CROSS CONNECTION CONTROL

New York State
Department of Health

PUBLIC WATER SUPPLY GUIDE

CROSS-CONNECTION CONTROL

January 1981

(Reprinted 2012)

Bureau of Water Supply Protection

NEW YORK STATE DEPARTMENT OF HEALTH

TABLE OF CONTENTS

	Pages
Preface	P-1
PART 1 – MANAGERIAL CONCEPTS	
Section 1, POLICY	1-1
Section 2, RESPONSIBILITIES	
A. State Department of Health	2-1
B. Supplier of Water	2-1
C. Customer Section	2-1
Section 3, RECOMMENDED PROGRAM FOR SUPPLIERS OF WATER	
Step 1 - Understanding Cross-Connection Control Concepts	3-1
Step 2 - Determine the Legal Foundation of your Program	3-1
Step 3 - Establish a Priority System	3-2
Step 4 - Estimate Customer Implementation Costs	3-2
Step 5 - Develop a Proposed Implementation Timetable	3-3
Step 6 - Review your Data & Proposed Procedure with the Local Health Department Engineer	3-4
Step 7 - Explain the Proposed Program to your Management	3-4
Step 8 - Plan an Executive Information Session	3-4
Step 9 - Notify Affected Customers	3-5
Step 10 - Monitor Program Progress	3-5
Step 11 - Initiate Testing Requirements	3-5
PART 2 – TECHNICAL CONSIDERATIONS	
Section 4, DEFINITIONS	4-1
Section 5, CROSS-CONNECTION CONTROL PRINCIPLES	
A. The Containment Method	5-1
B. The Internal Plumbing Method	5-1
Section 6, DETERMINING THE DEGREE OF HAZARD	
A. Use, Toxicity, and Availability of Contaminants	6-1
1. Hazardous Facilities	6-2
2. Aesthetically Objectionable Facilities	6-3
3. Non-Hazardous Facilities	6-3
B. Availability of a Supplementary Supply of Water	6-4

TABLE OF CONTENTS (Continued) Pages

C. Fire Fighting System Evaluation 6-5 6-4

1. Wet System 6-5
2. Dry System 6-6
3. System Water Supply Arrangements (AWA M-14) 6-7

D. Corresponding Backflow Protection Recommended: (AWWA M-14) 6-8

E. Illustrations of Containment Control 6-8

Section 7, TYPICAL INSTALLATION DETAILS

A. Principles 7-1
B. Double Check Valve Assemblies 7-2
C. Reduced Pressure Zone Device 7-4
D. Air Gap 7-7

Section 8, ACCEPTABLE DEVICES

A. Determination of Acceptability 8-1
B. Unacceptable Devices 8-2

Section 9, PLANS & SPECIFICATIONS

A. Preparation 9-1
B. Submission and Approval 9-1

Section 10, TESTING & MAINTENANCE

A. Testing 10-1
B. Test Procedure for Double Check Valve Assemblies 10-2
C. Test Procedure for Reduced Pressure Zone Devices 10-5
D. Maintenance 10-7

Appendix A, INTERNAL PLUMBING CONTROL PROGRAM FOR THE ELIMINATION OF CROSS-CONNECTIONS

Appendix B, REFERENCES

PREFACE

A cross-connection control program is effective so long as there is a cooperative effort between the supplier of water, Health Department and the water customer. Education and careful surveillance are the keynotes to success.

To that end, this Guide has been prepared to present the New York State Department of Health policy and requirements for cross-connection control and to provide guidance and direction to the supplier of water seeking an effective program.

State policy requires a degree of protection commensurate with the degree of hazard regardless of whether the hazard is immediate or potential.

The management aspects described in Section 3 must be thoroughly understood in order to begin a successful program.

POLICY

A. Hazardous cross-connections must be promptly eliminated.

B. Cross-connection control is the responsibility of the supplier of water and the water customer (Part 5, New York State Sanitary Code, Subpart 5-1 Public Water Supplies, Section 5-1.31).

C. Cross-connection control by containment must be employed and requires the installation of an acceptable backflow prevention device in every water service line to a facility for which a potential hazard exists. Such devices should be installed at or as near the property line of the facility as possible.

D. The degree of protection shall be commensurate with the degree of hazard. The following is a minimum:

Degree of Hazard of Facility	Protection Required
Hazardous	Either an Air Gap or a Reduced Pressure Zone Device
Aesthetically Objectionable	Double Check Valve Assembly
Non-Hazardous	Internal Plumbing Control

E. Internal plumbing control necessary for the protection of the on-premise user, is not equivalent to containment, but is a necessary adjunct to a totally protective program. The water customer is responsible to prevent cross-connections within his facility.

F. Testing and maintenance records shall be kept by the supplier of water for each required backflow prevention device.

G. The planning and implementation steps, including suitable timetables, of a supplier's cross-connection control program should receive the endorsement of the Local Health Department Engineer.

H. When initiating a cross-connection control program, a supplier should first put a major emphasis on isolating those facilities that pose the greatest hazard in the most vulnerable portion(s) of the distribution system.

I. All plans and specifications relating to cross-connection control must be approved by the local water supply official and the State Department of Health. A completed works approval is also required for the installation of acceptable backflow prevention devices at all new customer facilities, and for corrections to installations at existing customer facilities.

RESPONSIBILITIES

A. State Department of Health

The Department of Health is authorized by the Public Health Law § 201 to supervise and regulate the sanitary aspects of water supplies. A community's water supply system must be free of all sanitary hazards, including unprotected cross-connections. Accordingly, the Department can require the supplier of water to take preventive action against any water customer who may pose a threat to the public water supply system and see to it that such a customer is required by the supplier to install, test and maintain an acceptable backflow prevention device.

The Department of Health also requires that customers prevent cross-connections in on-premises piping systems.

B. Supplier of Water

The supplier of water responsibility for cross-connection control is found in Part 5 of the State Sanitary Code, Section 5-1.31 entitled, "Cross Connection Control."

The supplier of water is responsible to assure that water of questionable or unsuitable quality does not enter the public water supply system.

The supplier is required to determine the degree of hazard that a facility poses to his water supply system, and to require that an acceptable backflow prevention containment device be installed, tested, operated and maintained and that adequate records of maintenance and repair be kept.

C. Customer

The customer has the primary responsibility of preventing contaminants from entering the potable water piping system and subsequently, the public water supply.

He shall, as required by the supplier of water per Part 5, Section 5-1.31 (a) and (b), install, test, operate, maintain and keep adequate maintenance and repair records for every backflow prevention device installed to provide containment. Additionally, as stated in Part 5, Section 5-1.31(c), the customer shall prevent cross-connections between the potable water piping system and any other piping system within his facility.

RECOMMENDED PROGRAM FOR SUPPLIERS OF WATER

Suppliers of water should carefully consider the following implementation steps when developing a cross-connection control program. All aspects of a properly planned program should be understood before beginning any particular portion.

Although a successful program has the valuable benefit of providing protection for the customer, it also can have significant impact on the time demands of the water department. In addition, acceptable backflow prevention devices are expensive. Usually, the need for control is a surprise to the customer. These facts reinforce the need to understand the implementation steps and their interdependence.

STEP 1: UNDERSTANDING CROSS-CONNECTION CONTROL CONCEPTS

Do you understand the material in this publication? If not, it is going to be difficult to explain cross-connection concepts to your customers – or to your superiors.

If there are portions of this material that are confusing or unclear, call your Local Health Department or the Bureau of Public Water Supply Protection for assistance.

Clear up your questions before proceeding.

STEP 2: DETERMINE THE LEGAL FOUNDATION OF YOUR PROGRAM

Part 5-1.31 of the New York State Sanitary Code is the legal basis for your cross-connection control program.

A local ordinance which further defines requirements, jurisdiction, and enforcement procedures may already exist. If not, adopting one is recommended.

Small suppliers in particular must decide whether to assume the responsibility for plumbing control when the community has no separate plumbing or building jurisdiction.

Most suppliers have some type of authority to enter the customer's premises. If not, this responsibility should be established.

County Health Departments may have promulgated more stringent requirements. Find out if there are in legal form, get copies, and evaluate how they may affect your program decisions.

In summary, find out what rules and regulations are in effect and the affect from your own ordinances. Discuss these with your attorney.

Make sure you are familiar with the legal basis for your program.

STEP 3: ESTABLISH A PRIORITY SYSTEM

Become familiar with the technical section of this publication called "Determining the Degree of Hazard".

Make three master lists with the following titles:

(1) Hazardous Facilities

(2) Aesthetically Objectionable Facilities

(3) Non-Hazardous Facilities

Using the billings for your service area and the lists provided in Section 6 (Determining the Degree of Hazard) develop a master list of company names.

For Non-Hazardous Facilities, enter only those customers that raise a follow-up question in your mind.

Review your distribution system records and identify areas of

... chronic low pressures

... chronic leakage

... chronic breaks

Draw these areas by outline or shading on a distribution system map. You have now pictured those portions of your water supply system most vulnerable to potential contamination from cross-connections.

Develop priority tables as follows:

1st priority - those Hazardous Facilities located within the most vulnerable portion of your distribution system.

2nd priority - those Aesthetically Objectionable facilities within the most vulnerable area.

3rd priority - those Hazardous facilities not within the most vulnerable portion of your distribution system.

4th priority - those Aesthetically Objectionable facilities not within the most vulnerable area.

STEP 4: ESTIMATE CUSTOMER IMPLEMENTATION COSTS

It will be helpful to know the economic impact on the customer, industry group and community. The installation of backflow prevention devices is relatively expensive and may require budget planning. Implementation timetables must consider budget implications.

A rough installation cost estimate can be made by using the following assumptions and procedures:

... assume that all "Hazardous Facilities" will use RPZ (air gaps are usually more expensive since elevated tanks or ground storage tanks with pumping facilities would be required).

... assume that each water service line on your priority lists requires a backflow prevention device.

... assume that the average RPZ installation includes separate above-grade housing, drainage and heat.

... assume that the average DCV installation includes a pit and heating.

... from your records, determine the number of water service lines for each customer in your priority listings.

The total cost per facility will be the cost for a device installed per water service line times the number of service lines.

Manufacturer's technical representatives can provide the most recent equipment costs.

STEP 5: DEVELOP A PROPOSED IMPLEMENTATION TIMETABLE

You now have sufficient data to begin implementation. Develop a reasonable timetable plan. The following is an example:

1st year
- Develop program plan
- Get management approval
- Amend local regulations if needed
- Start educational program

2nd year
- Notify priority # 1 & # 2 customers of requirements
- Receive and approve plans for priority #1 & #2 customers
- Continue educational program

3rd year
- Priority #1 & #2 devices installed
- Notify priority #3 & #4 customers of requirements
- Receive & approve plans for priority #3 & #4 customers
- continue educational program

(cont'd next page)

Priority #3 & #4 devices installed
Get first testing results from priority #1 & #2 customers
Followup & update functions

Get first testing results from priority #3 & #4 customers
Followup & update functions
Consider enforcement actions

STEP 6: REVIEW YOUR DATA & PROPOSED PROCEDURE WITH THE LOCAL HEALTH DEPARTMENET ENGINEER

At this point, it is recommended that you review the information developed with the Local Health Department Engineer. Discuss the various aspects of your proposed implementation plan. Adjust the proposed program to your mutual satisfaction.

The program requirements and the potential impact can be developed to this point by water department staff, with assistance from the local health department. It is important to gather this information prior to program implementation. Your superiors must be informed of the benefit and impact to the community before customers are notified of cross-connection control program requirements.

STEP 7: EXPLAIN THE PROPOSED PROGRAM TO YOUR MANAGEMENT

Explain the program to your management personnel. With the above information, you should be able to answer most questions. After a series of meetings or at a time when all questions have been answered, request endorsement of the proposed cross-connection control program.

If you do not receive endorsement of the proposed program, refer the matter to the Local Health Department Engineer.

STEP 8: PLAN AN EXECUTIVE INFORMATION SESSION

After you have management's endorsement, arrange a series of informal informational meetings with major customers that you anticipate will be affected by your cross-connection control program. This meeting should be an educational session with a generous opportunity for questions and discussion.

These sessions should precede the issuing of "formal" notices of your cross-connection control requirements. A general public informational meeting would also be advisable.

STEP 9: NOTIFY AFFECTED CUSTOMERS

Notify, by letter, first and second priority customers that require containment control.

The letter should be brief, clear, and solicit their cooperation. A joint meeting between you and the customer should be suggested to answer questions. Include a tour of the facility to confirm your information on the number of service connections and the degree of potential hazard.

If new information dictates, revise the priority listing of the customer or revise the timetable of achieving compliance.

If the customer challenges your requirements, explain your legal authority in a second letter. Solicit help from your legal counsel or from your Local Health Department Engineer as necessary.

Attempt to develop agreement on what is needed to be done and a specific customer timetable of compliance. Once agreement has been achieved, confirm the agreement in writing.

STEP 10: MONITOR PROGRAM PROGRESS

Followup as necessary to determine that customer compliance and overall program implementation is progressing satisfactorily.

Notify your Local Health Department Engineer every six (6) months of the progress you are making in your cross-connection control program.

STEP 11: INITIATE TESTING REQUIREMENTS

Once containment devices have been approved and installed, review the testing requirements with each customer, including frequency of testing (a yearly test should be considered a minimum), and how to report the testing results. Form DOH-1013 could be used. (See Section 10 Testing &Maintenance).

DEFINITIONS

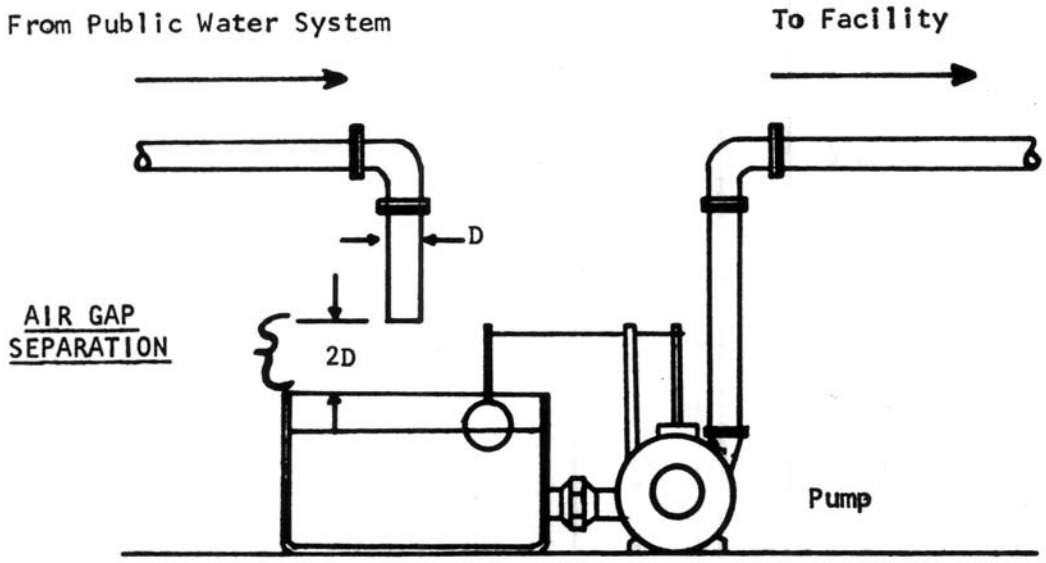
1. Acceptable Backflow Prevention Device is an acceptable air gap, reduced pressure zone device or double check valve assembly as used to contain potential contamination within a facility.

