STANDARD

for

DRY CHEMICAL EXTINGUISHING SYSTEMS

JULY

1957

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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 two hundred national and regional societies and associations (list on outside back cover) and seventeen thousand individuals, corporations, and organizations. Anyone interested may become a member; membership information is available on request.

This pamphlet is one of a large number of publications on fire safety issued by the Association including periodicals, books, posters and other publications; a complete list is available without charge on request. All NFPA standards adopted by the Association are published in six volumes of the **National Fire Codes** which are re-issued annually and which are available on an annual subscription basis. The standards, prepared by the technical committees of the National Fire Protection Association and adopted in the annual meetings of the Association, are intended to prescribe reasonable measures for minimizing losses of life and property by fire. All interests concerned have opportunity through the Association to participate in the development of the standards and to secure impartial consideration of matters affecting them.

NFPA standards are purely advisory as far as the Association is concerned, but are widely used by law enforcing authorities in addition to their general use as guides to fire safety.

Definitions

The official NFPA definitions of shall, should and approved are:

SHALL is intended to indicate requirements.

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

APPROVED refers to approval by the authority having jurisdiction.

Units of measurements used here are U. S. standard. 1 U. S. gallon = 0.83 Imperial gallons = 3.785 liters.

Approved Equipment

The National Fire Protection Association does not "approve" individual items of fire protection equipment, materials or services. The standards are prepared, as far as practicable, in terms of required performance, avoiding specifications of materials, devices or methods so phrased as to preclude obtaining the desired results by other means. The suitability of devices and materials for installation under these standards is indicated by the listings of nationally recognized testing laboratories, whose findings are customarily used as a guide to approval by agencies applying these standards. Underwriters' Laboratories, Inc., Underwriters' Laboratories of Canada and the Factory Mutual Laboratories test devices and materials for use in accordance with the appropriate standards, and publish lists which are available on request.

DRY CHEMICAL EXTINGUISHING SYSTEMS

(NFPA No. 17 — 1957)

This standard, developed by the Committee on Dry Chemical Extinguishing Systems with the concurrence of the Committee on Special Extinguishing Methods, was adopted by the National Fire Protection Association on May 23, 1957. Further changes were adopted by the NFPA Board of Directors in the name of the Association on July 1, 1957. It is the first edition.

The Dry Chemical Extinguishing Systems Committee was activated in 1952. At that time there was no dry chemical extinguishing system tested and listed by a nationally recognized testing laboratory, but by late 1954 a system was tested and listed by Underwriters' Laboratories, Inc. At its meeting in January 1955 the Committee prepared an outline of a standard on Dry Chemical Extinguishing Systems, and in the following year prepared the standard that was tentatively adopted by the National Fire Protection Association on June 7, 1956. This first edition is the tentative standard with minor revisions.

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FOREWORD

Dry chemical has been used for many years in fire extinguishers. It is effective and efficient in extinguishing the rapidly spreading surface fire typical of flammable liquids and its greatest use has been protecting this type of hazard. Because dry chemical is electrically nonconducting, it is often a desirable medium to use on fires involving electrically energized equipment. Dry chemical has also been used on surface-type Class A fires, such as in the textile industry, where its rapid flame knockdown and retardant properties are useful.

Dry chemical systems, described in this pamphlet, are designed to discharge dry chemical from fixed nozzles and piping, or from hose lines.

The intent of the pamphlet is to indicate the general rules which would be applicable to any system, and to indicate the design and calculation considerations applicable to these systems. There is little available published information on dry chemical systems, and the limited field experience of approved systems makes it difficult to prepare specific recommendations and rules covering the installation of these devices.

In order to comprehend the limitations and specifications applicable to these systems, it is necessary to understand some of the principles involved in the use of dry chemical with system equipment.

The flow of dry chemical (suspended solid particles in a gaseous medium) involves relatively new techniques which do not follow the general hydraulic theories. Therefore, most of the flow principles have been determined experimentally.

Also, the extinguishing action of dry chemical is not yet completely explainable, and the quantities required for the extinguishment of fires under a wide range of conditions have been determined experimentally. In many cases, empirical formulas must be derived to permit a more comprehensive interpretation of the data.

In order to provide inspection authorities and other jurisdictions with sufficient information to examine and judge the acceptability of specific installations, the data accumulated by the equipment manufacturer must often be statistically analyzed. The result of this statistical analysis, in most cases, must be specific values for rate-of-flow, quantity, and other design factors.

It is obvious that many questions remain unanswered at this time. This pamphlet is issued, at the present time, to act as a guide in the consideration of the factors which must be present to properly analyze a particular installation.

Standard for Dry Chemical Extinguishing Systems

(NFPA No. 17 — 1957)

INTRODUCTION

1. Purpose. These Standards are prepared for use and guidance of those charged with the purchasing, designing, installing, testing, inspecting, approving, listing, operating or maintaining dry chemical fire-extinguishing systems, in order that such equipment will function as intended throughout its life.

2. Scope. These Standards are minimum requirements for dry chemical fire-extinguishing systems. They contain only the necessary essentials and suggestions to make them workable in the hands of those skilled in this field. Portable dry chemical equipment is covered in the Standards for the Installation, Maintenance and Use of Portable Fire Extinguishers.*

Only those skilled in the field are competent to design and install this equipment. It may be necessary for many of those charged with the purchasing, inspecting, testing, approving, operating, and maintaining this equipment to consult with an experienced and competent fire protection engineer in order to effectively discharge their respective duties.

3. Arrangement. These Standards are arranged as follows:

Introduction.

Chapter 1 — General Information and Requirements.

Chapter 2 — Total Flooding Systems.

Chapter 3 — Local Application Systems — Fixed Nozzle Type.

Chapter 4 — Local Application Systems — Hand Hose Line Type.

Appendix.

The Appendix contains material that will aid in understanding and applying these Standards.

4. Definitions. For purpose of clarification, the following general terms used with special technical meanings, in this Standard, are defined.

APPROVED refers to approval by authority having jurisdiction.

*NFPA No. 10, Available in pamphlet form and in National Fire Codes Vol. IV from the National Fire Protection Association, 60 Batterymarch St., Boston 10.

AUTHORITY HAVING JURISDICTION is usually the purchaser or the competent engineer or organization appointed by him to interpret and make decisions as set forth in these Standards. Where insurance is involved, the inspection department representing the insurance carrier generally becomes the authority having jurisdiction. In some cases, civil or military authorities may have final jurisdiction.

LISTED refers to the listing for the use intended, of devices and materials that have been examined by and meet the recognized standards of such testing laboratories as the Underwriters' Laboratories, Inc., Factory Mutual Laboratories, and Underwriters' Laboratories of Canada. All equipment should bear a label or some other identifying mark as required by the listing.

SHALL is intended to indicate requirements.

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

CALCULATION AND DESIGN as used in this pamphlet refer to the process of computing, with the use of graphs or tables, the system characteristics such as flow rate, nozzle pressure, outlet pressure, and pressure drop.

CLASS "A" FIRES are fires in ordinary combustible materials where the "Quenching" and cooling effects of quantities of water or solutions containing large percentages of water, are of first importance.

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

CLASS "C" FIRES may be defined as fires in electrical equipment where the use of a "Nonconducting" extinguishing agent is of first importance.

CHAPTER 1.
GENERAL INFORMATION AND REQUIREMENTS

11. General Information

111. Scope. Chapter 1 contains general information, and the design and installation requirements for all features that are generally common to all dry chemical systems.

