokers, are active rain or shine. Even so, there is about 65 times more chance for a fire to occur on a class-4 day (for a system of rating on a scale of 1 to 5) than on a class-1 day in the eastern United States as a whole, as shown in the tabulation on page 9. This ratio varies for different parts of the country. Thus, fire-danger ratings can be used to indicate relative ignitibility of similar fuels.

In any test of the effectiveness of a fire-prevention campaign, the danger existing during the period must be considered, otherwise a reduction in the number of man-caused fires due to favorable weather

[4] Additional information on different kinds of danger ratings and the elements of each may be found in Forest Fire Danger Indexes, by Jemison (*12*).

conditions might be mistaken for good prevention technique. Or, conversely, if the fire weather was critical, prevention efforts may have paid off even though numbers of fires were not reduced over previous less dangerous periods. Conditions that influence the ease of ignition should be considered in studies of the efficiency of prevention work, if fire-danger ratings are available.

TABLE 1.—*Average number of fires per danger-class day for 14 Eastern States, October 1942 to December 1947* [1]

State	Fire-danger-class day					Total fires, basis
	1	2	3	4	5	
	Number	*Number*	*Number*	*Number*	*Number*	*Number*
Connecticut	0.3	1.6	9.8	27.8		4,570
Delaware [2]	.04	.2	.4	1.1		209
Kentucky [3]	.02	.3	1.9	3.2		685
Maine	.3	1.3	4.6	11.5		1,854
Maryland [4]	.2	1.1	5.2	20.5		3,768
Massachusetts [5]	.6	1.9	11.7	32.2	52.0	6,591
New Hampshire	.4	1.0	5.2	17.8		2,189
New Jersey	.4	2.2	7.5	28.2		6,869
New York [6]	.2	.9	3.5	10.5	67.7	1,825
Pennsylvania	.4	1.6	9.7	52.9	122.2	8,468
Rhode Island	.2	.5	1.8	6.7		1,693
Vermont	.1	.4	2.4	4.3		716
Virginia	.4	1.9	13.2	52.0		10,428
West Virginia	.4	1.5	9.3	24.7		5,729
All States	.3	1.3	6.9	22.2	[7] 69.2	55,594

[1] Does not include fires that burned on days of unknown danger class.
[2] 1943–45 only.
[3] 1 fire district through 1944, 4 districts 1945, 3 districts 1946, 5 districts 1947.
[4] 1945 not included.
[5] Western district not included in 1946 and 1947.
[6] Adirondacks and Long Island only.
[7] Only 5 class-5 days recorded 1942 to 1947.

The actual results of the war and postwar fire prevention work in Tidewater Virginia, illustrate this use. In 1943 the Dismal Swamp and environs were unprotected but, as a security measure, fire protection was organized and prevention stressed, with a satisfactory reduction in actual number of fires over a 5-year period. Was this improved condition the result of successful prevention or of favorable weather? Danger ratings were available for the period and the basic relation with expected fire occurrence, already described in connection with figure 5, was known. Consequently, the effectiveness of prevention could be established, as brought out in the following tabulation for the spring fire season in southeastern Virginia. Here it is shown that the actual number of fires in the Southeast District decreased steadily. During the same period, the expected number of fires for the district, as calculated from the local relationship for a long period between fire occurrence and fire-danger ratings, increased because of more critical conditions of inflammability.

Year:	Number of spring fires: Actual	Expected
1943	207	74
1944	219	93
1945	153	109
1946	107	104
1947	88	134

Danger ratings serve as useful guides to officials whose duty it is to open or close the woods for visitors, and to restrict smoking, debris burning, or campfires. Numerical danger ratings are readily understood by the average layman and can therefore be advantageously used to educate hunters, campers, fishermen, and tourists. These people are willing to be extra careful on bad days if they know that the definition of a "bad" fire day is based on something more than a mere guess.

Ratings have much public appeal when presented in showy form. Fire-danger display boards, colored flags similar to storm warnings, and a large variety of showy displays have been worked out on the basis of measured fire-danger classes to educate and interest the general public and users of the forests. In New England and other parts of eastern United States, fire-danger information with suitable explanatory warnings is commonly put on the air by radio broadcasting companies.

In the eastern United States and the South, where recreation and other forms of public use are especially important, national forests, national parks, Indian reservations, State departments, and many private agencies individually practice fire prevention to some extent. With so many different organizations functioning, reasonable uniformity in regulating the use of fire is essential. In 14 Eastern States (table 2), 1942–47, 85 percent of the debris-burning fires that "got away" did so on class-3, -4, or -5 days in spite of active burning permit systems in most States. These fires burned 133,665 acres out of 146,541 acres burned by this class of fire. In a portion of one State in the southern Appalachians, 76 percent of fires that escaped from debris burners over a 6-year period did so on class-4 and -5 days, the two highest danger classes. These instances would indicate that more rigid control over issuance of permits is needed.

TABLE 2.—*Number of debris-burning fires, total area burned, and average size of fire, by fire-danger classes in 14 Eastern States, 1942–47*

Fire-danger class	Fires	Area burned	Average size of fire
	Number	*Acres*	*Acres*
1	222	1, 437	6. 5
2	1, 206	11, 439	9. 5
3	4, 670	67, 347	14. 4
4	3, 575	66, 180	18. 5
5	7	138	19. 7
All classes	9, 680	146, 541	15. 1

USE OF FIRE-DANGER RATINGS IN PRESUPPRESSION

A summary of the uses of danger ratings in presuppression follows:

1. Fire-danger ratings can be used in building up or cutting down a presuppression organization as weather and other temporary aspects of fire danger change. When a man in charge of fire control hires guards and lookout men by the day, employing them only when it is "dry," and depending on his own or someone else's judgment, sometimes men are on the job when they are not needed and at other times they are not available when they should be. With an organization planned to function on the basis of fire-danger ratings, however, lookout men, patrolmen, guards, and crews go on fire duty when they are needed. Likewise during periods of low danger these men can be safely used on nonfire projects.

If fire danger actually differs between ranger or warden districts, then the operation of lookout towers varies correspondingly, and the district dry enough to have fires has its lookout points manned. When such a flexible scheme of fire organization duty is established in relation to fire danger, the fire executive has some basis for auditing administrative performance and laxness in plan execution. An illustration of the use of danger ratings to guide the build-up of a fire organization is given in figure 6. The importance of having men and equipment on hand at the right time is further emphasized by average area-burned and suppression-cost figures. Those for Virginia, 1942–46, based on 8,759 fires are as follows:

	Size and cost	
Fire-danger class:	*Average area burned per fire (acres)*	*Average suppression cost per fire (dollars)*
1	7	9.78
2	11	15.42
3	21	19.41
4	44	28.61
5	--	-----

2. The operation of a fire-danger rating scheme shows up the unseasonable or otherwise unexpected periods of dangerous fire weather. This is good insurance against off-season let-downs and other forms of unpreparedness on the part of the fire organization. In some sections of the country, long fire seasons are not as common as short periods of high fire danger occurring throughout the year. Some of the most disastrous fires have resulted from the inability of fire men to recognize the development of a dangerous period in time to be prepared for it. Such was true in parts of New England in October 1947, when about 220,000 acres were burned and 16 people lost their lives in Maine (*24*) after the fire season was thought by some of the township fire control forces to have ended. Following a soaking rain on September 22, fire danger gradually built up to explosive conditions by October 21, as shown by these average ratings from three fire-danger stations adjacent to the troubled area:

Dates:	*Fire-danger class*
Sept. 23 to Oct. 6	2
Oct. 7 to Oct. 13	3
Oct. 14 to Oct. 20	4
Oct. 21	5
Oct. 22	4
Oct. 23 and 24	5
Oct. 25 to Nov. 3	4
Nov. 4 to Nov. 10	3
Nov. 11 to Nov. 17	2

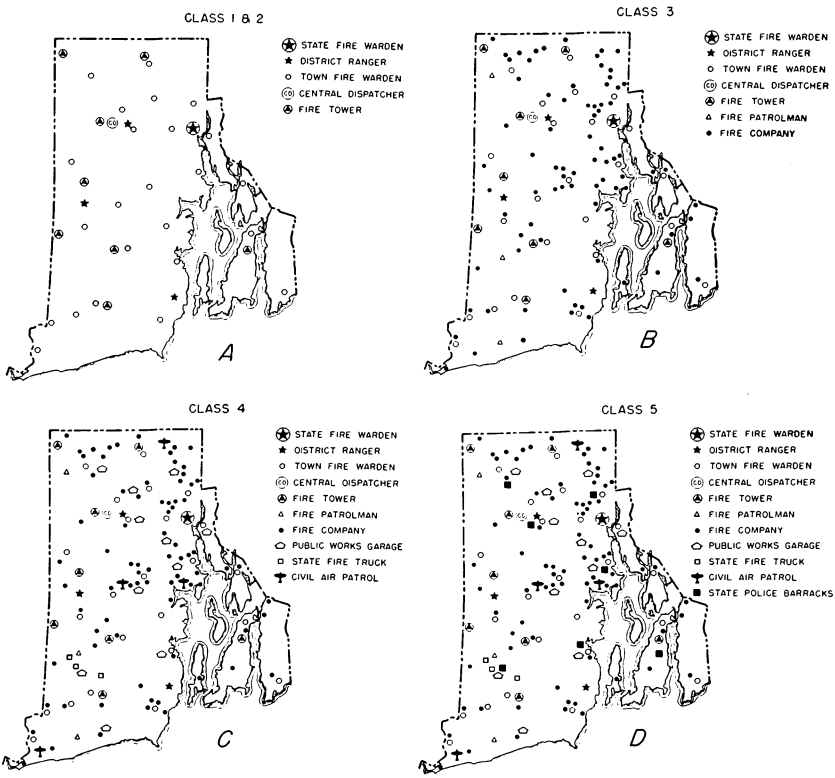

***Figure 6*.—The organization plan for Rhode Island based on measured fire danger. This is an illustration of the use of fire-danger ratings to intensify preparedness as fire danger increases.**

A, The regular organization is available. Burning permits issued without restriction. Eleven fire-weather broadcasts made daily during the spring fire season from six commercial stations.

B, Fire patrolmen, fire companies, and deputy fire wardens supplement the regular organization. Burning permits restricted.

C, The civil air patrol, State fire truck crews, and maintenance crews at State garages stand by. No burning permits issued; all outstanding permits canceled.

D, State police supplement the forest fire patrol. All organized fire suppression crews stand by. The size of initial attack forces is increased. The public may be banned from all forests by Governor's proclamation.

3. Danger ratings assist a new man or even an old-timer in new country to become familiar with his fire job without having to learn by costly experience. He may analyze past records and see what actual fires have done under specific measured conditions. He can understand and interpret such records, being sure that they are not influenced by someone's personal opinions.

4. Fire-danger ratings which are numerical indexes and not indefinite terms like "good," "bad," or "very bad" permit comparisons of the severity of conditions in two or more districts, forests, States, or regions. Thus the accomplishments of different administrative

units can be balanced against the seriousness of fuel and weather conditions under which each organization worked. For example, scarcity of fires and smallness of area burned have often been misconstrued as evidence of good fire prevention and suppression, whereas the real reason was very favorable weather. Conversely, a good fire record might be taken to indicate an easy fire problem, whereas the accomplishment was really the result of exceptionally fine work by the fire-control organization in spite of critical weather. Obviously the efficiency of a fire-control organization should not be judged only on the basis of fires and acres burned.

5. Fire-danger ratings, or even a tally of days in the higher danger classes, make possible useful comparisons of seriousness of fire seasons by *years* for any unit. It is quite useful to be able to compare a current year's accomplishments in fire control with those of past years. Also, in planning the financial aspects of fire control, it is desirable to know the frequency of critical and easy years. Danger ratings form a valid basis for such a classification. For example, on the Cumberland and Monongahela National Forests, the number of class-3 or higher days has varied as follows:

	Total number of class-3, -4, and -5 days	
Year:	*Cumberland National Forest*	*Monongahela National Forest*
1942 (October to December only)	60	56
1943	130	100
1944	121	63
1945	73	79
1946	89	123
1947	66	79

Comparisons of average weighted danger ratings are even more useful because they give weighted values that reflect likelihood of fire occurrence.

Current fire control funds are allotted by the Forest Service to various national forests partly on the basis of expected severity of burning conditions. Such a basis for financing helps to insure an equitable distribution of funds.

6. An accumulation of danger ratings for different fire control units will show legislators and those who administer fire funds the comparative financial needs of the several units reasonably similar with respect to topography and fuel type. In Virginia, for example, there are 103 days of class-3 or higher danger per year (1943–46 average). In Massachusetts, a State with similar fuel types, there are only 65 such days. This is not the whole story, of course, but it illustrates one useful type of information obtainable from danger ratings. Hayes, in 1944 and 1945, and Lindenmuth, in 1946 and 1947, made exhaustive analyses of fire records and forest fire danger for 14 Northeastern States.[5] They have developed strong correlations between many fire factors and fire danger, which aid fire control executives.

There is some degree of error involved in using fire-danger ratings based only on fuel moisture and weather as guides to presuppression needs, rate of spread of fire, extent of accomplishments, and the like. However, for areas not differing essentially in risk, visibility condi-

[5] A series of processed reports issued each year for each State by the Southeastern Forest Experiment Station in cooperation with Region 7, Forest Service.

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tions, fuel type, and topography, these fire-danger ratings constitute a basis for presuppression planning and action.

FIRE-DANGER RATINGS USED IN SUPPRESSION

Danger ratings are almost as valuable after the fire starts as before. One of their most vital uses is to give dispatchers and fire bosses a knowledge of fire behavior by danger classes in different fuel types. An analysis of national forest fire reports (*13*) shows the following rates of spread for hardwood leaf litter, a common fuel type.

Fire danger:	*Average spread of fire perimeter per hour (chains)*
1	5
2	12
3	19
4	28
5	36

Thus, measurements of existing danger help to tell dispatchers whether to send 10 men or 50. Fire bosses are likewise guided in reducing the manpower on a fire as danger decreases. It is reemphasized here that other factors affecting rate of spread and resistance to control, as well as fuel moisture and weather, must be carefully considered in dispatching.

Fire-danger ratings are quite valuable in postfire reviews of action taken. Without them as background, it is not possible to reconstruct conditions accurately and conduct a critical investigation to draw out the best lessons for strengthening future action.

DANGER RATINGS APPLIED TO DAMAGE APPRAISAL

Ratings of fire danger can be used to indicate roughly what the intensity of a fire in a given fuel type will be or has been. This information, in turn, is essential to the proper rating of fire damage, especially in hardwood and some southern pine types. Most fire control organizations do not now have the personnel available to make a detailed survey of each burned area and must rely on generalized tables to ascertain damage after a fire.

The most practical way to approximate damage in a known stand of timber is to correlate it with fire intensity as indicated by danger measurements. In some types, trees may continue to die for five or more years after a fire, the damage varying, of course, with fire intensity. In some instances it is desirable to begin legal proceedings immediately to collect fire damages. Suppose a 5-year wait to determine total mortality is impossible. If so, a danger rating obtained during the fire often serves as an index of fire intensity and consequently of expected losses. Such use has been made of ratings in the South where a damage appraisal system has fire-danger class as one variable (*20*). The average timber losses per acre in satisfactorily stocked sapling pine-hardwood stands, for example, are as follows:

Fire danger:	*Damage per acre burned*
1	*Negligible*
2	$0.70
3	2.20
4	$4.30
5	10.10

Such use of fire-danger ratings is general and should not supplant actual appraisal of damage on the ground when such can be made.

DANGER RATING AND PRESCRIBED BURNING

Prescribed burning to reduce fuel concentrations, kill unwanted hardwood brush, prepare good seedbeds, or accomplish other things is being practiced in certain sections on an increasing scale. An understanding of the severity of fire expected for different classes of danger takes much of the guesswork out of prescribed burning. For example, burning to improve game food supplies, stand composition, seedbeds, and certain other conditions involved in the management of forest resources is facilitated if probable fire intensity is known ahead of time.

A word of caution is needed here as with other applications of danger ratings. Most prescribed fires are backfires rather than headfires, and danger ratings serve merely as rough guides to fire behavior and intensity. If the practitioner recognizes this fact and checks his information on fuel and weather conditions with experienced judgment, he will be able to obtain the kind of burn that he planned.

Danger ratings have a place, too, in prescribed burning for protection, in that they help determine when to accomplish maximum fuel reduction with minimum damage or risk. Hundreds of miles of strips between parallel plowed fire lines are burned every year in the South as firebreaks. Burning crews do a better job if their activities can be guided by measured danger; and the best job is obtained with the least undue risk.