2. Acceptable Devices are those devices or assemblies found to be acceptable for containment control in New York State in accordance with the Department of Health requirements as outlined in Section 8 of this Guide.

3. Aesthetically Objectionable Facility is one in which substances are present, which if introduced into the public water supply system could be a nuisance to other water customers, but would not adversely affect human health. Typical examples of such substances are: food-grade dyes, hot water, stagnant water from fire lines in which no chemical additives are used, etc.

4. Air Gap Separation means the unobstructed vertical distance through the free atmosphere between the lowest opening from any pipe or faucet supplying water to a tank, plumbing fixture, or other device and the flood level rim of the receptacle. The differential distance shall be at least double the diameter (D) of the supply pipe. In no case shall the air gap be less than 1 inch. (See FIG. 4-1).

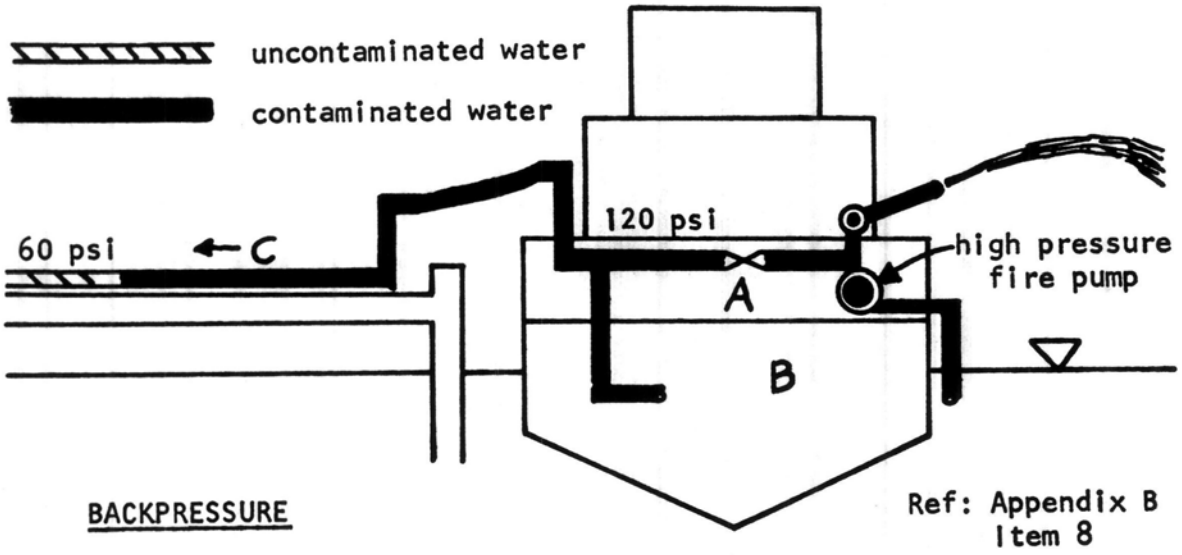
FIG. 4-1



5. Backflow means a flow condition, induced by a differential in pressure, that causes the flow of water or other liquids and/or gases into the distribution pipes 0f.a public water supply from any source other than its intended source.

6. Backpressure means the resulting backflow of contamination, polluted, or otherwise unacceptable quality water from a plumbing fixture or other customer source(s) into a public water supply system due to a greater pressure within the customer's water system. (See FIG. 4-2).

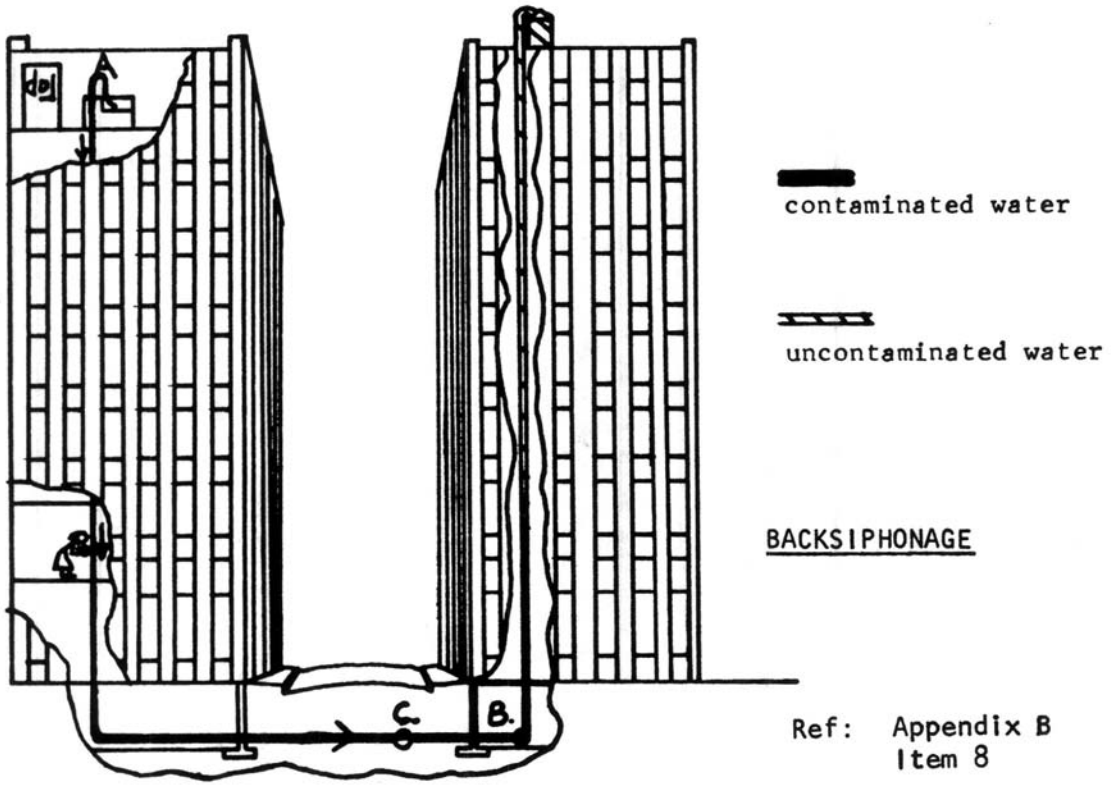
FIG. 4-2



Example: Only the valve at A separates the potable and the sea water systems aboard a vessel. The vessel's potable water system, at B, is being filled from the public water supply system at C which is delivering water at a pressure of 60 psi. At the same time, the sea water fire fighting system is activated, which provides sea water at a pressure of 120 psi. If valve A is open, or leaks, the sea water will be forced into the public water supply system.

7. Backsiphonage means the backflow of contaminated or polluted water, or water of questionable quality from a plumbing fixture or other customer source(s), into a public water supply system main due to a temporary negative or sub-atmospheric pressure within the public water supply system. (See FIG. 4-3).

FIG. 4-3



Example: A hose is submerged in a laboratory sink at A. Both buildings are connected to the same public water supply system, C. This main often lacks adequate pressure. The building on the right has installed a booster pump in the basement at B, in order to alleviate low pressures. The booster pump could deplete the water in main C, thereby subjecting the customer's water system to a pressure less than atmospheric thus causing a reversal of flow from the laboratory in the opposite building.

8. Customer means a water user served by a public water system.

9. Customer's Water System means the piping used to convey water supplied by a public water supply system throughout a customer’s facility.

10. Containment means cross-connection control which isolates the customer's entire facility from the public water system so as to provide the protection necessary to prevent contamination of the public water supply in the event of backflow from the customer's facility.

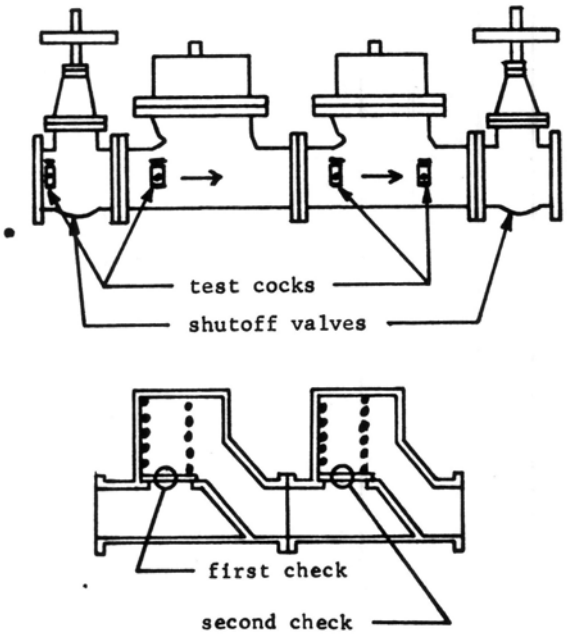
11. Contamination means the presence in water of a substance that tends to degrade its quality.

12. Cross-Connection means a physical connection through which a water supply could be contaminated.

13. Degree of Hazard means whether a facility is rated as Hazardous, Aesthetically Objectionable or Non-Hazardous.

14. Double Check Valve (DCV) Assembly, Acceptable means two single independently acting check valves, including tightly closing shutoff valves located at each end of the assembly and suitable connections for testing the watertightness of each check valve. (See FIG. 4-4).

FIG. 4-4



DCV

15. Hazardous Facility is one in which substances may be present which if introduced into the public water system would or may endanger or have an adverse effect on the health of other water customers. Typical examples: laboratories, sewage treatment plants, chemical plants, hospitals, mortuaries.

16. Interconnection is a joining of two independently operated public water supply distribution systems.

17. Local Health Department Engineer is the city, county, district or regional health department engineer having jurisdiction.

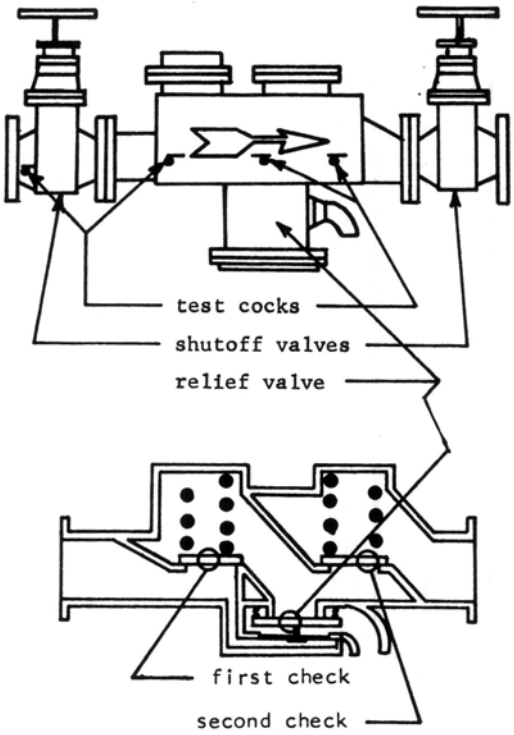
18. Non-Hazardous Facility is one which does not require the installation of an acceptable backflow prevention device.

19. Plumbing Control is prevention and elimination of cross-connections within the customer's water system by enforcement of building or plumbing codes.

20. Public Water Supply System means a supplier of water system including the source, treatment works, transmission mains, distribution system and storage facilities serving the public.

21. Reduced Pressure Zone (RPZ) Device, Acceptable means a minimum of two independently acting check valves, together with an automatically operated pressure differential relief valve located between the two check valves. During normal flow and at the cessation of normal flow the pressure between these two checks shall be less than the upstream (supply) pressure. I n case of leakage of either check valve, the differential relief valve, by discharging to the atmosphere, shall operate to maintain the pressure between the checks at less than the supply pressure. The unit must include tightly closing shutoff valves located at each end of the device, and each device shall be fitted with properly located test cocks. (See FIG. 4-5).

FIG. 4-5



RPZ

22. Supplementary Supply means any water source or system, other than the public water supply, that is available within the water customer's facility.

23. Supplier of Water means the owner or operator of a public water system.

CROSS-CONNECTION CONTROL PRINCIPLES

A. The Containment Method

Using the containment approach to cross-connection control results in totally isolating a facility with a potential hazard from the public water supply system. Each water service line to such a facility must be protected in a manner commensurate with the degree of hazard.

When any portion of a consumer's water supply system is rated hazardous, then the entire system receives the same rated degree of hazard. That includes piping for potable as well as non-potable water. Under certain conditions, fire sprinkler system connections to a public water supply system may warrant a separate evaluation of the type of protective device required. See Section 6 for details.

Protecting the public water supply system by virtue of containment has important advantages for the supplier of water. A containment program is managed with greater administrative ease than a program requiring just internal cross-connection control devices. Once a facility is contained, only routine maintenance and testing of the backflow prevention devices installed on the water service connections is required to ensure protection of the public water supply system.

This is in contrast to continued reinspections of the facility's piping system. Identifying and eliminating all cross-connections in complex piping systems is a difficult and repetitive task.

Historically, the supplier of water has been held accountable when backflow from a customer's facility has contaminated the public water supply system. Positive safeguards of distribution system water quality, which are inherent in a containment oriented cross-connection control program, help to limit the liability of a supplier of water should a backflow condition occur within a facility.

B. The Internal Plumbing Method

Even after a facility has been contained and the public water supply system protected, the on-premise user is still vulnerable to potentially contaminated water if cross-connections exist within the facility. Additionally, there is a need for effective plumbing code enforcement for those facilities rated as non-hazardous, such as private homes and small stores with simple plumbing systems which may have plumbing code violations.

Local plumbing and building codes or ordinances are intended to control these cross-connection hazards. Administration and enforcement of plumbing/building codes or ordinances is usually a function of a local department or agency other than the supplier of water.

The supplier of water should avoid internal plumbing responsibilities when other local departments have jurisdiction.

The supplier of water should evaluate the local plumbing control program and where it is weak, consider all commercial facilities as either hazardous or aesthetically objectionable. Where a comprehensive inspection program exists, he may consider certain commercial establishments non-hazardous.