112. Dry Chemical. Dry chemical is a finely divided powder, usually sodium bicarbonate, with additives to prevent caking, and to increase flowability.

1121. The theory of extinguishment of fires by dry chemical has not definitely been established. Explanations advanced have to do with the heat-absorption characteristics of the finely divided powder, contributory extinguishment by carbon dioxide and water vapor released as a result of breakdown of the dry chemical, and the inhibiting effect on the combustion chain.

113. Use and Limitations. Dry chemical extinguishing systems are useful within the limits of this Standard in extinguishing fires in specific hazards or equipments, and in areas where rapid flame knockdown is essential.

1131. Some important types of hazards and equipment that dry chemical systems may satisfactorily protect include:

1. Flammable liquids and materials having the same burning characteristics such as naphthalene and pitch.
2. Flammable liquids or gases issuing under pressure.
3. Electrical hazards such as transformers, and oil circuit breakers.
4. Ordinary combustibles such as paper and textiles where the fire is likely to be of a surface nature.

1132. Dry chemical systems should not be used to extinguish fires involving the following materials:

1. Chemicals containing their own oxygen supply such as cellulose nitrate.
2. Reactive metals such as sodium, potassium, magnesium, titanium, and zirconium.
3. Deep-seated Class A fires.
4. Delicate low voltage electrical relays.

114. Types of Systems. The types of systems recognized in these Standards include:

Total Flooding Systems.
Local Application Systems — Fixed Nozzle Type.
Local Application Systems — Hand Hose Line Type.

1141. A TOTAL FLOODING SYSTEM consists of a fixed supply of dry chemical normally connected to fixed piping with nozzles arranged to discharge dry chemical into an enclosed space or enclosure about the hazard. This type of system shall be arranged to operate automatically and/or manually by those normally in the vicinity of the hazard.

1142. A LOCAL APPLICATION SYSTEM — FIXED NOZZLE TYPE consists of a fixed supply of dry chemical normally connected to fixed piping with nozzles arranged to discharge dry chemical directly on the burning material. This type of system shall be arranged to operate automatically and/or manually by those normally in the vicinity of the hazard.

1143. A LOCAL APPLICATION SYSTEM — HAND HOSE LINE TYPE consists of a fixed supply of dry chemical normally connected to a system of piping and hose, or just to hose lines, and intended to discharge dry chemical through a hose and nozzle by trained personnel.

115. Systems Protecting One or More Hazards. Systems may be used to protect one or more hazards or groups of hazards except as provided in Sub-sections 1151 and 1152.

1151. Where, in the opinion of the authority having jurisdiction, two or more hazards may be simultaneously involved in fire by reason of their proximity, each hazard shall be protected with an individual system or the system shall be arranged to discharge on all potentially involved hazards simultaneously.

1152. Where hand hose lines may be used for the protection of a hazard on which a fixed system is installed, the hand hose line shall be supplied by a system other than that supplying the discharge for the fixed system.

12. Personnel Safety

121. Hazards to Personnel. The discharge of large amounts of dry chemical to extinguish fire may create hazards to personnel such as reduced visibility and temporary breathing difficulty.

1211. Large-volume discharges of dry chemical may seriously interfere with visibility during and immediately after the discharge period.

122. Safety Requirements. In any proposed use of dry chemical where there is a possibility that men may be trapped in locations made hazardous by a dry chemical discharge, suitable safeguards shall be provided to insure prompt evacuation of such locations, and also to provide means for prompt rescue of any trapped personnel. Such safety items as personnel training, warning signs, discharge alarms, pre-discharge alarms, and breathing apparatus shall be considered.

123. Electrical Clearances. All system components shall be so located as to maintain standard* electrical clearances from live parts.

13. Specifications, Plans and Approval

131. Purchasing Specifications. Specifications for dry chemical fire extinguishing systems shall be drawn up with care under supervision of a competent engineer, and with the advice of the authority having jurisdiction. To insure a satisfactory system, the following items should be in the specifications.

1311. The specifications should designate the authority having jurisdiction and indicate whether plans are required.

1312. The specifications should state that the installation shall conform to these Standards and meet the approval of the authority having jurisdiction.

1313. The specifications should include the specific tests that may be required to meet the approval of the authority having jurisdiction, and indicate how cost of testing is to be borne.

132. Plans. Where plans are required, their preparation shall be entrusted to none but fully experienced and responsible persons.

1321. These plans shall be drawn to an indicated scale or be suitably dimensioned, and shall be made so they can be easily reproduced.

*A table of such clearances may be found in NFPA Standard No. 15, Water Spray Systems for Fire Protection, available in pamphlet form and in National Fire Codes, Vol. IV from the National Fire Protection Association, 60 Batterymarch Street, Boston 10, Massachusetts.

1322. These plans shall contain sufficient detail to enable the authority having jurisdiction to evaluate the hazard or hazards, and to evaluate the effectiveness of the system. The details on the hazard shall include the materials involved in the hazards, the location of the hazards, the enclosure or limits and isolation of the hazards, and the exposure to the hazard. The detail on the system shall include basic calculations for the amount of dry chemical required, the rate-of-flow of dry chemical, nozzle pressure and/or pressure drop through the piping, size of piping, the location and size of dry chemical containers and how connected, the location and size of nozzles, hose lines, detection devices, operating devices and auxiliary equipment, and wiring diagrams where electrical power is used. Sufficient information shall be indicated to identify properly the apparatus and devices used. Any special features should be adequately explained.

133. Approval of Plans. Where plans are required, they shall be submitted by the purchaser to the authority having jurisdiction for approval before work starts.

1331. Where field conditions necessitate any material change from the approved plan, the change must be approved.

1332. When such material changes from approved plans are made, corrected "as installed" plans shall be supplied to the owner and the authority having jurisdiction, if different.

134. Approval of Installations. The completed system shall be tested by qualified personnel to meet the approval of the authority having jurisdiction. These tests shall be adequate to determine that the system has been properly installed, and will function as intended. Only listed or approved equipment and devices shall be used in these systems.

1341. Such tests should include a discharge of expellant gas and dry chemical through the piping and nozzles. Observations for serious gas leakage and for continuity of piping with free unobstructed flow shall be made. Where the discharge of dry chemical is not desirable, arrangements shall be made to discharge expellant gas through the piping and nozzles, and observations made of the flow of expellant gas through all nozzles. The labeling of devices with proper designations and instructions should be checked.

14. Operation and Control of Systems

141. Methods of Actuation. Systems shall be classified as manual or automatic in accordance with the method of actuation.

1411. A manual system is one in which human agency is required for actuation, although it may have other features that are automatic.

1412. An automatic system is one which is actuated by automatic means. Such systems shall also have means for manual actuation.

142. Detection of Fires. Fires or conditions likely to produce fire may be detected by visual (human senses) or by automatic means.

1421. Visual detection may be used only with permission of the authority having jurisdiction, except in manually actuated systems where fire or conditions likely to produce fire can be readily detected by such means.

1422. Automatic detection may be by any listed or approved method or device that is capable of detecting and indicating heat, flame, smoke, combustible vapors, or an abnormal condition in the hazard, such as process trouble, that is likely to produce fire.

1423. An adequate and reliable source of energy shall be used in detection systems.

143. Operating Devices. Operating devices include expellant gas cylinder valve releasing mechanisms, dry chemical discharge controls, shutdown equipment, all of which are necessary for successful performance of the system.

1431. Operation shall be by listed or approved mechanical, electrical, or pneumatic means. An adequate and reliable source of energy shall be used.

