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TM 5-813-6

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

WATER SUPPLY

WATER SUPPLY

FOR FIRE PROTECTION

This is a reprint of former EM 1110-345-228, 2 July 1958, including effective pages from Changes No. 1 and 2. Redesignated TM 5-813-6 by DA Cir 310-28, 17 March 1965.

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By Order of the Secretary of the Army:

Official:

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*Major General, United States Army,
The Adjutant General.*

HAROLD K. JOHNSON,
*General, United States Army,
Chief of Staff.*

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No. 3

WATER SUPPLY FOR FIRE PROTECTION

TM 5-813-6, 2 July 1958, is changed as follows:

- 1. Remove old pages and insert new pages as indicated below.

Remove pages

Insert pages

5 and 6

5 and 6

- 2. An asterisk appears before each line of text that is changed.

- 3. Below is a list of revised or added pages in the 2 July 1958 issue of TM 5-813-6, with Change 3:

| <u>Page</u> | <u>Issue in effect</u> | <u>Superseded</u> |
|-------------|------------------------|-------------------|
| 6 | C 3 | (Basic) |
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| AI-2 | C 2 | C 1 |

- 4. This transmittal sheet should be filed in front of the publication for record purposes.

By Order of the Secretary of the Army:

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ENGINEERING AND DESIGN
WATER SUPPLY FOR FIRE PROTECTION
Army and Air Force

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ENGINEERING AND DESIGN

WATER SUPPLY FOR FIRE PROTECTION

Army and Air Force

1. **PURPOSE.** This manual prescribes the water-supply requirements for fire protection at Army and Air Force installations. It prescribes the duration, rates of flow, and residual pressure required for fire-hydrant flows and for automatic sprinkler systems. It establishes the method of determining the number and type of pumps to be used for supplying water for fire protection.

2. **SCOPE.** The manual will be used by all Corps of Engineers personnel performing military construction and by Air Force personnel planning military construction.

3. **REFERENCES.**
- a. EM 1110-345-220 Water Supply—General (AFM 88-10, Chap. 1).
 - b. EM 1110-345-221 Water Sources (AFM 88-10, Chap. 2).
 - c. EM 1110-345-222 Water Treatment (AFM 88-10, Chap. 3).
 - d. EM 1110-345-223 Water Storage (AFM 88-10, Chap. 4).
 - e. EM 1110-345-224 Water Distribution Systems (AFM 88-10, Chap. 5).
 - f. EM 1110-345-229 Water Supply for Special Projects (AFM 88-10, Chap. 7).

4. **RESCISSION.** Engineering Manual for Military Construction, Part XI, Chapter 4, October 1946.

5. **GENERAL.** Water supply for fire protection is the quantity of water necessary to support required fire flows, in addition to domestic and industrial consumption at estimated prevailing rates during the period of fire flow. It also includes quantities required to meet automatic sprinkler demands, except as such demands are provided from separate sources, in addition to hose stream demands at reduced fire flows estimated to prevail during periods of sprinkler operation. Overall water-supply-system design at any particular installation will be based upon meeting the predominating largest demand under variable conditions for the maximum prevailing fire-flow requirement. Exception will be made where economic or physical conditions make this optimum requirement infeasible to achieve. Fire flow is the quantity of water in gallons per minute that is required for a specified duration of time to afford effective control of major fire involvement at any designated facility. These quantities are established to provide the required flow of water for delivery from immediate groupings of fire hydrants within 300 feet of the specific facility involved, plus water requirements for integral support of any automatic sprinkler systems that may be involved in the same fire. Fire flows are computed at 10 pounds residual pressure, except where automatic sprinkler support is involved. In such cases reduced fire flow under sprinkler-operation conditions, plus required sprinkler demand must be at a residual pressure adequate for effective sprinkler-system operation. Any deviations from these criteria will be presented to and approved by the Chief of Engineers, or Headquarters U. S. Air Force, through the appropriate service channels.

