NFPA No. 18

STANDARDS

for

WETTING AGENTS

1951

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NATIONAL FIRE PROTECTION ASSOCIATION
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National Fire Protection Association

International

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The National Fire Protection Association was organized in 1896 to promote the science and improve the methods of fire protection and prevention, to obtain and circulate information on these subjects and to secure the cooperation of its members in establishing proper safeguards against loss of life and property by fire. Its membership includes over a hundred and seventy-five national and regional societies and associations and over thirteen thousand individuals, corporations, and organizations. Membership in the National Fire Protection Association is open to any society, corporation, firm or individual interested in the protection of life or property against loss by fire.

This pamphlet is one of a large number of publications on fire safety issued by the Association. The standards prepared by the technical committees of the National Fire Protection Association and adopted in the conventions of the Association, are intended to prescribe reasonable measures for minimizing fire losses. All interests concerned have opportunity through the National Fire Protection Association to participate in the development of the standards and to secure impartial consideration of matters affecting them.

This pamphlet, sponsored by the General Committee on Special Extinguishing Methods, was prepared by the NFPA Committee on Wetting Agents. It was initiated in 1949, tentatively adopted in 1949 and finally adopted in revised form by the National Fire Protection Association on May 11, 1951. Details of the NFPA action are recorded in the Advance Reports and Proceedings.

STANDARDS FOR WETTING AGENTS

(No. 18)

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Foreword

1. Water has been accepted for many years as the most practical fire fighting agent because of its almost universal availability, its great heat absorption capacity and because it is a liquid.

2. The increasing use of wetting agents by the fire services has become quite pronounced in the past few years, and gives indication of becoming a permanent and important factor in the field of fire control. Experience, as well as tests, has indicated that the addition of a proper wetting agent to plain water will, when properly applied, increase the extinguishing efficiency of that water with respect to quantity used as well as time saved. The value of such a factor may well become of considerable importance, especially in rural areas where the amount of water available for fire fighting is often inadequate. This is due to the fact that the addition of a proper wetting agent to the charge in a booster tank will increase the extinguishing efficiency of the water. In other cases, such as forest fires, the increased efficiency becomes an important consideration since most of the water must be transported manually in portable equipment. Certain types of fires, such as those in baled cotton, stacked hay, some rubber compounds and some flammable liquids, which do not ordinarily respond to treatment with plain water may be extinguished when a proper wetting agent is used. This property may be attributed to an increase in the penetrating, spreading and emulsifying powers of plain water due to such factors as lowering the surface tension. This decreased surface tension can be described as a disruption of the forces holding the surface film of plain water together, thereby permitting it to flow and spread uniformly over solid surfaces. As a result, the treated water acquires the ability to penetrate into small openings and recesses which plain water would flow over by the simple bridging action of the surface film. It is to be noted that such solutions exhibit not only penetrating and spreading qualities, but increased absorptive speed and superior adhesion to solid surfaces.

3. The exact nature of the extinguishing action on flammable liquids is not fully understood. Such actions as the prevention of spattering in shortenings, crude oil, asphalt, and like materials are influenced by many factors and apparently are a complex function involving emulsification, frothing, solubility, dilution and cooling.

4. There are numerous chemicals which fulfill the primary function of a wetting agent, which is to lower the surface tension of plain water. However, very few of these chemicals are suited to fire control work because application to this purpose is complicated by such considerations as toxicity, corrosive action on equipment and stability in naturally occurring waters. In view of this fact, therefore, these standards set forth certain basic minimum requirements and limitations for the use of a wetting agent as an aid for fire extinguishment. The requirements are intended to insure that the addition of a wetting agent to any natural water shall not affect that water adversely with respect to fire fighting properties, nor render it harmful to personnel, property or equipment. It is further intended to establish standards for the evaluation of wetting agents as fire extinguishing mediums.

SECTION I. GENERAL INFORMATION

100. Introduction

101. Purpose. The standards herein set forth are, in general, the requirements for the performance and use of wetting agents as related to fire control and extinguishment and are prepared for the guidance of the fire services, authorities having jurisdiction, and others concerned with judging the acceptability and use of any chemical offered for such purpose.

102. Scope. These standards are limited to qualification tests, methods of evaluation, general rules for application, and limitations for use of wetting agents as related to fire control and extinguishment.

a. The method whereby the wetting agent is added to water is not herein specifically set forth. The solution may be premixed in tanks or may result from bringing the wetting agent into contact with water by any suitable proportioning device, providing, however, said device shall be approved in accordance with applicable standards.