1432. All operating devices shall be designed for the service they will encounter, and shall not be readily rendered inoperative or susceptible to accidental operation. Devices shall be normally designed to function properly from minus 20°F. to 150°F., or marked to indicate temperature limitations.

1433. All devices shall be located, installed, or suitably protected so that they are not subject to mechanical, chemical or other damage which would render them inoperative.

1434. The normal manual control for actuation shall be located so as to be conveniently and easily accessible at all times including the time of fire. The control shall cause the complete system to operate.

1435. All automatically operated valves controlling the release and distribution of expellant gas and dry chemical shall be provided with approved independent means for emergency manual operation. If the means for manual actuation of the system required in Sub-section 1412 provides approved positive operation independent of the automatic actuation, it may be used as the emergency means. The emergency means, preferably mechanical, shall be easily accessible and located close to the valves controlled. If possible, the system shall be designed so that emergency actuation can be accomplished from one location.

1436. Manual controls shall not require a pull of more than 40 lb. (force) nor a movement of more than 14 in. to secure operation.

1437. Means shall be provided for checking the contents of the cylinders which contain the expellant gas to assure that the available supply of expellant gas is sufficient to cause operation of the system.

1438. All shutdown devices shall be considered integral parts of the system and shall function with the system operation. If the expellant gas is used to pneumatically operate these devices, then the gas must be taken prior to its entry into the dry chemical tank.

1439. All manual operating devices shall be identified as to the hazard they protect.

144. Supervision. Supervision of automatic systems is advisable where the possible loss because of any delay of actuation may be high and/or where the detection or control systems are so extensive and complex that they cannot be readily checked by visual or other inspection. When supervision is provided, it should be so arranged that there will be immediate indication of failure. The extent and type of supervision shall be approved by the authority having jurisdiction.

145. Alarms and Indicators. Alarms and/or indicators may be needed to indicate the operation of the system, hazard to personnel, or failure of any supervised device or equipment. Such devices shall be of such a type and should be provided in such

numbers and such locations as are necessary to accomplish satisfactorily their purpose subject to approval of the authority having jurisdiction. They may be audible or visual.

1451. A positive alarm or indicator should be provided to show that the system has operated and must be re-serviced.

1452. Alarms should be provided to give ample positive warning of a discharge where hazard to personnel may exist.

1453. Alarms indicating failure of supervised devices or equipment shall give prompt and positive indication of any failure and shall be distinctive from alarms indicating operation or hazardous conditions.

15. Dry Chemical Supply

151. Quantities. The amount of dry chemical in the system shall be at least sufficient for the largest single hazard protected or multiple hazards which are to be protected simultaneously.

152. Quality. The dry chemical supplied with the system shall be that produced by the manufacturer of the equipment. The characteristics of the system are dependent upon the composition of the dry chemical, as well as other factors and, therefore, it is absolutely necessary to use the dry chemical provided by the manufacturer of the system. This dry chemical shall be of a type listed for use with the equipment.

153. Replenishment. Where a dry chemical system protects multiple hazards by means of selector valves, sufficient dry chemical and expellant gas shall be kept on hand for one complete recharge of the system. For single hazard systems, a similar supply should be kept on hand if the importance of the hazard is such that it cannot be shut down until recharges can be procured. These reserve supplies may be permanently connected to the system at the discretion of the authority having jurisdiction.

154. Storage. The original dry chemical supplied with this system is maintained in the dry chemical chambers. Storage of reserve quantities of dry chemical shall be in a clean dry area, in metal drums, or plastic-lined containers which will assure against the entrance of moisture in even small quantities. Prior to replenishing the system, the dry chemical shall be carefully checked to determine that it is in freely running powdery condition, and the pressure of the expellant gas container shall be checked to determine that it is above the minimum recommended by the manufacturer.

1541. The dry chemical tank and expellant gas assemblies shall be located as near as possible to the hazard or hazards they protect, but they shall not be located where they will be exposed to a fire or explosion in these hazards.

1542. The dry chemical tank and expellant gas assemblies shall not be located so as to be subject to severe weather conditions, or to be subject to mechanical, chemical, or other damage.

1543. When excessive climatic or mechanical exposures are expected, suitable guards or enclosures shall be provided.

1544. General ambient storage temperatures for the dry chemical tank and expellant gas assemblies shall normally not exceed 140°F., nor be less than minus 20°F. Exposure extremes of short duration can be tolerated. Otherwise, compensating methods shall be provided for maintaining the general ambient.

16. Distribution System

161. Pipe and Fittings. The piping for a dry chemical system embodies distinctive features necessitated by the characteristics of the agent. These features will be discussed later. The installation of piping shall parallel good automatic sprinkler practice as indicated in the Standards for the Installation of Sprinkler Systems.* Pipe shall be of steel, galvanized in accordance with Specification A120–47 of the American Society for Testing Materials and any subsequent revisions thereof. Special corrosion-resistant material shall be used for corrosive atmospheres.

1611. Pipe fittings shall be of steel or malleable iron complying with American Standards for a pressure rating based on the pressures used to operate the system.

162. Arrangement and Installation of Piping and Fittings. Piping shall be installed in accordance with good commercial practices.

1621. All piping shall be laid out to produce the desired rate-of-flow at the nozzles, and care shall be taken to avoid possible restrictions due to foreign matter and faulty fabrication.

*NFPA No. 13. Available in pamphlet form and in National Fire Codes Vol. IV from the National Fire Protection Association, 60 Batterymarch St., Boston 10.

1622. The piping system shall be securely supported and shall not be subject to mechanical, chemical, or other damage. Where explosions are possible, the piping system shall be hung from supports that are least likely to be displaced.

1623. Pipe shall be reamed and cleaned before assembly, and after assembly, the entire piping system shall be blown out with dry gas before nozzles or discharge devices are installed.

163. Valves. All valves shall be suitable for the intended use, particularly in regard to flow capacity and operation. Selector valves shall be of the quick-opening type, allowing essential free passage of the dry chemical without restriction. Valves shall be of the listed type or deemed suitable for such use as a part of the system.

1631. Valves shall not be easily subject to mechanical, chemical, or other damage.

164. Discharge Nozzles. Discharge nozzles shall be suitable for the use intended in accordance with subsequent chapters.

1641. Discharge nozzles shall be of adequate strength for use with the expected working pressures.

1642. Discharge nozzles shall be of brass, stainless steel, or other corrosion-resistant materials, or be protected inside and out against corrosion. They shall not be made of combustible materials, and shall withstand the expected temperatures without deformation.

1643. Discharge nozzles shall be able to resist normal mechanical, chemical, or other damage.

1644. Discharge nozzles shall be so connected and supported that they may not readily be put out of adjustment.

1645. Discharge nozzles shall be clearly marked for identification of type and size.

1646. Discharge nozzles shall be provided with protective caps where clogging by foreign materials is likely.

17. Maintenance and Instruction

171. Inspection and Tests. At least annually, all dry chemical systems shall be thoroughly inspected and checked for

proper operation by a competent engineer or inspector. Regular service contracts with the manufacturer or installing company are recommended.

1711. The goal of this inspection and testing shall be not only to insure that the system is in full operating condition, but shall indicate the probable continuance of that condition until the next inspection. Attention at this inspection shall be given to any extension of the hazard protected by the system.

1712. Suitable discharge tests shall be made when any inspection indicates their advisability.

1713. The engineer's report, with recommendations, shall be filed with the owner.

1714. Between the regular service contract inspection or tests, the system shall be inspected visually or otherwise by approved or competent personnel, following an approved schedule.