The intent here is to urge the supplier to develop a comprehensive cross-connection control program wherein initially he concentrates on those facilities representing the highest risk of possible contamination of the public water supply through cross-connections.

DETERMINING THE DEGREE OF HAZARD

To achieve containment, an acceptable backflow prevention device must be installed in every service connection to a facility.

Three categories should be considered when determining the degree of hazard posed by a facility and making the subsequent determination of the type of protective device required. They are:

A. Use, Toxicity, and Availability of Contaminants

B. Availability of a Supplementary Supply of Water

C. Fire Fighting System Evaluation

Based on these considerations, it will be possible to rate a facility as hazardous, aesthetically objectionable or non-hazardous.

A hazardous facility must be contained through the use of a RPZ or an air gap.

An aesthetically objectionable facility must be contained through the use of a DCV.

Non-hazardous facilities should be protected through an internal plumbing control program to ensure that plumbing cross-connections are adequately protected or eliminated.

A. Use, Toxicity, and Availability of Contaminants

The following listings will be helpful in determining the degree of hazard posed by a particular facility based on use and availability of contaminants.

It is not possible to list every circumstance and facility type that may be encountered by a supplier while evaluating his customers. The supplier, while evaluating a facility, also should rely on good common sense and the help of the Local Health Department Engineer. Valuable references such as those listed in Appendix B are very useful in determining the degree of hazard.

1. Hazardous Facilities

The following partial listing gives examples of the types of facilities which would require an acceptable RPZ or air gap to be installed in the service connection to the public water distribution system.

Type of Facility	Potential Hazard
Sewage & industrial wastewater treatment plants & pumping stations, sewer flushers, etc.	Sewage industrial wastewater, contaminated water, toxic chemicals, etc.
Paper manufacturing or processing, dye plants, petroleum processing, printing plants, chemical manufacturing or processing, industrial fluid systems, steam generation, rubber processing, tanneries	Toxic chemicals, water conditioning compounds Examples: Toxic dyes, acids, alkalies, solvents, quaternary ammonia compounds, mercury, chromium, etc.
Canneries, breweries, food processing, milk processing, ice manufacturing, meat packers, poultry processing, rendering companies, etc.	Process wastewater, steam, detergents, acids, caustics, refrigeration lines
Hospitals, clinics, laboratories, veterinary hospitals, mortuaries, embalmers, etc.	Bacterial cultures, laboratory solutions, blood & tissue waste, toxic materials, etc.
Shipyards, marinas, etc.	Sea water, sewage, contaminated water, etc.
Metal-plating, photo-processing, launderies, commercial car washes, commercial refrigeration systems, dry cleaning establishments, etc.	Toxic chemicals, concentrated cleaning agents, solvents, etc. Examples: Cyanides, fluorides, copper, chromium, caustic & acid solutions, etc.
Commercial greenhouses, spraying & irrigation systems using weedicides, herbicides, exterminators	Toxic chemicals Examples: Ammonium salts, phosphates, 2.4 D sodium arsenite, lindane, malathion, etc.

Boiler systems, cooling towers or internal fire - fighting systems using conditioners, inhibitors, corrosion control chemicals, etc. Typically: apartment buildings cooling towers warehouses	Toxic chemicals Examples: Hydrazine, sodium compounds, antifreeze solutions, etc.

2. Aesthetically Objectionable Facilities

The following partial listing gives examples of the types of facilities which would require an acceptable OCV to be installed in the service connection to the public water distribution system.

Type of Facility	Potential Hazard
Customer fire protection loops, fire storage tanks; with no chemical additives	Stagnant water, objectionable tastes, odors
High temperature potable water	Objectionable temperatures
Utilization of food grade dyes	Objectionable color
Complex plumbing systems in commercial buildings Typically: barber shops beauty salons churches apartment buildings gas stations supermarkets nursing homes construction sites carnivals	Plumbing errors, obsolete plumbing equipment, poor plumbing inspection/correction programs

3. Non-Hazardous Facilities

The containment approach would not apply. The following partial listing indicates the type of facility that would probably qualify:

Type of Facility	Corrective Measures
Private homes	None; rely on internal plumbing control
"Dry" commercial establishments without complex plumbing systems	

B. Availability of a Supplementary Supply of Water

The existence of a supplementary supply of water available to a facility may create the situation wherein the facility rating changes to a more severe category.

As an example, see FIG. 6-5. In this case, the warehouse was rated as aesthetically objectionable since only the stagnant water in the fire system was of concern.

However, the existence of the well (the supplementary supply) which was of unsatisfactory quality, yet necessary for fire protection, resulted in changing the facility rating to hazardous. Consequently, a RPZ must be installed in the service connection to the public water supply distribution system.

In the instance where the supplementary source water quality is found acceptable, an agreement should be reached between the supplier and the water customer for a sampling program appropriate to monitor the supplementary source water quality. The customer should be made aware, that if at any time the New York State Drinking Water Standards are exceeded, an acceptable RPZ or air gap will have to be installed on the service connection to the public water supply system.

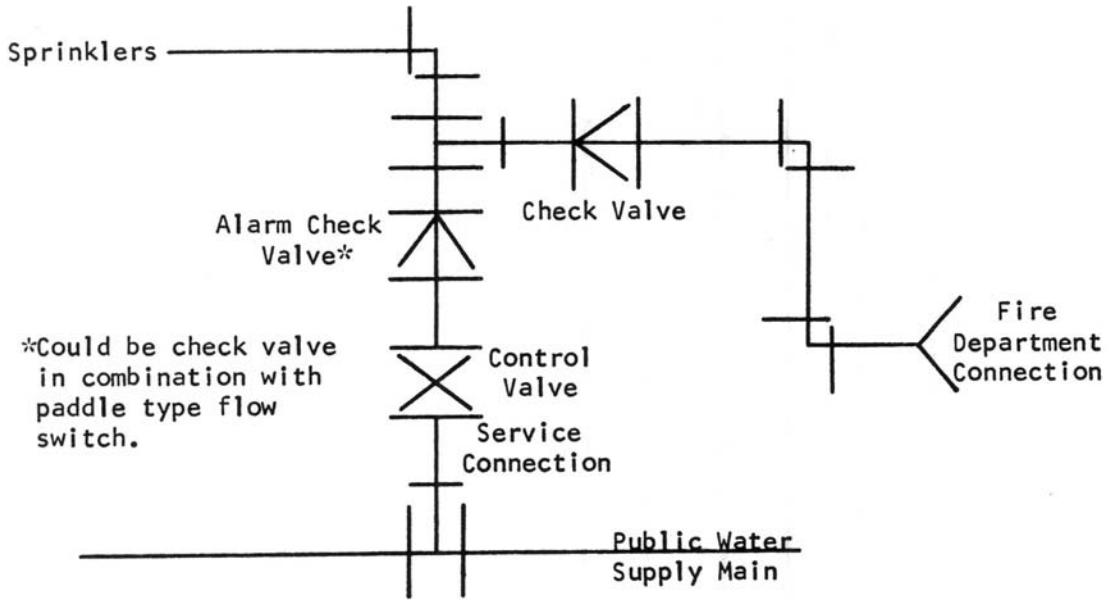
C. Fire Fighting System Evaluation

A separate evaluation of the fire fighting system in use at a facility is generally required because of the number of variables involved in making the determination of adequate protection of the public water supply system.

Two types of automatic fire sprinkler systems comprise the majority of fire fighting systems.

1. Wet System

The first and most common is the wet system. (FIG. 6-1). The piping for this system contains water at all times, is connected to a pressurized water supply and instantly discharges water when the sprinklers open.

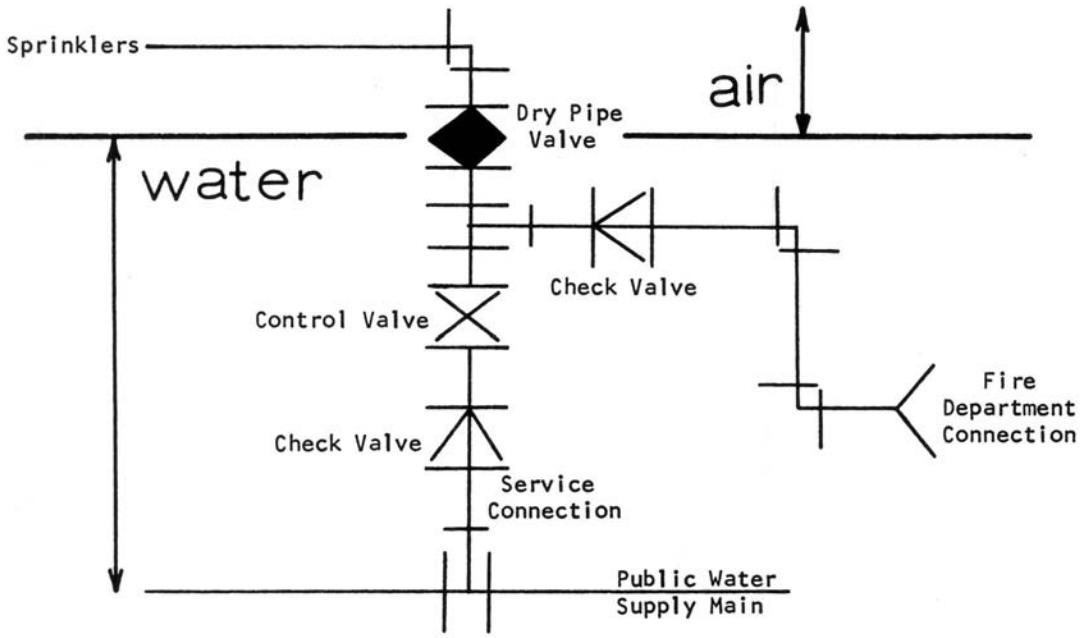


WET SYSTEM (FIG. 6-1)

2. Dry System

The dry system (FIG. 6-2) has the same piping arrangement as a wet system, however, the lines are filled with air under pressure.

A dry pipe valve separates the air filled piping from the source water. It opens allowing water to flow when a sprinkler opens and releases the air pressure.



DRY SYSTEM (FIG. 6-2)

There are two other types of dry systems which have special uses – the deluge system and the preaction system. They have air under atmospheric pressure in the sprinkler lines and use deluge valves rather than dry pipe valves. In the deluge system, the sprinklers are always open and all sprinklers discharge at the same time. In preaction systems, the sprinklers selectively discharge water.

FIGURES 6-1 & 6-2 reflect the basic requirements of the National Fire Protection Association (NFPA) standards, which serve as the industry design standards.

The National Fire Codes published annually by the NFPA require:

1. a minimum 4" service connection.
2. a fire department connection on the sprinkler system side of the check valve.
3. alarms for systems with 20 or more sprinklers.

The sprinkler system service connection is usually an independent connection to the public water supply and as such should be separately evaluated as to the hazard posed.

Fire department connections are used to pump water into the sprinkler system. The quality of water pumped into the sprinkler system may be of concern.

The alarms used in the systems serve to eliminate cross-connections between the sprinkler system and the domestic system since any flow would set off the alarms.

3. System Water Supply Arrangements (AWWA M-14)

The following outlines the type of acceptable backflow prevention device required by class of sprinkler system used ("AWWA Manual No. M-14, Backflow Prevention and Cross-Connection Control").

The device is the minimum needed to satisfy containment requirements and applies only to sprinkler systems connected to public water supply water mains.

Class 1 – direct connections from public water mains only; no pumps, tanks, or reservoirs; no physical connection from other water supplies; no antifreeze or other additives of any kind; all sprinkler drains discharging to atmosphere, dry wells, or other safe outlets.

Class 2 – same as Class 1, except that booster pumps may be installed in the connections from the street mains (Booster pumps do not affect the potability of the system; it is necessary, however, to avoid drafting so much water that pressure in the water main is reduced below 20 psi).

Class 3 – direct connection from public water supply main plus one or more of the following: elevated storage tanks; fire pumps taking suction from above ground covered reservoirs or tanks; and pressure tanks (All storage facilities are filled or connected to public water only, the water in the tanks to be maintained in a potable condition. Otherwise, Class 3 systems are the same as Class 1).

Class 4 – directly supplied from public mains similar to Classes 1 and 2, and with an auxiliary water supply on or available to the premises; or an auxiliary supply may be located within 1,700 ft. of the pumper connection.

Class 5 – directly supplied from public mains, and interconnected with auxiliary supplies, such as: pumps taking suction from reservoirs exposed to contamination, or rivers and ponds; driven wells, mills or other industrial water systems; or where antifreeze or other additives are used.

Class 6 – combined industrial and fire protection systems supplied from the public water mains only, with or without gravity storage or pump suction tanks.

D. Corresponding Backflow Protection Recommended: (AWWA M-14)

Class 1 – none, other than the check valve required by the National Fire Code.

Class 2 – none, other than the check valve required by the National F i re Code.

Class 3 – will generally require minimum protection (approved DCV) to prevent stagnant waters from backflowing into the public potable-water system.

Class 4 – will normally require backflow protection at the service connection. The type (air gap, RPZ, or DCV) will generally depend on the quality of the auxiliary supply. Will normally need maximum protection (air gap or RPZ) to protect the public potable-water system.

Class 5 – will normally need maximum protection (air gap or RPZ) to protect the public potable-water system.

Class 6 – protection would depend on the requirements of both industry and fire protection, and could only be determined by a survey of the premises.

E. Illustrations of Containment Control

FIG. 6-3 A storage warehouse has an automatic sprinkler system, rest rooms and kitchen facilities.

There is no source of water other than the public water supply for fire fighting purposes.

The facility consists of a Class 1 sprinkler system and does not use contaminants. Rated non-hazardous. The National Fire Code requires a check valve in the water service connections.

FIG. 6-4 A storage warehouse has a fire fighting system, rest rooms and kitchen facilities. It also has a fire storage tank on the roof. Based on a potential stagnant water condition (Class 3 sprinkler system) a DCV is required.