OPERATION OF A FIRE-DANGER MEASURING SYSTEM

The proper locations for fire-danger stations are well standardized, as are the instruments and methods of using them. The measurements of fuel moisture, wind, condition of vegetation, and season of year as already outlined in this publication are herewith described in greater detail, because the establishment and operation of an efficient fire-danger measuring network require the right equipment, properly installed and used, at acceptable locations in the forest. Experience shows that errors of determining fire danger will be very small if the methods described are carefully followed.

SELECTION OF FIRE-DANGER STATION LOCATION

NUMBER

The number of stations required to sample adequately the major differences in fuel moisture and weather conditions depends primarily on elevation and aspect. In complex topography the weather is usually quite variable, but in flat country it tends to be more uniform over large areas. In the mountains of the East, about one station per 150,000 gross acres or one per 300,000 acres in level or rolling country is enough to begin with. "Holes" in the network will show up if the degree of sampling is insufficient.

Local fire occurrence is another factor to be considered. Fire-danger measurements are more important where concentrations of fires occur. Generally, fires occur in the valleys and accessible areas. High elevations and remote areas usually present less of a problem. The danger stations should be located accordingly.

Finances and supervision are often practical limitations. Stations should be established only in locations and to the extent that they can be properly installed, adequately maintained and operated, and properly inspected and supervised. All of these measures are necessary to produce accurate records.

Local administrative subdivisions and communication facilities also are influencing factors. Good communication between the station and the administrative headquarters is essential. Ordinarily, at least one station is recommended for each administrative subdivision for efficient operation.

EXPOSURE

The exact spot for setting up a fire-danger station should be selected with extreme care; otherwise the fuel moisture and wind measured may be typical only of the immediate surroundings. If the site is typical of the problem areas, however, the danger ratings obtained can be used with certainty that they represent conditions of major importance.

All stations following the previously described systems of danger rating should be located under natural forest conditions if satisfactory results are to be obtained. It has been well established that soil and air temperatures, humidity, wind, radiation, and evaporation vary sharply between forest and open land. Thus, equilibrium fuel moistures and the rates of moisture gain and loss differ with exposure. Also, deciduous forests go through seasonal changes, unlike nontimbered areas, that bear important relations to fuel moisture. Danger stations cannot be operated satisfactorily in cities, on watered lawns, or other untypical sites.

The forest conditions at a danger station site should not be modified at any time during the course of erecting or operating the station; litter should not be disturbed, no undergrowth should be cut, nor other changes made. Exposures in sedgegrass fields or similar completely exposed areas should be avoided unless a satisfactory forest exposure is unavailable. In such a case, alternative exposures are permissible (*14*).

The following points may serve as a guide to danger-station location. In the eastern mountain and Piedmont regions:

Slope.—Choose a 10- to 20-percent slope if possible; level ground to 10-percent slopes, and 20- to 30-percent slopes, are next best.

Aspect.—Choose a south to southwest exposure if possible. West is next best, southeast and northwest slopes are permissible but not recommended. East, northeast, and north aspects should be avoided.

Cover.—Choose a hardwood site even in a pine-hardwood mixture where pine constitutes a good part of the stand. Moisture measurements of the important flash fuels particularly are more representative under such conditions. Age of stand is of minor importance, but the timber should be pole-size or larger.

In the pine areas of the Coastal Plain:

Cover.—Choose a typical pine stand representative in density and composition of the predominant conditions. Avoid dense patches of young growth or wide, open cut-overs. The best exposure is in a thinned pole stand or partially cut saw-timber stand.

In all regions cover density and relation of topography to prevailing winds are more important than slope and aspect. Stations should be so located as to receive winds from all directions or at least the prevailing daytime direction.

In order to maintain comparability between stations and between administrative units, it is desirable to have one individual designate or approve the locations over as large an area as possible. In this way all limiting factors can be uniformly evaluated and suitable sites chosen.

EQUIPMENT USED IN FIRE-DANGER MEASUREMENT AND ITS INSTALLATION

A fuel-moisture scale and set of fuel-moisture indicator sticks, rain gage, anemometer, and weighing shelter comprise the essential equipment needed at a fire-danger station. A complete list of equipment and materials for setting up a station is given on page 45. The following information will be helpful in planning for such a station.

GROUND PLAN FOR DANGER STATION AS A WHOLE

The arrangement of danger-station equipment should be similar to that shown in figure 7. Ordinarily the weighing shelter and sticks will be at one location and the rain gage in a nearby opening.

A wire fence around the shelter and sticks is essential to reduce the chances of stick breakage by domestic stock or wild game and meddling by passers-by. Sometimes a smaller wire fence around only the sticks serves the purpose.

A definite path should be laid out for the observer to follow at all times within the enclosure to avoid trampling of small vegetation and eventual destruction of the litter. Small logs on the ground around the sticks are recommended to avoid disturbing the litter under the sticks.

If the location is on a hillside, a ditch may be needed on the upper side to prevent washing.

FUEL-MOISTURE INDICATOR STICKS

The fuel-moisture indicator sticks used in the eastern and southern United States are made from basswood. Each set consists of three flat sticks 2⅜ inches by 18 inches, one-eighth inch thick. They are exposed on wire supports as shown in figure 8. They should always be *8 inches* above the litter, numbered side *down*. Sticks are stamped "expose other side" to help observers remember to return the sticks always with the same side up. Orientation of the sticks north, south, or in other directions is unnecessary. Sticks are carefully calibrated at the Southeastern Forest Experiment Station, Asheville, N. C., and can be obtained from that office.

Basswood sticks, being flat with a maximum of surface area for their volume, gradually lose weight because of weathering processes. During the calibration period, weathering corrections are calculated so that current compensations for this loss in weight can be made. A

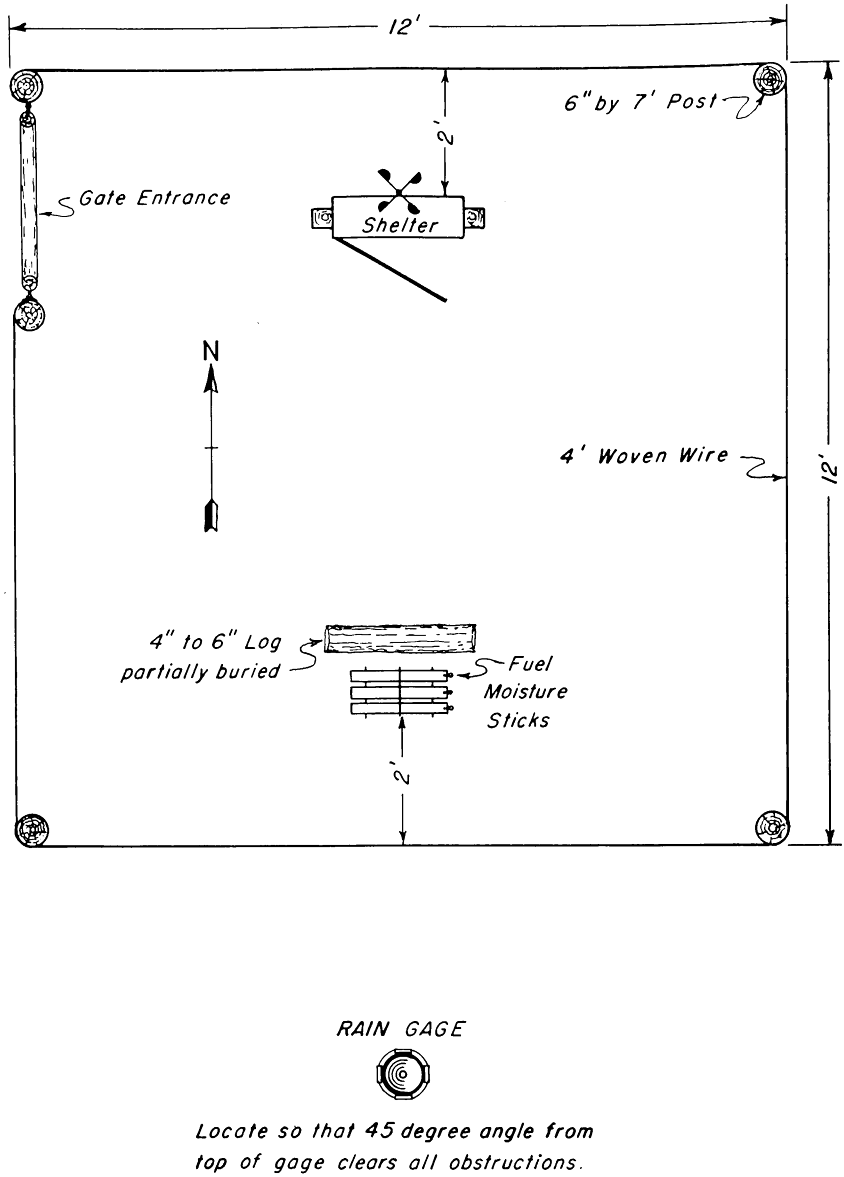

Figure 7.—**Ground plan for danger station.**

calibration card, enclosed with each set of sticks, shows the proper settings of the sliding adjustment on the balance arm of the scale to allow for weathering.

When sticks are lost, broken, or chipped, a new set should be ordered at once. Old sets should be destroyed at the end of the period indicated by the calibration card.

In hardwood stands, a location should be chosen where the sticks will be fully exposed to the sun during the leafless season and completely shaded during the green season. Such conditions are representative of fuel exposures in these stands.

In coniferous stands, a location should be selected where the sticks will get partial sunlight and shade through the day in a proportion approximate to that received by natural litter. If the stand is typical in density of the type to be sampled, then a suitable stick location can be chosen by study of probable sun and shade patterns at each of several possible spots.

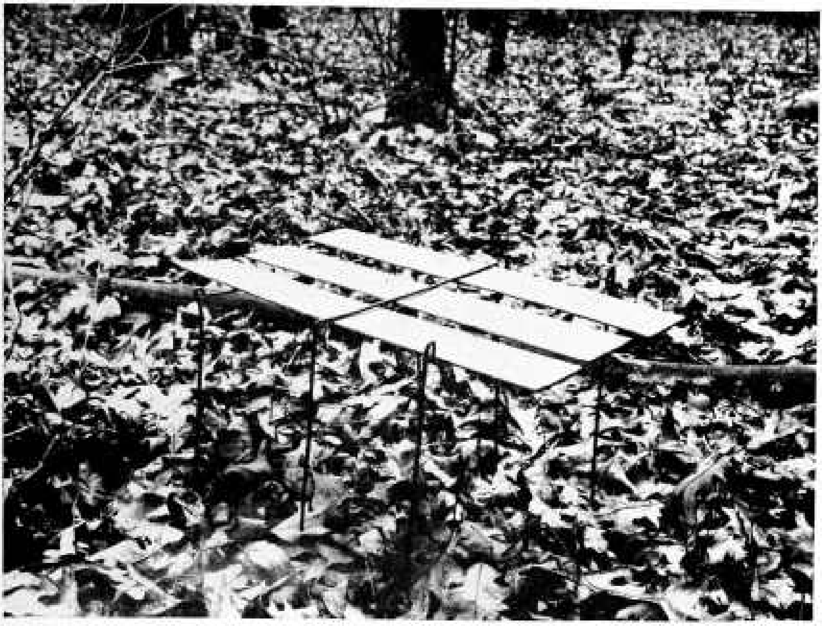

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Figure 8.—A set of fuel-moisture indicator sticks used in the eastern and southern United States.

On some areas, such as cut-over land or blowdown, the sticks must be exposed to nearly full sunlight to be typical of natural fuel. In general, the sticks should be placed south of the weighing shelter and free of unnatural shadow cast by fence posts, stumps, or other objects.

FUEL-MOISTURE SCALE

The fuel-moisture scale, developed by Byram (*2*), is used to determine the moisture content of fuel-moisture indicator sticks. The instrument (fig. 9) consists of a pivoted balance arm or beam mounted on a lacquered 10- by 10-inch metal back. A sliding weight or counterbalance on the beam is used to adjust the scale for sets of sticks of different oven-dry weights from 75 to 115 grams.

The balance arm of the instrument has a small hook on the left end to which a set of fuel-moisture indicator sticks is attached when a reading is to be taken. The other end points to the average moisture content of the sticks, shown on a curved scale graduated from 0 to 50 percent.

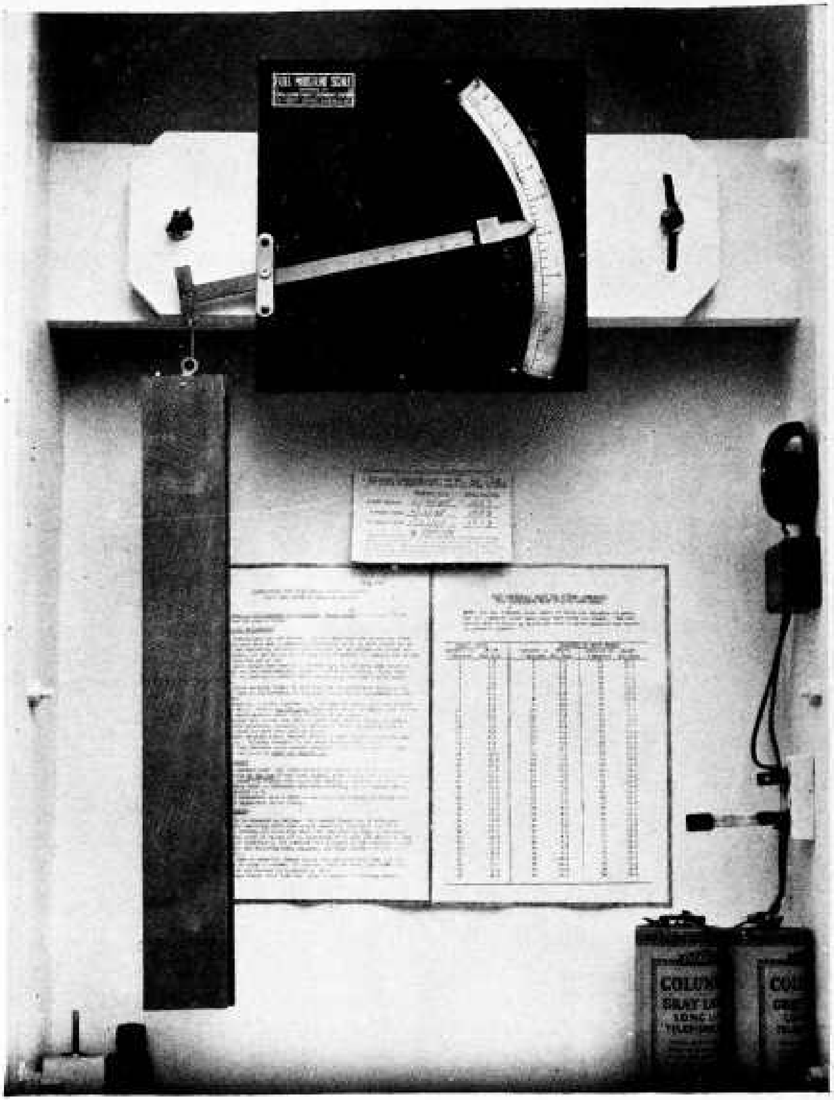

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Figure 9.—The Appalachian fuel-moisture scale.

The balance arm pivots on a nickel-silver pin. All other parts except the back are of solid brass, usually nickel plated. A standard 100-gram test weight accompanies each instrument and is used as a ready method of leveling the device to obtain the zero setting. Each scale is packed in a wooden box suitable for shipping. Detailed specifications may be obtained from the Southeastern Forest Experiment Station, Asheville, N. C.

Tests show that when fuel moistures are below 20 percent the instrument will indicate true moistures within ±0.2 percent, while from 20 to 50 percent the error is not more than ±0.5 percent.

Current costs of the fuel-moisture scale range from $10 to $17.50 each.[6]

The fuel-moisture scale must be mounted substantially in a shelter described on the following pages, so that the top edge of the instrument is about 3 inches from the roof of the box. This will give plenty of room for the wood sticks to hang from the scale without striking the bottom of the box.

An easy way of mounting the device, described below and illustrated in figure 9 and later in figure 10, permits leveling it quickly and accurately. First, screw the scale firmly to a piece of wood 3/4 by 5½ by 18 inches long. Four holes are provided in the scale back for this purpose. Bore a 1/4-inch hole near one end and cut a 3/8- by 3-inch curved slot across the width of the board near the other end. Then fasten the board with scale attached to a board 3/4 by 5½ by 23 inches and secure both by means of 1/4- by 2-inch carriage bolts with wing nuts and washers as shown in figure 9.

The crosspiece holding the scale should be approximately level. The slot will permit precise leveling of the scale before the wing nuts are tightened. It may be leveled again if the ground settles and tips the shelter slightly from the vertical.