1715. At least semiannually, all expellant gas cylinders shall be checked for contents. This can normally be done by determining the pressure in the cylinder.

1716. At least semiannually, the dry chemical in the system shall be examined to determine whether it is in freely running powdery condition.

172. Maintenance. These systems shall be maintained in full operating condition at all times. Use, impairment, and restoration of this protection should be reported promptly to the authority having jurisdiction.

1721. Any troubles or impairments shall be corrected at once by competent personnel.

173. Instruction. All persons who may be expected to inspect, test, maintain, or operate dry chemical fire extinguishing systems shall be thoroughly trained and kept thoroughly trained in the functions they are expected to perform.

1731. Training programs approved by the authority having jurisdiction shall be established to accomplish this.

CHAPTER 2. TOTAL FLOODING SYSTEMS

21. General Information

211. Description. A total flooding system consists of a fixed supply of dry chemical permanently connected to fixed piping, with fixed nozzles arranged to discharge dry chemical into an enclosed space or enclosure about the hazard.

212. Uses. This type of system may be used where there is a permanent enclosure about the hazard that is adequate to enable the required concentration to be built up.

2121. Total flooding extinguishment should be used only where no reignition is anticipated, since the extinguishing action is transient.

213. General Requirements. Total flooding systems shall be designed, installed, tested, and maintained in accordance with the applicable rules in the previous Chapter, and with the additional rules set forth in this Chapter.

22. Hazard Specifications

221. Enclosure. Under this class of protection, a well enclosed space is assumed in order to minimize the loss of the extinguishing medium. Total flooding systems should be used in enclosed hazards with all openings in wall or floors closed automatically when the system is discharged.

2211. Total flooding systems shall not be used for fires which may be deep-seated.

2212. The discharge of dry chemical into a closed space may cause a slight egress of flammable vapors and gases, and their safe venting to atmosphere without their spreading to adjacent fire hazards or work areas shall be considered.

222. Leakage and Ventilation. Since the efficiency of the dry chemical system depends upon the development of an extinguishing concentration of dry chemical, leakage of dry chemical from the space shall be avoided.

2221. Openings, such as doorways, windows, etc., shall be arranged to close automatically before, or simultaneously with, the start of the dry chemical discharge.

2222. Where forced air ventilating systems are involved, they shall be shut down and/or closed before, or simultaneously with, the start of the discharge.

223. Types of Fires. Surface fires are the most common hazard particularly adaptable to extinguishment by total flooding systems.

2231. Deep-seated fires involving solids subject to smoldering shall not be protected with dry chemical systems.

23. Dry Chemical Requirements and Distribution

231. General. The factors which must be considered in the total flooding of enclosed spaces with dry chemical are minimum quantity of dry chemical required, the minimum rate of flow of dry chemical, and the limitations of spacing of the nozzles. An example of the data required is included in the Appendix.

NOTE: The limiting specifications for a dry chemical system may very well be a function of the flow characteristics of the particular dry chemical and equipment used by the manufacturer of the system. Therefore, it is not possible, at least at the present time, to specify exact values for quantity required, rate-of-flow required, or nozzle distribution. The above considerations are carried in this pamphlet to point out the important features which should be made available to the purchaser, inspector, or other authorities charged with the examination and evaluation of this system. These data should be established by investigation and tests confirmed by a recognized testing laboratory.

2311. The quantity of dry chemical and flow rate provided shall be sufficient to create a fire extinguishing concentration in all parts of the enclosure despite nominal misalignment of the nozzles.

2312. The nozzles shall be placed so as to provide not less than the minimum design concentration of dry chemical in all parts of the enclosure.

2313. The nozzles shall be located so that the discharge will not be obstructed.

CHAPTER 3.
LOCAL APPLICATION SYSTEMS — FIXED NOZZLE TYPE

31. General Information

311. Description. A local application system consists of a fixed supply of dry chemical permanently connected to a system of fixed piping with nozzles arranged to discharge directly into the fire.

312. Uses. Local application systems may be used for the extinguishment of surface fires in flammable liquids, gases, and shallow solids such as paint deposits, where the hazard is not enclosed or where the enclosure does not conform to the requirements for total flooding. Application of dry chemical may be from nozzles mounted on the tank side or from overhead nozzles.

3121. Examples of hazards that may be successfully protected by local application systems include dip tanks, drainboards, quench tanks, spray booths, oil filled electric transformers, etc.

313. General Requirements. Local application systems shall be designed, installed, tested, and maintained in accordance with the applicable rules in previous Chapters and with the additional rules set forth in this Chapter.

32. Hazard Specifications

321. Extent of Hazard. The hazard must be so isolated from other hazards or combustibles that fire will not spread outside the protected area. The entire hazard must be protected. The hazard shall include all areas that are or may become coated by combustible liquids or shallow solid coatings, such as areas subject to spillage, leakage, dripping, splashing, or condensation, and all associated materials or equipment such as freshly coated stock, drainboards, hoods, ducts, etc., that might extend fire outside or lead fire into the protected area.

322. Location of Hazard. The hazard may be indoors, partly sheltered, or completely out-of-doors. It is essential that the dry chemical discharge be such that winds or strong air currents do not impair the protection.

33. Tank Side Nozzle Systems

331. General. Application of dry chemical from tank side nozzles is desirable where no interference with the discharge will result from normal processes in the hazard.

332. Dry Chemical Requirements and Distribution. The factors which must be considered in the tank side application of dry chemical to a fire area are the minimum quantity of dry chemical required, the minimum rate of flow of dry chemical, the nozzle distribution pattern, and the limitations of placement of nozzles with respect to the flammable liquid surface. See note under Section 231. An example of the data required is included in the Appendix.

3321. The quantity of dry chemical and flow rate provided shall be sufficient to extinguish fires under calm weather conditions, under drastic wind conditions, and under severe updrafts that might be caused by the fire and shall also be capable of extinguishing fires despite nominal misalignment of the nozzles.

3322. In order to provide proper distribution of dry chemical, the nozzles shall be so placed about the hazard that the ranges and discharge patterns at the expected nozzle pressure will completely cover the hazard.

3323. The nozzles shall be so located about the flammable liquid surface as to prevent splashing during discharge.

3324. Drainboard areas shall be treated as if they were deep layer flammable liquid areas. Although it is recognized that fires on drainboards or drip pans are less severe than the deep layer flammable liquid, no distinction has been made in these Standards.

34. Overhead Nozzle Systems

341. General. Certain hazards may require remote placement of nozzles, so as not to interfere with the normal processes occurring in the hazard. This type of application is referred to as local application by overhead nozzles.

342. Dry Chemical Requirements and Distribution. The factors which must be considered in the overhead nozzle application of dry chemical to a fire area are the minimum quantity of dry chemical required, the minimum rate of flow of dry chemical, and the limitations of spacing and placement of nozzles

with respect to the flammable liquid surface. See note under Section 231. An example of the data required is included in the Appendix.

3421. The quantity of dry chemical and flow rate provided shall be sufficient to extinguish fires under all draft conditions and shall also be capable of extinguishing fires despite nominal misalignment of the nozzles.

3422. The nozzles shall be so placed as to provide an extinguishing concentration of dry chemical over the entire hazard during discharge.

3423. The nozzles shall be so located above the flammable liquid surface as to prevent splashing during discharge and yet permit the dry chemical to reach the fire area without being carried away by drafts.