120. Definitions

121. CLASS A FIRES may be defined as fires in ordinary combustible materials where the quenching and cooling effects of quantities of water, or solutions containing large percentages of water, is of first importance.

122. CLASS B FIRES may be defined as fires in flammable liquids, greases, etc., where a blanketing effect is essential.

NOTE: This classification of fires does not appear to be entirely compatible with current practice, which includes extinguishment of fires in certain liquid flammable materials with water spray where "blanketing" with steam is only one of the factors effective in the extinguishing process, there being others of equal or greater importance.

123. CLASS C FIRES may be defined as fires in electrical equipment, where the use of a non-conducting extinguishing agent is of first importance.

124. A WETTING AGENT may be defined as a chemical compound which, when added to plain water in proper quantities, materially reduces the surface tension of plain water and increases its penetrating, spreading and/or its emulsifying ability.

***125.** WET WATER may be defined as any water to which a proper wetting agent has been added.

***126.** PLAIN WATER may be defined as any water to which a wetting agent has not been added.

127. Definitions of commonly used words are included as follows:

a. SHALL is intended to indicate requirements.

b. SHOULD is intended to indicate recommendations or that which is advised but not required.

c. APPROVED refers to approval by the authority having jurisdiction.

d. LISTED refers to devices and materials which have been tested by nationally recognized laboratories for compliance with the standards of construction and performance of such laboratories with regard to their suitability for installation in accordance with this Standard.

*Further information appears in the Appendix.

130. Uses

131. In general, these standards are intended to signify that a wetting agent which successfully meets the requirements herein set forth shall not be limited in use or application except as herein specified.

***132.** The addition of proper wetting agent to plain water will increase its penetrating, spreading, and/or emulsifying ability, thus reducing the volume of water required to extinguish fires which can be extinguished by plain water and should extend the extinguishing use of water to include all Class A combustibles and also Class B combustibles which are ordinarily stored at atmospheric temperature and pressure.

133. In general, wetting agents can be effectively applied and used with all types of standard fire protection equipment where plain water is normally used. The degree of efficiency obtained will depend on utilizing the most efficient application methods, techniques, and devices for the hazard involved. (See Limitations, paragraph 140.)

***134.** When water containing wetting agent is applied to a fire, some of the wetting agent remains. This residual wetting agent may be effective in reducing the surface tension of plain water which may subsequently be applied.

135. The range and discharge capacity of solid stream or spray nozzles discharging water containing a wetting agent in concentration recommended by the manufacturer should not be appreciably changed from that when used with plain water. The discharge angle of spray nozzles should not be changed more than 10 per cent from that realized when plain water is used.

136. The authority having jurisdiction shall be consulted in all cases where the use of wet water is considered for use in fixed equipment such as water spray or sprinkler systems. The volume of extinguishing medium required will vary with each type of system and hazard. Therefore, as in the instance of hand application methods, each case must be considered upon its own merits. The addition of a wetting agent to the water discharged through a fixed piping fire protection system should materially improve performance with respect to extinguishment time, necessary rate of water application and range of materials on which such discharge may be effective.

137. Effective exposure protection can be accomplished by the application of wet water directly to the exposed structure or equipment to reduce the heat transferred from the exposing fire. This protection is afforded whether applied from portable or fixed equipment, and by the use of wet water the total volume of solution can be materially reduced from that required for plain water.

140. Limitations

141. The use of wetting agents in fire control work is necessarily limited to cases in which the penetrating, cooling and quenching action of

*Further information appears in the Appendix.

water is of primary importance, and in which the presence of water will not constitute a hazard, from either a chemical or physical standpoint. (See also articles 210 and 320).

142. Class A Fires. Wet water shall not be used to combat fire in combustible solids which are capable of reacting with water in such a manner as to constitute a hazard.

143. Class B Fires. Wet water is no more effective than plain water in extinguishing fire in flammable liquids which are not ordinarily stored at atmospheric temperature and pressure. (See paragraph A132.)

***144. Class C Fires.** Since the addition of a wetting agent has a tendency to increase the electrical conductivity of plain water, it should not be used on Class C fires.