WEIGHING SHELTER

A weighing shelter is necessary at a fire-danger station to protect the fuel-moisture scales from the weather and to provide shelter from the wind during the actual process of moisture determination. It is also convenient to have in one shelter the wind circuit batteries, switch, and buzzer. Other equipment such as test weight for scales, rain-measuring stick, weathering chart for indicator sticks, wind correction chart, and instructions for danger-station operation may also be kept there.

The weighing shelter should be a weatherproof box of the dimensions shown in figure 10. It should be mounted substantially on posts that are set in concrete to eliminate vibration and shifting of the shelter due to wind and settling of the ground. A full-sized hinged door on the front of the shelter gives the observer plenty of room in which to work. It is provided with a panel of glass, so that the final reading on windy days may be made with the door shut. Materials for one shelter [7] can be purchased for about $15.

Figure 9 illustrates a convenient arrangement for each item housed within the weighing shelter. Beneath the scales is fastened the weathering correction card for wood sticks. At the right, behind the wood sticks is a sheet showing correction for wind readings. The large sheet in the center of the shelter gives instructions and points (reproduced in the appendix, p. 36) that the observer must continually watch in operating a station. Buzzer, switch, and batteries are at the right, and the test weight and can of anemometer oil are to the left. The rain-measuring stick hangs at the side of the shelter.

Shelters should always be located on the north side of the site in order to avoid casting shadows on the fuel-moisture indicator sticks. If a window is provided in the door, the shelter can be turned in any

[6] An instrument maker who has supplied scales in the past is named in the appendix.

[7] These materials are listed in the appendix, p. 45.

DETAILS OF WEIGHING SHELTER

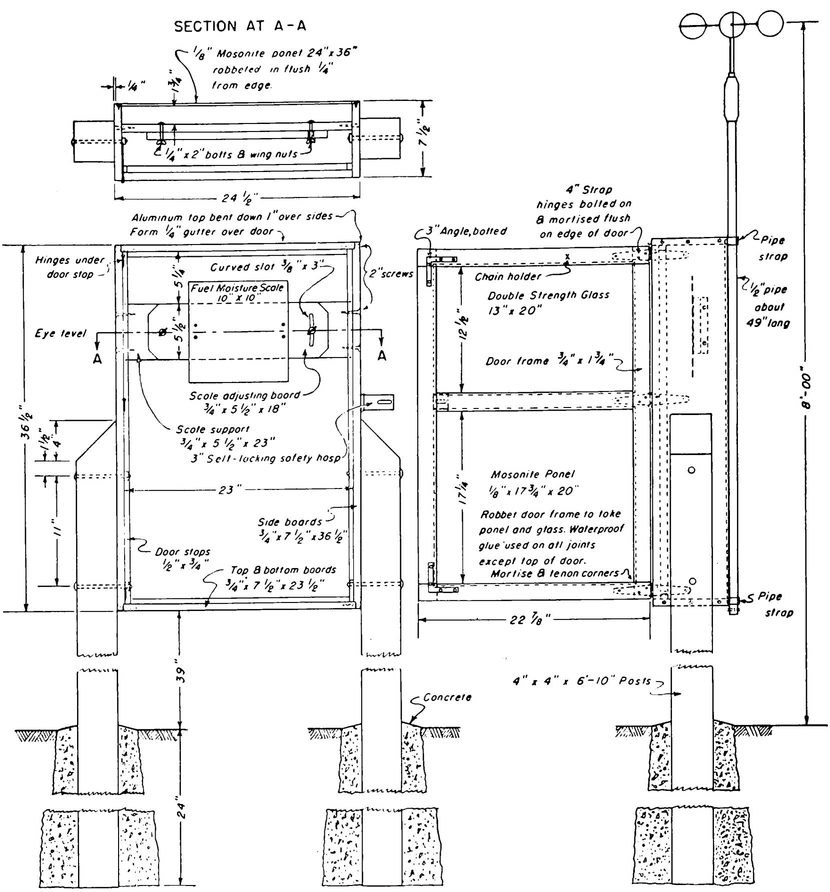

Figure 10.—Diagram of weighing shelter and details for mounting fuel-moisture scale and anemometer.

convenient direction. If no window is provided, the shelter should be turned so the door opens away from the prevailing winds to facilitate weighing the sticks on windy days.

The shelter should be elevated so that the numeral 10 on the graduated arc of the fuel-moisture scales is approximately at eye level of the average observer. A step in front of the shelter can be supplied for the special convenience of an individual if needed.

RAIN GAGES AND SUPPORTS

A rain gage consists of a sharp-edged, funnel-shaped receiver that concentrates precipitation into a small metal measuring tube housed in a larger metal container. The "catch" of rain is measured with a small graduated ruler or measuring stick. The ratio of receiver area to that of the tube is 10 to 1. Therefore, an inch of water in the tube indicates about one-tenth inch of rain.

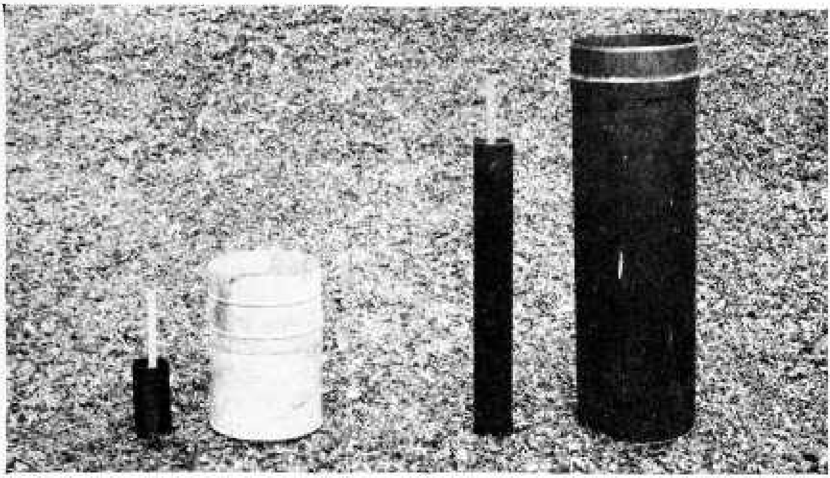

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Figure 11.—The Forest Service rain gage (left) and the standard U. S. Weather Bureau rain gage (right).

Two types of rain gages are recommended (fig. 11), the United States Weather Bureau standard pattern and the Forest Service type. The former is ruggedly constructed of sheet metal, is about 28 to 30 inches high and 8 inches in diameter, and has a capacity of 2 inches in the measuring tube and large overflow capacity. Its cost ranges from about $8.50 to $25.

Most danger stations use the Forest Service rain gage, costing $2.50 to $5. It is made of galvanized iron and is about 12 inches high and slightly less than 8 inches in diameter. It has a capacity of ½ inch

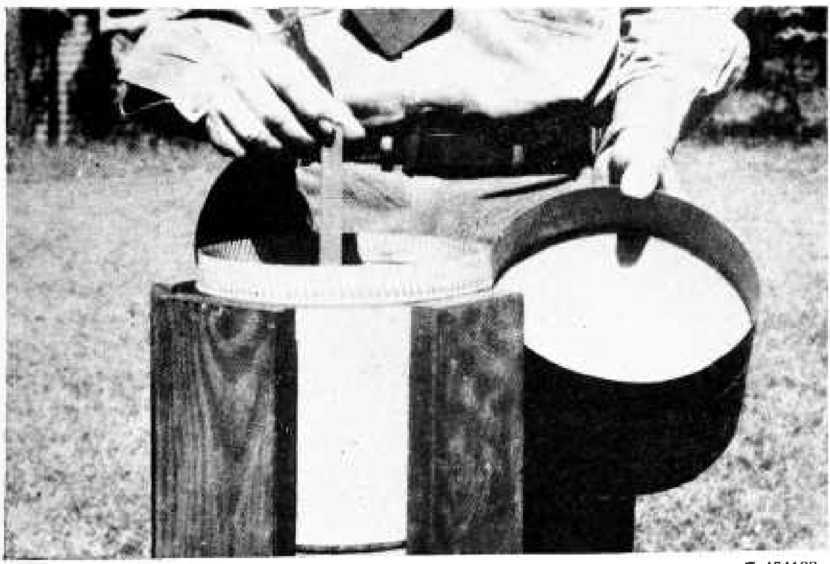

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Figure 12.—The Forest Service rain gage and post mounting.

plus a 6-inch overflow. In other respects its resembles the larger gage. Comparative tests conducted by the Northern Rocky Mountain Forest and Range Experiment Station and by the Southeastern Station indicate that the Forest Service pattern is satisfactory.

Rain-measuring sticks are graduated rulers reading to inches, tenths, and hundredths. Broken or dirty sticks may be replaced at a cost of 15 to 30 cents per stick.[8]

Rain gages should be securely supported so that the funnel top is level and about waist high. A Forest Service gage can be supported, as shown in figure 12, atop an 8-inch post to which four vertical strips have been nailed. At permanent weather stations, a support such as the one diagrammed in figure 13 is desirable.

The rain gage should be placed in an opening in the forest or a nearby clearing where a 45° angle from the top of the gage clears the nearest obstacle. This puts the rain gage at a distance at least equal to the height of the obstacle. Sometimes such an exposure is not possible but it should be selected when available. Next best is to place the gage directly under the center of the largest crown opening.

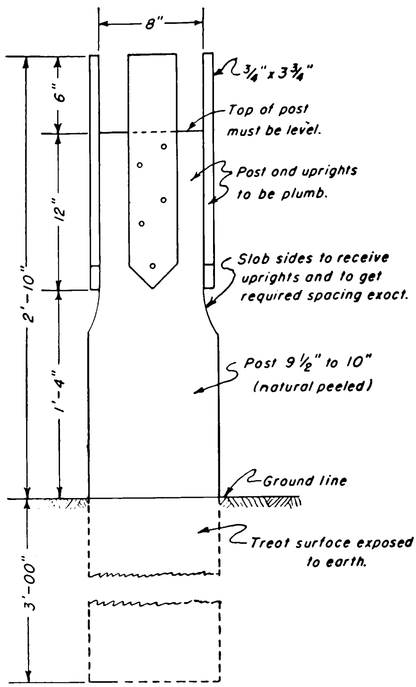

Figure 13.—Diagram of rain-gage support.

ANEMOMETERS

There are a variety of low-cost cup anemometers satisfactory for use at fire-danger stations. These are all the so-called "airways" or "buzzer type" that indicate current velocity by transmitting signals or buzzes for each 1/60 mile of wind passing the instrument. Several anemometers are shown in figure 14.

Some types are more accurate than others, especially at low velocities, but all can be recommended for danger measurement.[9] All of these anemometers use correction charts to convert indicated to true velocity.

Anemometers do not come equipped with a mounting device, but most of them have bases threaded to fit a standard 3/8-inch or 1/2-inch pipe thread. A suitable iron pipe mounting is diagrammed in figure 10. All wire, batteries, buzzers, and switches necessary to complete the signal circuit can be purchased at any hardware store. Two 1 1/2-volt dry-cell batteries will supply the necessary current. A small

[8] Manufacturers supplying rain gages and measuring sticks are listed in the appendix.

[9] Instruments may be obtained from the manufacturers listed in the Appendix; prices range from $17.50 to $35 per instrument.

electric buzzer or flasher bulb provides the best signal and a single-bladed knife switch is recommended.

The anemometer should be supported so that the cups are at or within half a foot of the 8-foot level, a height adopted as standard for ground wind measurement at eastern fire-danger stations. No artificial barriers to wind movement, such as buildings, should modify typical forest conditions in any direction. Anemometers should not be nearer than 10 feet to trees 10 inches or larger in diameter.

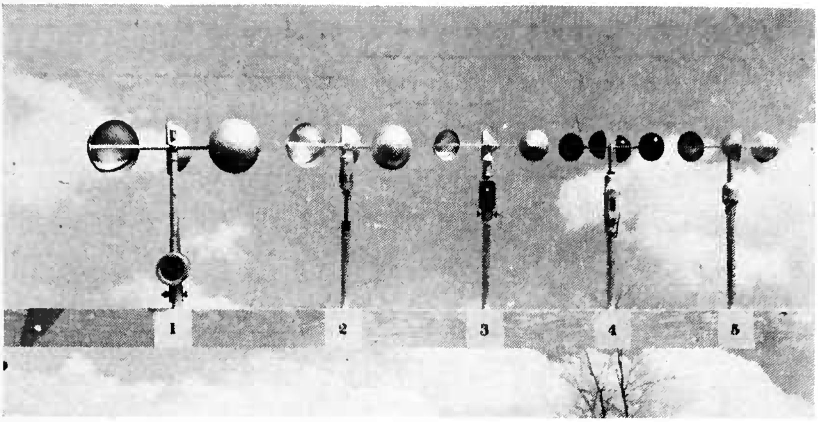

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Figure 14.—Number 1 is a highly accurate and expensive anemometer used at Weather Bureau stations. Numbers 2 to 5 are low-cost anemometers satisfactory for use at fire-danger stations. Number 2, Chisholm; 3, Friez airways type; 4, Stewart; 5, Dozier.

Occasionally a satisfactory anemometer exposure cannot be found in the immediate vicinity of the danger station, on account of the interference of topography or buildings. If so, the anemometer may be set up in a desirable spot to get a better exposure. By wiring the instrument back to the weighing shelter and adding sufficient batteries, wind readings may be taken without the necessity of the observer walking to the chosen spot.

Although the $\frac{1}{60}$-mile transmitters are satisfactory for fire-danger measurement, there is some advantage in having cumulated wind movement, because a more reliable average can then be obtained. Several types of counters or mileage cumulators are available for attachment to anemometers. Also, standard anemometers of high quality, with dials from which total wind movement to the nearest $\frac{1}{10}$ mile can be read, may be purchased from several companies for prices starting at $80. Instruments can also be obtained with the additional $\frac{1}{60}$-mile transmitting feature.

WHEN TO MEASURE WEATHER AND FUEL FACTORS

The man responsible for fire control uses fire-danger measurements to help him answer two basic questions: What is the likelihood of fires starting? And how big is the job of suppressing any fires that do occur? All other questions are subordinate. Accordingly, fire-danger measurements should be taken at times which will provide the best answers to those two basic questions.

The number of accidental fires which start is determined principally by the prevalence of debris-burning fires, campfires, discarded matches and smoking materials, hot coals, etc., and the inflammability of the forest fuels. The size of the suppression job for a single fire is also determined principally by the inflammability of the fuels and wind velocity. Topography, ground cover, and many other factors contribute, but to a lesser degree.

An analysis of daily fire occurrence in the Northeast, based on 10,000 fires which occurred in 12 Northeastern States from October 1942 through June 1943, shows that almost half of the fires start between noon and 3:30 p. m., e. s. t. A summary of dew-point temperatures at Asheville, N. C., (*18*) for the years 1926–32, shows that on the average the minimum dew-point temperature on clear and partly cloudy days falls to a practical minimum near noon, and thereafter drops slowly to an absolute minimum near 3 p. m. Dew point is a direct index of the amount of moisture in the air. A summary of mean relative humidity and maximum air temperatures recorded at Burlington, Vt., (*5*) July 1911 to December 1915, inclusive, shows that on the average minimum relative humidity values and maximum air temperatures occur between 2 p. m. and 3 p. m.

Limited records of fuel moistures indicated by sticks in eastern Virginia show that minimum moisture content, 3 or more days after a rain of 0.25 inch or more, occurred at 3 p. m., e. s. t., on approximately 75 percent of such days. This apparently indicates a slight lag in time for the sticks to come to equilibrium with the factors controlling their moisture content. Generally speaking, the average daily march of wind velocity follows closely the changes in temperature and is in direct proportion to the temperature over level regions or at low elevations such as valley floors or lower slopes. Some seasonal variations do occur in the mean values of these factors but are ignored for practical purposes.

All this evidence indicates that in the East the answer to the two basic questions can best be determined between 1 p. m. and 3 p. m., e. s. t. The 2 p. m. observation made by most agencies is probably a good compromise and is recommended as the basic observation. It should be made at a minimum of one station on each administrative unit on every day of the year to provide adequate records.

Some additional observations are required by the United States Weather Bureau for forecasting purposes. These should be made as directed and are not covered by this discussion, which refers particularly to fire control.

Early morning observations have little value in fire control in the eastern United States. Indicated fuel moistures are generally high and are influenced mainly by conditions that prevailed during the night. Wind velocities generally are low, in keeping with the temperature. Conditions recorded at danger stations in the early morning do not set a pattern for the day. Early morning observations are not recommended. On the other hand, late morning observations have been found useful to determine when a lookout should actually be "on top," as opposed to cutting wood, packing water, or doing other work on the ground. They are also useful to indicate the pattern of weather to be expected later in the day.