3424. Drainboard areas shall be treated as if they were deep layer flammable liquid areas. Although it is recognized that fires on drainboards or drip pans are less severe than the deep layer flammable liquid, no distinction has been made in these Standards.

CHAPTER 4. LOCAL APPLICATION SYSTEMS — HAND HOSE LINE TYPES

41. General Information

411. Description. Hand hose line systems consist of a hose and nozzle assembly connected, by fixed piping or directly, to a supply of dry chemical. A separate dry chemical supply can be provided for hand hose line use or dry chemical can be piped from a central storage unit which may be supplying several hose lines or fixed manual or automatic systems. See Sub-section 1152.

412. Uses. Hand hose line systems may be used to supplement fixed fire-protection systems, or to supplement first aid fire extinguishers for the protection of specific hazards for which dry chemical is a suitable extinguishing agent. These systems shall not be used as a substitute for other fixed dry chemical fire extinguishing systems equipped with fixed nozzles, except where the hazard cannot adequately or economically be provided with fixed protection. The decision as to whether hose lines are applicable to the particular hazard shall rest upon the authority having jurisdiction.

413. General Requirements. Hand hose line systems shall be installed and maintained in accordance with the applicable provisions of Chapters 1, 2 and 3, except as outlined below.

42. Hazard Specifications

421. Hand hose line systems may be used to combat fires in all hazards covered under Chapter 1, except those which are inaccessible and beyond the scope of manual fire fighting.

43. Location and Spacing

431. Location. Hand hose line stations shall be placed such that they are easily accessible and within reach of the most distant hazard which they are expected to protect. In general, they shall not be located such that they are exposed to the hazard.

432. Spacing. If multiple hose stations are used, they shall be spaced so that any area within the hazard may be covered by one or more hose lines.

433. Actuation. Manual actuation shall be possible at each hose line station.

44. Dry Chemical Requirements

441. Rate and Duration of Discharge. The rate and duration of discharge, and consequently the amount of dry chemical, should be determined by the type and potential size of the hazard. A hand hose line shall have a sufficient quantity of dry chemical to permit its use for a minimum of 30 seconds. The discharge of dry chemical also depends upon the minimum rate-of-flow required to prevent surging and interrupted discharge. An unusually low rate-of-flow will cause the dry chemical and expellant gas to separate out resulting in uneven flow from the

nozzle. These values for minimum rate-of-flow shall be established by the manufacturer.

442. Provision for Use by Inexperienced Personnel. The possibility of these hose lines being used by inexperienced personnel must be considered, and adequate provision made so that there will be a sufficient supply of dry chemical to enable them to effect extinguishment of the hazards they are likely to encounter.

443. Simultaneous Use of Hose Lines. Where simultaneous use of two or more hose lines is possible, a sufficient quantity of dry chemical shall be available to supply the maximum number of nozzles that are likely to be used at any one time for at least 30 seconds and at the appropriate rate-of-flow.

45. Equipment Specifications

451. Hose. Hose lines on systems shall incorporate hose listed for this use. Normally, identifying marking on the hose will indicate the acceptability of the hose for this purpose.

452. Nozzle Assemblies. Nozzles shall be designed so that they can be handled by one man, and must contain a quick-opening shutoff arrangement to control the flow of dry chemical.

453. Hose Line Storage. The hose shall be coiled on a hose reel or rack such that it will be ready for immediate use without the necessity of coupling and may be uncoiled with a minimum of delay. If installed outdoors it should be protected against the weather.

454. Charging the Hose Line. Operation of hand hose line systems depends on manual actuation and manipulation of a discharge nozzle. Speed and simplicity of operation is essential.

4541. The hose lines shall be cleared of dry chemical immediately after use. The pressurizing valve shall remain in the open position during the entire fire-fighting operation.

46. Training

461. Successful extinguishment of fire with hand hose lines is greatly dependent upon the individual ability and technique of the operator. All personnel who are likely to use this equipment at the time of a fire shall be properly trained in its operation and in the fire fighting techniques applicable to this equipment.

APPENDIX, EXPLANATORY

The following Appendix material describes the design data and calculation procedure used for the evaluation of the "Ansul" PS-150, PS-300 and PS-500 piped systems. It is included for two purposes: first, as an example of the type of information which must be made available for the evaluation of a dry chemical system; and secondly, as a means of evaluating the above systems. Since the flow characteristics of a dry chemical system are dependent upon the composition and the physical properties of the dry chemical and the design of the equipment, this design and calculation information is applicable only to the above systems.

A-10. Calculation and Design — General

The following section relates to the design considerations and calculations involved in the layout of a dry chemical system for various methods of application.

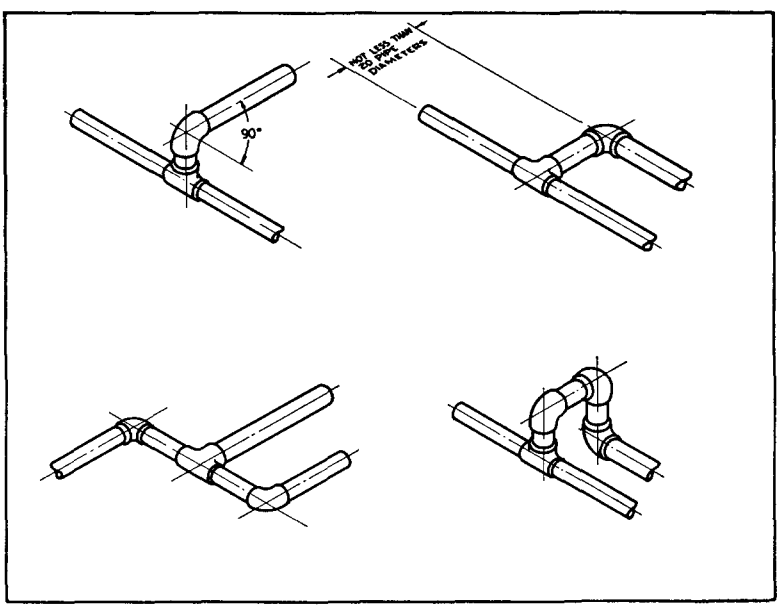

Fig. 1. Illustrations of acceptable means of piping into a tee in a dry chemical system.

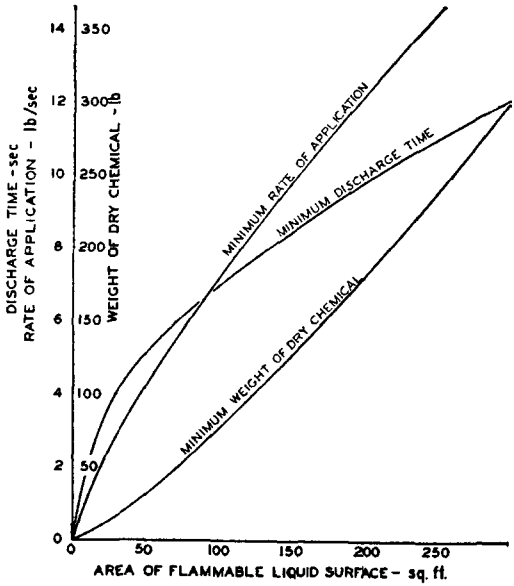

Fig. 2. Design limitations for local application of dry chemical for extinguishment of flammable liquid fires using tank side nozzles.