145. Foam. Wetting agents should not be used in connection with chemical or mechanical foam-producing substances, since the action of the wetting agent is such as to reduce the surface tension of the bubble-forming film, and thereby prevent formation of an effective foam blanket.

146. The use of wetting agents is acceptable in plain water type portable extinguishers. Use in soda and acid type or in plain water types to which anti-freeze has been added may appreciably reduce the efficiency of the wetting agent; therefore, its use in such equipment is questionable and should be limited to specific hazards on which tests have been conducted and which are satisfactory to the authority having jurisdiction.

147. Corrosion Limitations. The problem of the effect on various materials of aqueous solutions of wetting agents in recommended concentrations should be recognized.

***a. Corrosion of Metals.** Distilled water solutions of the wetting agent, in concentrations specified for use by the manufacturer, should be substantially no more corrosive to steel, brass, bronze and copper than distilled water. Corrosion shall be judged both on the basis of weight loss per unit area, and on the degree of localized pitting.

The action of a wetting agent solution in galvanized or similarly coated equipment should be investigated before use.

***b. Action on Fire Hose.** Distilled water solutions of the wetting agent in concentrations specified for use by the manufacturer shall exhibit no more attack than distilled water, over at least a 30-day period, on any nonmetallic material incorporated in the manufacture of fire hose or other fire-fighting equipment. Such materials shall include natural rubber, synthetic rubber, asphalt coating and any other special plastic protective coatings that may be in general use. Degree of attack shall be judged on the basis of change in weight as well as on dimensional stability.

Cotton and linen yarn immersed for 24 hours in a distilled water solution of the wetting agent in any concentration specified for use by the manufacturer, shall suffer no more than a 10 per cent loss in tensile strength based on a control sample of identical yarn immersed in distilled water.

*Further information appears in the Appendix.

148. Wet water penetrates salvage covers and may render them permanently pervious.

150. Basic Requirements

151. The use of wetting agents for fire extinguishment should be based on the requirements outlined in Section III.

152. Wetting agents for fire-fighting shall be listed by a nationally recognized testing laboratory and shall be approved by the authority having jurisdiction.

153. Special equipment, such as proportioners, shall be listed by a nationally recognized testing laboratory and shall be approved by the authority having jurisdiction.

154. Equipment and/or wetting agents offered for use on which approval is pending, shall be submitted to the authority having jurisdiction.

SECTION II. SPECIFICATIONS

200. General

201. Equipment. Wetting agents which comply with the specifications herein set forth, shall be allowed for use with standard equipment, provided said equipment is primarily designed to utilize water as a medium of fire control in accordance with paragraphs 133 and 136. Permissible use with new types of equipment shall be determined by the authority having jurisdiction.

202. The concentration for use of the active ingredient or ingredients of a wetting agent is to be specified by each manufacturer, and acceptance tests and approvals shall be based on such specifications.

***a.** Wetting agents when added to plain water in concentration specified for use shall appreciably reduce the surface tension of the plain water.

b. The addition of the wetting agent, in concentrations specified for use by the manufacturer, shall not appreciably change the characteristics of plain water with regard to boiling or freezing temperature.

c. A wetting agent to be used for fire extinguishing purposes shall be readily soluble in plain water and easily and uniformly mixed.

d. Approvals shall indicate the use for which the material is effective as on Class A or Class B materials or as a defoaming agent.

***e. pH.** The pH of aqueous solutions of the wetting agents in concentrations recommended for use by the manufacturer should be between 7 and 12 at 60° F.

f. Solubility. At 60° F. the wetting agent should form a true solution, dispersion or emulsion with water which is stable up to the maximum concentration recommended for use by the manufacturer.

***g. Separation Temperature.** Aqueous solutions of the wetting agent in concentrations recommended for use by the manu-

*Further information appears in the Appendix.

facturer shall have a separation temperature not higher than 40° F. Any haziness, cloudiness or precipitation occurring during the course of the test should be checked as an indication of separation.

***h. Separation on Standing.** The wetting agent, in concentrations specified for use by the manufacturer, shall display no tendency to "layer out" or otherwise separate, on standing for 30 days at a temperature of 40° F.±1°. The formation of two or more distinct layers, or haziness, cloudiness or precipitation occurring during the course of the test should be checked as an indication of separation.

i. Containers. Shipping containers shall be suitable for extended storage periods and should not be refilled except by the original manufacturer.