Late afternoon observations at 5 p. m. normally show a decline from the peak danger earlier in the day. Usually by late afternoon fuel moisture has increased and wind velocity has fallen. Occasionally a continuation of high danger into the evening hours is possible. Hence, a 5 p. m. measurement during the fire season is recommended. In the nonfire season, however, year-long stations should make the 2 p. m. observation only.

Additional observations to control the action on going fires, of course, should be made as needed. These extra observations need not be part of the permanent record.

TAKING MEASUREMENTS AND RATING FIRE DANGER

Taking fire-danger measurements and integrating them into numerical ratings require a high degree of accuracy if the ratings are to be a reliable basis for fire control action. Carefully developed instructions for observers are given in detail in the Appendix to ensure proper measurements.

The numerical ratings are obtained from the danger meter by following instructions printed thereon. It should be remembered that the class of fire danger or burning index obtained represents conditions at the particular time and place the observations were made. Dispatchers or others who use danger ratings will get the most help from the ratings if they are thoroughly familiar with the fire weather pattern over their district in relation to measured fire danger. By watching fire behavior in relation to topography, fuel type, and wind direction, they will learn how to interpret and modify danger ratings for each slope or drainage. For example, some coves tend to remain wetter than others. Fuels on exposed ridge tops may dry out quicker after a rain and reach lower minima than the danger-station ratings indicate. Experienced judgment is invaluable in applying the basic burning index values in the job of dispatching.

SUMMARIZING FIRE-DANGER RECORDS

Administrative units usually require ratings of fire danger for daily fire control planning. When only one fire-danger station is operating within a unit, the ratings are used to represent the entire area. When one unit has two or more danger stations, however, some method of calculating average unit danger is needed.

One method of summarizing, formerly quite popular, consisted of averaging the fuel moisture, wind, and rain data from the several stations. This often gave ambiguous results and is no longer in general use. By averaging the rain, the unit as a whole was often basing its ratings on a much smaller amount of precipitation than some individual stations actually received.

Another method of summarizing, used by the Southeastern Forest Experiment Station and now incorporated in the scale of the new type 5–W fire-danger meter, is that of averaging weighted danger ratings from all the individual stations in the unit to determine a single rating representing the entire unit. Danger ratings expressed only in the five classes cannot be averaged arithmetically without weighting. This is true because a class-4 day is not four times as severe a day as a class-1 day so far as fire occurrence, rate of spread, or any of the other elements of fire control are concerned. The class-4 day actually is many times more severe. Accordingly, the scale on the type 5–W meter was developed to express this comparison of severity in a linear form based only on the element of fire occurrence. Records from thirteen Northeastern States comprise the basic data.

Any number of ratings on the type 5–W meter scale can be averaged arithmetically to determine a composite average representing the group, provided the areas represented by the individual ratings are approximately equal. Similarly, danger ratings expressed in the five-class scale when converted to the type 5–W scale by means of the tabulation on page 9 can be averaged in the same manner.

This method may be amplified by including area weight factors where the areas represented by different stations differ significantly. For example, a district is served by danger stations A and B. A represents one-third of the district and has a danger rating of class 2 or a burning index of 5 today. B represents two-thirds of the district and has a danger rating of class 3 or a burning index of 20 today. The district rating would be calculated by multiplying each area by its corresponding burning index and adding, as follows:

Area A: $\frac{1}{3} \times 5 = 1.67$
Area B: $\frac{2}{3} \times 20 = 13.33$
District average (sum) 15.00 (or class 3).

Tables or alinement charts can easily be developed to handle the mathematics of this method, thereby making it very simple to apply in actual practice. This method is recommnded in the mountains of the eastern United States. Until a 100-point scale is developed for the Coastal Plain meter, danger classes should not be added and averaged at the Coastal Plain and Piedmont stations.

PREDICTING TOMORROW'S FIRE DANGER

Like any other kind of forecasting, the prediction of fire danger requires judgment. It cannot be accomplished mechanically. Fuel moisture and wind velocity are particularly difficult to forecast. Even the well-known weather factors like air temperature, humidity, and precipitation cannot be predicted for small localities with a high degree of accuracy.

Regular fire-weather forecasts are very useful, and they attempt with considerable success to localize predictions for national forests or similar-sized units. Further localization depends on local knowledge and interpretation gained from on-the-ground experience.

In the eastern United States, fire-weather forecasts are prepared by the United States Weather Bureau and originate from their Asheville, N. C., and Boston, Mass., offices. Special fire-weather forecasters are employed at both points. Forecasts are available to all interested parties in the territories served during regular designated seasons and also by special request.

Regular weather forecasts generally include information on clouds, relative humidity, temperature, wind velocity, wind direction, precipitation, and factors affecting visibility. Recently fuel-moisture predictions have been included on a trial basis. Instruction booklets furnished free of charge by either office fully explain all codes and the terminology used (23) and must be studied prior to making any attempt to use these forecasts.

Regular within-season forecasts are not made for any particular point but rather cover an area of varying size within which the variables considered are expected to be fairly uniform. Experience and study will help an observer to interpret the forecasts specifically to fit local conditions. Requested forecasts, on the other hand, attempt to cover the specific designated area.

Predicted wind velocity is expressed in terms of in-the-woods velocity, 8 feet above ground. In the absence of specific forecasts of fuel moisture, this factor must be calculated locally from the air temperature and relative humidity predictions. The following general rules are helpful in making calculations:

1. Rising temperature, no change in relative humidity: somewhat lower fuel moisture.
2. Rising temperature, higher relative humidity: little change in fuel moisture.
3. Rising temperature, lower relative humidity: much lower fuel moisture.
4. Lower temperature, no change in relative humidity: somewhat higher fuel moisture.
5. Lower temperature, higher relative humidity: much higher fuel moisture.
6. Lower temperature, lower relative humidity: little change in fuel moisture.

Sufficient time must have elapsed following a rain to permit the indicator sticks to come to equilibrium with their surroundings before these general rules apply. This period varies with the season. By local study and observation, these rules can be expressed in actual values with reasonable accuracy, thereby facilitating their use.

The meter for the Piedmont and Coastal Plain has a fire-danger forecasting feature incorporated in it. If a prediction for tomorrow's weather is available, the meter may be used as a guide to coming fire danger. However, common sense and a careful study of existing and predicted weather are often more satisfactory than any mechanical method.

TRAINING AND INSPECTION

Emphasis must continually be placed upon accuracy to obtain reliable records. An adequate program of training and inspection is indispensable in accomplishing this objective.

Ordinarily a qualified trainer can profitably spend at least 2 hours with each new observer at the station, going over the details pertinent to reading the various instruments and recording the data. Follow-up training needs will vary with observers and can best be determined by periodic inspections and checking of the records.

Inspections as frequent as monthly are desirable, but a minimum of two per year, spring and fall, are essential. The jobs of locating stations, training observers and dispatchers, maintaining and servicing the instruments, checking and filing records, assembling and analyzing data for most effective use, etc., can all be handled efficiently

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by one man to provide proper coordination. Proper attention to these functions will require the full-time services of 1 man for approximately each 100 danger stations in continuous operation.

A standard inspection outline or check list is helpful to assure proper attention to details. A suggested outline, used successfully in the Northeastern States since 1945, is included in the appendix.

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APPENDIX

INSTRUCTIONS FOR OBSERVERS AT FIRE-DANGER STATIONS

The usefulness of fire-danger ratings depends upon the reliability of the records that go into the ratings. Fire-danger station observers should realize that their accuracy and carefulness, above all else, are absolutely essential if the most is to be obtained from a system of danger measurement. Figure 15 gives instructions and points that the observer must continually watch. Each observer should understand that the errors he makes carry right on through to presuppression and suppression action. He can be responsible for a fire getting away if he is careless in handling and reading instruments.

CARE OF INSTRUMENTS

Proper care of instruments is essential to obtaining reliable fire-danger records. Many of the following points can be handled by the observer. Others should be handled by an administrative officer. Definite responsibilities for the various jobs should be established by the organization involved.

Fuel-moisture indicator sticks.—Always be sure that the three sticks which constitute a set are kept on the wire supports with the side marked "expose other side" down, approximately horizontal, and 8 inches above the litter as shown in figure 8. They should always be returned to this position immediately after each weighing and left exposed to the weather at all times, *even when the station is not being operated.* The many sets of wood sticks in use will not weather uniformly if one set is exposed one way and a second set in another manner.

INSTRUCTIONS FOR FIRE DANGER STATION OBSERVERS
(Post this sheet in weighing shelter)

GENERAL:

Accuracy of all readings is essential. Never guess at a value. Write reading down as soon as taken.

FUEL MOISTURE MEASUREMENT:

1. Instructions for new sticks: (a) The date when new sticks are first exposed and each date when a weathering correction is to be made should be recorded on the weathering correction card as soon as the sticks are placed out in the weather; (b) new sticks can be used 6 to 8 months; (c) destroy old sticks when new ones are put in use.

2. Scale should read exactly 0 percent when the 100-gram test weight is on the hook and the counterbalance slide is set at 100.0 grams. Check this weekly. If not reading 0, correct by loosening wing nuts and tilting scale up or down.

3. Before weighing sticks be sure that the counterbalance slide on the horizontal beam is set correctly at the point indicated on the weathering correction card.

4. Weigh all 3 sticks together. Do not read the scale until the pointer has become still. Always tap the pivot block with finger or pencil just before reading to avoid possible error from friction in the pivot.

5. Handle wood sticks with care -- never with sweaty, dirty, or greasy hands -- avoid splitting, chipping, or marring -- brush off lightly with a clean, dry cloth any dirt that gets on sticks.

6. After weighing always replace sticks on their supports with the numbered side down. Maintain adequate litter under sticks at all times.

7. If fuel moisture scale becomes sluggish, place a few drops of kerosene oil on the pivot -- never use machine oil.

WIND MEASUREMENT:

1. To measure wind: (a) close switch; (b) listen for first signal; (c) immediately at the end of the first signal, start timing for a 2-minute period; (d) count all signals that occur for exactly 2 minutes; (e) refer to wind correction chart to determine true wind velocity. If no signals occur, the wind velocity is 0.

2. Oil anemometer once a month -- use only 2 or 3 drops of a very light oil, such as typewriter oil or 3-in-1.

RAIN MEASUREMENT:

1. Rain is measured as follows: (a) remove funnel top of rain gage; (b) lower rain measuring stick down inside measuring tube until the stick rests on the bottom; (c) raise rain stick and read the top edge of the water line (The rain stick is marked off in hundredths of an inch and should be read to the nearest hundredth.); (d) overflow that collects in the large can should be poured into the measuring tube, measured, and added together to get the total rainfall.

2. If snow is expected, remove funnel top and measuring tube, and let snow collect in large container. To measure, melt the snow, pour water into measuring tube and proceed as in measuring rain.

3. Always remove inner tube when there is danger of freezing weather.

Figure 15.—Instruction sheet to be placed in weighing shelter.

If the spot where the sticks are placed is exposed to high winds, it may be necessary to secure them to the wire supports to prevent them from being blown off. This may be done by using a piece of heavy galvanized wire hinged to one support so that it rests across the sticks and can be swung out of the way when a reading is to be taken. Or a "croquet wicket" made with right angle bends can be placed over the three sticks to hold them with moderate pressure to the wire supports.

The fuel-moisture indicator sticks will give a reliable indication of the changes in fuel moisture content if they are handled carefully and the following points observed:

1. Never handle the sticks with sweaty, dirty, or greasy hands. Excessive handling clogs the pores of the wood so that it will not respond readily to atmospheric moisture changes.
2. Handle the sticks carefully to avoid splitting, chipping, or marring.
3. If dust or dirt of any kind should get on the sticks, brush it off lightly with a clean, dry cloth or soft brush.
4. Keep the ground under and around the wire supports covered with leaves so that hard rains will not splash mud on the sticks.
5. Notify the ranger or other responsible forest officer if anything happens to the set of sticks, so that immediate replacements may be made.

The removal of wood fibers from the surface of the sticks by wasps or other insects can usually be ignored. Ordinarily the thickness of the layer removed is less than that of a piece of paper and only a portion of the total surface is affected. The resulting error under such conditions is slight.

Weighing shelter.—The following check list is helpful in maintaining the shelter in first-class condition:

1. Keep posts steady and plumb; they should be set in concrete or braced.
2. Keep box firmly fastened to posts.
3. Maintain box free of leaks and cracks.
4. Hang door properly so it closes tightly.
5. Give shelter a coat of paint once a year.

Fuel-moisture scale.—The fuel-moisture scale should be handled with care the same as any other delicate instrument. Observance of the following points will help produce accurate records.

1. *Do not* oil the pivot. This is made of hard nickel silver, and requires no lubricant.
2. When removing sticks from hook, avoid jarring the beam.
3. Be sure hook is hung properly and swings freely in all positions. Usually the hook is shaped with a small half circle on one end; this is the part on which the sticks are hung. The other end of the hook is a flat arm which is the end that goes through the beam. If the hook becomes rusty or lost, replace with one of similar shape. A common paper clip provides suitable wire for this use.
4. If the shelter or scales are to be moved, tie the scale beam to the stop pin to prevent jarring.
5. If the bright parts of the scale become corroded, clean with kerosene or a nonabrasive metal polish.

Anemometer.—Regular attention to this instrument is required to assure proper service and accuracy. The following points should be observed:

1. Check lubrication once each month. If oil is needed, add only two or three drops of a light or low viscosity household oil or typewriter oil. Less oil is needed in the summertime. Excessive oiling is harmful as it gums the instrument and makes it sluggish.

2. Keep the spindle plumb at all times. Otherwise, uneven wearing will result and inaccuracies will occur.

3. Cups should be attached tightly to the arms. If loose, replace entire rotor assembly.

4. Check the circuit switch periodically to be sure it is tight and clean. If loose, the rivet and prongs can be tightened by mashing with a pair of pliers. If corroded, the prongs and blade can be cleaned with fine sandpaper or by scraping with the blade of a knife.

5. If buzzer fails, check contact points, as this is the usual cause of trouble. If points are stuck together, break apart and clean points with fine sandpaper.

6. Keep all connections tight at all times.

7. Anemometers should be taken down and carefully cleaned once a year. Instructions for cleaning each type of instrument are given on pages 47 to 50. Observers should not take these instruments apart for cleaning unless they have been specifically instructed to do so by their superior officer.

Rain gage.—The following points all influence the reliability of the rainfall records:

1. Keep top of gage level.
2. Handle funnel carefully; if it becomes bent, restore its round shape.
3. Check currently for leaks; resolder any which occur.
4. Handle stick at top only, so lower part will not become greasy. If it becomes illegible, replace with a new one.
5. Remove inner tube during freezing weather to prevent damage. At intermittently operated stations, always remove inner tube when leaving station.
6. For greater accuracy in regions where snow occurs, remove funnel during winter to catch snow.
7. Clean out debris currently.

HOW TO MEASURE WEATHER AND FUEL FACTORS

Moisture content.—The fuel moisture is determined at each observation at the assigned time *except* when the ground is blanketed with snow. Under such conditions the sticks are not weighed and the snow on the sticks is not disturbed. The snow is allowed to melt in a normal manner until weighing of the sticks is resumed. The observer should follow the steps given below when determining fuel moisture.

1. Check the fuel-moisture scale to see that it is level or that its "zero setting" is correct. To do this, first set the sliding adjustment on the balance arm at 100 and hang the 100-gram test weight on the hook at the left end of the beam. When the beam stops swinging, *tap the pivot with the finger* to settle the pointer to the correct mark. It may lag a little owing to a slight amount of friction at the pivot point. If the pointer does not read zero, loosen the wing nut on the right and move the slotted scale support until zero is indicated. After the wing nut is tightened, tap the pivot with the finger again. If the pointer still does not read zero, repeat the operation until the zero point is reached. *The scale should thus be checked and leveled once each week* or whenever it may get out of adjustment for any reason.

2. Adjust the slider on the beam by setting it exactly on the figure corresponding to the corrected weight of the sticks. The corrected weight is shown by calendar date on the card which accompanies each set of sticks (fig. 16). This corrected weight is changed periodically because the sticks lose a slight amount of weight when exposed to the weather.

WEATHERING CORRECTION CARD SET NO. 48-537

Set slider on balance arm of scale according to date

	Calendar Date	Scale Setting
First Exposed	July 1, 1948	99.2
6 weeks later	Aug. 12, 1948	98.7
6 weeks later	Sept. 23, 1948	98.2

INSTRUCTIONS

When the sticks are first exposed, the three dates should be entered in the blank spaces above, using a calendar. Use slider setting recorded on top line for first 6 weeks, middle line for second 6 weeks, and bottom line for remainder of the 6-month period.