6. AIR FORCE BASES, ARMY CAMPS, and CANTONMENTS. A study will be made in each case to determine whether an increase in fire-flow requirements is necessary to take care of areas containing large housing units, hospital buildings, office buildings, commercial, industrial, or technical buildings of nonstandard types of construction. Where undivided fire areas in utility and shop buildings approach the size of warehouses, a fire flow the same as for warehouse areas will be provided. Where individual warehouses approach 40,000-square-foot individual fire areas with multiple adjoining sections, the fire-flow requirements will be as described in paragraph 9.

a. *Installations With Population of 6,000 or More.* The design of the water system will in general be adequate to supply water for fire protection to the maximum single fire flow or to two lesser simultaneous fire flows at points remote from one another, each at 1,000 g.p.m. for 4 hours at 10 pounds per square inch residual pressure at fire hydrants.

b. *Installations With Population Over 1,000 but Less Than 6,000.* The design of the water system will in general be adequate to supply water for fire protection to any part of the developed area with a minimum fire flow of 1,000 gp.m. for 4 hours at 10 pounds per square inch residual pressure at fire hydrants.

c. *Small Installations With Population of Less Than 1,000.* With a population from 300 to 499, a fire flow of 150 to 250 g.p.m. for 2 hours is required, without fire pumpers. With a population from 500 to 1,000, it is contemplated that fire pumpers will be provided, and a minimum fire flow of 500 g.p.m. for 2 hours will be provided. The fire-flow requirements for small Air Force installations will be in accordance with applicable provisions of paragraphs 10, 13, 15, 16, 17, and 19.

Note. It is not possible to establish a definite policy that will govern all cases of fire protection for small Army camps and Air Force installations, and final decisions must be made after due consideration has been given to all factors, including initial cost, operating cost, availability of water, use of critical materials and equipment, and the nature of the project.

d. *Prisoner-of-War Camps.* For prisoner-of-war camps the fire flow will be in accordance with the requirements for other projects discussed above.

e. *Housing.* Fire-flow requirements for hose streams will be as shown in table I:

Table I. Fire-Flow Requirements for Hose Streams for Housing

| Type | Hours | Fire-resistive and unprotected (USAF type "N") | Ordinary and wood frame (USAF type "C") |
|-----------------------|-------|--|---|
| | | <i>g.p.m.</i> | <i>g.p.m.</i> |
| <i>Family Housing</i> | | | |
| Single Family | 1 | 500 | 500 |
| Duplex | 1 | 500 | 750 |
| Row | 2 | 750 | 1000 |
| Apartment | 2 | 1000 | 1500 |
| <i>Troop Housing</i> | | | |
| Under 50 Men | 1 | 500 | 750 |
| 50-99 Men | 2 | 500 | 1000 |
| 100-499 Men | 2 | 1000 | 1500 |
| Over 500 Men | 2 | 1500 | 2000 |

Total flows must be available at not less than 10 pounds per square inch at fire hydrants and may be obtained by manual starting of pumps.

7. HOSPITALS. a. *With Automatic Sprinkler Protection.* Fire flows will vary with the number of beds and type of construction. See table II.

Table II. Fire-Flows (g.p.m.) with Automatic Sprinkler Protection (for Hospitals)

| No. of beds | Hours | Fire resistive noncombustible (USAF type "N") | Ordinary and wood frame (USAF type "C") |
|---------------|-------|---|---|
| Under 100 | 2 | 500 (S) + 500 (H) | 500 (S) + 500 (H) |
| 100-499 | 3 | 500 (S) + 500 (H) | 500 (S) + 1,000 (H) |
| 500-999 | 3 | 500 (S) + 500 (H) | 500 (S) + 1,000 (H) |
| 1,000 or more | 4 | 500 (S) + 500 (H) | 500 (S) + 1,000 (H) |

(S) = Supply for Sprinkler Systems
(H) = Supply for Hose Streams

An initial flow of 500 g.p.m. must be available at a residual pressure adequate to discharge a maximum of 500 g.p.m. from those parts of the sprinkler system most remote from the point of supply, without the manual operation of any valves or pumps. This maximum of 500 g.p.m. for sprinklers may be revised downward under certain conditions. The system will also be capable of supplying, concurrently with automatic sprinkler flow, 25 g.p.m. to each of two small-hose stations with minimum residual pressure of 15 pounds per square inch at the uppermost hose outlet. The total volume, sprinkler demand plus hose streams, must be available at the required sprinkler pressure and may be obtained by the prompt manual operation of valves or pumps.

b. Without Automatic Sprinkler Protection. Fire flows will vary with the number of beds and type of construction. See table III.