***j. Action after Freezing.** Aqueous solutions of the wetting agent in concentrations recommended for use by the manufacturer, after being frozen and then warmed to 60° F., shall return to normal condition after agitation for one minute.

***k. Nozzle Discharge.** The allowable deviation for range, pattern and discharge rate shall not be more than 10% as compared to plain water discharge at the same temperature and pressure.

203. Evaluation Tests. The standards, 202j to 203 inclusive, are not intended to be absolute requirements as it is impossible, at present, to evaluate all the factors encountered in actual fire extinguishment. It is deemed necessary at this time to have some means whereby the probable performance of a wetting agent can be estimated before it is put into actual use. The following tests have been selected as being most indicative of probable performance.

***a. Wetting Action on Class A Combustibles.** At a minimum solution temperature of 60° F., the wetting time of one inch squares of canvas should be less than 15 sec. The tests should be made with aqueous solutions of the wetting agent in such concentrations as are specified for use by the manufacturer.

***b. Absorption Action on Class A Combustibles.** A wick test to determine extinguishment efficiency, based on rate of absorption, should be made on aqueous solutions of the wetting agent in concentrations specified for use by the manufacturer. Using quick fire starters, this test should indicate an efficiency of at least 200 per cent compared to plain water.

c. Extinguishing Action on Class B Combustibles. The extinguishing ability of a wetting agent on Class B combustibles is dependent upon the physical characteristics of the combustible involved such as flash point and the ability of the wetting agent used to form a proper emulsion. Therefore, no practical small scale tests have been developed for Class B applications.

204. Container Marking. The submitter shall include the following information on the container label:

a. The manufacturer's name or trade-mark or some other distinctive symbol agreed upon with the nationally recognized testing laboratory to clearly identify the wetting agent as a listed chemical.

*Further information appears in the Appendix.

b. Concentration for use with various types of combustibles.

c. Surface tension of solutions of recommended concentration in distilled water.

d. Viscosity at 60° F. of the concentrated wetting agent.

e. Indicate recommended storage conditions.

f. Lot number and/or date of manufacture.

210. Toxicity

***211.** In general, wetting agents, including chemicals used as corrosion inhibitors, do not appear to present a problem with respect to toxicity. This question, however, should be given consideration and may become of material importance where wetting agents are being considered for fire protection use in such plants as those processing food products or pharmaceuticals.

212. Under no conditions should wet water in any concentration be taken internally.

SECTION III REQUIREMENTS

300. System Requirements

301. The standards herein set forth shall be considered supplementary to existing standards covering any particular type of system or equipment. Cases in which the two standards are in apparent disagreement shall be handled in accordance with the prior standard until such time as the authority having jurisdiction may decide otherwise.

302. Calculations. The manufacturer shall provide such information and data as may be required to indicate the amount of wetting agent which is to be added to plain water to make up the necessary concentration.

310. Fire Department Supply Requirements

311. The wetting agent may be premixed in a booster tank in such concentration as may be specified by the manufacturer. Where such premixing is considered undesirable, an amount of wetting agent determined to be sufficient for the water contained in the portable tanks on the apparatus should be carried in a container which can readily be emptied into such tanks.

312. Where portable tanks are not a part of the apparatus, or where it is desired to carry the wetting agent separately for use either with water from portable tanks or with water from other sources of supply, the amount considered necessary should be carried in a suitable tank connected to appropriate proportioning equipment on the apparatus. Where such equipment is used also to take suction from hydrant supplied by potable water, extra care should be exercised to prevent contamination of such potable water supplies with wetting agent.

*Further information appears in the Appendix.

313. Additional supplies. Additional supply of wetting agent will be needed to insure continuity of operation and this should be carried on the apparatus. Further supply should be stocked in fire department houses to recharge the apparatus.

320. Fixed Systems

321. Existing standards covering all fixed systems shall be followed where the addition of a wetting agent to the system is contemplated. Such installations shall be approved by the authority having jurisdiction with consideration being given primarily to the change in the physical and chemical characteristics of wet water with regard to:

a. The effect of the wetting agent on existing systems and/or materials of construction, including the possibility of plugging of such systems due to the dirt and scale loosening properties of wetting agents.

b. The possibility of increased water damage due to the high absorption ability of wet water.

c. The possibility of increased floor loads due to the retention of large volumes of wet water.

d. Contamination of potable water supplies.