Figure 16.—A sample weathering card.

All the information on the card except the dates is filled in before the sticks are mailed. The observer must fill in the dates as indicated, using a calendar. Post the card in the shelter beneath the scales for handy reference. In case the card is lost, do not request a new set of sticks. A replacement card can be obtained just as quickly from the Southeastern Forest Experiment Station by supplying the number and its original weight which are recorded with indelible pencil on the underside of each stick.

3. Hang the three wood sticks *together* on the scale hook by means of the hanger fastened to each stick. Figure 9 illustrates the correct manner in which to suspend the sticks on the hook. *After the beam stops swinging, tap the pivot before reading the scale.* This is important and its omission has caused frequent errors in the past. The pointer indicates the average moisture content of the three sticks. This should be read to the nearest one-tenth of 1 percent up to 20 percent and nearest one-half of 1 percent above 20 percent.

4. Record the fuel moisture as read. Whenever the ground is blanketed with snow, record "S" (for snow) in the fuel moisture column of the daily record form.

Wind velocity.—Wind velocity is determined at each observation at the assigned time *except* when the ground is blanketed with snow or the fuel moisture exceeds 30 percent. Wind measurements are made as follows:

1. At stations equipped with a buzzer-type anemometer, close the switch and listen for the first buzz. Start timing with a watch immediately after the first buzz stops. *Do not* count this first signal but

count all others during the period indicated on the wind correction chart posted in the shelter. Whenever the wind is variable or gusty, take a second separate observation and average the velocity from the two observations or double the length of the first observation period and divide the number of signals by two.

If a station is equipped with the Weather Bureau type anemometer having a dial, average velocity is obtained by subtracting one dial reading from a second, later one. To get miles per hour, this difference which represents the total air movement for the period must then be divided by the number of hours between the two readings. For example, at 1 p. m. a reading of 621.5 was observed and at 5 p. m., 640.7. The difference is 19.2 miles, which divided by 4 hours equals 4.8 miles per hour average velocity. This value must then be corrected, as explained in the next point. Observers should note that the dial on this type of instrument goes up to 990.0 miles and then starts over again.

2. For buzzer-type anemometers, refer to the wind correction chart posted in the shelter. Opposite the number of signals counted for the established period, read the actual wind velocity directly. For example, with a Stewart anemometer nine signals in 2 minutes equal an actual velocity of 5.5 miles per hour.

For the Weather Bureau dial type anemometer, refer to the correction chart in the column for your special anemometer as described. Opposite the group within which your average falls, read the correction which must be added or subtracted to obtain the actual velocity. For example, an average of 4.8 m. p. h. with a three-cup anemometer requires an addition of a correction of 1 m. p. h. Therefore, actual velocity would be 5.8 m. p. h.

3. Record the actual velocity to the nearest one-half mile. If cups are not turning, record as zero. If the ground is blanketed with snow or the fuel moisture exceeds 30 percent, record "X" (for no observation taken). Correction charts for anemometers are given on pages 51 to 58.

Precipitation.—Precipitation is measured each day, usually once during the 24-hour period either at the first or last observation for the day. The administrative agency should establish a standard procedure for this observation. Precipitation is measured as follows:

1. Carefully remove the funnel from the top of the gage. If the small measuring tube is level full, empty it and refill it from the contents of the larger can. Count the number of level full tubes thus discarded. When the small measuring tube is not level full, measure its contents with the graduated stick furnished for this purpose. Handle only the end of the stick with the highest graduations, to prevent the stick from becoming illegible from grease or dirt. Insert the opposite end of the stick into the measuring tube, which is either standing level inside the main can or has been placed on a chosen level surface. Hold the stick vertical and avoid stirring or splashing. Withdraw the stick and note the position of the water line with respect to the nearest graduation.

2. Sticks are graduated in inches, tenths, and hundredths of rain. An inch of water equals only one-tenth inch of rain because the funnel top of the gage concentrates ten times the actual rainfall into the measuring tube. The amount of rain is recorded in decimals, like dollars

and cents: 1.25 equals 1 inch and 25 hundredths. Each level full measuring tube will be counted as ½ inch if the shorter, galvanized, Forest Service type gage is used, or 2 inches if the taller, copper, Weather Bureau gage is used. It is true that allowing full credit for each such tubeful without inserting the stick causes a slight error equal to the volume of the stick. But such error is slight enough to be negligible.

3. Record actual reading in inches and hundredths. If amount is less than one-half of one-hundredth (less than halfway of the first graduation on the stick), record a "T" for trace. If only a few drops of rain have fallen and are not noticeable in the gage, also record a "T." *Do not* record moisture from dew or condensation. Record precipitation each day even though fuel moisture and wind observations may have been omitted according to instructions. In regions where snow is likely to fall at intervals through a winter fire season, the funnel top of the rain gage should be left off to facilitate the catch of snow. Always melt snow and ice in the rain gage and pour the water into the small inner tube before measuring in the regular way.

Days since last rain.—For the mountain regions, all rains with a *total precipitation* of less than 0.25 inch are disregarded when tallying "days since last rain." For the Piedmont and Coastal Plain, where meter type 7 is used, all rains less than 0.50 inch are disregarded. To determine total precipitation, add together all precipitation measured over a period during which measured fuel moisture does not drop below 20 percent. For example, suppose it rained 0.38 inch yesterday afternoon and 0.20 inch this morning, stopping at 11 a. m. when it cleared and the sun came out. Since no pronounced drying could have occurred during the night between the two rains, for all practical purposes the amount of the last rain would be 0.58 inch. If "today" had remained cloudy and foggy and the fuel moisture did not drop below 20 percent, zero days since rain would be shown for today. When intermittent showers extend over a period of a day or more with the fuel moisture remaining above 20 percent, they should be called one rain.

It is emphasized that all distinctly separate small rains and showers (separated by conditions of fuel moisture below 20 percent) that total less than 0.25 inch for the mountains and 0.50 for the lower country are disregarded in summarizing days since rain.

The first day on which the measured fuel moisture drops below 20 percent at any observation following a "measurable" rain is recorded as 1 day since rain. This may be the same day on which the rain ended. Each succeeding day is recorded as an additional day since rain until a total precipitation of at least 0.25 or 0.50 inch is again measured.

As long as snow covers the ground at time of observation, days since rain are zero and remain so until the snow becomes patchy at the station site. When snow begins to leave the ground bare, again start recording days consecutively.

At part-time stations when records are resumed, the observer should determine the necessary data on rainfall from the nearest full-time station.

Vegetative condition.—Since there is no exact and practical way to measure condition of vegetation, certain indices combined with the best judgment of the field men are relied upon to determine the status of this factor. Usually one administrative officer on each administrative unit will make this decision. Instructions differ slightly for hardwood forests and pine forests.

In the hardwood types, in all cases, the condition of *lesser* vegetation will be classified; that is, grasses, weeds, and shrubs as distinct from trees. The classification "green" is used from the time when grasses, weeds, and shrubs become one-half to three-quarters grown, continuing through the summer until they are cured by fall frosts. These changes usually coincide with the period when hardwood trees become more than three-quarters leafed out until the first noticeable and widespread fall coloration. The spring transition period extends from the time grasses and weeds begin to spring up in profusion until they are three-quarters grown. This period usually coincides with the time the tree leaves reach the "size of squirrels' ears" until trees are three-quarters leafed out. The fall transition—shorter and more abrupt than the spring period—begins when the first fall frost causes curing of the lesser vegetation and lasts until it is at least 90 percent cured. Tree leaves have usually begun to fall quite generally throughout the forest by the end of the autumn transition. The classification "cured" is easy to determine and is used for the remainder of the year. This period extends from that time in the fall when lesser vegetation is 90 percent cured into the spring when grasses and weeds begin the period of rapid growth.

There must be exceptions to the general rules for determining condition of vegetation. For example, on areas where huckleberry brush predominates, curing may begin much earlier than elsewhere. In sedgegrass fields where little else grows, the period "green" may first occur about mid-July or early August. In cases where the spring transition period is well advanced and a late frost occurs to set back this early growth, it is necessary to return to "cured" until the vegetation overcomes the setback. During summer and fall, occasional periods of extended drought cause the lesser vegetation to cure prematurely. Such seasons should be classed as "transition" for the duration of the drought.

However, if care is used, the classification of *vegetation in general* can be made with little chance for serious discrepancy. Figure 17 will be of some assistance in this.

The greatest difficulty comes in mountain areas where elevation differences produce all three conditions simultaneously on a small area. In such cases the unit should be rated on the basis of vegetative condition in areas where fire occurrence is greatest. This will most likely be valleys and lower slopes in the East.

The guides suggested for the hardwood types apply also in the pine types of the Piedmont and Coastal Plain, with minor modifications. Mid or late summer in these types usually brings a curing of the lesser vegetation. Accordingly, "fall transition" should begin with the arrival of this condition. Killing frosts also usually occur at a later date in these areas, but "transition" should continue until the lesser vegetation has been killed. "Spring transition" will usually be of relatively short duration while growth is starting, as outlined under hardwood types.

Visibility.—Visibility distance is not a factor in determining the danger-rating index. It is mentioned here only because certain agen-

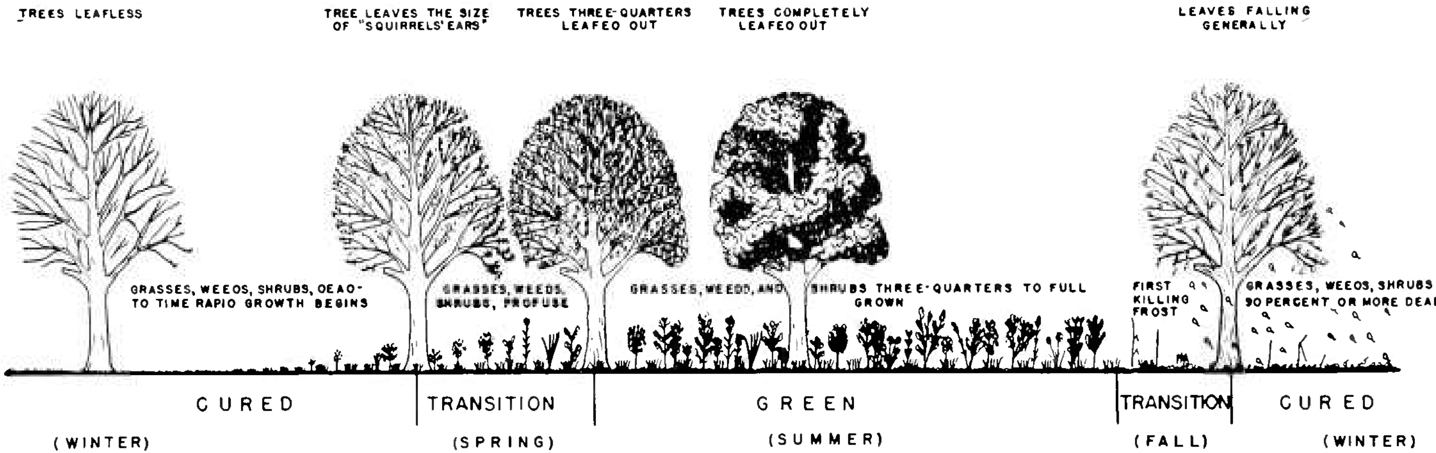

Figure 17.—Classification of condition of lesser vegetation.

cies record it as part of the daily data, and it is a very important element in fire control planning. When poor visibility accompanies high fire danger, a different fire control organization becomes necessary. Perhaps more lookout men must be put on the job or special patrols be sent out to cover predetermined routes. Visibility distance is considered in prearranged organization plans.

Visibility distance recorded *should not* be the unaided estimates of an observer. Visibility distances should always be determined with the aid of instruments, such as a haze meter, or by using visibility scales, such as dark ridge visual range tables. Unguided estimates are not only meaningless but can be very deceptive. Important decisions are based on this type of information, so reliability must be paramount. For detailed information on visibility measurement, the reader is referred to Byram and Jemison (*4*).

WHEN TO TAKE FIRE-DANGER MEASUREMENTS

In the eastern United States, observations during the fire season customarily are made at 9 a. m., 2 p. m., and 5 p. m., e. s. t. Lookout stations manned at 10 a. m. may take their first daily danger measurement at that hour. A standard of 2 p. m. for the afternoon observation is recommended, because danger usually reaches its peak between 1 p. m. and 3 p. m. The 5 p. m. reading normally shows the decline of daily danger, but may also indicate the less usual but significant continuation of dry, windy conditions. When fires are burning uncontrolled, additional danger measurements may be useful to aid suppression. Of course, in such cases as many extra observations should be made as are needed. These need not be made part of the permanent record.

RATING TODAY'S FIRE DANGER

When all the factors contributing to current fire danger have been measured, the integration of these measurements into a single index is a simple mechanical procedure accomplished with the danger meter. Instructions for the operation of each type of meter are printed right on the meter.

A fire-danger rating is developed individually for each set of observations. Actual wind velocity and fuel moisture content measured at the particular observation, plus the daily rainfall, accumulated days since rain, condition of vegetation (and season in the case of the mountain meters) are weighted automatically by the meter, one at a time, as the slide or disks are manipulated. The resulting figure is expressed either as a 5-point class or 100-point burning index, and represents conditions at the time the particular set of observations was made.

In the mountain hardwood litter fuels, cumulative drying, indicated by days since rain, has a more pronounced effect than in the Coastal Plain grass fuels; hence this factor is given more weight on the mountain meter.

For statistical reporting purposes each day must be given an over-all rating. The *fire-danger rating for the day* at any individual station is considered to be the highest rating computed at any single observation during the day at that station. No averages for fuel moisture or wind are taken, as they lead to ambiguous situations. Ratings based on a combination of fuel-moisture content at 9 a. m. and wind velocity at 5 p. m., for instance, are unreliable. For example, if danger rated class 2 at 9 a. m., class 4 at 2 p. m., and class 3 at 5 p. m., the *rating for the day* would be class 4, the highest rating computed at the three observations.

When the ground is blanketed with snow, fuel moisture and wind velocity need not be measured. Record the fire-danger rating in such cases as class 1 or burning index 0, depending on the scale used.

RECORDING OBSERVATIONS

Observations should be recorded on the proper form for the region in which the station operates. Representative forms used in the East together with self-explanatory instructions are reproduced on pages 59 to 64.

Accumulated records are indispensable in determining and analyzing trends, in evaluating the success or failure of programs, or in systematic fire control planning in general. Their full value can be realized only by making clear, legible records; currently checking all data; filing properly to assure permanence.

All records should be thoroughly checked before filing. This offers an opportunity to advise the observer of any errors made. Moreover, it assures that the records on file are reliable.

The cost of handling the records properly is only a fraction of the cost of obtaining them. It is good business to keep them and use them.

ITEMIZED LIST OF EQUIPMENT AND MATERIALS FOR A FIRE-DANGER STATION

Quantity	*Item*
1__________	Shelter box and supporting posts.
1__________	Rain gage stand.
1__________	Rain gage and rain measuring stick.
1__________	Anemometer.
1__________	Fuel-moisture scale and leveling weight.
1__________	Bell buzzer.
1__________	Knife switch, single-pole, single-throw type.
6 feet______	Double-lead hook-up wire, approximately No. 16.
12 feet_____	No. 9 galvanized wire for stick supports and holding wire.
2__________	No. 6 dry cell batteries (1½ volt, telephone type).
4 feet______	Standard ½-inch water pipe, threaded one end for anemometer support. If anemometer ordered takes ⅜-inch pipe, use reducer and short nipple.
2__________	Pipe straps with 4 1-inch screws, for holding anemometer support pipe.
1__________	Can of light oil for anemometer.
1__________	Set of fuel moisture sticks and weathering correction card.
1__________	Anemometer correction chart.
1__________	Instructions for observer.
1__________	Fire-danger meter.
1__________	"Forest Fire Danger Measurement in the Eastern United States."
40_________	Fire danger daily record forms (approximately year's supply).

BILL OF MATERIALS FOR WEIGHING SHELTER

Number pieces	*Size and description* [1]
2__________	4″ x 4″ x 7′ hardwood posts for shelter support.
2__________	¾″ x 7½″ x 23½″ top and bottom of shelter.
2__________	¾″ x 7½″ x 36½″ sides of shelter.

[1] See footnote at end of table.