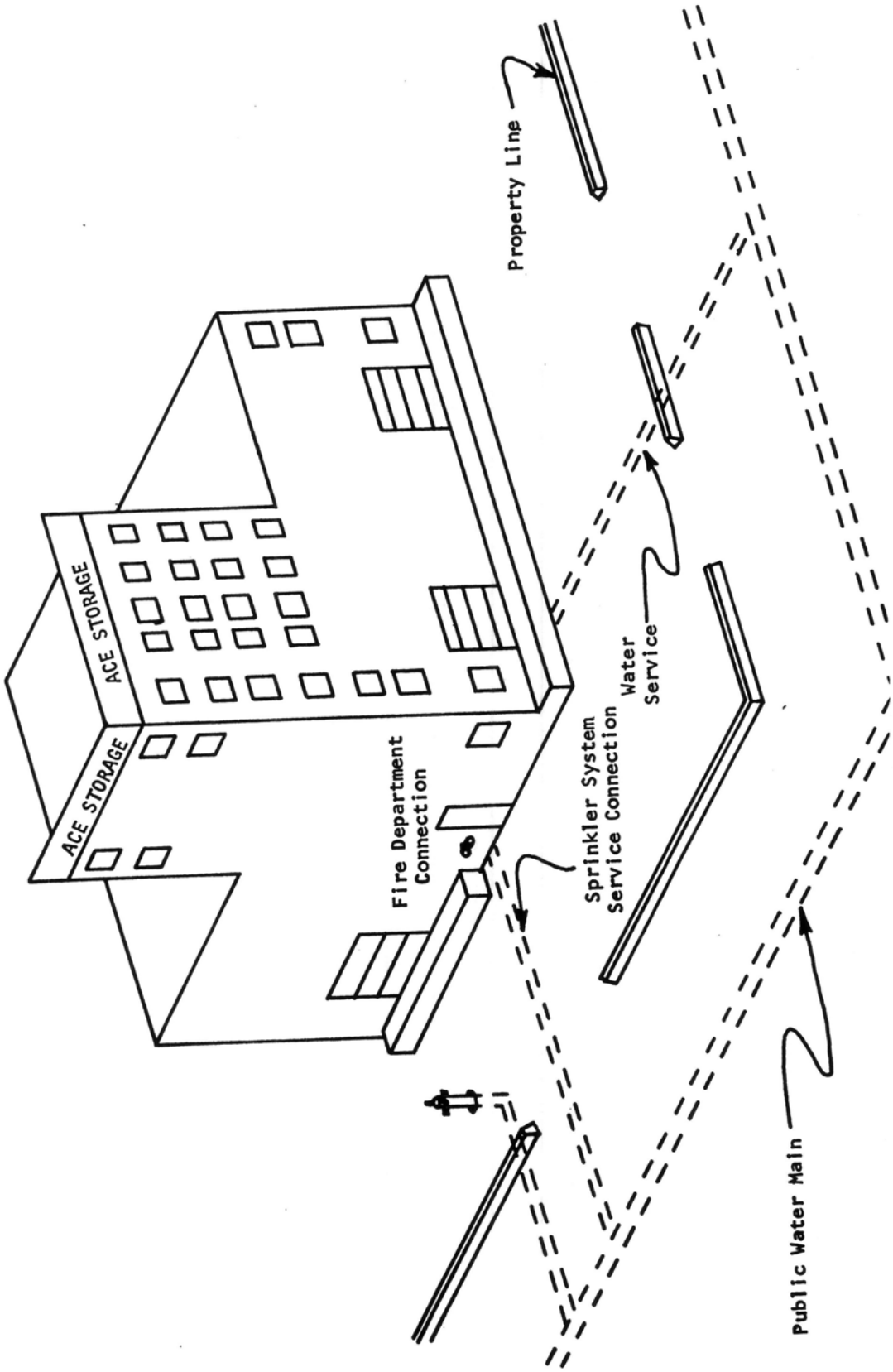

ACE STORAGE
ACE STORAGE
Fire Department Connection
Sprinkler System Service Connection
Water Service
Property Line
Public Water Main

FIG. 6-3

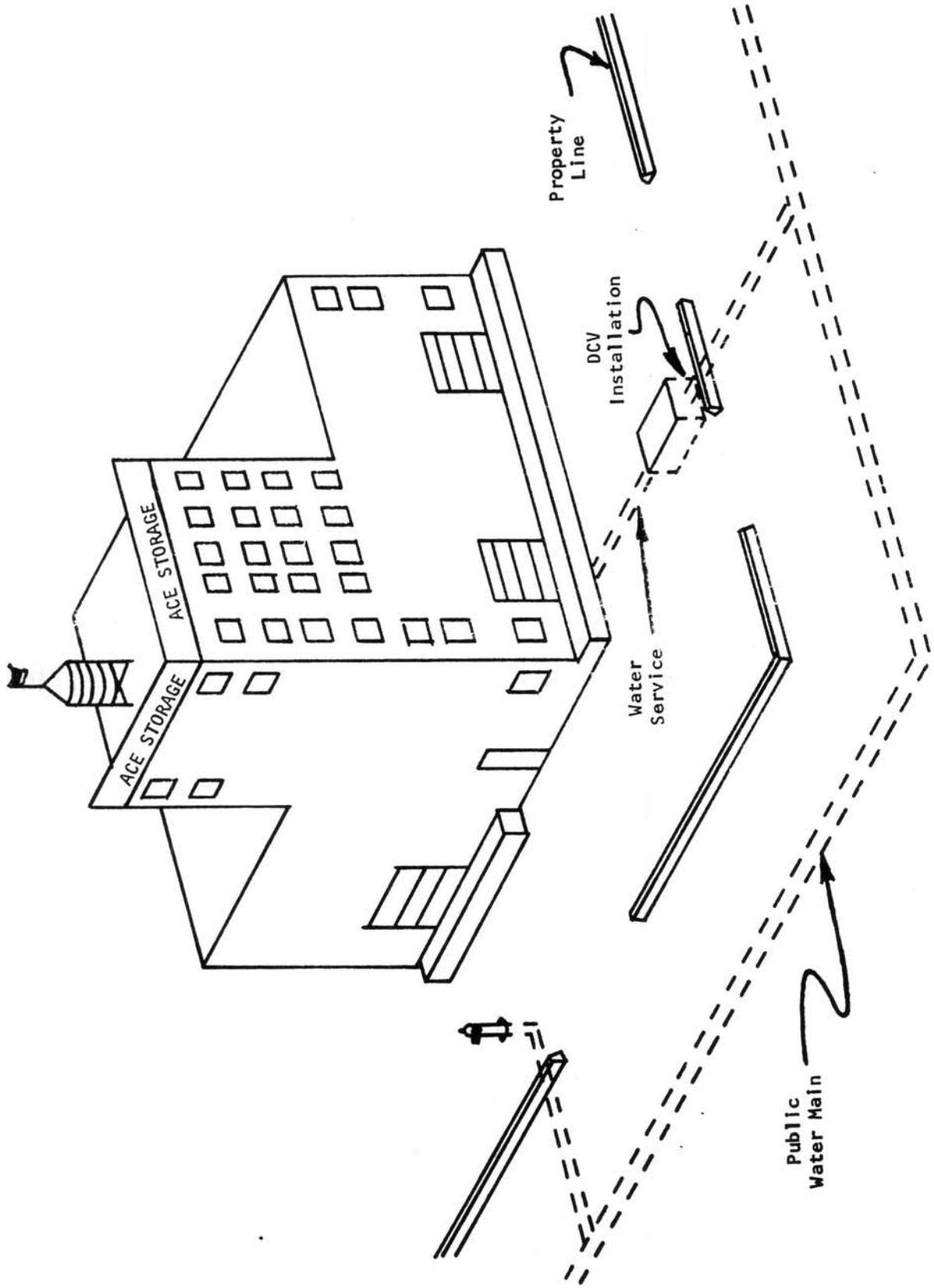

ACE STORAGE
ACE STORAGE
Property Line
DCV Installation
Water Service
Public Water Main

FIG. 6-4

FIG. 6-5 A commercial facility's administrative headquarters and warehouse has a fire loop and internal sprinklers. A supplementary supply (well) is interconnected to augment fire flows and is available for use within a customer's facility. The backflow prevention device required is dependent on two determinations:

1. the degree of hazard, i.e. hazardous, aesthetically objectionable or non-hazardous.
2. whether the supplementary supply meets the requirements of Part 5, Public Water Supplies.

The facility is initially rated as aesthetically objectionable since the stagnant water in the fire system is the only item of concern, however, through laboratory tests it is shown that the well does not meet the requirements of Part 5.

Therefore, the degree of hazard for the facility is hazardous and a RPZ or an air gap must be installed in the water service connection.

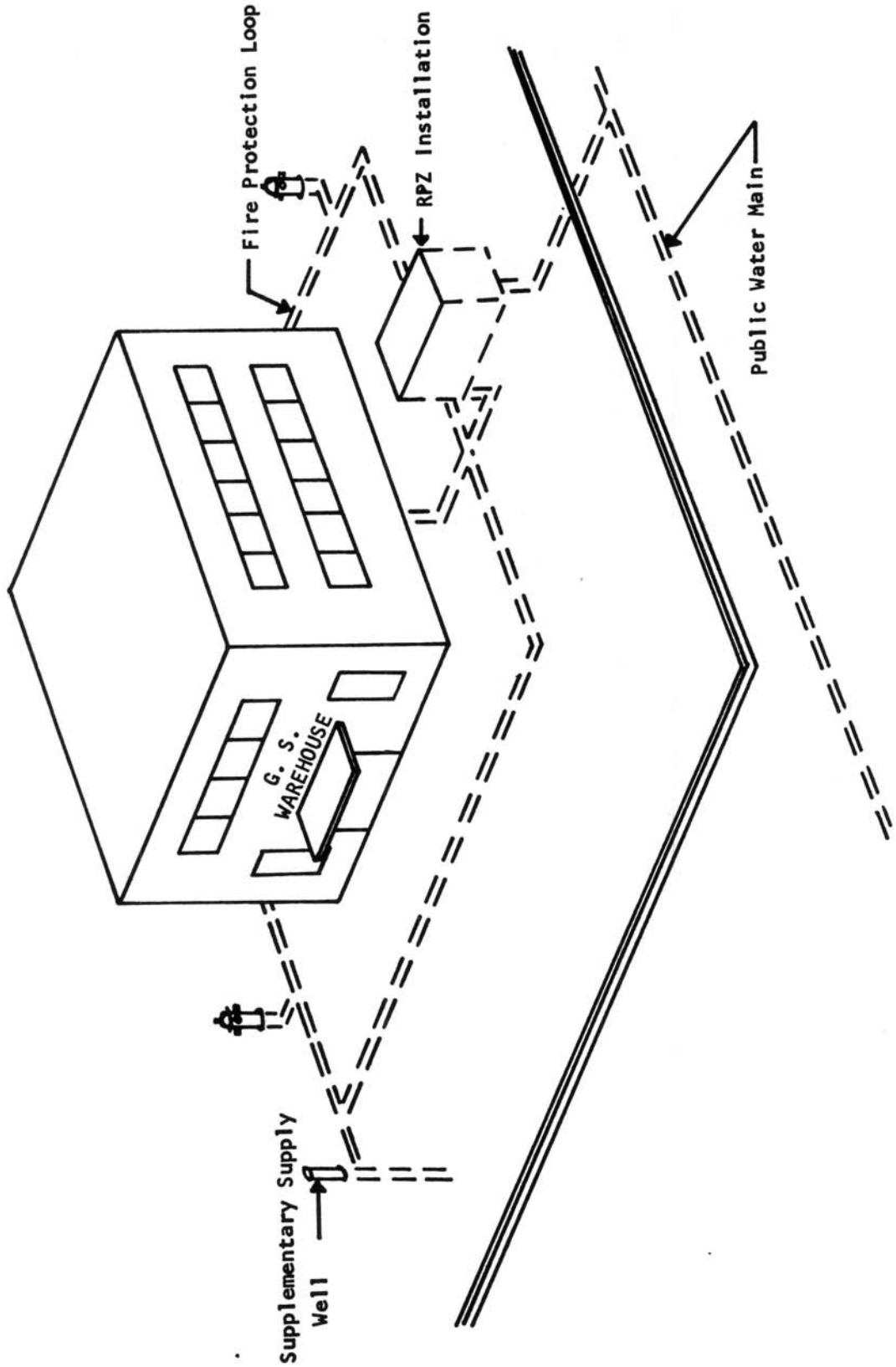

Fire Protection Loop
RPZ Installation
Public Water Main
G. S.
WAREHOUSE
Supplementary Supply
Well

FIG. 6-5

FIG. 6-6 A chemical process or manufacturing facility with two connections to the public water system. Each connection requires an air gap or RPZ installation because the customer's facility has been rated as hazardous.

This protective device is installed as close as possible to the public water system connection.

The sprinkler system is a Class 1 type since only the public water supply is available for fire fighting purposes. A protective device beyond that required by the National Fire Codes is not required.

NOTE: Where a customer has multiple connections to the public distribution system, significant economies can be achieved by reducing the number of connections.

FIG. 6-7 This medical laboratory is rated as hazardous and a RPZ has been installed in the water service connection.

The fire fighting system connection is independent of the normal water service and uses chemical additives making it a Class 5 system. Consequently, a RPZ is also required in the fire fighting system connection.

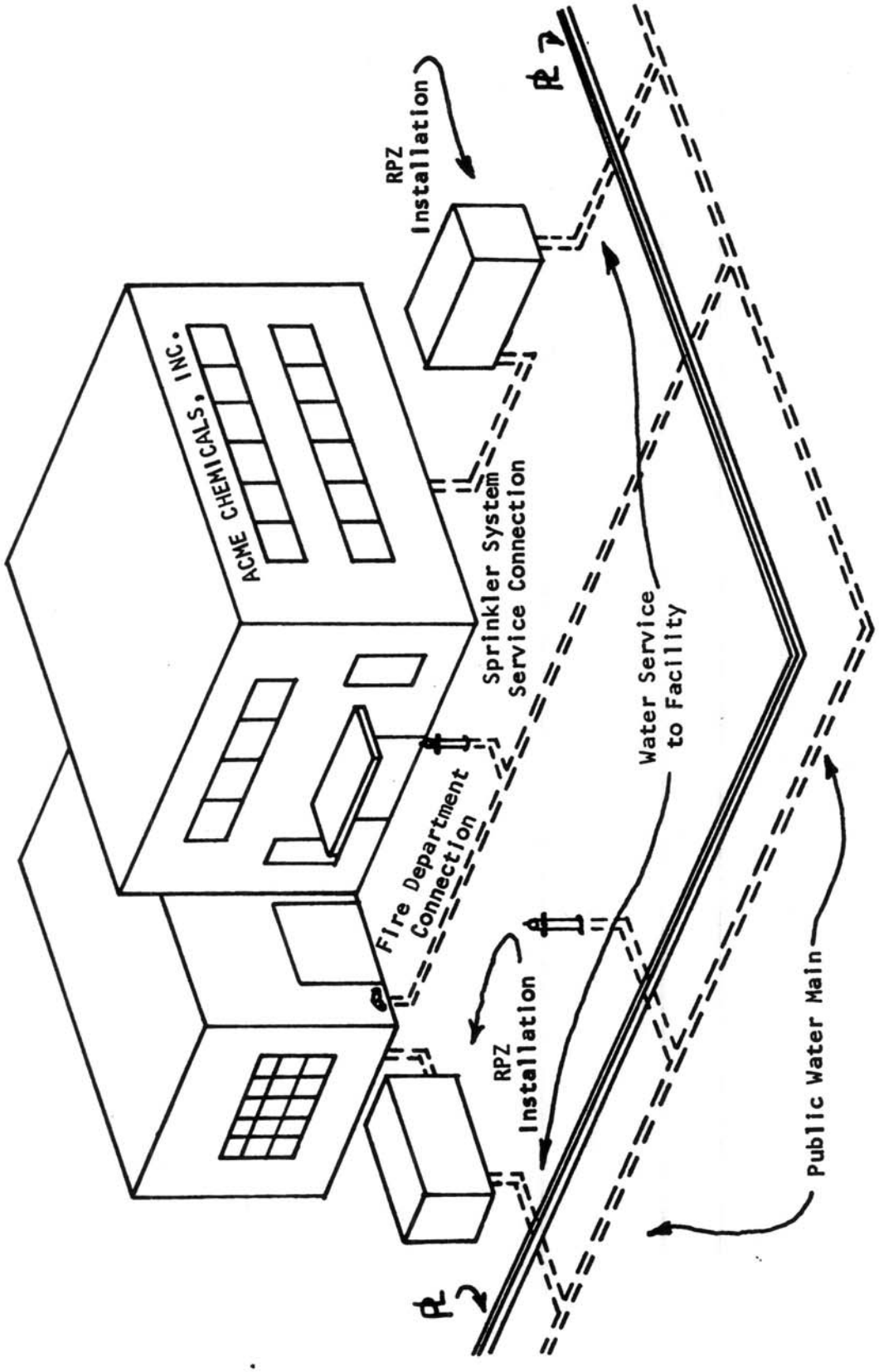

ACME CHEMICALS, INC.
RPZ Installation
Sprinkler System Service Connection
Fire Department Connection
RPZ Installation
Water Service to Facility
Public Water Main