Table III. Fire-Flows (g.p.m.) Without Automatic Sprinkler Protection (for Hospitals)

| No. of beds | Hours | Fire-resistive noncombustible (USAF type "N") | Ordinary and wood frame (USAF type "C") |
|---------------|-------|---|---|
| Under 100 | 2 | 1,000 | 1,000 |
| 100-499 | 3 | 1,000 | 1,250 |
| 500-999 | 3 | 1,250 | 1,500 |
| 1,000 or more | 4 | 1,500 | 2,000 |

Total flows must be available at not less than 10 pounds per square inch residual at fire hydrants and may be obtained by manual starting of pumps.

8. SPECIAL FACILITIES. a. Administrative, School, Recreational, and Club Buildings. Fire-flow requirements for hose streams in addition to any requirements for automatic sprinklers will be as shown in table IV.

Table IV. Fire-Flow Requirements¹ for Hose Streams (Administrative, School, Recreational, and Club Buildings)

| Area sq. ft. | Hours | Fire-resistive unprotected (USAF type "N") | Ordinary and wood frame (USAF type "C") |
|---------------|-------|--|---|
| Under 5,000 | 1 | 1,000 | 1,000 |
| 5001-10,000 | 2 | 1,000 | 1,000 |
| 10,001-25,000 | 2 | 1,000 | 1,500 |
| 25,001-50,000 | 3 | 1,000 | 2,000 |
| Over 50,000 | 3 | 1,500 | 2,000 |

¹ These requirements are in addition to any requirements for automatic sprinklers.

b. *Commercial, Community, Industrial, and Technical Buildings.* Fire-flow requirements for hose streams in addition to any requirements for automatic sprinklers will be as shown in table V.

Table V. Fire-Flow Requirements (g.p.m.) for Hose Streams¹ (Commercial, Community, Industrial, and Technical Buildings)

| Area sq. ft. | Hours | Fire-resistive unprotected (USAF type "N") | Ordinary and wood frame (USAF type "C") |
|-----------------|-------|--|---|
| Under 5,000 | 2 | 1,000 | 1,000 |
| 5,001-10,000 | 2 | 1,000 | 1,250 |
| 10,001-25,000 | 3 | 1,000 | 1,500 |
| 25,001-50,000 | 3 | 1,500 | 2,000 |
| Over 50,000 | 4 | 1,500 | 2,500 |

¹ In addition to any requirements for automatic sprinklers.

9. STORAGE AREAS, INDUSTRIAL FACILITIES, REPAIR AND PROCESSING SHOPS. a. *General.* Water requirements for fire protection for large depots, posts, industrial facilities, repair and processing shops, and similar projects, including extensive warehouse areas with individual warehouse sections approaching the size of depot warehouses, will vary with the type of storage facility, type of construction, and other local conditions. Tables VI and VII show flows required for individual fire areas in industrial facilities, repair and processing shops, and warehouses either closed or shed-type.

Table VI. Fire-Flows (g.p.m.) with Automatic Sprinkler Protection, for Individual Fire Areas (Industrial Facilities, Shops, and Warehouses)

| Fire Area, sq. ft. | Hours | Fire-resistive noncombustible (USAF type "N") | Ordinary and wood frame (USAF type "C") |
|-----------------------|-------|---|---|
| Under 5,000 | 2 | 500 (S) + 500 (H) | 500 (S) + 500 (H) |
| 5,001-30,000 | 3 | 1,000 (S) + 500 (H) | 1,000 (S) + 500 (H) |
| 30,001-50,000 | 4 | 1,000 (S) + 1,000 (H) | 1,000 (S) + 1,000 (H) |
| Over 50,000 | 4 | 1,000 (S) + 1,000 (H) | 1,500 (S) + 1,500 (H) |

(S) = Supply for Sprinkler Systems
(H) = Supply for Hose Streams

Note. The sprinkler supply must be available without manual operation of valves or pumps. Total flows for sprinklers and hose streams must be available at a residual pressure adequate to discharge the sprinkler (S) requirements from those parts of the sprinkler system most remote from the point of supply. Total flows may be obtained by manual starting of pumps.