Number pieces	*Size and description* [1]
1	¾″ x 5½″ x 23″ mounting board for scale.
1	¾″ x 5½″ x 18″ adjusting board for scale.
2	¾″ x 1¾″ x 35″ side strips for door.
3	¾″ x 1¾″ x 23″ top, center, and bottom strips for door.
2	½″ x ¾″ x 35″ door stops, sides.
2	½″ x ¾″ x 22″ door stops, top and bottom.
1	⅛″ x 24″ x 36″ tempered masonite panel for back.
1	⅛″ x 17¾″ x 20″ tempered masonite panel for door.
1	⅛″ x 13″ x 20″ double-strength window glass for door.
1	9½″ x 26½″ sheet-aluminum cover for roof.
3	4″ strap hinges for door.
18	1¼″ x 3/16″ bolts for strap hinges.
2	4″ x ½″ angle-iron braces for door, with ¾″ screws.
1	4″ safety hasp for door, self-locking type, with ¾″ screws.
2	¼″ x 2″ carriage bolts with wing nuts and 4 washers for scale adjusting board.
16	2″ wood screws for fastening sides of shelter to top and bottom and to mount scale support.
12	¾″ wood screws for fastening panel on back.
12	1½″ wood screws for fastening door stops.
1	10″ door chain with holding plates and screws.
4	cubic feet of concrete 1:2:3 mixture.
1	small can of waterproof glue.
4	6″ x ½″ bolts with 4 washers for supporting posts.
4	¾″ x 3/16″ round-head screws for mounting scale.
4	¾″ x 3/16″ round-head screws for fastening aluminum roof cover.

[1] All sizes are actual dimensions; widths and thicknesses conform to dimensions available commercially wherever possible.

PARTIAL LIST OF SUPPLIERS OF FIRE-WEATHER EQUIPMENT

The following lists are prepared merely for the information of those interested in operating fire-danger stations. The inclusion of a manufacturer's name implies no endorsement, although the specified item meets general standards set for fire-danger measuring equipment. The lists will be revised currently as additional information is obtained. Current lists will be furnished upon request.

FUEL-MOISTURE SCALES

A. E. Chisholm
2640 East Burnside Street
Portland, Oreg.

FUEL-MOISTURE INDICATOR STICKS

Director
Southeastern Forest Experiment Station
Box 252
Asheville, N. C.

RAIN GAGES

U. S. Weather Bureau Pattern

Science Associates
401 North Broad Street
Philadelphia 8, Pa.

W. S. Jenks & Son
723 Seventh Street Northwest
Washington, D. C.

Forest Service Type

F. A. Anderson Manufacturing Co.
214 Northwest Flanders Street
Portland, Oreg.

Western Fire Equipment Co.
San Francisco, Calif.

RAIN-MEASURING STICKS

Leupold & Stevens Instruments
4445 Northeast Glison Street
Portland 13, Oreg.

Precision Thermometer & Instrument Co.
1434 Brandywine Street
Philadelphia, Pa.
(24" length only)

Western Fire Equipment Co.
San Francisco, California

"AIRWAYS" TYPE ANEMOMETERS

(1/60-mile contact)

Dozier Manufacturing Co.
4223 Grove Street
Oakland, Calif.

Julian P. Friez & Sons
Division of Bendix Aviation Corp.
Baltimore, Md.

M. C. Stewart Co.
Ashburnham, Mass.

The Instruments Corp.
1031 East Baltimore Street
Baltimore 2, Md.

A. E. Chisholm
2640 East Burnside Street
Portland, Oreg.

Western Fire Equipment Co.
San Francisco, Calif.
(Includes knife switch, buzzer, coil of wire, oil can, and correction chart.)

ROUTINE FOR CLEANING ANEMOMETERS

Detailed steps for cleaning several types of anemometers are given below. Any of the general purpose, light or low viscosity, household, typewriter, or sewing machine oils are satisfactory for use in these instruments. When contact points do not close circuit properly, rub lightly with fine sandpaper and wipe with a clean, dry cloth.

STEWART

It is extremely important that the small socket in which the spindle of the instrument rests is not disturbed or removed from the housing in the cleaning process. Allow the anemometer to remain on the support, if accessible, while cleaning.

1. Remove small set screw from side of cup assembly. Do not unscrew bolt in end. Remove cup assembly by sliding it off main shaft.
2. Remove inspection plate by loosening the two holding screws.
3. To remove spindle, unscrew bushing shaft from cast-alloy housing and slide over spindle.
4. Now carefully remove the spindle. It may be necessary to move it from one side or the other before it will slide out. *Never turn cast housing upside down. Always keep in a standing position while cleaning.* If it is turned upside down, the small ball bearings will fall out.
5. Clean the shaft bushing and the spindle with kerosene.
6. Drop some anemometer oil on each end of the spindle, inside the top of the bushing shaft, and on the worm gear.
7. Slide spindle into place in housing and replace bushing shaft.
8. Replace cup assembly and small set screw; also replace the inspection plate, being sure the gasket is weatherproof. The anemometer is then ready for use.

When in use, check the need for oil monthly. Remove the inspection plate for observation. If oil is needed, place 1 to 2 drops on the top and 1 to 2 drops on the bottom of the spindle. Some models provide a screw on top of the rotor which, when removed, exposes an oil duct serving the top end of the spindle. In the other models, the cup assembly must be removed and the oil placed on the spindle above the top bearing.

FRIEZ

Allow the anemometer to remain on the support, if accessible, while cleaning.

1. Remove the tap from the top of the cup assembly and remove cups and skirt.
2. Remove inspection plate from side of anemometer.
3. Loosen set screw just above plate cover.
4. Slide shaft out of anemometer by lifting from the top.
5. Wash shaft in kerosene. Use deep container and plunge up and down. Allow excess kerosene to drain.
6. Replace the shaft by inserting into the housing from the top. Tighten set screw above plate cover.
7. Oil with light oil after assembling. Place 2 drops on the gear part of the shaft, 2 drops on the bearing at the top of the shaft, and 2 drops on bearing at bottom of shaft.
8. Check contact points.
9. Replace inspection plate. Slip on washer at top of shaft with the beveled side face down. Replace skirt and cups so as to revolve clockwise. Replace top securing the rotor, and the assembly is complete.

When in use, check the need for oil monthly. Loosen set screw above inspection plate. Raise cup assembly and spindle. If oil is needed, place 1 to 2 drops on top bearing, 1 to 2 drops on the gear, and 1 to 2 drops on the bottom of the spindle.

CHISHOLM (1936–1938 MODELS)

1. Disconnect wires and remove anemometer from mount.
2. Take out bolt on top and remove cup assembly.
3. Remove from the bottom of the anemometer the small bolt that goes through the main shaft. Negative contact wire is also attached to this screw when the anemometer is in use.
4. Remove electric contact unit by sliding carefully down over the end of the main shaft.
5. Remove small screw from revolving cylinder near the top. By turning the top aluminum casting to the left with one hand and holding the cylinder with the other, the two pieces are separated. Remove the spindle from the housing.
6. Now wash all parts with kerosene except the electric contact unit. Wash by plunging the parts up and down in a deep container. After washing, allow excess kerosene to drain from the parts.
7. Place about 2 drops of light oil around top of the two roller bearings attached to the shaft. Also add about 2 drops around the cylinder gear on the inside near the top.
8. Assemble anemometer. Place aluminum casting on top of roller bearings. Put cylinder up over shaft by turning it to the right until

the holes match in the cylinder and casting. Replace small screw. Looking in the anemometer from the bottom, move the cylinder until the small pin on the gear wheel is face up and in line with the shaft. Hold at this point. Now replace electric contact unit by sliding carefully up over the shaft into the cylinder. When holding the top of the anemometer away from you, the contact points should be to the left of the main shaft. Replace small bolt through electric unit and shaft. Attach cup assembly and replace bolt. The anemometer is now ready to be remounted.

The anemometer should be oiled once each month when it is in use. To do this, remove the bolt on top of the cup assembly and place no more than 3 drops of oil in the hole from which the bolt was removed.

CHISHOLM (1939 MODEL)

Allow the anemometer to remain on the support, if accessible, while cleaning.

1. Unscrew tap on top to remove cups.
2. Remove small screw at junction of top cylinder and housing.
3. Lift top cylinder and spindle; remove spindle from cylinder.
4. Remove inspection plate from top of housing by removing two holding screws. *Be sure to note position when removing.*
5. Clean the spindle and bearing assembly in top of cylinder with kerosene and a small brush. Wipe off the excess kerosene.
6. Check the contact points on the underside of the inspection plate.
7. Replace inspection plate *in the same position* as when removed.
8. Place 1 to 2 drops of light oil on both the top and bottom of the spindle as well as on the bearing assembly.
9. Assemble by replacing spindle in cylinder, replacing cylinder on housing and securing with the set screw, and replacing cups and securing with the tap.

When in use, check the need for oil monthly. Remove the cups and observe top bearing. If oil is needed, add 1 to 2 drops to top bearing only.

DOZIER (1938 AND OLDER MODELS)

Allow the anemometer to remain on the support, if accessible, while cleaning.

1. Remove inspection plate and gear assembly.
2. Check action of contact points by rotating the gear. Adjust the tension of the brass spring as needed.
3. Remove cups by unscrewing the top.
4. Clean the top and bottom of the spindle without removing it from the housing. Use kerosene and a small brush. Wipe off the excess kerosene.
5. Place 1 to 2 drops of light oil on both the top and bottom of the spindle.
6. Assemble by replacing the cups, gear assembly, and the inspection plate.

When in use, check the need for oil monthly. Remove the cups and observe the top bearing. Add 1 to 2 drops of light oil to the top bearing if needed.

DOZIER (1939 MODEL)

Allow the anemometer to remain on the support, if accessible, while cleaning.

1. Remove the cups by unscrewing the tap.
2. With two pipe wrenches, unscrew the top part of the cast housing and expose the gear assembly. Do not remove the spindle from the housing.
3. Clean the top and bottom of the spindle with kerosene and a small brush. Wipe off the excess kerosene.
4. Check the contact points.
5. Place 1 to 2 drops of light oil on both the top and bottom of the spindle.
6. Assemble by joining the two sections of the housing, replacing the cups, and securing with the tap.

When in use, check the need for oil monthly. Remove the cups and observe the top bearing. Place 1 to 2 drops of light oil on the top bearing if needed.

U. S. WEATHER BUREAU—3 AND 4 CUP TYPES

Remove from mount and disconnect wires before cleaning.

1. Unscrew brass oil cup.
2. Loosen set screw and remove cups.
3. Unscrew top bushing and lift spindle.
4. Remove glass cover plate by removing two holding screws. *Do not remove dials.*
5. Clean spindle and top bushing with kerosene. *Do not clean housing assembly.*
6. Blow out oil duct in top of spindle so it is *clear of all obstructions* from the top to the small hole in the side of the spindle at the level of the top bushing.
7. Inspect contact points.
8. Replace spindle, be sure it is seated properly in the bottom bearing. Replace top bushing. Replace cups and secure set screw.
9. Attach wires and check action of points by rotating cups. Adjust movable point with set screw, if necessary.
10. Replace glass cover.
11. Place 1 to 2 drops of light oil in top oil duct. Withdraw small, round inspection plug attached to a chain on the housing on the opposite side from the glass plate. Through this opening, place 1 to 2 drops of light oil both on the bottom of the spindle and on the spindle gear. Replace inspection plug.
12. Replace oil cup on top. Be sure wick feeds from oil cup into oil duct. Replace with a cotton cord of suitable size if needed. Fill oil cup with light oil.

When in use, check the need for oil monthly. Inspect bottom bearing by removing the inspection plug. Add 1 to 2 drops of light oil as needed. Inspect the top oil cup. Add light oil as needed to keep wick saturated.

WIND CORRECTION CHARTS FOR DIFFERENT TYPES OF ANEMOMETERS

WIND CORRECTION CHART FOR CHISHOLM ANEMOMETER

(1936–38 model with 4-inch cups)

NOTE.—Use the 4-minute count table if winds are variable or gusty. Use the 2-minute count table only when winds are steady. The corrected wind velocity in miles per hour is given opposite the number of contacts counted.

Steady winds		Variable or gusty winds	
Contacts in 2 minutes	Miles per hour	Contacts in 4 minutes	Miles per hour
1	1. 5	1	1. 0
2	2. 0	2–3	1. 5
3	2. 5	4–5	2. 0
4	3. 0	6–7	2. 5
5	3. 5	8–9	3. 0
6	4. 0	10–11	3. 5
7	4. 5	12–13	4. 0
8	5. 0	14–15	4. 5
9	5. 5	16–17	5. 0
10	6. 0	18–19	5. 5
11	6. 5	20–21	6. 0
12	7. 0	22–23	6. 5
13	7. 5	24–25	7. 0
14	8. 0	26–27	7. 5
15	8. 5	28–29	8. 0
16	9. 0	30–31	8. 5
17	9. 5	32–33	9. 0
18	10. 0	34–35	9. 5
19	11. 0	36–37	10. 0
20	12. 0	38–39	11. 0
21	12. 5	40–42	12. 0
22	13. 0	43–45	13. 0
23	13. 5	46–47	13. 5
24	14. 0	48–49	14. 0
25	14. 5	50–51	14. 5
26	15. 0	52–53	15. 0
27	15. 5	54–55	15. 5
28	16. 0	56–57	16. 0
29	16. 5	58–59	16. 5
30	17. 0	60–61	17. 0
31	17. 5	62–63	17. 5
32	18. 0	64–65	18. 0
33	18. 5	66–67	18. 5
34	19. 0	68–69	19. 0
35	19. 5	70–71	19. 5
36–37	20. 0	72–75	20. 0
38–39	21. 0	76–78	21. 0
40–41	22. 0	79–82	22. 0
42–43	23. 0	83–86	23. 0
44–45	24. 0	87–90	24. 0
46–47	25. 0	91–94	25. 0
48–49	26. 0	95–98	26. 0
50–51	27. 0	99–102	27. 0
52–53	28. 0	103–106	28. 0
54–55	29. 0	107–110	29. 0
56–57	30. 0	111–114	30. 0

WIND CORRECTION CHART FOR CHISHOLM ANEMOMETER

(1939 model with 2½-inch cups)

NOTE.—Use the 4-minute count table if winds are variable or gusty. Use the 2-minute count table only when winds are steady. The corrected wind velocity in miles per hour is given opposite the number of contacts counted.

Steady winds		Variable or gusty winds	
Contacts in 2 minutes	Miles per hour	Contacts in 4 minutes	Miles per hour
1	1. 5	1	1. 0
2	2. 0	2–3	1. 5
3	2. 5	4–5	2. 0
4	3. 0	6–7	2. 5
5	3. 5	8–9	3. 0
6	4. 0	10–11	3. 5
7	4. 5	12–13	4. 0
8	5. 0	14–15	4. 5
9	5. 5	16–17	5. 0
10	6. 0	18–19	5. 5
11	6. 5	20–21	6. 0
12	7. 0	22–23	6. 5
13	7. 5	24–25	7. 0
14	8. 0	26–27	7. 5
15	8. 5	28–29	8. 0
16	9. 0	30–31	8. 5
17	9. 5	32–33	9. 0
18	10. 0	34–35	9. 5
19–20	10. 5	36–37	10. 0
21	11. 0	38–40	10. 5
22	11. 0	41–44	11. 0
23	11. 5	45–47	11. 5
24	12. 0	48–49	12. 0
25	12. 5	50–51	12. 5
26	13. 0	52–53	13. 0
27	13. 5	54–55	13. 5
28	14. 0	56–57	14. 0
29	14. 5	58–59	14. 5
30	15. 0	60–61	15. 0
31	15. 5	62–63	15. 5
32	16. 0	64–65	16. 0
33	16. 5	66–67	16. 5
34	17. 0	68–69	17. 0
35	17. 5	70–71	17. 5
36	18. 0	72–73	18. 0
37	18. 5	74–75	18. 5
38	19. 0	76–77	19. 0
39–40	19. 5	78–81	19. 5
41–43	20. 0	82–85	20. 0
44–45	21. 0	86–90	21. 0
46–47	22. 0	91–94	22. 0
48–49	23. 0	95–98	23. 0
50–51	24. 0	99–102	24. 0
52–53	25. 0	103–106	25. 0
54–55	26. 0	107–110	26. 0
56–57	27. 0	111–114	27. 0
58–59	28. 0	115–118	28. 0
60–61	29. 0	119–122	29. 0
62–63	30. 0	123–126	30. 0

WIND CORRECTION CHART FOR DOZIER ANEMOMETER

NOTE.—Use the 4-minute count table if winds are variable or gusty. Use the 2-minute count table only when winds are steady. The corrected wind velocity in miles per hour is given opposite the number of contacts counted.