FIG. 6-6

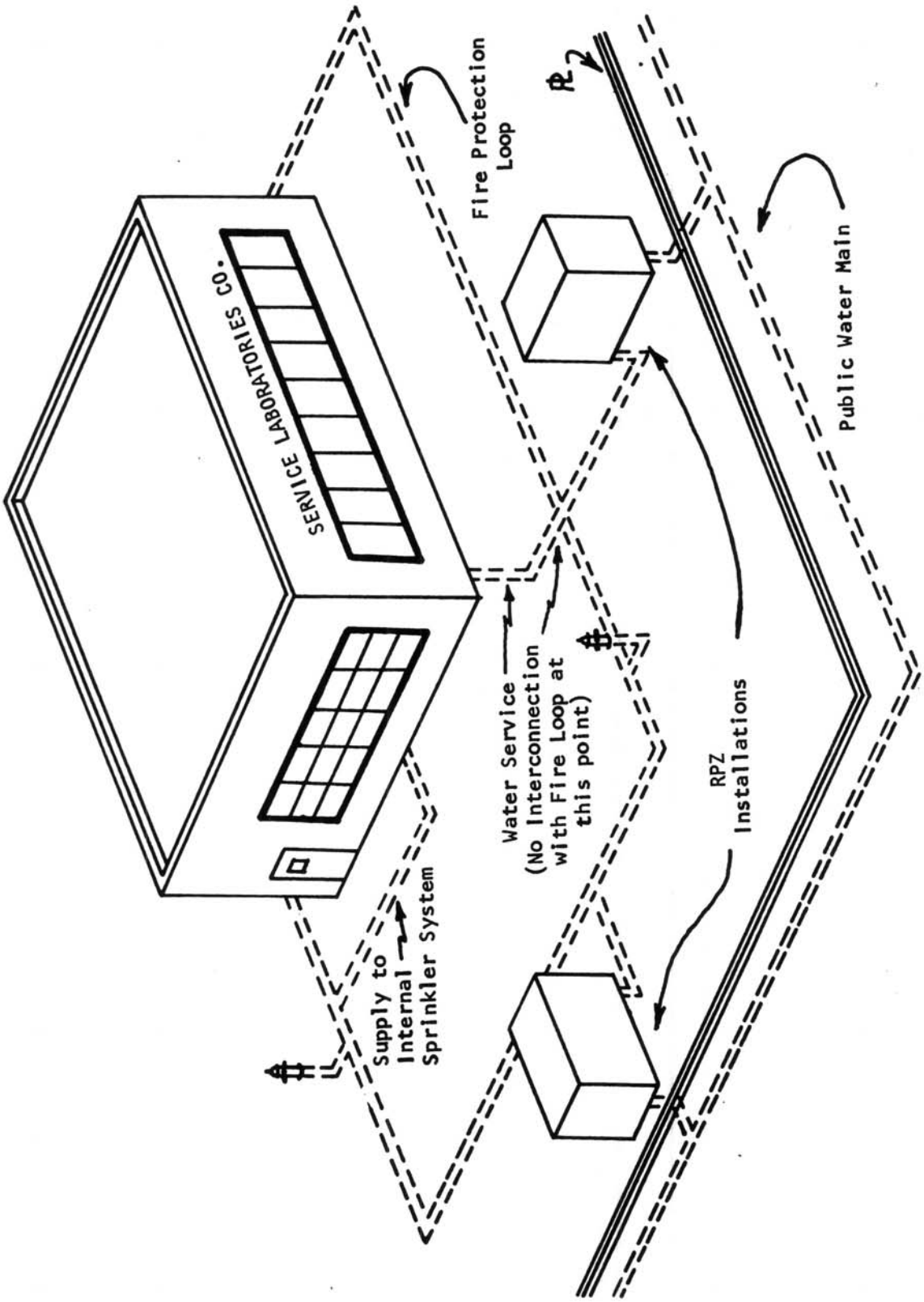

SERVICE LABORATORIES CO.
Fire Protection Loop
Public Water Main
Water Service (No Interconnection with Fire Loop at this point)
RPZ Installations
Supply to Internal Sprinkler System

FIG. 6-7

FIG. 6-8 A marina with one connection to the public water system. As marinas are rated as hazardous, a RPZ is required. An above ground installation is normally required because gravity drainage is usually difficult for these installations.

FIG. 6-9 A service station includes car wash facilities using commercial detergents. This is rated as a hazardous facility and requires a RPZ installation.

FIG. 6-10 A florist with a greenhouse using pesticides or fertilizers in the watering system would be rated as hazardous and require RPZ protection.

FIG. 6-11 An acceptable air gap installation to contain a hazardous facility has been bypassed to provide for dual service for fire flow considerations.

This and any other bypass around the water holding tank must be equipped with an acceptable RPZ as shown.

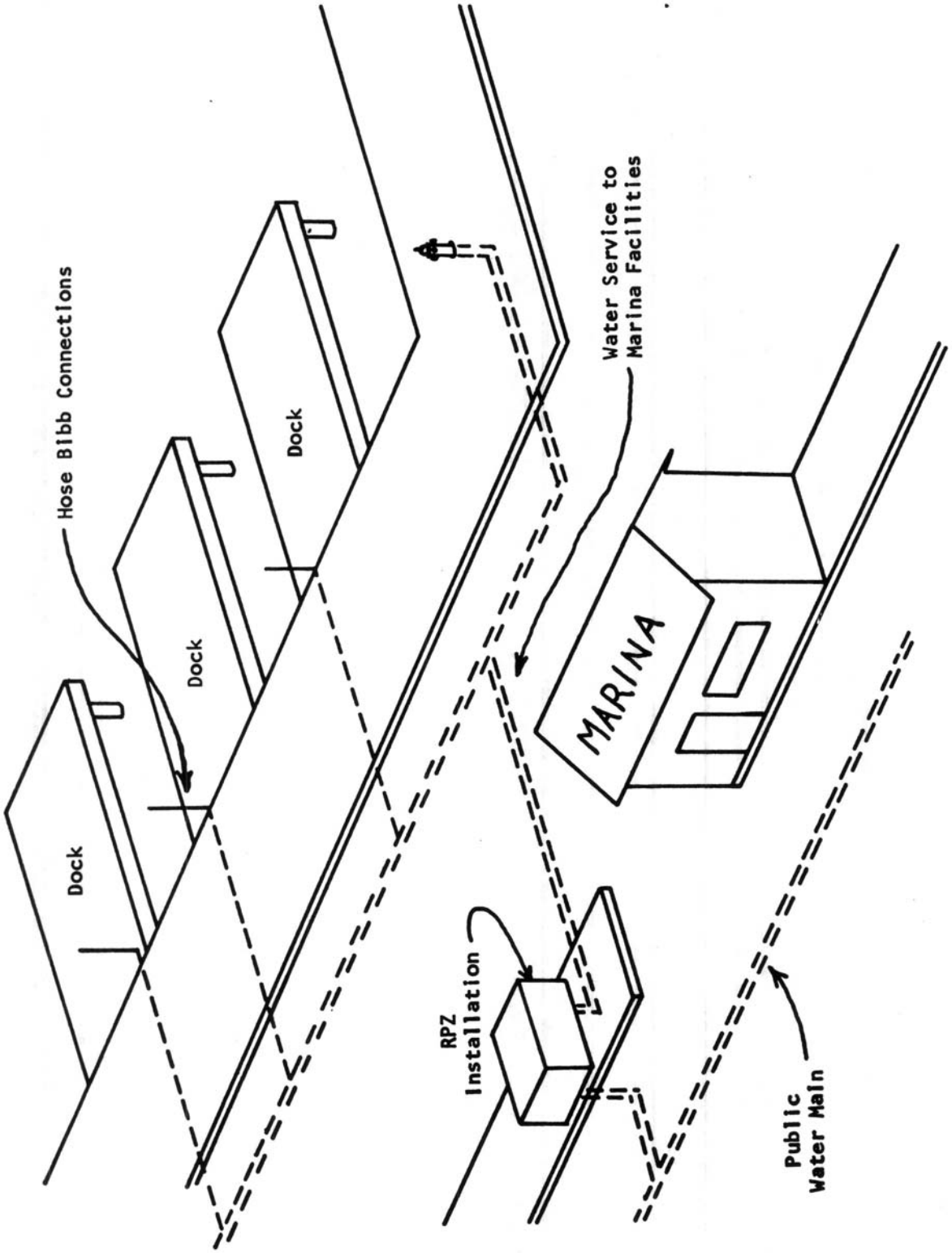

Hose Bibb Connections
Dock
Dock
Dock
Water Service to
Marina Facilities
MARINA
RPZ
Installation
Public
Water Main

FIG. 6-8

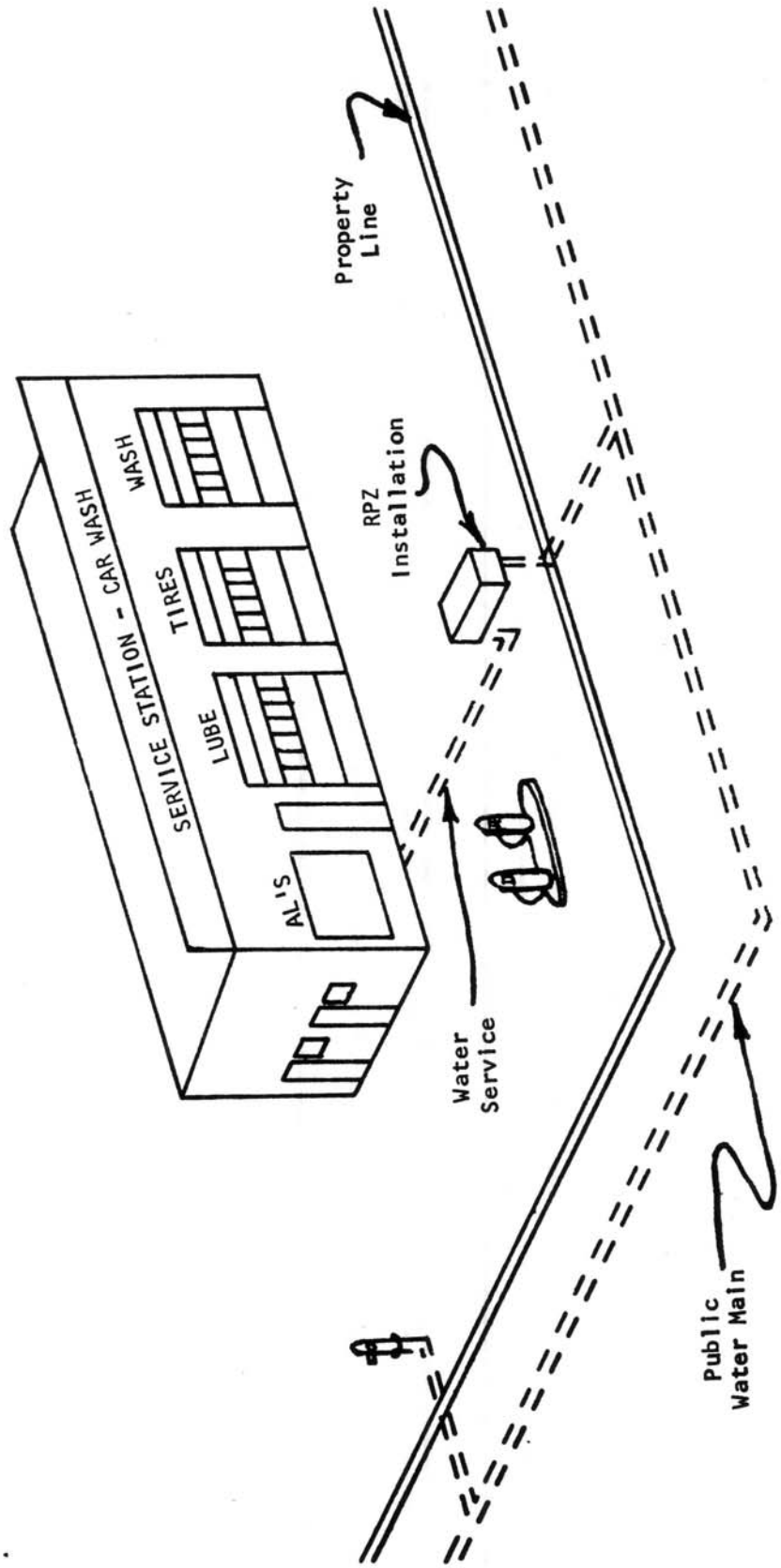

SERVICE STATION - CAR WASH
WASH
TIRES
LUBE
AL'S
Property Line
RPZ Installation
Water Service
Public Water Main