Table VII. Fire Flows (g.p.m.) Without Automatic Sprinkler Protection, for Individual Fire Areas (Industrial Facilities, Shops, and Warehouses)

| Fire Area, sq. ft. | Hours | Fire-resistive noncombustible (USAF type "N") | Ordinary and wood frame (USAF type "C") |
|-----------------------|-------|---|---|
| Under 5,000 | 2 | 1,000 | 1,000 |
| 5,001-30,000 | 3 | 1,500 | 2,000 |
| 30,001-50,000 | 4 | 2,000 | 3,000 |
| Over 50,000 | 4 | 3,000 | 4,000 |

Note. The water-supply facilities for large depots and similar projects must be adequate to supply 4,000-g.p.m. for 4 hours, a total of 960,000 gallons in the vicinity of any warehouse. At the 4,000-

g.p.m. rate, the residual pressure must be not less than 10 p.s.i. at the fire hydrants and may be obtained by manual starting of pumps.

b. *Special USAF, AMC Warehouse.* This warehouse, having 80,000-square-foot fire areas, requires a flow of 3,000 g.p.m. for 2 hours with a residual pressure adequate to discharge 1,000 g.p.m. from those parts of the sprinkler systems most remote from the point of supply. An initial flow of 2,000 g.p.m. at sprinkler pressure must be available without manual operation of valves or pumps. The water-supply facilities must be adequate to furnish a total of 4,000 g.p.m. for 4 hours in the vicinity of any AMC warehouse with a minimum residual pressure of 10 p.s.i. at the fire hydrants. The total water requirements will be 960,000 gallons. All requirements in excess of the initial 2,000-g.p.m. demand may be obtained from manually started pumps.

c. *Open Storage Areas.* In open storage areas, without buildings, the water-supply facilities must be adequate to deliver a total of 2,000 g.p.m. for 4 hours at a residual pressure of 10 p.s.i. from two adjacent fire hydrants. This requirement is not in addition to the fire flows in the warehouse areas but will be considered separately in designing the portion of the distribution system in the open storage area.

10. **AIRCRAFT HANGARS.** Army hangars, regardless of size, and Air Force hangars having a total floor area, including shops, exceeding 25,000 square feet will be protected by automatic sprinklers throughout craft areas, shops, offices, stock rooms, etc. Water-supply requirements will vary widely according to type of project.

a. *Hose Streams.* Table VIII covers the water requirements for hose streams but does not include sprinkler demands. Residual pressure at fire hydrant must be not less than 10 p.s.i.

Table VIII. Fire-Flow (g.p.m.) Requirements for Hose Streams (Aircraft Hangars)

| Area sq. ft. | Hours | Fire-resistive noncombustible (USAF type "N") | | Ordinary wood frame (USAF type "C") | |
|-------------------|-------|---|----------|-------------------------------------|----------|
| | | Spr. | Non-spr. | Spr. | Non-spr. |
| Under 15,000 | 2 | 1,000* | 2,000 | 1,000* | 2,000 |
| 15,000 to 50,000 | 2 | 1,000* | 2,000 | 1,000* | 2,000 |
| 50,001 to 100,000 | 2 | 1,000* | 2,000 | 1,500* | 2,500 |
| Over 100,000 | 2 | 1,500* | 3,000 | 2,000* | 4,000 |

* Sprinkler requirements must be added to these amounts.

b. *Closed-Head Sprinkler Systems.* Requirements for closed-head sprinkler systems in repair shops and in Air Force hangars having roof height of 35 feet or less, will be in accordance with table VI above.

c. *Sprinkler Systems in Aircraft Areas.* Requirements for sprinkler systems in aircraft areas of hangars will vary with size of hangar areas. Water supply will be sufficient for the operation of the largest number of sprinklers expected to operate assuming that a fire at any point will operate all sprinklers in every draft-curtained area that is wholly or partially within 75 feet of that point (measured horizontally). Total volume of water will be based on not less than 15 g.p.m. for each sprinkler expected to operate. Supply must be adequate for 45 minutes at the required rate. Where the post or base water system cannot supply water for fire-hose streams in addition to sprinkler demand, the pumps and reservoir will be increased in capacity as required. Standard Drawing No. 70-02-01 will be used as a guide in developing appropriate designs for pumphouses for fire protection of hangars.