Steady winds		Variable or gusty winds	
Contacts in 2 minutes	Miles per hour	Contacts in 4 minutes	Miles per hour
1	1. 5	1	1. 0
2	2. 0	2–3	1. 5
3	2. 5	4–5	2. 0
4	3. 0	6–7	2. 5
5	3. 5	8–9	3. 0
6	3. 5	10–12	3. 5
7–8	4. 0	13–16	4. 0
9	4. 5	17–19	4. 5
10	5. 0	20–21	5. 0
11	5. 5	22–23	5. 5
12	6. 0	24–25	6. 0
13	6. 5	26–27	6. 5
14	7. 0	28–29	7. 0
15	7. 5	30–31	7. 5
16	8. 0	32–33	8. 0
17	8. 5	34–35	8. 5
18	9. 0	36–37	9. 0
19	9. 5	38–39	9. 5
20	10. 0	40–41	10. 0
21	10. 5	42–43	10. 5
22	11. 0	44–45	11. 0
23	11. 5	46–47	11. 5
24	12. 0	48–49	12. 0
25	12. 5	50–51	12. 5
26	13. 0	52–53	13. 0
27	13. 5	54–55	13. 5
28	14. 0	56–57	14. 0
29	14. 5	58–59	14. 5
30	15. 0	60–61	15. 0
31	15. 5	62–63	15. 5
32	16. 0	64–65	16. 0
33	16. 5	66–67	16. 5
34	17. 0	68–69	17. 0
35	17. 5	70–71	17. 5
36	18. 0	72–73	18. 0
37	18. 5	74–75	18. 5
38	19. 0	76–77	19. 0
39	19. 5	78–79	19. 5
40–41	20. 0	80–82	20. 0
42–43	21. 0	83–86	21. 0
44–45	22. 0	87–90	22. 0
46–47	23. 0	91–94	23. 0
48–49	24. 0	95–98	24. 0
50–51	25. 0	99–102	25. 0
52–53	26. 0	103–106	26. 0
54–55	27. 0	107–110	27. 0
56–57	28. 0	111–114	28. 0
58–59	29. 0	115–118	29. 0
60–61	30. 0	119–122	30. 0

WIND CORRECTION CHART FOR FRIEZ ANEMOMETER

(Weather Bureau dial type with 3 cups)

NOTE.—Use the 4-minute count table if winds are variable or gusty. Use the 2-minute count table only when winds are steady. The corrected wind velocity in miles per hour is given opposite the number of contacts counted.

Steady winds		Variable or gusty winds	
Contacts in 2 minutes	Miles per hour	Contacts in 4 minutes	Miles per hour
1	1.5	1	1.0
2	2.0	2–3	1.5
3	2.5	4–5	2.0
4	3.0	6–7	2.5
5	3.5	8–9	3.0
6	4.0	10–11	3.5
7	4.5	12–13	4.0
8	5.0	14–15	4.5
9	5.5	16–17	5.0
10	6.0	18–19	5.5
11	6.5	20–21	6.0
12	7.0	22–23	6.5
13	7.5	24–25	7.0
14	8.0	26–27	7.5
15	8.5	28–29	8.0
16	9.0	30–31	8.5
17	9.5	32–33	9.0
18	10.0	34–35	9.5
19	10.5	36–37	10.0
20	11.0	38–39	10.5
21	11.5	40–41	11.0
22	12.0	42–43	11.5
23	12.5	44–45	12.0
24	13.0	46–47	12.5
25	13.5	48–49	13.0
26	14.0	50–51	13.5
27	14.5	52–53	14.0
28	15.0	54–55	14.5
29	15.5	56–58	15.0
30	15.5	59–62	15.5
31	16.0	63–65	16.0
32–33	16.5	66–67	16.5
34	17.0	68–69	17.0
35	17.5	70–71	17.5
36	18.0	72–73	18.0
37	18.5	74–75	18.5
38	19.0	76–77	19.0
39	19.5	78–79	19.5
40–41	20.0	80–82	20.0
42–43	21.0	83–86	21.0
44–45	22.0	87–90	22.0
46–47	23.0	91–94	23.0
48–50	24.0	95–101	24.0
51–53	25.0	102–106	25.0
54–55	26.0	107–110	26.0
56–57	27.0	111–114	27.0
58–59	28.0	115–118	28.0
60–61	29.0	119–122	29.0
62–63	30.0	123–126	30.0

WIND CORRECTION CHART FOR FRIEZ ANEMOMETER

(Weather Bureau dial type with 4 beaded cups)

NOTE.—Use the 4-minute count table if winds are variable or gusty. Use the 2-minute count table only when winds are steady. The corrected wind velocity in miles per hour is given opposite the number of contacts counted.

Steady winds		Variable or gusty winds	
Contacts in 2 minutes	Miles per hour	Contacts in 4 minutes	Miles per hour
1	1. 5	1	1. 0
2	2. 0	2–3	1. 5
3	2. 5	4–5	2. 0
4	3. 0	6–7	2. 5
5	3. 5	8–9	3. 0
6	4. 0	10–11	3. 5
7	4. 5	12–13	4. 0
8	5. 0	14–15	4. 5
9	5. 0	16–17	5. 0
10	5. 5	18–20	5. 5
11–12	6. 0	21–23	6. 0
13	6. 5	24–26	6. 5
14	7. 0	27–29	7. 0
15	7. 5	30–31	7. 5
16	8. 0	32–33	8. 0
17	8. 5	34–35	8. 5
18	9. 0	36–37	9. 0
19	9. 5	38–39	9. 5
20	10. 0	40–41	10. 0
21	10. 5	42–43	10. 5
22	11. 0	44–45	11. 0
23	11. 5	46–47	11. 5
24	12. 0	48–49	12. 0
25–26	12. 5	50–52	12. 5
27–28	13. 0	53–56	13. 0
29	13. 5	57–59	13. 5
30	14. 0	60–61	14. 0
31	14. 5	62–63	14. 5
32	15. 0	64–65	15. 0
33	15. 5	66–67	15. 5
34	16. 0	68–69	16. 0
35	16. 5	70–71	16. 5
36	17. 0	72–73	17. 0
37	17. 5	74–75	17. 5
38	18. 0	76–78	18. 0
39–40	18. 5	79–81	18. 5
41–42	19. 0	82–83	19. 0
43	19. 5	84–86	19. 5
44–45	20. 0	87–90	20. 0
46–47	21. 0	91–94	21. 0
48–49	22. 0	95–98	22. 0
50–51	23. 0	99–102	23. 0
52–54	24. 0	103–106	24. 0
55–56	25. 0	107–112	25. 0
57–59	26. 0	113–118	26. 0
60–61	27. 0	119–122	27. 0
62–63	28. 0	123–126	28. 0
64–65	29. 0	127–130	29. 0
66–67	30. 0	131–134	30. 0

WIND CORRECTION CHART FOR FRIEZ ANEMOMETER

(Weather Bureau dial type with 4 cups—not beaded)

NOTE.—Use the 4-minute count table if winds are variable or gusty. Use the 2-minute count table only when winds are steady. The corrected wind velocity in miles per hour is given opposite the number of contacts counted.

Steady winds		Variable or gusty winds	
Contacts in 2 minutes	Miles per hour	Contacts in 4 minutes	Miles per hour
1	1. 5	1	1. 0
2	2. 0	2–3	1. 5
3	2. 5	4–5	2. 0
4	3. 0	6–7	2. 5
5	3. 5	8–9	3. 0
6	4. 0	10–11	3. 5
7	4. 5	12–13	4. 0
8	5. 0	14–15	4. 5
9	5. 5	16–17	5. 0
10	6. 0	18–19	5. 5
11	6. 5	20–21	6. 0
12	7. 0	22–23	6. 5
13	7. 5	24–25	7. 0
14	8. 0	26–27	7. 5
15	8. 0	28–30	8. 0
16–17	8. 5	31–33	8. 5
18	9. 0	34–36	9. 0
19	9. 5	37–39	9. 5
20	10. 0	40–41	10. 0
21	10. 5	42–43	10. 5
22	11. 0	44–45	11. 0
23–24	11. 5	46–48	11. 5
25–26	12. 0	49–52	12. 0
27	12. 5	53–55	12. 5
28	13. 0	56–57	13. 0
29	13. 5	58–59	13. 5
30–31	14. 0	60–61	14. 0
32	14. 5	62–64	14. 5
33–34	15. 0	65–68	15. 0
35	15. 5	69–70	15. 5
36	16. 0	71–72	16. 0
37	16. 5	73–74	16. 5
38	17. 0	75–76	17. 0
39–40	17. 5	77–80	17. 5
41–42	18. 0	81–84	18. 0
43	18. 5	85–87	18. 5
44	19. 0	88–89	19. 0
45	19. 5	90–91	19. 5
46–48	20. 0	92–96	20. 0
49–51	21. 0	97–102	21. 0
52–54	22. 0	103–106	22. 0
55–56	23. 0	107–112	23. 0
57–59	24. 0	113–118	24. 0
60–62	25. 0	119–122	25. 0
63–64	26. 0	123–126	26. 0
65–67	27. 0	127–134	27. 0
68–69	28. 0	135–138	28. 0
70–71	29. 0	139–142	29. 0
72–73	30. 0	143–146	30. 0

WIND CORRECTION CHART FOR FRIEZ ANEMOMETER

(Airways type—without dial)

NOTE.—Use the 4-minute count table if winds are variable or gusty. Use the 2-minute count table only when winds are steady. The corrected wind velocity in miles per hour is given opposite the number of contacts counted.

Steady winds		Variable or gusty winds	
Contacts in 2 minutes	Miles per hour	Contacts in 4 minutes	Miles per hour
0	0. 0	1	1. 0
1	1. 5	2–3	1. 5
2	2. 0	4–5	2. 0
3	2. 5	6–7	2. 5
4	3. 0	8–9	3. 0
5	3. 5	10–11	3. 5
6	4. 0	12–13	4. 0
7	4. 5	14–15	4. 5
8	5. 0	16–17	5. 0
9	5. 5	18–19	5. 5
10	6. 0	20–21	6. 0
11	6. 5	22–23	6. 5
12	7. 0	24–25	7. 0
13	7. 5	26–27	7. 5
14	8. 0	28–29	8. 0
15	8. 5	30–31	8. 5
16	9. 0	32–33	9. 0
17	9. 5	34–35	9. 5
18	10. 0	36–37	10. 0
19	10. 5	38–39	10. 5
20	11. 0	40–41	11. 0
21	11. 5	42–43	11. 5
22	12. 0	44–45	12. 0
23	12. 5	46–47	12. 5
24	13. 0	48–49	13. 0
25	13. 5	50–51	13. 5
26	14. 0	52–53	14. 0
27	14. 5	54–55	14. 5
28	15. 0	56–57	15. 0
29	15. 5	58–59	15. 5
30	16. 0	60–61	16. 0
31	16. 5	62–63	16. 5
32	17. 0	64–65	17. 0
33	17. 5	66–67	17. 5
34	18. 0	68–69	18. 0
35	18. 5	70–71	18. 5
36	19. 0	72–73	19. 0
37	19. 5	74–75	19. 5
38–39	20. 0	76–78	20. 0
40–41	21. 0	79–82	21. 0
42–43	22. 0	83–86	22. 0
44–45	23. 0	87–90	23. 0
46–47	24. 0	91–94	24. 0
48–49	25. 0	95–98	25. 0
50–51	26. 0	99–102	26. 0
52–53	27. 0	103–106	27. 0
54–55	28. 0	107–110	28. 0
56–57	29. 0	111–114	29. 0
58–59	30. 0	115–118	30. 0

WIND CORRECTION CHART FOR STEWART ANEMOMETER

NOTE.—Use the 4-minute count table if winds are variable or gusty. Use the 2-minute count table only when winds are steady. The corrected wind velocity in miles per hour is given opposite the number of contacts counted.

Steady winds		Variable or gusty winds	
Contacts in 2 minutes	Miles per hour	Contacts in 4 minutes	Miles per hour
1	1. 5	1	1. 0
2	2. 0	2–3	1. 5
3	2. 5	4–5	2. 0
4	3. 0	6–7	2. 5
5	3. 5	8–9	3. 0
6	4. 0	10–11	3. 5
7	4. 5	12–13	4. 0
8	5. 0	14–15	4. 5
9	5. 5	16–17	5. 0
10	6. 0	18–19	5. 5
11	6. 5	20–21	6. 0
12	7. 0	22–23	6. 5
13	7. 5	24–25	7. 0
14	8. 0	26–27	7. 5
15	8. 5	28–29	8. 0
16	9. 0	30–31	8. 5
17	9. 5	32–33	9. 0
18	10. 0	34–35	9. 5
19	10. 0	36–39	10. 0
20	10. 5	40–41	10. 5
21	11. 0	42–43	11. 0
22	11. 5	44–45	11. 5
23	12. 0	46–47	12. 0
24	12. 5	48–49	12. 5
25	13. 0	50–51	13. 0
26	13. 5	52–53	13. 5
27	14. 0	54–55	14. 0
28	14. 5	56–57	14. 5
29–30	15. 0	58–60	15. 0
31	15. 5	61–62	15. 5
32	16. 0	63–64	16. 0
33	16. 5	66–67	16. 5
34	17. 0	68–69	17. 0
35	17. 5	70–71	17. 5
36	18. 0	72–73	18. 0
37	18. 5	74–75	18. 5
38	19. 0	76–77	19. 0
39	19. 5	78–79	19. 5
40–41	20. 0	80–82	20. 0
42–43	21. 0	83–86	21. 0
44–45	22. 0	87–90	22. 0
46–47	23. 0	91–94	23. 0
48–49	24. 0	95–98	24. 0
50–51	25. 0	99–102	25. 0
52–53	26. 0	103–106	26. 0
54–55	27. 0	107–110	27. 0
56–57	28. 0	111–114	28. 0
58–59	29. 0	115–118	29. 0
60–61	30. 0	119–122	30. 0

PREPARATION AND DISTRIBUTION OF FIRE-DANGER DAILY RECORD AND FIRE-DANGER DAILY SUMMARY

INSTRUCTIONS FOR PREPARING FIRE-DANGER DAILY RECORD (FORM 14–R–7 REV. DEC. 1947)

(Form 14–R–7 was adapted primarily for use by State agencies.)

Note to observers.—The instructions given below, and the form shown in figure 18, are meant to be used with the 100-point scale fire-danger meter (meter 5–W) issued by the Southeastern Forest Experiment Station. There has been no change in the instructions to fire-danger station observers regarding the operation of the danger station or in the procedures used in taking and recording fire-danger data. The same data are used in computing burning index from 1 to 100 as were used to compute danger class from 1 to 5. The burning index may be converted to danger class if desired—see dotted lines on outer circle of meter 5–W, or refer to the table printed on the back of meter 5–W at the bottom.

Column 2, state of vegetation.—Record "G" (for green), "T" (transition), or "C" (cured). See p. 42 for definitions of G, T, and C.

Columns 3, 6, 9; fuel moisture percent.—Record to nearest one-tenth percent up to 20 percent; to nearest one-half percent above 20 percent. Record "S" (for snow) if ground is covered with snow, and do not read sticks.

Columns 4, 7, 10; wind velocity miles per hour.—Record to nearest half-mile according to wind correction chart. If cups are not turning, record as zero.

Columns 5, 8, 11; burning index.—Record burning index given by Southeastern Forest Experiment Station fire-danger meter (type 5–W). See instructions on back of meter for procedure in operating meter. Record 0 (zero) when snow blankets the ground.

Columns 12, 13; precipitation began and ended.—Record time to the nearest 15 minutes and add "A" or "P" to denote a. m. or p. m. Record DN if rain started and stopped during night. Record "Cont." (for continued) in column 13 if it is still raining at 5 p. m., and show time of ending next day. For purposes of recording rain, the day begins and ends at 5 p. m. instead of midnight. Write the word "Showers" in Columns 12 and 13 if there is more than one start and stop in the 24-hour period 5 p. m. to 5 p. m.

Column 14, amount of precipitation.—Record in inches and hundredths like dollars and cents (5 hundredths=0.05; 1 inch and 25 hundredths=1.25, etc.). If less than 0.01 (one hundredth), record "T" (for trace).

Column 15, total precipitation.—Record amount of rain from Column 14, adding together rains that are not separated by drying weather (fuel moisture less than 20 percent). Disregard rains that total less than 0.25 inch; that is, do not record these small rains in Column 15. Do not repeat figure each day, record only when a change occurs. At beginning of a new month, record the last entry in Column 15 from preceding month. Disregard small rains that, following close to large rains, will cause the meter reading to increase.

Column 16, days since rain.—Record days since "Total Precipitation" computed in Column 15. Record "0" (zero) if the fuel moisture stays 20 percent or higher. Record "1" if the fuel moisture drops below 20 percent. This may be the same day as the rain. After "1" day is recorded, record days consecutively between rains entered in Column 15.

Column 17, burning index for the day.—Record the highest burning index computed in Columns 5, 8, or 11. Do not average.