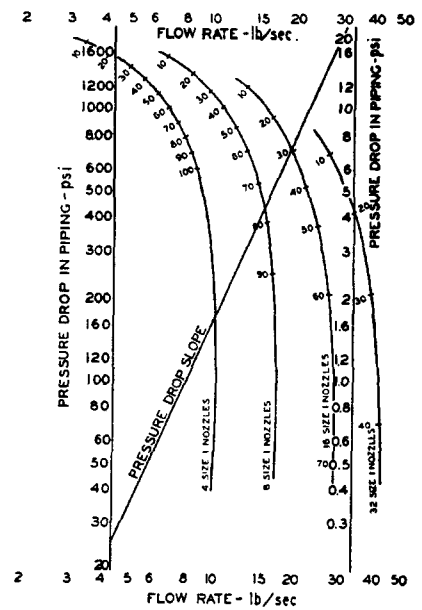

Fig. 3. Dry chemical piped systems flow rate calculation chart.

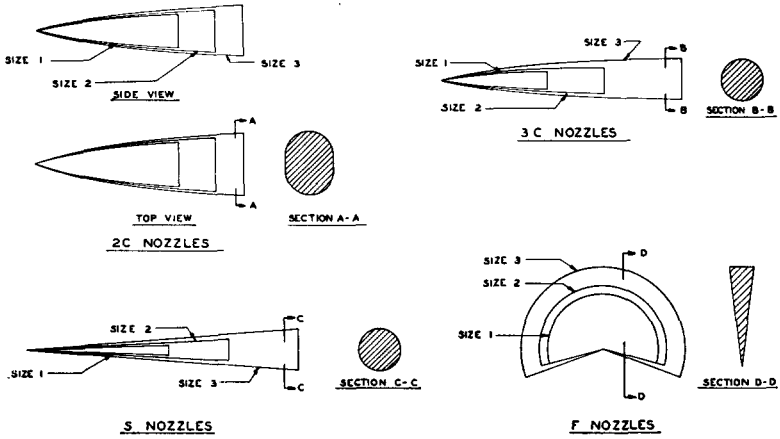

Fig. 4. Scaled comparison of nozzle patterns at 50 psi nozzle pressure.

The following are general rules presently applying to all methods of application:

1. The dry chemical used shall be that supplied by the manufacturer, inasmuch as the characteristics of flow and extinguishment were determined with this agent as used in this manufacturer's equipment.

2. All systems shall be balanced; that is, the pressure drop in one half of the system shall be approximately equal to the pressure drop in the other half. This requires that all splitting in the system be done by leading the supply pipe into a tee and branching equally from both sides of the tee. In no case shall branch piping from a supply pipe be made in any other manner.

3. To prevent separation of the expellant gas and dry chemical, no splitting of the piping shall be done at less than 20 diameters away from an elbow or another tee. In lieu of this, the supply pipe can be mounted so that even if dry chemical is thrown to one side, even splitting of the chemical will result. See Fig. 1 for this method of piping.

A-20. Location Application — Tank Side Nozzles

The three factors to be considered with these systems are the weight of dry chemical, the flow rate, and the distribution. The steps necessary to lay out the system are as follows:

1. Determine the area to be protected.

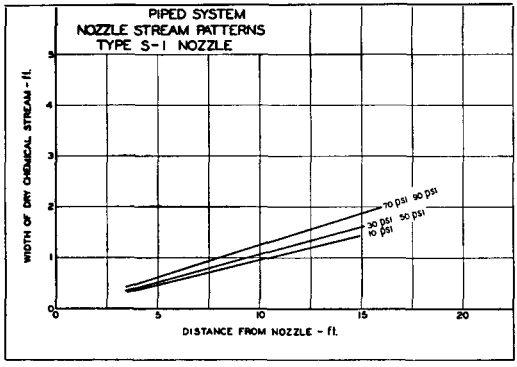

Fig. 5. Piped system nozzle stream patterns, Type S-1 nozzle.

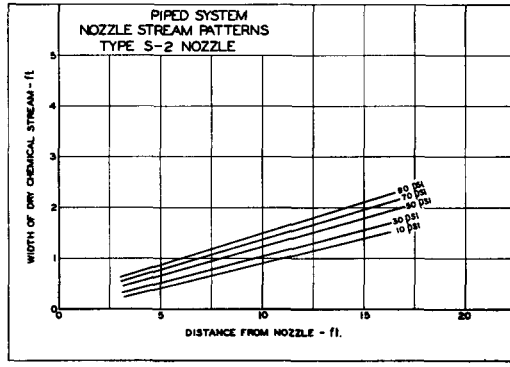

Fig. 6. Piped system nozzle stream patterns, Type S-2 nozzle.

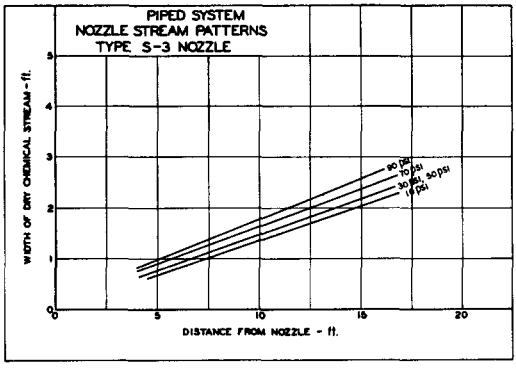

Fig. 7. Piped system nozzle stream patterns, Type S-3 nozzle.

2. Refer to the graph, Fig. 2, and with the area value as the abscissa, determine the ordinate value for the curves on minimum weight and minimum rate required. At the same time, record the minimum discharge time.

3. The weight value determines the size of the unit required.

4. The nozzles shall then be located on the drawing; the number of nozzles to be selected on the basis of coverage provided by the nozzles. It will be of aid to superimpose the discharge patterns on the hazard area. If open areas remain, especially around the perimeter, more nozzles shall be used. Nozzle patterns are shown by Figs. 4 to 17, inclusive. An example of nozzle pattern layout is described in Section A-70.

5. The piping shall be sketched in and designated alphabetically so that "A" is the supply pipe from the unit, "B" the branch piping from "A," "C" the branch piping from "B", etc. Determine the number of feet of each piping required to any one nozzle, keeping in mind that for each ell, 20 ft. of equivalent length is added, and for each tee, 45 ft. of equivalent length is added to the piping. The equivalent length for the tee is added to the smaller piping leading from the tee. The equivalent length of pipe for a selector valve manifold is 90 ft.

6. The pipe sizes are then selected and the pressure drops for an assumed flow rate of 12 lb./sec. are then determined from the chart, Table 1.

7. The total pressure drop is located as an ordinate value on the graph, Fig. 3. (An explanation of the origin of this graph is given in the Section A-60.) A line is drawn through this pressure-drop value, parallel to the "pressure-drop slope" line shown on the graph.

8. The line will intersect one or more of the curves labeled "4 size 1 nozzles," "8 size 1 nozzles," "16 size 1 nozzles," and "32 size 1 nozzles." These are the system choices available. It should be pointed out that, since the nozzle flow rate doubles with each increase in the nozzle number, the curve for the "4 size 1 nozzles" is also the curve for "2 size 2 nozzles," and "1 size 3 nozzle." The same situation exists with the other curves.

9. From the intercept of the curve for the system selected, the calculated values for the system can be picked off the graph. The flow rate is indicated by dropping straight down to the abscissa value on the graph. The nozzle pressure is read from the curve at the point of intercept.

10. Once the flow rate has been determined for the system, it shall be checked to assure that it is not less than the minimum flow rate required as shown by Step 2.