11. **PLANT REQUIREMENTS.** Requirements for plants vary widely, according to type of project and location. Generally, large quantities of water must be available for long periods. Usually, it is not necessary to have a separate fire-protection system, although in certain cases it may be necessary, under exceptional circumstances, to maintain a nonpotable supply for fire-protection purposes (see paragraph 6 of EM 1110-345-224, regarding dual systems). If such a supply is utilized, provision should be made for the chlorination of the nonpotable supply, while it is in use, and for flushing out the system afterwards.

12. **SURPLUS-PROPERTY INSTALLATIONS.** It is not contemplated that elaborate underground systems will be provided, but single feeder mains, ramps to natural water supplies, or suction reservoirs will be provided so that water supplies for fire fighting will be available within 1,000 feet of each part of the storage area or within 500 feet of each building. The requirements for water supply for fire protection will be determined for each case. In each instance, available municipal water supply or natural sources of water such as rivers, ponds, etc., will be used before extensive work to attain these requirements is authorized.

13. **AIR CONTROL AND WARNING STATIONS.** Criteria for these stations are given in EM 1110-345-229, Water Supply for Special Projects.

14. **SPECIAL WEAPONS AND ORDNANCE PROCESSING AREAS.** Fire flows for these areas vary and will be determined for each project as required. In general, they will be comparable to those required for facilities of similar size for other storage and industrial use.

15. **POL STORAGE AND HANDLING AREAS.** Installed foam fire-protection systems will not be required on underground fuel tanks or on aboveground tanks having floating roof, or on horizontal tanks or tanks not exceeding 30 feet in diameter or approximately 5,000 barrels in capacity. Installed foam fire-protection systems will be provided for other tanks in accordance with provisions of the National Board of Fire Underwriters Pamphlet No. 11, "Foam Extinguishing Systems," which pertains to semiportable installations with tanks equipped with fixed discharge outlets and piping terminating a safe distance from tanks, as defined in those standards. Water supply for foam extinguishing systems will be 1,000 g.p.m. at 10 p.s.i. residual for 2 hours. Fire hydrants for POL storage and handling areas will be spaced 300 feet apart.

16. **VEHICLE PARKING.** Fire flow will be 500 g.p.m. for 2 hours at 10 p.s.i. residual pressure at vehicle-parking areas and 1,000 g.p.m. for 2 hours at extensive vehicle-storage yards. Hydrants will be spaced so that all recurrently used areas can be reached from at least one hydrant with 300 feet of hose. This requirement includes all nonportable aircraft-maintenance docks or shelters.

17. **AIRCRAFT FUELING, MASS PARKING, SERVICING, AND MAINTENANCE AREAS.** Water supply will be adequate to deliver 500 g.p.m. for 2 hours at 10 p.s.i. residual from each of two fire hydrants. Fire hydrants will be installed along the edge of aircraft parking and servicing aprons, spaced approximately 300 feet apart, so that every part of the apron can be reached by approximately 600 feet of hose. Top of hydrants will not be higher than 24 inches above the ground level. Flush-type fire hydrants will not be used. One or more fire hydrants will be located within 300 feet of all operational service points.

* Request will be made to HQDA (DAEN-MCE-U) WASH DC 20314, for criteria interpretation when necessary.

18. **TENT OR HUTMENT CAMPS.** Water supply for fire protection will be provided only for warehouses, mess halls, latrines, and similar structures. Requirements will be as set forth in paragraph 6 above.

19. SPECIAL PROJECTS. Water-supply requirements for fire protection at National Guard stations, guided-missile stations, and similar projects will be issued by special instructions. (See EM 1110-345-229.)

20. ALLOWANCES FOR DOMESTIC AND INDUSTRIAL DEMAND. In addition to the fire flow, consideration will also be given to that portion of the domestic or industrial demands that cannot be restricted during a fire, in establishing the "fire demand" as defined in EM 1110-345-220.

21. SUMMARY OF FIRE-FLOW REQUIREMENTS. Table IX is a summary of the fire-flow requirements for projects of various types. Fire flows for individual buildings may necessitate an increase over the minimum shown in this table.