Form 14-R-7
Rev. Dec. 1947

FIRE DANGER DAILY RECORD
(Instructions on back of sheet)

Received______by____
Checked______by____
Recorded______by____

State________________District________________Station________________

Month________________19_____Observer________________

Day of the Month	State of Vegetation	9 A.M. EST			2 P.M. EST			5 P.M. EST			PRECIPITATION for the past 24 hours (5 PM to 5 PM)			DAILY SUMMARY		
		Fuel Moisture Percent	Wind Velocity Miles per Hour	Burning Index	Fuel Moisture Percent	Wind Velocity Miles per Hour	Burning Index	Fuel Moisture Percent	Wind Velocity Miles per Hour	Burning Index	Began	Ended	Amount	Total Precipitation	Number of Days Since Rain	Burning Index for the Day
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1																
2																
3																
4																
5																
6																
7																
8																
9																
10																
11																
12																
13																
14																
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21																
22																
23																
24																
25																
26																
27																
28																
29																
30																
31																

Figure 18.—Fire-danger daily record (Form 14–R–7).

FIRE-DANGER DAILY RECORD (FORM 14NF-R-7, REV. SEPT. 1947)

(This form is designed for use on the national forests of Region 7.)

The data obtained at each station will be recorded on Form 14 (fig. 19) by the observer immediately after each measurement. The observer will make one carbon copy to be retained at the danger station. The original copy should be forwarded to the district office at the end of each month. During fire season two copies of Form 14 will be

Form 14NF-R-7
Rev. Sept. 1947

FIRE DANGER DAILY RECORD

Received__________ by____
Checked__________ by____
Recorded__________ by____

FOREST ____ DISTRICT ____ STATION ____ MONTH ____ 19__ OBSERVER ____

1	Day of the Month		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
2	Visibility	9:00 AM EST																															
3	State-Weather	9:00 AM EST																															
4	Wind Direction	9:00 AM EST																															
5	Fuel Moisture	9:00 AM EST																															
6	Wind Velocity	9:00 AM EST																															
7	Burning Index	9:00 AM EST																															
8	Visibility	2:00 PM EST																															
9	State-Weather	2:00 PM EST																															
10	Wind Direction	2:00 PM EST																															
11	Fuel Moisture	2:00 PM EST																															
12	Wind Velocity	2:00 PM EST																															
13	Burning Index	2:00 PM EST																															
14	Visibility	5:00 PM EST																															
15	State-Weather	5:00 PM EST																															
16	Wind Direction	5:00 PM EST																															
17	Fuel Moisture	5:00 PM EST																															
18	Wind Velocity	5:00 PM EST																															
19	Burning Index	5:00 PM EST																															
20	Began	PRECIPITATION for the past 24 hours (5 PM to 5 PM) Nearest 15 Minutes																															
21	Ended																																
22	Amount																																
23	Avg. Visibility	DAILY SUMMARY																															
24	Vegetation State	DAILY SUMMARY																															
25	Total Precipitation	DAILY SUMMARY																															
26	Number of Days Since Rain	DAILY SUMMARY																															
27	Burning Index for Day	DAILY SUMMARY																															

Figure 19.—Fire-danger daily record (Form 14NF-R-7).

maintained in the district office from telephone reports made by the danger-station observer. At the end of each month the district copies should be checked against the observer's original for mistakes in posting or misunderstanding over the telephone. The observer's original copy and one corrected copy of Form 14 should be forwarded to the supervisor, the other retained in the district files. If district copies of Form 14 are not maintained currently by telephone, as will normally be the case out of fire season, the district and supervisor's copies may be prepared at the end of the month from the observer's original form. If the daily summary section of Form 14 and burning index are not filled in by the observer, this should be done in the district office before mailing the copies to the supervisor's office.

INSTRUCTIONS FOR PREPARING FIRE-DANGER DAILY RECORD (FORM 14NF–R–7, REV. SEPT. 1947)

Columns marked by an asterisk (*) must be filled in by all stations.

Columns 2, 8, 14, and 23; visibility.—Record estimated distance at which ⅛-acre fire can be seen to nearest mile. Column 23 is average of columns 2, 8, and 14.

Columns 3, 9, and 15; state of weather.—Use symbol as follows:

1—Clear: clouds cover less than 4 tenths of sky.
2—Partly cloudy: clouds cover 4 tenths to 7 tenths of sky.
3—Cloudy: clouds cover 8 tenths or more of sky.
4—Dense or thick fog: visibility less than one-half mile due to fog.
5—Haze (other than smoke): visibility less than 6 miles due to haze.
6—Light rain: not sufficient rain to form puddles or to wet through ordinary clothing within 5 minutes.
7—Moderate or heavy rain: puddles form rapidly; ordinary clothing wets through in 1 to 3 minutes.
8—Light snow: visibility more than one-half mile.
9—Moderate or heavy snow: visibility less than one-half mile.
10—Thick or dense smoke: visibility less than one-half mile.

Columns 4, 10, and 16; wind direction.—Use symbol as follows:

1—NE	3—SE	5—SW	7—NW	9—Variable or unknown
2—E	4—S	6—W	8—N	0—Calm

**Columns 5, 11, and 17; fuel moisture.*—Record to nearest one-tenth percent up to 20 percent; to nearest one-half percent above 20 percent. Record "S" (for snow) if ground is covered with snow and do not read sticks.

**Columns 6, 12, and 18; wind velocity.*—Record to nearest half-mile according to wind correction chart. If cups are not turning, record as zero.

Columns 7, 13, and 19; burning index.—Record burning index given by Southeastern Forest Experiment Station fire-danger meter. Record zero when snow blankets the ground.

**Columns 20 and 21, precipitation began and ended.*—Record to nearest 15 minutes and add "A" or "P" to denote a. m. or p. m. Record DN if rain started or stopped during night. Record "Cont." (for continued) in column 21 if it is still raining at 5 p. m. and show time of ending next day. For purposes of recording rain the day begins and ends at 5 p. m. instead of midnight. Write the word "Showers" in columns 20 and 21 if there is more than one start and stop in the 24-hour period 5 p. m. to 5 p. m.

**Column 22, amount of precipitation.*—Record in inches and hundredths like dollars and cents (5 hundredths=0.05; 1 inch and 25 hundredths=1.25, etc.). If less than 0.01 (one hundredth), record "T" (for trace).

**Column 24, vegetation stage.*—Record 1 (cured), 2 (transition), and 3 (green). (See p. 42 for definitions.)

**Column 25, total precipitation.*—Record amount of rain from column 22, adding together rains that are not separated by drying weather (fuel moisture less than 20 percent). Do not repeat figure each day; record only when a change occurs. Disregard rains that total less than 0.25 inch. At beginning of a new month record total carried over from preceding month. Disregard small rains that, following close to large rains, will cause the meter reading to increase.

Column 26, days since rain.—Record days since Total Precipitation computed in column 25. Record "0" (zero) if the fuel moisture stays 20 percent or higher. Record "1" if the fuel moisture drops below 20 percent. After "1" day is recorded, record days consecutively between rains entered in column 25.

Column 27, burning index for the day.—Record highest burning index computed in columns 7, 13, or 19.

FIRE-DANGER DAILY SUMMARY FOR THE DISTRICT (FORM 15–R–7, REV. SEPT. 1947)

Form 15 (fig. 20) should be prepared each month. Out of fire season, or when only one station is operating on a district, it will only be necessary to complete the heading and fire occurrence section. This may be done at the end of the month on back of observer's Form 14 when it is received. During fire season, or whenever more than one station is in operation on a district, this form should be posted daily from data recorded on Form 14. The data from column 23 on Form 14 should be posted under the name of the danger station, and the district average computed to the nearest mile. The data from column 27 should be posted under the name of the danger station. The district average burning index should be recorded to the nearest unit from 1 through 17 and to the nearest unit of 5 from 20 through 100. Odd figures followed by .5 should be thrown up, even figures thrown down. For example: 17 and 18, average 17.5, should be recorded as 18; 35 and 40, average 37.5, should be thrown up to 38 and recorded as 40. Fire organization class on duty today and predicted class needed for tomorrow should be recorded as per the fire plan, which is according to danger class at present. The danger-class equivalents according to burning index are tabulated on the burning index meter. When only one station is in operation on a district, the data on visibility and burning index need not be entered on Form 15. The fire occurrence section, however, should be completed each month. If no fires, write NONE. Two copies of Form 15, together with the observer's original Form 14 and one corrected Form 14, should be mailed to the supervisor's office at the end of each month. The supervisor's office should forward the observer's original Form 14, and one copy of Form 15, to the Southeastern Station each month as soon as all the records are received from the districts.

Form 15-R-7
Rev. Sept. 1947

FIRE DANGER DAILY SUMMARY FOR THE DISTRICT

FOREST ______ DISTRICT ______ MONTH ______ 19__

Day of the Month		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Visibility from Danger Stations																																
	District Average																															
Burning Index from Danger Stations																																
	District Average																															
Fire Organization Class on Duty Today																																
Predicted Class Needed for Tomorrow																																
Summary of Fire Occurrence on the District by Final Area Size Classes — Class of Fire	A																															
	B																															
	C																															
	D																															
	E																															
	Daily Total																															

These data recorded by ______________ Checked by ______________

Figure 20.—Fire danger daily summary (Form 15–R–7).

POINTS TO FOLLOW IN OPENING AN INTERMITTENT FIRE-DANGER STATION

Scale shelter.—Check firmness and alignment of shelter post and mounting of shelter on post. Tighten and align post and box if needed.

Check box for leaks, and door for proper closure. Make necessary repairs.

Annually check condition of paint. Repaint outside as needed. Do not repaint inside.

Scale.—Annually check scale, including pivot pin, for corrosion and rust. Clean scale, using only a clean, dry rag and pointed stick to clean the pivot pin and seat, and replace rusted hook if needed.

Fuel-moisture sticks.—Remove any large twigs or limbs that have fallen near or over the rack.

Measure the height of the wire rack so the moisture sticks will be 8 inches above the litter.

Be sure bare ground or dirt is not showing under the rack or around the edges. If the soil is showing, place enough leaves or litter under the rack to cover up the bare area.

Be sure the sticks have been exposed continuously to the weather. Replace with new sticks if the exposure has been interrupted for any reason.

Anemometer.—Check for alignment. Plumb if necessary.

Thoroughly clean the anemometer, following the proper routine for the type instrument in use.

Rain gage.—Check support for firmness and alignment. Repair and level as needed.

Check can, tube, and funnel for leaks; check funnel for shape. Restore round shape and repair leaks as needed.

Check measuring stick for legibility. Replace if in poor condition.

POINTS TO FOLLOW IN CLOSING AN INTERMITTENT FIRE-DANGER STATION

Scale shelter.—Weatherproof and lock door.

Anemometer.—Disconnect contact wires, remove instrument from support and store in safe place.

Wipe threads on support with an oily rag.

Rain gage.—For short periods of vacancy, remove funnel and tube and store in safe place. Can should remain exposed, to collect precipitation during vacancy.

For prolonged periods of vacancy, remove entire gage from support and store in a safe place.

Fuel-moisture sticks.—Allow sticks to be exposed in the normal manner for the full period specified on the weathering correction card. Do not interrupt this period even when leaving the station unoccupied.

INSPECTOR'S REPORT—FIRE-DANGER STATION INSPECTION

State or Forest______________ District______________ Station______________
Date____________________ Observer______________ Inspector______________
Inspection Rating__________________

INSTRUCTIONS: Numbers in parentheses refer to pages where appropriate instructions may be found in the handbook "Forest Fire-Danger Measurement in the Eastern United States."

Opposite each condition listed below, enter "1" if condition is correct, or "0" if incorrect. List all incorrect items by number at bottom of page, enter appropriate remarks covering repairs or adjustments or training given during the inspection, and indicate where follow-up is needed.

When inspection is completed, compute Inspection Rating and enter above in space provided. This inspection covers 100 items, and the rating is determined by adding all the conditions checked "1" or by subtracting the number of "0" conditions from 100. A minimum rating of 90 is considered standard. Substandard ratings indicate the need for additional training and closer supervision by the district headquarters. All ratings should be discussed freely with observers.

Rain measurement

1. Gage exposure satisfactory (28) ____________ ____
2. Protected from violent winds_ ____
3. Gage support adequate (28)__ ____
4. Support firm in ground (28)__ ____
5. Funnel top level (28) ______ ____
6. Funnel top correct height (28)____________ ____
7. Funnel top undamaged (38)__ ____
8. Gage leakproof____________ ____
9. Gage clean inside (38)_______ ____
10. Inner tube undamaged______ ____
11. Tube removed during freeze__ ____
12. Measuring stick intact (28)__ ____
13. Stick legible, handled carefully ______________ ____
14. Rain measured correctly (40)_ ____
15. Measured to nearest 0.01"__ ____
16. Time recorded nearest 15 minutes ______________ ____
17. Time recorded correct columns ______________ ____
18. Gage emptied after each reading ______________ ____
19. Amount of rain recorded correctly ______________ ____
20. Less than 0.01" recorded as "T" ______________ ____

Remarks—Rain measurement

Sheet 2—Station Inspection Station ____________________

Wind measurement

(Anemometers should not be repaired or adjusted except by trained personnel)

21. Anem. exposure satistfactory (29) ____________________ ____
22. Cups correct height (29) ______ ____
23. Anem. mounting satisfactory (28) ____________________ ____
24. Post firm in ground (25) ______ ____
25. Anemometer plumb (38) ______ ____
26. Anemometer firm on post ____ ____
27. Cups not loose or damaged __ ____
28. Cups all face same way ______ ____
29. Cups rotate clockwise ________ ____
30. Cups rotate freely with no binding ________________ ____
31. Anemometer clean inside ____ ____
32. Oiled monthly, correct amt. of oil ____________________ ____
33. Contacts close every 12–15 turns ____________________ ____
34. Contacts clean, adjustment correct ________________ ____
35. Anemometer not worn excessively ____________________ ____
36. Casing leakproof ______________ ____
37. Wiring soldered or taped ____ ____
38. Wiring not loose or broken __ ____
39. Buzzer or flasher in order ____ ____
40. Switch in order __________ ____
41. Battery condition satisfactory ____________________ ____
42. Circuit has enough batteries _ ____
43. Wind chart posted in shelter _ (25) ____________________ ____
44. Wind chart used correctly (40) ____________________ ____
45. Uses watch to time wind (39) ____________________ ____
46. Start time end of 1st signal __ ____
47. Wind recorded nearest ½ mile ____________________ ____
48. Recorded "0" when cups not turning ________________ ____
49. Times wind at least 2 minutes ____________________ ____
50. Extra readings on gusty days days (40) ______________ ____

Remarks—Wind measurement

Sheet 3—Station Inspection Station____________________

Fuel-moisture measurement

51. Shelter construction adequate (25) ____
52. Shelter leakproof (37) ____
53. Paint in good condition (37) ____
54. Shelter firm on post (37) ____
55. Post firm in ground (37) ____
56. Shelter does not lean ____
57. Door does not bind ____
58. Door opens in lee of wind (26) ____
59. Door provided with lock ____
60. Shelter clean inside (25) ____
61. Instruction sheet posted (25) ____
62. Scale mounting adjustable (25) ____
63. Scale firmly mounted ____
64. Scale convenient height (26) ____
65. Scale figures clean and legible ____
66. Adjusting board approx. level (25) ____
67. Scale pivot does not bind (65) ____
68. Pointer swings freely full scale ____
69. Slider firm but not loose ____
70. Hook does not bind ____
71. Hook adequate to hold sticks ____
72. Balancing weight stored in shelter ____
73. Checks scale correctly (38) ____
74. Checks balance once a week (38) ____
75. Scale balanced (38) ____
76. Sticks replaced regularly ____
77. Stick exposure satisfactory (22) ____
78. Vegetation unmolested at site (20) ____
79. Sticks correct height (35) ____
80. Stick support adequate (35) ____
81. Sticks held on support (36) ____
82. Sticks approx. horizontal (35) ____
83. Proper side up (35) ____
84. Protected from animals (21) ____
85. Protected from washing (21) ____
86. Sticks not shaded by shelter (23) ____
87. Adequate litter under sticks (37) ____
88. Sticks clean and intact (37) ____
89. Handled by edges (37) ____
90. Weathering card posted ____
91. Dates correct on card (39) ____
92. Dates complete on card (39) ____
93. Slider set correctly (39) ____
94. Waits till sticks stop swinging ____
95. Sticks swing free of shelter (25) ____
96. Taps pivot before reading (39) ____
97. Scale read properly (39) ____
98. Readings entered on standard form ____
99. Records "S" for snow (59) ____
100. State of vegetation recorded (41) ____

Remarks—Fuel-moisture measurement

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