More specific specifications will depend on field experience and the application of wetting agents to fire protection problems.

SECTION IV. SERVICE REGULATIONS

400. Inspection

401. Due to its greater penetrating power, wet water is capable of passing through small openings which would be impassable to plain water. For this reason it will often be found that old, but apparently sound, equipment will have a tendency to spring leaks when charged with wet water, especially at worn packing glands. For this reason all old packings should be renewed when the switch is made to wet water, and regular inspections should be held thereafter in order to minimize losses, as well as to ascertain that the equipment is in good operating condition.

402. Schedule. The inspection schedule should be arranged by the authority having jurisdiction. It is herein recommended that for the first month after the initial addition of a wetting agent, inspections should be made at frequent intervals. After the first leaks have been detected and repaired only routine inspections will be necessary, and these may be arranged to suit other inspection or drill schedules.

403. Points of Inspection. All points which might conceivably be subject to leakage should be carefully examined. These would include valve packings, retainers, bushings, threaded joints, screw unions, etc.

410. Testing

411. The functional parts of a system in which wet water is being used should be tested periodically in accordance with the standard applying to that system. In addition to this functional testing, which should be a part of the regular drill program, samples of the wet water should be

tested periodically in accordance with the following schedule and test procedure.

412. Schedule. It is herein recommended that premixed solutions of the wetting agent be tested once every 30 days in accordance with the following test procedure, and that this same test be applied immediately following the preparation of a new charge of wet water. In cases where the solution is never premixed, but is to be made up at the fire scene, the concentrate should be used to make up a small test sample. This sample should then be subjected to the wetting test as detailed in Section II, paragraphs 203a and A203a. Failure to meet the test will be an indication that the wetting agent has deteriorated, in which case the authority having jurisdiction should be notified, and steps taken to correct the situation.

420. Maintenance

421. General Rules. Rules and regulations as set forth in applicable standards should be observed in the maintenance of systems in which wet water is being used. Special care should be taken to replace worn packings and to eliminate other potential sources of leakage.

SECTION V. INSTRUCTIONS FOR USE

500. Precaution

501. It will be noted that Section II, paragraph 210, of this Standard makes it requisite that a wetting agent shall meet certain minimum requirements concerning toxicity in order to be properly approved. However, in the interest of safety it is herein recommended that all personnel who have occasion to use wetting agents in any form, be duly instructed to avoid unnecessary contact, especially with the concentrate.

502. Due care should be exercised during mixing and testing operations.

503. Contamination of food dispensing utensils should be avoided.

504. Under no conditions should "horseplay" involving wetting agents or solutions thereof, be allowed.

505. Constant care should be exercised to keep every container of wetting agent properly and clearly identified.

510. Application

511. In general, recognized application techniques can be followed where wetting agents are used. Primary consideration should be given, however, to the characteristics of wet water in that a wetting agent is active only when it comes in contact with the combustible involved.

512. Wetting agents do not increase the heat absorption capacity of plain water, but may increase the heat absorption efficiency of such water due to its greater spreading and penetrating ability. It is for that reason

that wet water, to be most efficiently utilized, must be applied directly to the surface of the combustible.

520. Storage

521. Proper facilities for storing the concentrate and/or pre-mix solutions in accordance with the recommendations of the manufacturer should be provided. In general, no wetting agent should be stored at a temperature below 50° F.

522. Anti-freeze Solutions. In cases where pre-mixed solutions of the wetting agent are exposed to possible freezing temperatures, it must be determined that the wetting agent can be used in conjunction with anti-freeze materials before such use is permitted. The manufacturer should specify which anti-freeze materials, if any, are suitable for use with his product.

APPENDIX

The following appendices are intended to furnish clarification, explanation and examples for the rules contained in the main text of this standard. Therefore, the provisions of the appendix are not mandatory but indicate recommended practice and procedure.

A125. The term "water" as used in the standard includes all potable supplies. However, water from other sources may be used provided tests indicate the satisfactory performance of the specific wetting agent under consideration.

A126. Attention is invited to modern fire-fighting methods which include extinguishment of fires in certain flammable liquid materials with water spray when blanketing (with steam or as a result of emulsification) is only one of the factors effective in the extinguishing process, there being others of equal or greater importance.

A132. The expression "Stored at atmospheric temperature and pressure" is intended to include those combustibles having a vapor pressure up to 300 mm. of mercury at 20° C.