FIG. 6-9

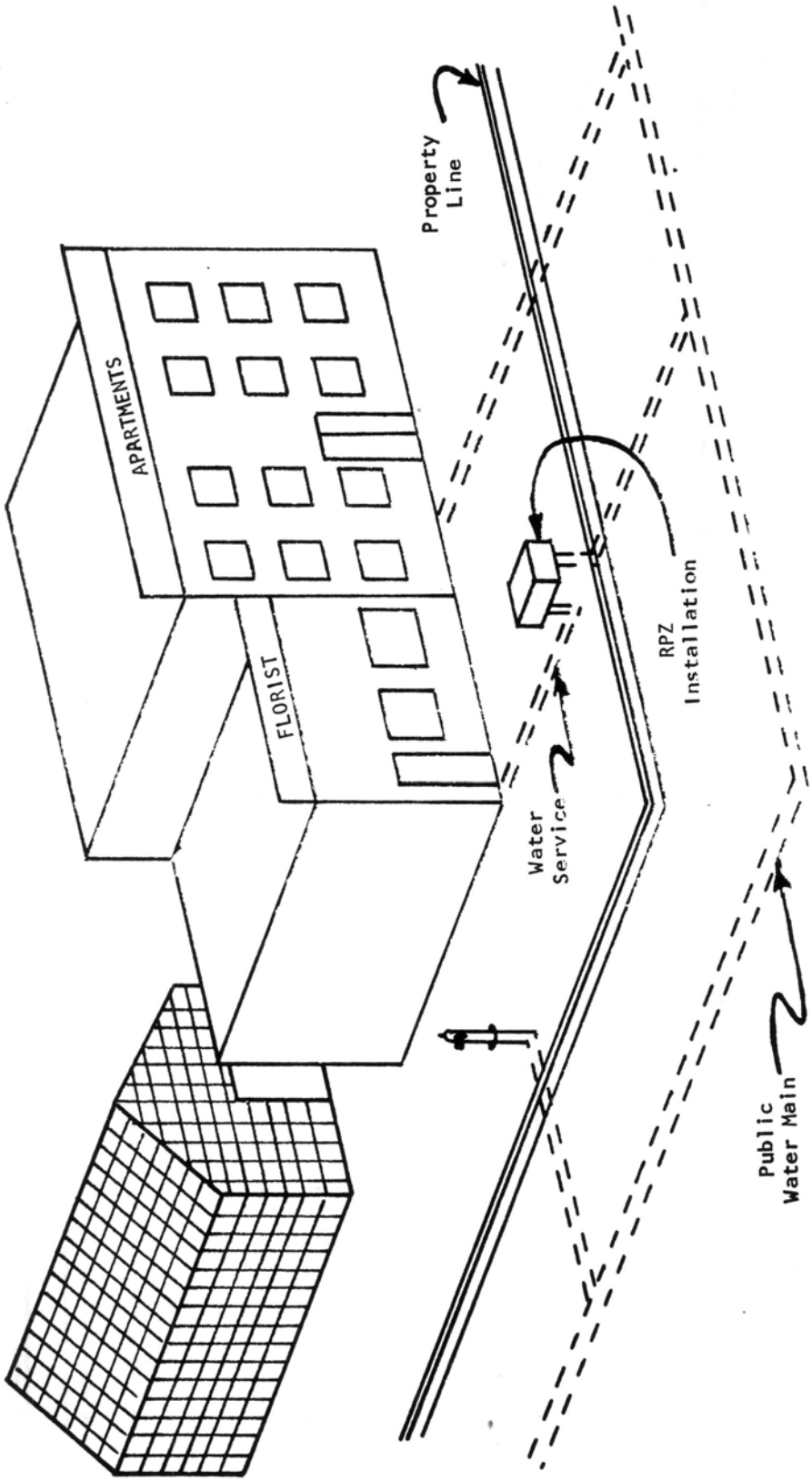

APARTMENTS
FLORIST
Property Line
Water Service
RPZ Installation
Public Water Main

FIG. 6-10

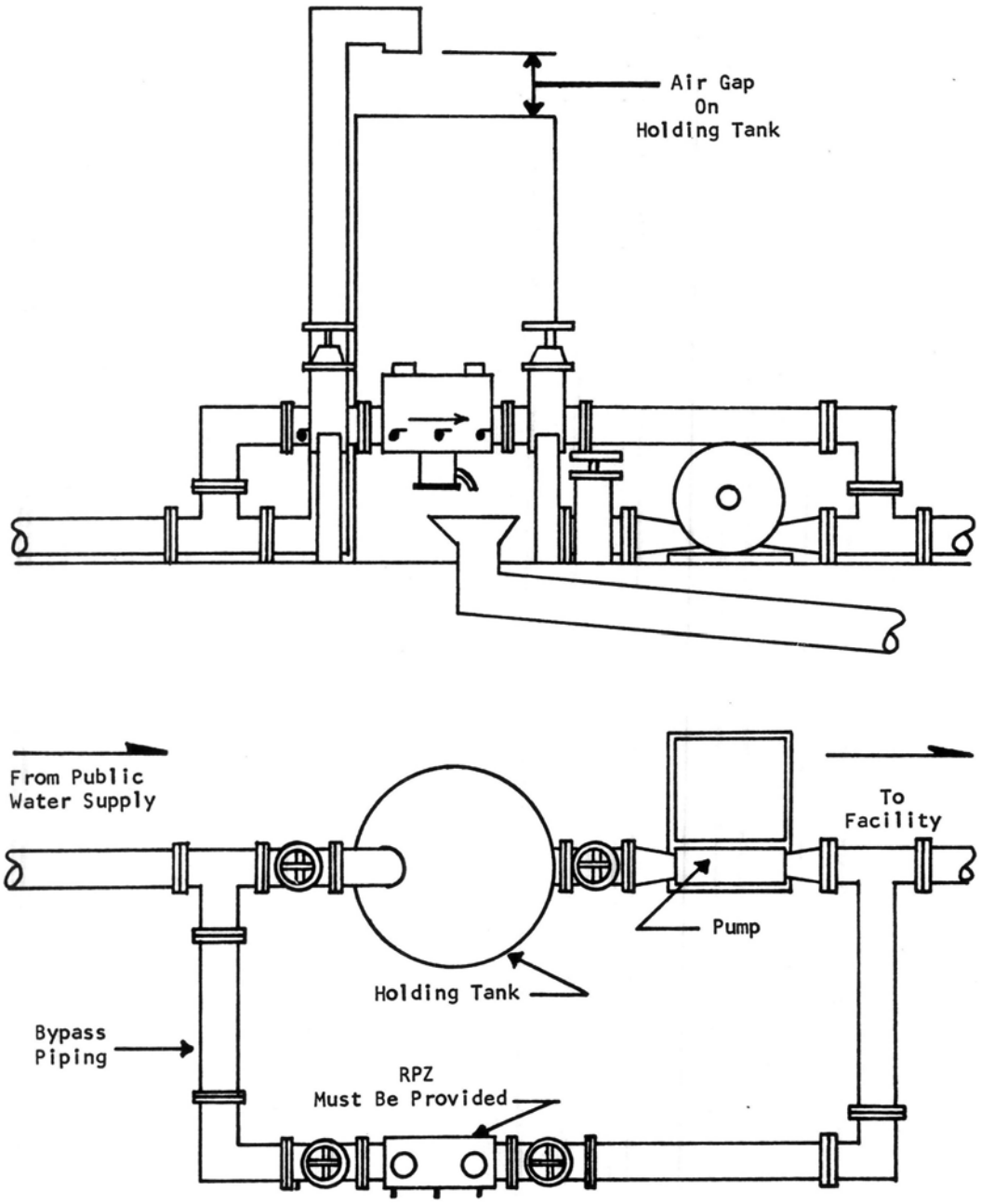

Air Gap
On
Holding Tank
From Public
Water Supply
To
Facility
Pump
Holding Tank
Bypass
Piping
RPZ
Must Be Provided

FIG. 6-11

TYPICAL INSTALLATION DETAILS

A. Principles

The following material shows design concepts pertinent to the installation of backflow prevention devices. The design of specific installations should be in accordance with the requirements of the State Education Law. See Section 9 for more details.

In general, backflow prevention devices must be protected against freezing and must be accessible for testing and maintenance. Pit installations are acceptable. However, in the case of RPZ, a pit installation is usually not feasible since a gravity drain must be provided which cannot be connected directly to a sewer.

The accompanying figures show the use of floor drains for RPZ installations. An acceptable alternate is the use of a funnel raised to just below the discharge port of the device ensuring, of course, that an air gap be maintained. No direct connection to the device for the purpose of drainage is permitted which negates the inherent protection afforded by an air gap at the relief valve discharge port. It is good practice to have the discharge end of the gravity drain visible so that it can be checked as a matter of daily routine by a facilities maintenance staff.

It must be kept in mind that a large RPZ with a fouled check valve can discharge at a rate of several hundred gallons per minute when subjected to high differential pressures. The gravity drain should be designed for the greatest discharge possible.

Although it is preferred that backflow prevention devices be installed as close to the property line as possible, it is recognized that in certain instances, as when in an urban area, that this is not possible. I n those instances where it is necessary to install a device within a facility, the same considerations should be given to potential for freezing , access for maintenance and testing and in the case of a RPZ, drainage.

All devices must be installed so that they are not subject to flooding.

In certain instances, backflow prevention devices installed in parallel on a service line may be needed to meet the needs of a facility. Such instances are:

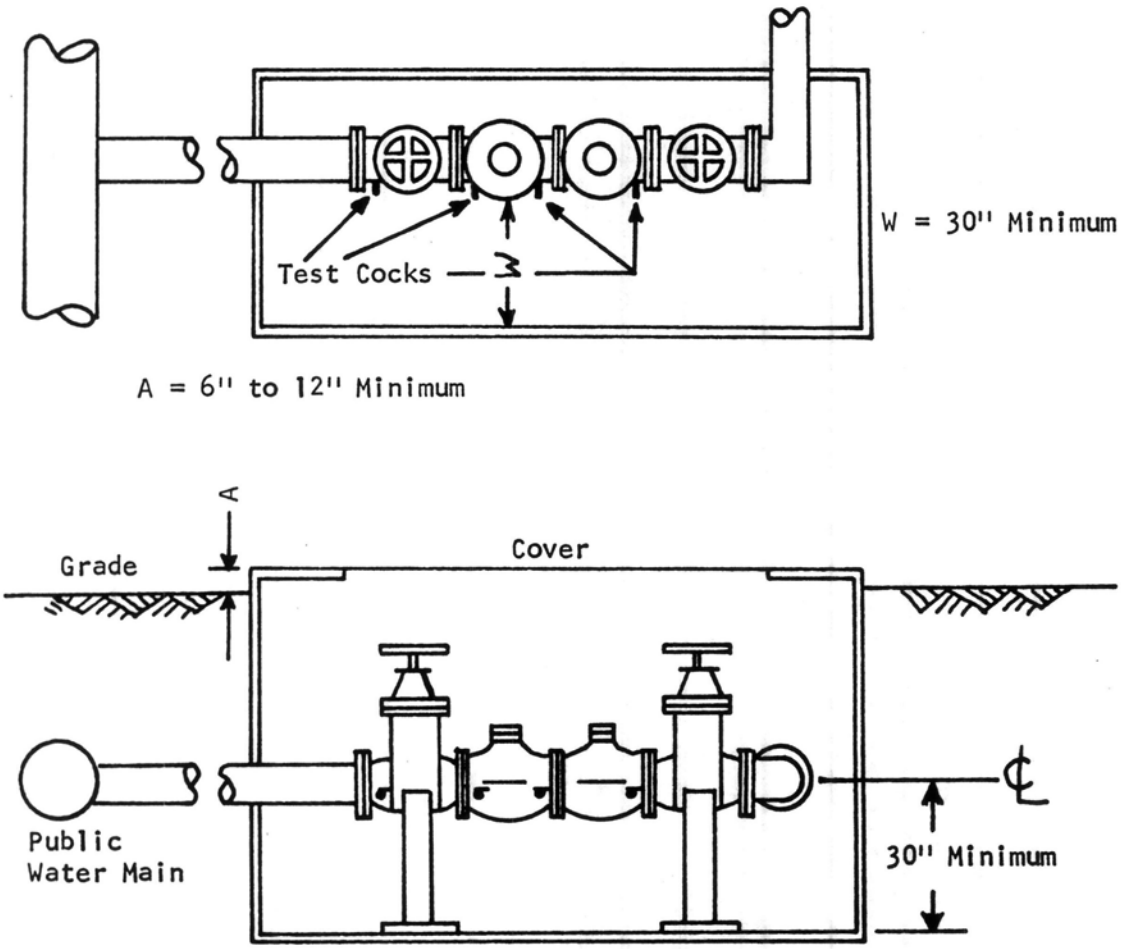
1. Where the water service line to be protected is greater than 10", branching the line and installing parallel devices may be utilized.
2. Where the facility requires continuous water service, a parallel installation will allow for removing one device at a time from service for testing and maintenance.
3. Where dual service for fire flow requirements are necessary as in Section 6, Figure 6-11.

In no case may the installation of a backflow prevention device include unprotected bypass piping. Closed gate valves on the bypass do not constitute protection.

B. DCV

This device does not require any special installation precautions except to protect the unit from freezing and insure that the test cocks are accessible. Adequate access to the test cocks is necessary to facilitate required testing. Normal maintenance considerations should be satisfied.

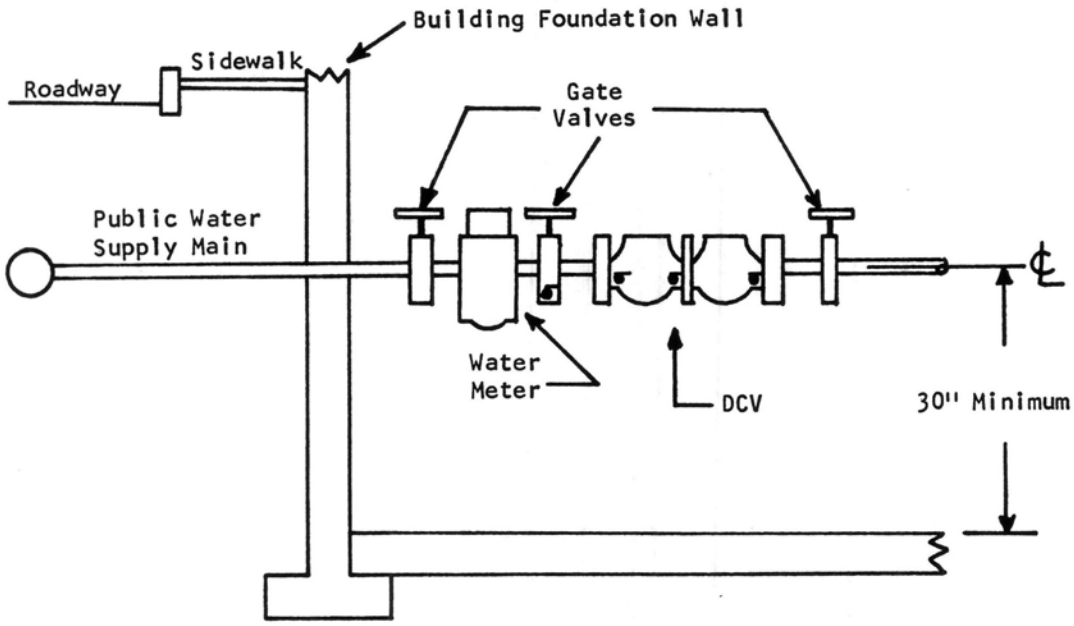
FIG. 7-1



PIT INSTALLATION

DCV Installed

Within a Facility



NOTE: Device to be installed above highest possible flooding.