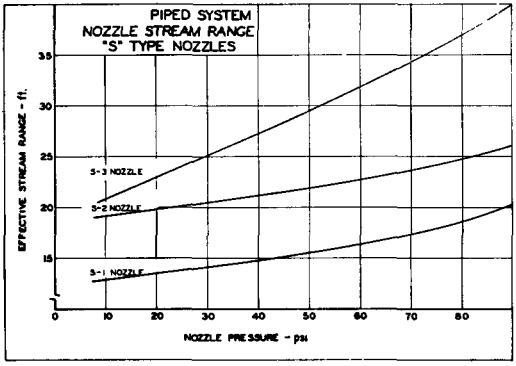

Fig. 8. Piped system nozzle stream range, "S" type nozzle.

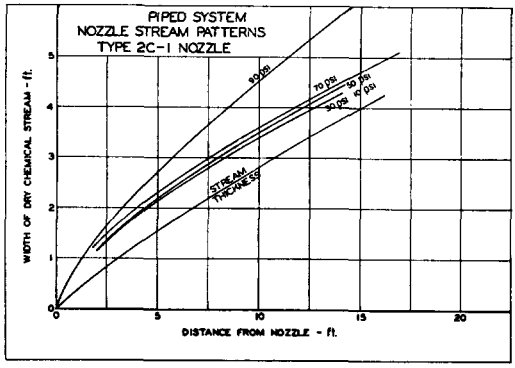

Fig. 9. Piped system nozzle stream patterns, Type 2C-1 nozzle.

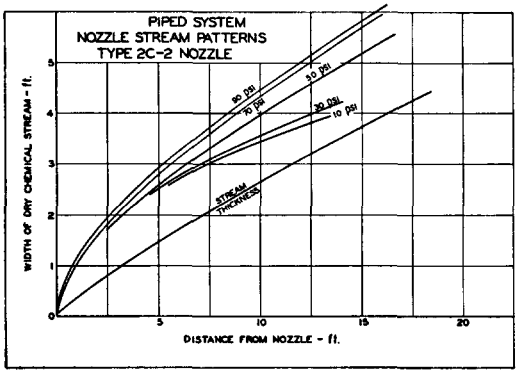

Fig. 10. Piped system nozzle stream patterns, Type 2C-2 nozzle.

11. Also for each size of piping, there is a minimum flow rate below which surging of the discharge stream may result rather than a smooth discharge. These values for the various piping are shown on the pressure-drop chart, Table 1. The actual flow rate shall be not less than the minimum flow rate for each size pipe used in the system.

12. The nozzle pressure as shown on the curve shall be not less than 10 psi.

In summarizing this step-by-step procedure, it should be pointed out that there are several flow rates involved in the problem as follows:

(a) Minimum flow rate required for extinguishment. (Selected from Fig. 2.)

Table 1. Dry Chemical Piped Systems Pressure Drop Calculation Sheet
(all pressure drops based on a system flow of 12 lbs. per sec.)

Pipe Designation	Nominal Pipe Size	Minimum Flow Rate for System	Pressure Drop per ft. of pipe
A	2	12.4 lb/sec	0.128
A	1 1/2	7.3	0.347
A	1 1/4	5.4	0.526
A	1	3.3	1.94
A	3/4	2.0	5.20
B	2	24.8	0.0275
B	1 1/2	14.6	0.0755
B	1 1/4	10.8	0.140
B	1	6.6	0.420
B	3/4	4.0	1.10
B	1/2	2.4	3.38
C	1 1/2	29.2	0.0166
C	1 1/4	21.6	0.0309
C	1	13.2	0.0917
C	3/4	8.0	0.244
C	1/2	4.8	0.780
D	1	26.4	0.0201
D	3/4	16.0	0.0540
D	1/2	9.6	0.160
E	1		
E	3/4	32.0	0.0120
E	1/2	19.2	0.0350
F	1/2	38.4	0.0074

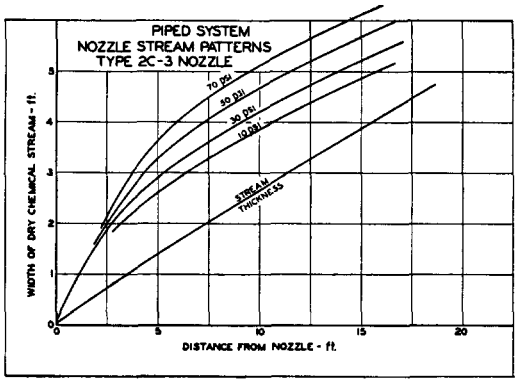

Fig. 11. Piped system nozzle stream patterns, Type 2C-3 nozzle.

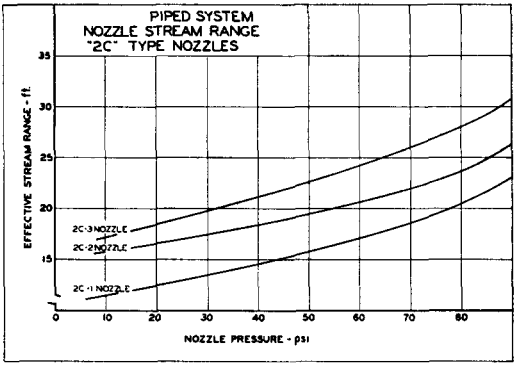

Fig. 12. Piped system nozzle stream range, Type 2C nozzle.

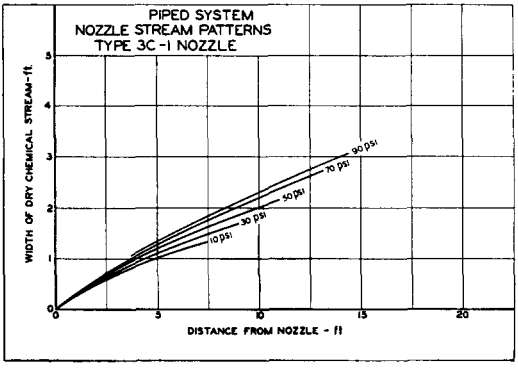

Fig. 13. Piped system nozzle stream patterns, Type 3C-1 nozzle.

(b) Minimum flow rate to prevent surging. (Shown by Column 3 on Table 1.)

(c) Assumed flow rate of 12 lb./sec. to permit the use of the graph shown as Fig. 3.

(d) The actual flow rate as determined by the abscissa value from the graph, Fig. 3.

An example of these calculations is worked out in Section A-50.

The minimum distances between nozzle and liquid surface for the nozzles used for local application are as follows:

F-1 Nozzles.....4 in.
F-2 Nozzles.....6 in.
2C-1 Nozzles.....6 in.
2C-2 Nozzles.....6 in.

A-30. Local Application — Overhead Nozzles

Inasmuch as the data on overhead nozzle application are limited, the use of this system need not involve the calculations covered in the previous section of the report. The following limitations are presently applicable to this method of fire protection:

1. The maximum area to be protected shall be not in excess of 50 sq. ft. This area can be protected by the Model PS-150 unit.

2. This system is intended for protection of indoor hazards only, inasmuch as wind conditions outdoors will influence the discharge.

3. The minimum flow rate shall be as shown for the areas on the graph, Fig. 2, using 150 per cent of the actual hazard area as the abscissa value.

4. The maximum nozzle pressure shall be not greater than 50 psi nor less than 10 psi. This prevents splashing when the nozzles are mounted in accordance with the following recommendations.

5. The distance between the flammable surface and the nozzles shall be as follows:

C Type Nozzles..... 7 ft. to 10 ft.
S Type Nozzles.....12 ft. to 14 ft.