A134. Field observations indicate that in the use of wetting agents for fire extinguishment the water present is expendable due to its conversion into steam which gives cooling effect; whereas, the wetting agent itself is non-expendable (except for runoff) up to an undetermined temperature which is much higher than the boiling point of water. It is also indicated that when sufficient (the quantity being undetermined as yet) non-expendable wetting agent has been applied to a fire, it continues to be effective with the addition of plain water. Additional fire tests or field experience will be necessary to determine these indicated items.

A144. Should wet water come in contact with electrical equipment, the wetting agent may remain behind after the water has dried off, and may constitute a hazard when the equipment is put back in operation. Thorough flushing, or other positive cleaning action shall be undertaken following the contact of wet water with electrical equipment.

A147a. Corrosion of Metals. Samples of mild steel (also brass, bronze, and copper — see end of this article) are to be tested for corrosion in prepared solutions of the wetting agent in all concentrations specified for use by the manufacturer.

For continuous storage the use of such materials as cast iron, aluminum, zinc, galvanized iron, lead or lead coated iron, die cast alloys (such as white metal, zinc, etc.) or "air dried" types of coatings (which may include plastics, oil paint, lacquers and asphalt) should be avoided unless the manufacturer guarantees the product for such use. This is due to the fact that wetting agents, although non-corrosive, exhibit a tendency to accelerate corrosion due to the cleaning and penetrating action and will penetrate and loosen unbonded coatings which are not of the "baked on" type.

Specimens approximately 1 in. wide by 5 in. long are cut from $\frac{1}{16}$ in. thick hot rolled sheet steel. The mill scale is removed by pickling in warm hydrochloric acid containing Rodine inhibitor, and the specimens are then cleaned by scrubbing with soap and water, rinsed in acetone, dried in a desiccator and weighed.

The samples are then suspended in wide-mouth one quart bottles containing 800 cc. of the solution to be tested. The specimens are hung from glass thread in such a manner that approximately 1 in. of metal extends above the surface of the liquid. For comparison, metal samples are similarly exposed to distilled water. The test containers are then stored at room temperature for one month. At the end of this time, they are carefully removed from the containers and cleaned by immersion in hot 20 per cent sodium hydroxide solution containing zinc dust. The alkali is removed by rinsing in hot water, and the specimens further cleaned by scrubbing with soap and water. They are then rinsed in acetone, dried in the desiccator, and reweighed. The corrosion rates are calculated as inches per year from the weight loss during exposure using the following formula:

$$\text{Inch per year} = \frac{43.9 \times \text{weight loss in g.}}{12 \times \text{density of metal (g./cc.)} \times \text{area in sq. in.} \times \text{hours exposed}}$$

A minimum of two tests per solution to be evaluated are to be conducted and the average corrosion rate used.

A corrosion rate substantially greater than that of the distilled water control should be cause for rejection.

Examine the specimens for signs of pitting, and the presence of more than two pits deeper than 1/5 the thickness of the specimen should be cause for rejection.

This procedure is also used for other metals as well as steel, with the exception of the pickling and sodium hydroxide treatment.

A147b. Action on Fire Hose. This test is to consist essentially of a visual determination of the effects of wet water on nonmetallic materials used in the manufacture of fire-fighting equipment and shall include samples of fire hose, natural rubber, synthetic rubber, asphalt, etc.

Cut 1 in. (approximately) squares of the materials, weigh, and place them separately in 100 cc. of the prepared solution. Similar control

samples are to be placed in distilled water. Allow to stand for at least 30 days, and at the end of this time, examine the samples visually for signs of swelling, softening, or disintegration. Dry the sample by wiping with a soft cloth and weigh.

The samples should exhibit no more attack than the control samples in distilled water, nor any greater increase in weight.

Fifty samples of cotton yarn and fifty of linen yarn of the types used in fire hose are cut in 12 in. lengths. For a period of 24 hr., 25 of each of these are immersed in distilled water and 25 of each in the prepared solution of the wetting agent. Remove the samples after 24 hr., dry them between towels and condition for 48 hr. at 100° F. Tensile strength tests are then conducted according to A.S.T.M. Specification No. 180–44.

The average strength of the 25 samples of yarn immersed in the wet water shall not be less than 90 per cent of the 25 samples of the same yarn from the distilled water.