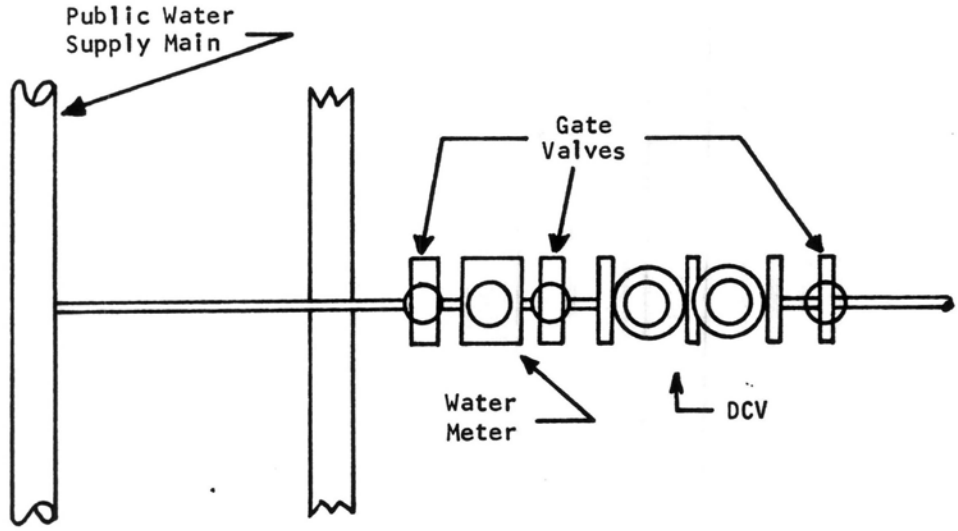


FIG. 7-2

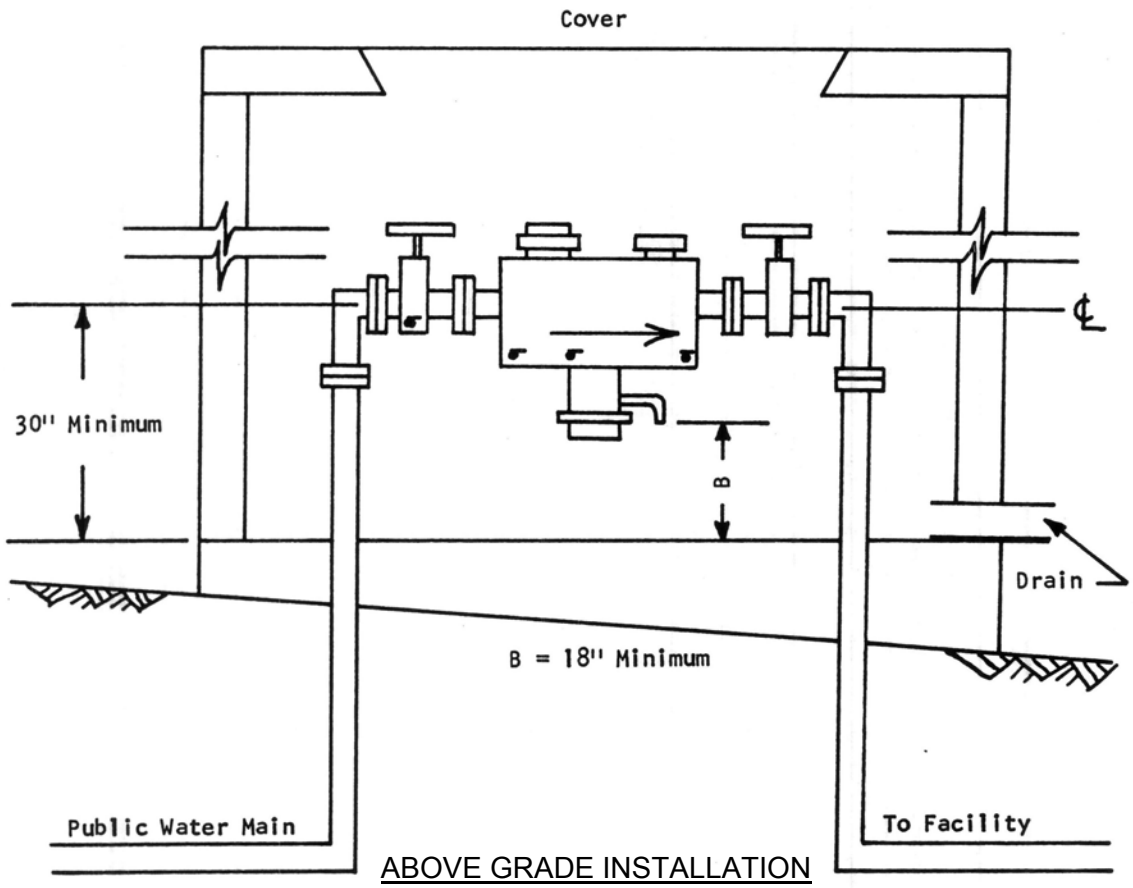
C. RPZ

These devices must also be protected against freezing and the test cocks should be positioned to facilitate testing.

Normal maintenance considerations must also be satisfied. Experience to date shows that an above grade installation is usually required in order to satisfy adequate drainage and access.

Note: Keep snow cleared away from drain.

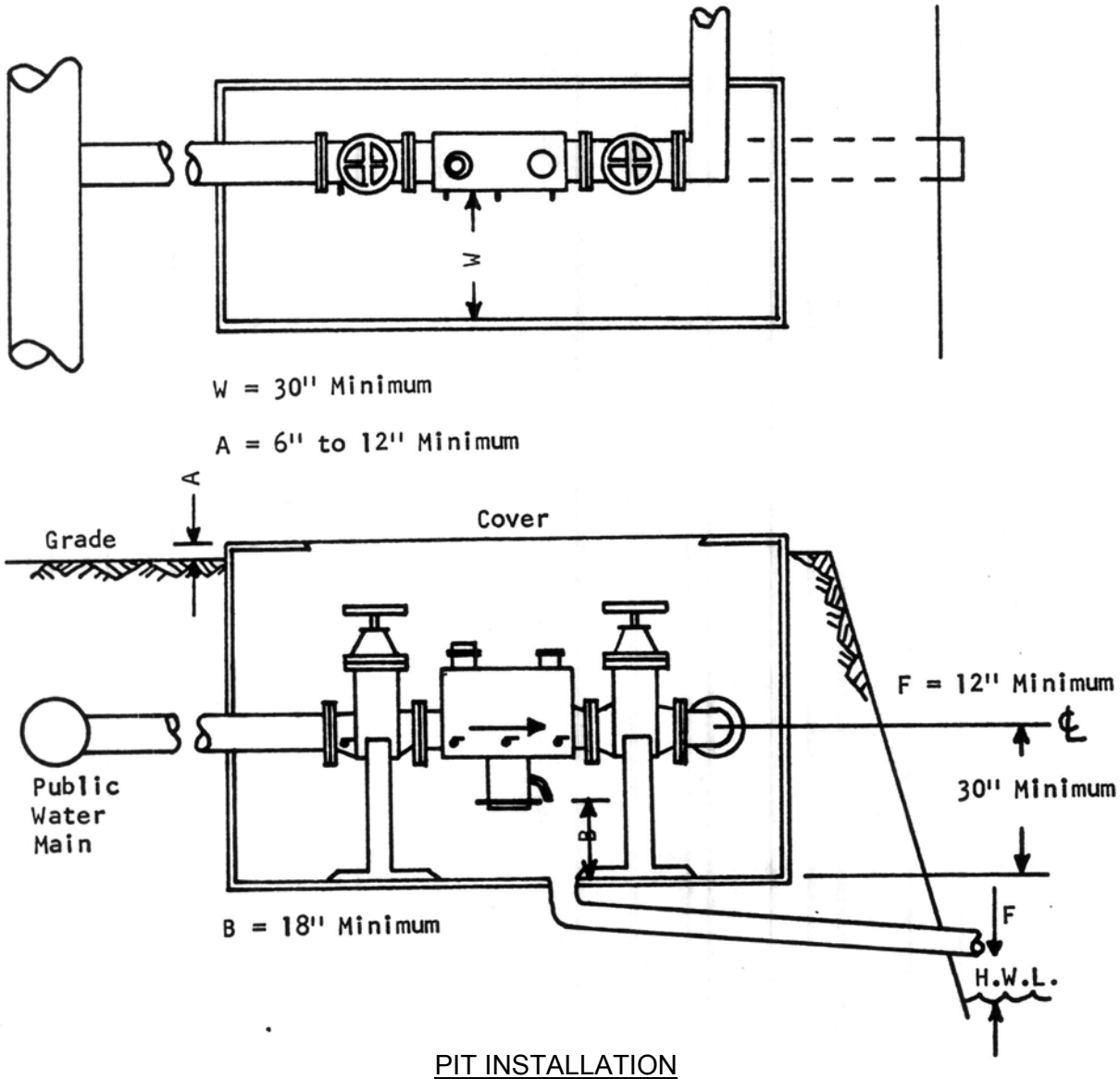
FIG. 7-3



ABOVE GRADE INSTALLATION

RPZ

The improper installation of these devices can negate the desired protection. Most critical is the need to provide a gravity drain large enough to receive the maximum potential discharge of the relief valve. This drain cannot be subject to flooding and must be screened.

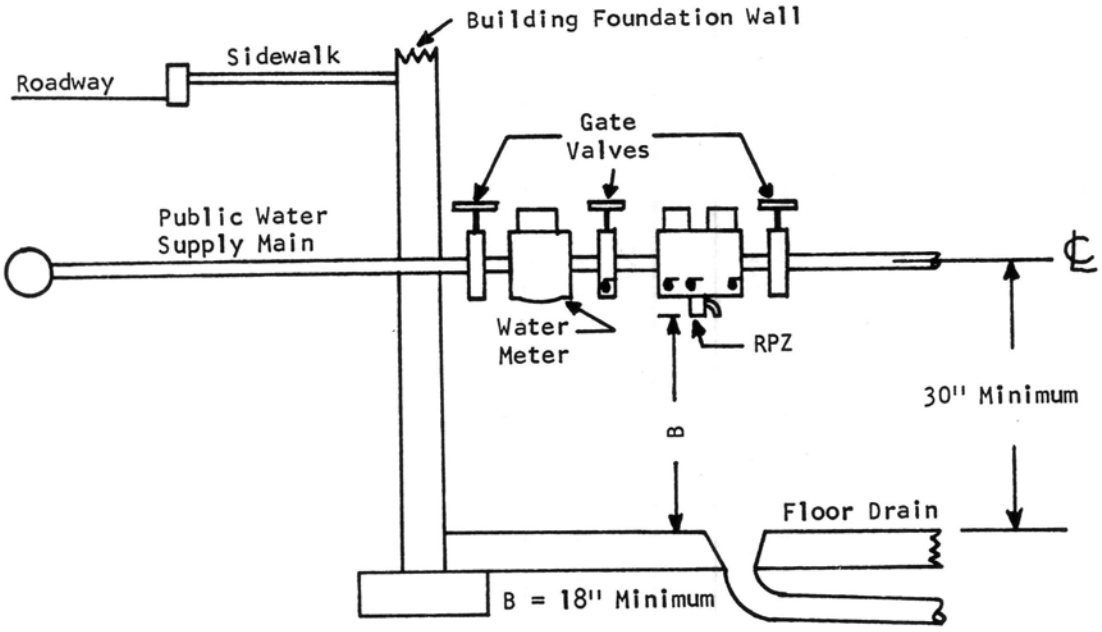


PIT INSTALLATION

FIG. 7-4

RPZ

INSTALLED WITHIN A FACILITY



NOTE: Device to be installed above highest possible flooding

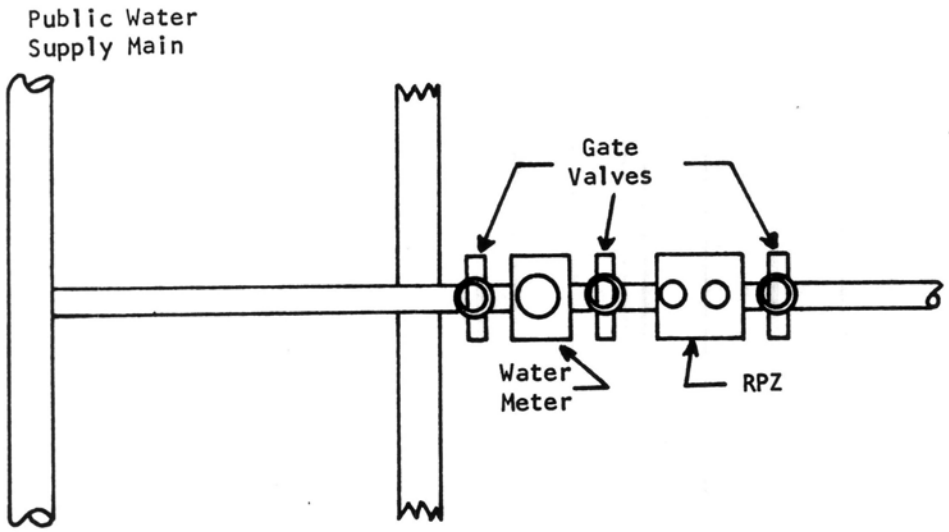


FIG. 7-5

D. Air Gap

This method of cross connection prevention is profusely illustrated in plumbing control publications. The same basic requirement is also appropriate for containment control; namely, that the opening of the inlet pipe be at least two (2) diameters (of the inlet pipe) above the flood or overflow level of the tank or vessel. In no case shall the gap be less than 1 inch.