Table IX. Minimum Fire-Flow Requirements
(Note: 1 - 2 = 1 fire for 2 hours, S = At Sprinkler Pressure)

| Type of project | 150 to 250 g.p.m. | 500 g.p.m. | 1,000 g.p.m. | 2,000 g.p.m. | 3,000 g.p.m. | 4,000 g.p.m. |
|---|----------------------------|---------------|-----------------|-----------------|-----------------|-----------------|
| I. USAF Bases, Army Camps & Cantonments. | | | | | | |
| a. Population 6,000 and greater Warehouse Area. | | | 2-4 | 1-4S | | |
| b. Population between 1,000 and 6,000 Warehouse Area. | | | 1-4 1-4S | | | |
| c. Population between 500 and 999. | | 1-2 | | | | |
| d. Population between 300 and 499. | 1-2 | | | | | |
| e. Population less than 300 (See par. 6c.) | | | | | | |
| II. Hospitals (See par. 7.) | | | | | | |
| III. Special Facilities (See par. 8.) | | | | | | |
| IV. Storage Projects (See par. 9.) | | | | | 1-2S | 1-4 |
| V. Aircraft Hangars (See par. 10.) | | | | | | |
| VI. Plants, Special Weapons, & Ordnance Processing Areas as determined individually. | | | | | | |
| VII. AC&W Stations (See EM 1110-345-229.) | | | | | | |
| VIII. Surplus-Property Storage (See par. 12.) | | | | | | |
| IX. POL Storage and Handling Areas. | | | 1-2 | | | |
| X. Vehicle Parking. | | 1-2 | | | | |
| XI. Aircraft Fueling, Mass Parking, and Servicing Aprons. | | | 1-2 | | | |
| XII. Tent or Hutment Camps (See par. 18.) | | | | | | |

22. PUMPING STATIONS FOR FIRE PROTECTION. The most satisfactory source of water supply for sprinkler systems is an elevated tank or high-level reservoir. For the initial sprinkler requirements the tank will have a minimum capacity of 75,000 gallons. Another acceptable source is a dependable municipal water system with adequate supply-line connections. Where it is impractical or uneconomical to construct elevated tanks of adequate size to supply all water for fire protection, ground-storage reservoirs and booster pumping stations will be required. Ground-storage and pumping facilities will be designed for the full fire-flow requirements without reduction because of small amounts that may be initially available from elevated storage. The effect of such elevated storage will be con-

sidered mainly in determining the requirements for automatic starting of pumps. If the initial or total required volume of water is available but at insufficient pressure, the necessary pumps may be supplied as a booster-pump installation, provided the underground water-distribution system is adaptable to such an arrangement. Ground-storage reservoirs will be in accordance with Corps of Engineers standard drawings. High water level will be maintained automatically by suitable connections from post or base water systems through back-flow-preventing devices.

a. Selection of Pumps. Pumps will be centrifugal, horizontal-shaft type directly connected to driver by flexible coupling. Pump and driver will be mounted on a common base and installed to operate under a positive suction head at all times. Where economy can be achieved, vertical-shaft turbine-type pumps may be used. Where the fire demand exceeds 1,000 g.p.m., two or more pumps will be used. Each fire pump will generally have a capacity not in excess of 1,000 g.p.m. except where this limitation would necessitate the installation of more than five pumps. The maximum rated capacity of any pump will be 2,500 g.p.m. Pump pressure should normally not exceed 100 pounds per square inch. Raising the pressure above this will be avoided to the maximum extent possible.

b. Pumps for Hose Streams and Closed-Head Sprinkler Systems. Pumps supplying hose streams alone, or hose streams in addition to automatic sprinkler systems having closed heads only, will generally be engine-driven only and manually controlled except where automatically controlled electric-motor-driven pumps are necessary for supplying initial automatic closed-head-sprinkler-system demand as discussed herein. Elevated storage on the distribution system, preferably 250,000 gallons but not less than 75,000 gallons, will be provided to furnish the initial sprinkler demand. Where under normal operation without fire pumps, a flow of 1,000 g.p.m. at a residual pressure suitable for automatic sprinkler operation is available in addition to the average daily demand, fire pumps may be manually controlled. Where in addition to the average daily demand, a flow of 500 g.p.m. to 1,000 g.p.m. is available but where the initial sprinkler demand exceeds the available supply, one 1,000 g.p.m. electrically driven pump will be equipped for automatic starting. Where a flow of less than 500 g.p.m. is available, a number of 1,000 g.p.m. electrically driven pumps sufficient to supply the initial sprinkler demand will be equipped for automatic starting.