A202a. Surface Tension. Solutions in such concentration as are specified for use by the manufacturer are to be used, and an average of three determinations should be the reported value. Measurements are carried out on any standard instrument, such as the du Nuoy Tensiometer, and the proper correction factor applied to the determined values.

A202e. The pH of aqueous solutions of wetting agents is a measure of the acidity and alkalinity of the solution. Variations substantially below 7 or above 12 may result in serious increase in corrosion rate or may have material effect on its value in fire protection and fire extinguishment.

pH should be measured in accordance with standard practice procedures on a standard type pH meter at water temperatures of 60° F. ±1°. Any municipal water works laboratory can perform these tests.

A202g. Separation Temperature. Place a 100 cc. sample of the prepared solution in a clean beaker or flask and adjust it roughly to 60° F. Then, with constant mild agitation, lower the temperature of the sample by immersing it in an ice bath, and visually observe it for signs of separation. Record the temperature at which separation first occurs.

A202h. Separation on Standing. Prepare samples of the solution, in all concentrations specified for use by the manufacturer, by placing 100 cc. in suitable flasks provided with cork stoppers. Immerse the samples in a constant temperature bath adjusted to 40° F. ±1°, and maintain them at this temperature for a period of 30 days. At the end of this time, carefully remove the samples and observe them for signs of layering, or precipitation.

A202j. Action after Freezing. Place 100 cc. of the prepared solution in a clean beaker or flask and immerse it in a suitable bath, or place it in the freezing section of a refrigerator, until the sample has completely solidified. Record the freezing temperature. After complete solidification has taken place, remove the sample and gently warm it to 50° F. without agitation. As soon as this temperature has been reached, remove the source of heat and stir the sample for one minute. At the end of this time make visual observation to ascertain whether or not the wetting agent has gone back into solution. The solution should become completely homogeneous upon completion of this test.

A202k. Effect on Nozzle Discharge. Fasten two playpipes, equipped with a 1 in. Underwriters' tip, in a stationary position so as to form an angle of 30° with the horizontal. Discharge a stream of plain water through one nozzle, and wet water through the other, and compare the rate of discharge, discharge angle and discharge range of the two streams at the following nozzle pressures: 40, 60 and 100 lbs. per sq. in. The angle of discharge can be closely approximated by arranging to run the tests against a suitable background on which radial lines have been previously drawn. A visual comparison will serve to establish the discharge angle quite closely, and this may then be measured in order to obtain the numerical value.

The range and discharge rate can be measured in any convenient manner. Record the results of all tests.

A203a. Wetting Action Efficiency Standard: CLASS A COMBUSTIBLES, CANVAS WETTING TESTS. The following outlines the test procedure for determining efficiency of wetting action, on Class A combustibles, of wet water solutions.

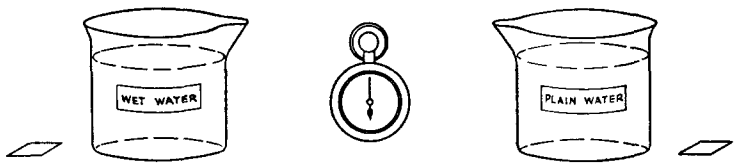

FIG. 1(a)

(1) Cut a supply of 1 in. squares from a standard sample of Mt. Vernon No. 6 Canvas, made by Mt. Vernon Woodbury Mills, Columbia, South Carolina. (Two 1 in. squares of canvas and a stop watch are required for each test.) Prepare samples of wet water and plain water in suitable containers, adjust the temperature to a minimum of 60° F., and remove any foam from the surface.

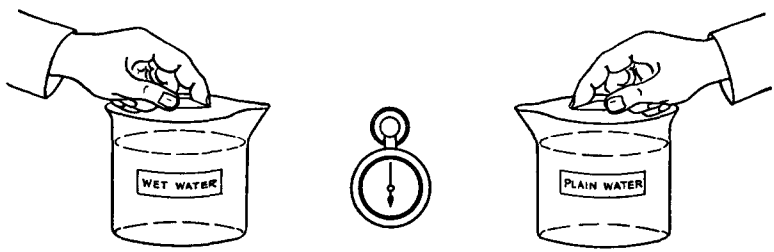

FIG. 1(b)

(2) Place squares of the canvas flat on the surface of the solutions simultaneously by dropping from a height of approximately 1 in. above the liquid surface. (The holding medium should not come in contact with the wet water.)