6. The nozzles are to be mounted symmetrically so that one nozzle covers not more than 12½ sq. ft. of area. For rectangular or odd-shaped hazards, the 12½ sq. ft. coverage is applicable, but in addition, the distance between the centerline of the nozzle patterns superimposed on the hazardous area shall be not more

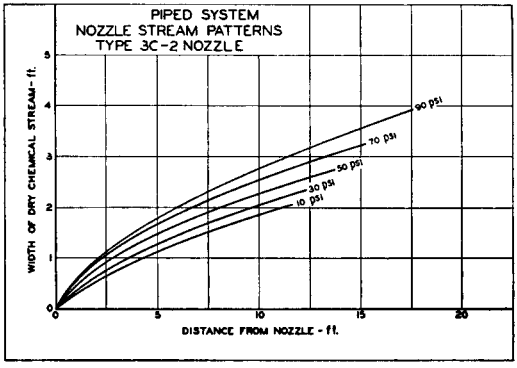

Fig. 14. Piped system nozzle stream patterns, Type 3C-2 nozzle.

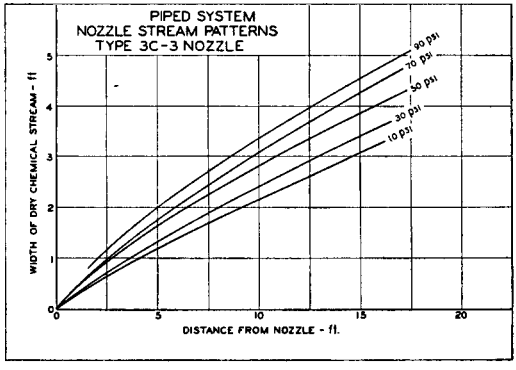

Fig. 15. Piped system nozzle stream patterns, Type 3C-3 nozzle.

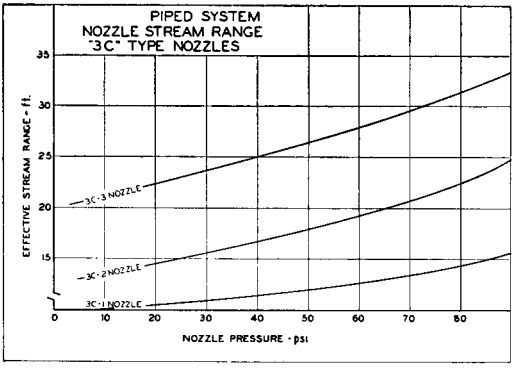

Fig. 16. Piped system nozzle stream range, Type 3C nozzle.

than 4 ft. Spacing is based on these limitations rather than on pattern coverage as is necessary when using tank side nozzles.

NOTE: The calculation of rate-of-flow and nozzle pressure is the same as described previously; namely, determining the total equivalent length of A, B, etc., piping, determining the pressure drop for an assumed rate of 12 lb./sec. on Table 1, picking out the pressure drop on Fig. 3, and drawing a parallel line to the pressure-drop slope line through the pressure drop point to where it intersects the system curves. From this point of intercept, the actual rate-of-flow and nozzle pressure can be determined.

A-40. Total Flooding

The three factors to be considered in total flooding are again, quantity, rate-of-flow and distribution. Based on present available data, the procedure for laying out the system is as follows:

1. Determine the volume to be protected. Allowances in the total volume shall be permitted for machinery or other bulky objects in the room.

2. The volume shall be multiplied by the factor 0.0385 lb./cu. ft. to indicate the minimum quantity of dry chemical required. The volume shall also be multiplied by 0.00125 lb./sec./cu. ft. to indicate the minimum flow rate required.

3. The nozzles shall be distributed symmetrically to result in even distribution of chemical throughout the volume. Distance between centerlines of nozzles shall be not greater than 7½ ft. and distance from nozzle to any wall not greater than 3¾ ft. The maximum volume protected per nozzle shall be not greater than 500 cu. ft.

4. Calculation of rate-of-flow, nozzle pressure, etc., shall be as described previously. The nozzle pressure shall be not less than 10 psi. The D nozzle used for total flooding is a size 1.

5. Total flooding systems shall be used in enclosed hazards with all openings in walls or floors closed automatically when the system is discharged.

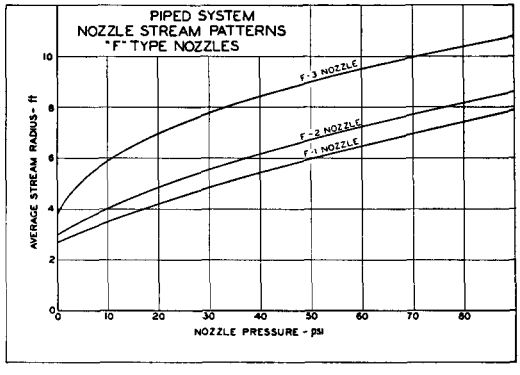

Fig. 17. Piped system nozzle stream patterns, Type F nozzle.

6. The volume to be protected shall be free of obstructions within 6 ft. below nozzles which will interfere with proper distribution of dry chemical over the probable fire area.

7. The maximum volume to be protected shall not exceed 8500 cu. ft.

A-50. Calculation Example — Tank Side Nozzle Protection

Fig. 18 illustrates a typical hazard, a dip tank containing a flammable liquid. Fig. 19 is the calculation sheet used for this example. The following steps are used in the calculations:

1. Using the area of the tank (120 sq. ft.) as the abscissa value, draw a vertical line intersecting the curves for minimum weight of dry chemical, minimum rate of application, and minimum discharge time on Fig. 20. The point of intersection results in values of 96 lb. as the minimum design weight of dry chemical, 8.3 lb./sec. flow rate, and 7.6 sec. minimum discharge time. Thus, a 150 lb. unit would be used.

2. Place nozzles and sketch in piping, labeling it as A for the main supply line, B for the next branch, and so on. Superimposing the approximate nozzle patterns on the area will indicate the number of nozzles to be used.

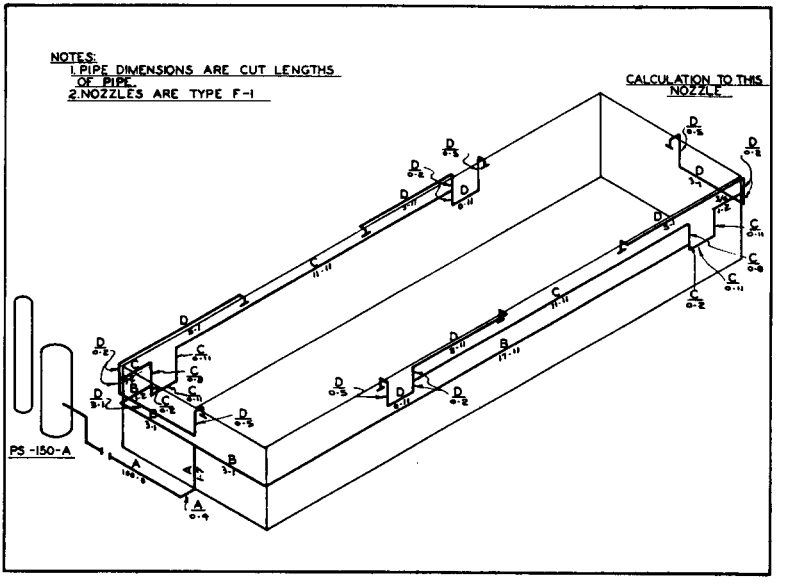

Fig. 18. Example for sample calculation. Dip tank 6 ft. by 20 ft. with 10-in. freeboard.