Automatic starting of fire pumps may be accomplished by drop in pressure in the underground distribution system where characteristics of the water-supply system are such that a sprinkler demand of 500 g.p.m. will cause sufficient line-pressure drop at the pump, and maximum domestic and industrial demand will not cause unnecessary starting of pumps. Where distribution-system pressure cannot be utilized, automatic fire pumps will be started by waterflow from any sprinkler system. Automatically started fire pumps will not be arranged to stop automatically. Equipment for the control of automatic fire pumps will be in accordance with the standards of the National Board of Fire Underwriters.

Where electric power is economically available from two independent and reliable sources, pumps will be electric-motor-driven only. Where such power is not available, dual-drive pumps will be installed with automatic starting on the electric motor only.

c. Pumps for Deluge Sprinkler Systems. So far as feasible, the post or base water system will furnish fire-hydrant demands, thus reserving reservoir and pump service for sprinklers. A reliable and automatic method that does not require starting of any of the large pumps will be provided for filling and pressurizing the supply between pumps and sprinkler systems. Back-flow-preventing devices will be required between the potable-water system and the ground-storage reservoir.

All pumps will be equipped for automatic and manual starting but will not be arranged for automatic stopping. The first pump will be started by each of the following means: the operation of a deluge valve, the operation of a thermostatic system, the flow of

water through the alarm check valve of any closed-head system involved. The second and subsequent pumps will be started in sequence upon drop in pressure due to increased demand for water.

Where two independent and reliable sources of electric power meeting all the requirements of the National Board of Fire Underwriters' Pamphlet No. 20 are available or can be provided economically, pumps will be electric-motor-driven only. Where such power supply is not available, pumps will be engine-driven only. Dual drive will not be provided.

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APPENDIX I

PUMPING STATION FOR FIRE PROTECTION OF HANGARS

Air Force

1. Fire pumps will be gasoline- or diesel-engine-driven. Dual drive (internal combustion engine - electric motor) or engine-generator will not be provided.
2. Automatic internal-combustion-engine pump controllers will be of an approved type as evidenced by the attachment of the seal or label of a nationally recognized agency adequately equipped and competent to perform such services, such as the Underwriters' Laboratories, Inc., or the Factory Mutual Laboratories.
3. Engine storage batteries will be substantially supported, secured against displacement, and located where they will not be subject to excessive heating or expose electrical control panels to the effects of escaping vapors.
4. Carburetors of the down-draft type will have suitable provision, in addition to the carburetor float valve, for preventing delivery of liquid gasoline to the engine cylinders. This provision may be a drain from the intake manifold piped to discharge to a safe location.
5. Back-flow-prevention-device arrangement as shown on Sheet No. 5 of Standard Drawing No. 70-02-01 is a mandatory requirement.
6. Jockey pump, pressure tank, and accessory equipment will be provided to pressurize the systems served by fire pumping stations where available pressure from existing mains is less than 30 p.s.i. The fire-pump-starting control system will be so arranged that the fire pumps will be responsive to a reduction in pressure in the supply system resulting from the operation of any deluge or closed-head system served by the pumping station.
7. Fire pumps and reservoirs will be sized to provide a 45-minute full-capacity flow and as indicated below:

EM 1110-345-228
Change 2
15 Jan 64

| <u>Hangar Dwg No.</u> | <u>Single-Stage Capacity-gpm</u> | <u>Centrifugal Fire Pumps Head-psi</u> | <u>Quantity</u> | <u>Reservoir Capacity(gal)¹</u> |
|-----------------------|--------------------------------------|--|-----------------|--|
| AW 39-01-65,66,& 67 | 1500 | 80 or 100 | 3 | 200,000 |
| AW 39-01-73 | 2000 | 80 or 100 | 4 | 360,000 |
| AW 39-01-74 | 2000 | 80 or 100 | 2 | 250,000 |
| | 1500 | 80 or 100 | 1 | |
| Special hangars | 2500 | 100 | 4 | 450,000 |

¹Where there is an adequate volume of water available but the residual pressure is inadequate for direct supply, a booster pumping station taking suction from the supply mains will be considered. In this event the pressure characteristics of the pumps will be adjusted and the reservoir will be deleted.

8. Louvered openings for ventilation of pump houses will be sized in accordance with climatic requirements, and means will be provided to restrict the size of such openings during cold weather.