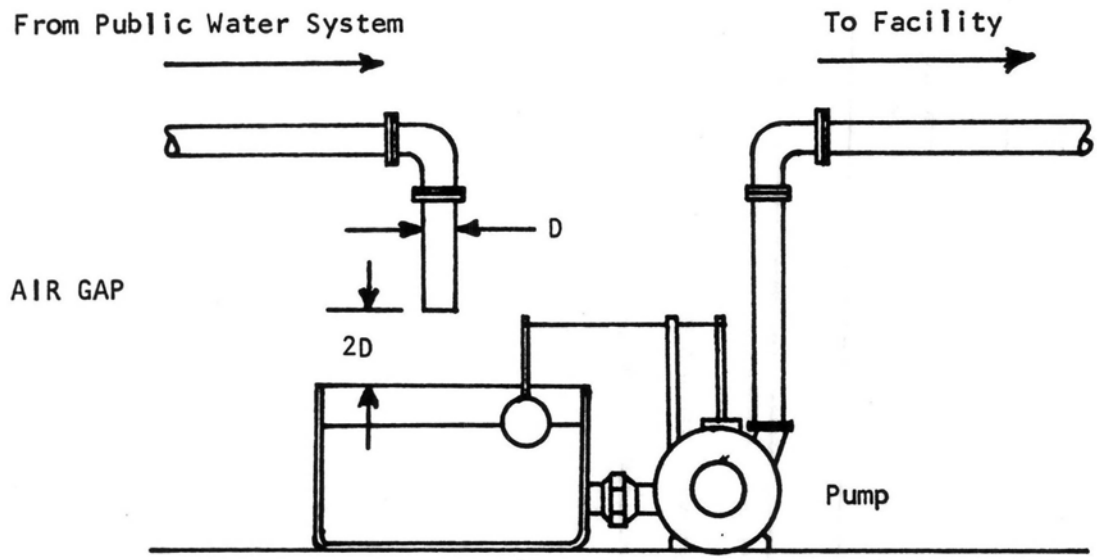


FIG. 7-6

ACCEPTABLE DEVICES

A. Determination of Acceptability

Only three devices are applicable to the containment concept of cross-connection control. These are the DCV – the RPZ and the air gap.

Which DCV or RPZ are acceptable? Acceptance of a device is based on one of the following two evaluation procedures:

1. A device will be placed on the New York State Department of Health list of Acceptable Devices when it has successfully passed both the Laboratory and the Field Evaluation phases of the Foundation for Cross Connection Control & Hydraulic Research approval program and the manufacturer has been granted a Certificate of Approval.
2. A device which has been evaluated against each of the following three standards by an independent testing laboratory and shown to comply will be placed on the New York State Department of Health list of Acceptable Devices:
   a. Foundation for Cross-Connection Control and Hydraulic Research, Manual of Cross-Connection Control, Section 10 – Specifications of Backflow Prevention Devices.
   b. American Society of Sanitary Engineering Standard No. 1013 (RPZ) or No. 1015 (DCV).
   c. American Water Works Association Standard C506. The Bureau of Public Water Supply Protection will review the evaluation report of the backflow prevention devices under test and shall determine what sizes, if any, are possible.

Based on the above, a list of acceptable devices is published from time to time. As new units are found acceptable, the list will be revised and will be available as a separate guideline available from the Local Health Department Engineer.

B. Unacceptable Devices

The following devices are not acceptable for the containment approach:

.... Check Valves

.... Gate Valves

.... Four Way Plug Valve

.... Barometric Loop

.... Spool Connection

.... Swing Joint Connection

.... Vacuum Breakers

PLANS & SPECIFICATIONS

A. PREPARATION

"The New York State Education Law Pertaining to Professional Engineers and Land Surveyors" Article 145ff, Section 7200, requires that a project involving the safeguarding of life, health and property must be designed by a Registered Professional Engineer (P.E.) of the State of New York.

The design of backflow prevention device installations is such a project.

There are two exceptions to the P.E. requirement for design:

1. An architect licensed in this State may design the installation.
2. If the water customer is a "municipality" and the total cost of the installation does not exceed $5,000.00, a non-P.E. employee of the municipality may design the installation.

How this criteria is met, i.e., the need for a P.E., has considerable flexibility and the supplier of water should explore the following possibilities with his customers. For example:

a. The supplier of water may wish to hire a P.E. to design three or four typical installations. The fee could be paid from water revenues or through special billing to affected customers.
b. The supplier of water may require that several customers with similar installations come in under one submission. In this way, the customers select the engineer and pay only a portion of the design fee.
c. Each customer may, of course, select and pay an engineer individually.
d. Customers may utilize P.E.'s on their own staff.

B. SUBMISSION AND APPROVAL

The following forms and procedures should be followed:

Forms: 1. DOH-347 – New York State Department of Health Application for Approval of Backflow Prevention Device(s).

2. DOH-1013 – Report of Testing and Maintenance of Backflow Prevention Device.

Procedure:

Water Customer	1. Notifies the Local Water Supply Official (LWSO) of intent to make and maintain a service connection to the public water supply system.
LWSO	2. Investigates conditions at the site of proposed service connection installation requests technical advice from Local Health Department Engineer (LPHE), i f necessary.
	3. Requests Water Customer to submit plans and specifications and application (Form DOH-347) for proposed connection, in quadruplicate.
Water Customer	4. Submits plans, specifications and application (Form DOH-347), in quadruplicate, to LWSO.
LWSO	5. Reviews submission, transmits with recommendations to FIELD, in quadruplicate.
	5a. Disapproves and returns submission to Water Customer for correction and resubmittal.
LHDE	6. Reviews submission, transmits with recommendations for approval to Bureau of Public Water Supply Protection (BPWSP), in quadruplicate.
	6a. Disapproves and returns submission to LWSO for correction and resubmittal.
LWSO	7. Adds approval, forwards copies of each document to BPWSP, FIELD and Water Customer.

Water Customer	8. Installs approved protective devices in accordance with the plans approved by BPWSP.
	9. Disassembles and overhauls RPZ or DCV every five years.
	10. Submits reports of inspection, testing, disassembly and overhaul to LWSO and Local Health Department Engineer within 30 days of completion.
LWSO	11. Inspects and tests protective devices at least annually and maintains a record of inspections (Form DOH-1013).

NEW YORK STATE DEPARTMENT OF HEALTH

Bureau of Public Water Supply Protection

Application for Approval of Backflow Prevention Devices

PRINT OR TYPE ALL ENTRIES EXCEPT SIGNATURES
Please completed items 1 through 12a + Block and Lot Numbers

Block #	Lot #	FOR DEPARTMENT USE ONLY Log No.

1. Name of Facility	2. City, Village, Town	3. County	
4. Location of Facility (Street)	City	state	zip
4a. Phone Numbers	5. Contact Person		
5. Approx. Location of Device(s)	6. Mfg. Model #	Size of Device(s)	

# of Fire Services	# of Domestic Services	# of Combined Services	Total # of Services	Total # of Buildings

7. Name of Owner	Title	Phone Number	8. Nature of works ☐ Initial Device Installation ☐ Replace Existing Device
Full Mailing Address Address _____ street City _____ state _____ zip _____ Owner's Signature Date _____/_____/_____ M D Y			8a. ☐ New Service ☐ Existing Service 8b. ☐ New Building ☐ Existing Building ☐ Major Renovations

9. Name of Design Engineer or Architect Address _____ Street City _____ State _____ Zip _____ _____ Signature **Original Ink signature and seal required on all copies**	10. NYS License # _____ ☐ PE ☐ RA ☐ Other _____ 10a. Telephone Number(s) _____ Date _____/_____/_____ M D Y

11. Water System Pressure (psi) at Point of Connection Max _____ Avg _____ Min _____	12. Estimate Installation Cost	12a. Estimate Design Cost

13. Degree of Hazard

☐ Hazardous
☐ Aesthetically Objectionable

List of processes or reasons that lead to degree of hazard checked:

_____

_____

14. Public water supply name Mailing Address _____ street _____ City state zip Telephone No. ( )	Name of supplier's designate representative Title _____ Signature _____ _____/_____/_____ M D Y

Note: All applicants must be accompanied by plans, specifications and an engineer's report describing the project in detail. The project must first be submitted to the water supplier, who will forward it to the local public health engineer. This form must be prepared in quadruplicate with four copies of all plans, specifications and descriptive literature.

DOH-347 (5/91)

NEW YORK STATE DEPARTMENT OF HEALTH
Bureau of Public Water Supply Protection

Report on Test and Maintenance of Backflow Prevention Device

PART A

Please use a separate form for each device.

For the year _____

☐ Initial test - *Complete entire form*

☐ Annual test - *Complete Part A only*

Public Water Supply	Account No.	County	Block	Lot

Facility Name _____

Address _____
Street City Zip

Location of Device _____

Device Information	Manufacturer	Type ☐ RPZ ☐ DCV	Model	Size (in inches)	Serial Number

	Check Valve No. 1	Check Valve No. 2	Differential Pressure Relief Valve	Line Pressure _____psi
Test before repair	Leaked ☐ Closed tight ☐ Pressure drop across first check valve _____ psid	Leaked ☐ Closed tight ☐	Opened at _____ psid	Date ☐☐ ☐☐ ☐☐ M D Y
Describe repairs and materials used				Repaired by Name _____ Lic # _____ Date repaired: ☐☐ ☐☐ ☐☐ M D Y
Final test	Closed tight ☐ Pressure drop across first check valve _____psid	Closed tight ☐	Opened at _____ psid	Date ☐☐ ☐☐ ☐☐ M D Y

Water Meter Number	Meter Reading	Type of Service: (check one) • Domestic • Fire • Other_____

Remarks (Describe deficiencies: bypasses, outlets before the device, connections between the device and point of entry, missing or inadequate airgaps, etc.)

Certification: This device ☐ meets, • ☐ does NOT meet, the requirements of an acceptable containment device at the time of testing
I hereby certify the foregoing data to be correct.

Print Name	Certified Tester No.	Signature	Expiration Date
			_____/_____/_____

Property owner•s (or owner•s agent) certification that test was performed:

Print Name	Title	Signature	Telephone
			(____)_____-_____

PART B Certification that installation is in accordance with the approved plans. (To be completed by the design engineer or architect or water supplier.)

I hereby certify that this installation is in accordance with the approved plans.

Name	Title	Date	NYS DOH Log #
License Number	Phone ( )	m d y	_____

Representing		
Address		
City	State	Zip
Signature_____		

Describe minor installation changes

NOTE: Send one completed copy to the designated health department representative and one copy to the water supplier within 30 days of the testing device.
Notify owner and water supplier immediately if device fails test and repairs cannot immediately be made.

DOH- 1013(9/91)

INSTRUCTIONS FOR COMPLETING DOH-1013 (9/91)
REPORT ON TEST AND MAINTENANCE OF BACKFLOW PREVENTION DEVICE

PART A - To Be Completed by Certified Tester

- Indicate the test year and whether initial or annual test.
- Complete public water supply name, customer account number (if available) and county.
- Complete block and lot (if available) for New York City Metropolitan area tests.
- Complete facility name, address and specific location of device (e.g., meter room, etc.)
- Complete device information including manufacturer, type, model, size and serial number.
- Complete section •Test Before Repair• and indicate:
  - Whether check valve #1 leaked or closed tight. For RPZ devices, the pressure drop accross the check valve must be at least 5.0 psid.
  - Whether check valve #2 leaked or closed tight.
  - Opening of RPZ differential pressure relief valve - must be at least 2.0 psid or device must be failed and/or repaired.
  - Complete water system line pressure in psi and indicate test date.
- Describe any repairs and materials used and the name and license number of the repairer and indicate repair date.
- Complete •final test• section only if repairs have been made.
- Indicate the water meter number/meter reading and the type of service (describe •other• e.g., boiler feed, irrigation line, etc.)
- Complete the Remarks section if there are any deficiencies.
- Complete the certification indicating if the device meets or does not meet the requirements at the time of testing - print and sign your name and indicate certificate number and expiration date.
- Have the property owner (or owner•s agent) certify that test was performed.

PART B - To Be Completed By Design Engineer, Architect or Water Supplier for initial Tests Only

- Complete name, title, license number, phone number, company name and address.
- Sign and date form and indicate NYSDOH (or local health department/water supplier).
- Describe minor installation changes.

After completion, submit copies of test reports to the supplier of water, customer, State or local heatlh department and retain copies for the tester•s personal records.

Revised 12/93

INSTRUCTIONS FOR COMPLETING DOH-1013 (9/91)
REPORT ON TEST AND MAINTENANCE OF BACKFLOW PREVENTION DEVICE

PART A - To Be Completed by Certified Tester

- Indicate the test year and whether initial or annual test.
- Complete public water supply name, customer account number (if available) and county.
- Complete block and lot (if available) for New York City Metropolitan area tests.
- Complete facility name, address and specific location of device (e.g., meter room, etc.)
- Complete device information including manufacturer, type, model, size and serial number.
- Complete section •Test Before Repair• and indicate:
  - Whether check valve #1 leaked or closed tight. For RPZ devices, the pressure drop accross the check valve must be at least 5.0 psid.
  - Whether check valve #2 leaked or closed tight.
  - Opening of RPZ differential pressure relief valve - must be at least 2.0 psid or device must be failed and/or repaired.
  - Complete water system line pressure in psi and indicate test date.
- Describe any repairs and materials used and the name and license number of the repairer and indicate repair date.
- Complete •final test• section only if repairs have been made.
- Indicate the water meter number/meter reading and the type of service (describe •other• e.g., boiler feed, irrigation line, etc.)
- Complete the Remarks section if there are any deficiencies.
- Complete the certification indicating if the device meets or does not meet the requirements at the time of testing - print and sign your name and indicate certificate number and expiration date.
- Have the property owner (or owner•s agent) certify that test was performed.

PART B - To Be Completed By Design Engineer, Architect or Water Supplier for initial Tests Only

- Complete name, title, license number, phone number, company name and address.
- Sign and date form and indicate NYSDOH (or local health department/water supplier).
- Describe minor installation changes.

After completion, submit copies of test reports to the supplier of water, customer, State or local heatlh department and retain copies for the tester•s personal records.

Revised 12/93

TESTING & MAINTENANCE

A. Testing

Backflow prevention devices must be tested and inspected to insure continued reliability. Tests should be made after initial installation and after each repair. The frequency of routine testing and inspection should be specified by the supplier of water. A yearly test should be considered as the minimum.

The supplier must decide who will pay for and be responsible for testing backflow prevention devices. This type of service could be offered by the supplier of water at a fee, or, it could be done by a private individual, or by some other arrangement acceptable to the supplier of water.

In any case, the person doing the testing should be trained and competent in this specialized area. The larger suppliers should have a minimum of two trained and capable testers on their staff for consultation and review purposes. It is the intent of the Department of Health to eventually offer training programs and establish a certification procedure for testers of containment equipment.

The testing procedures for DCV and RPZ are given on the following pages. More detailed procedures can be found in technical references avail able from the manufacturers.

B. Test Procedure for DCV

TEST NO. 1

Purpose — To test No. 1 check valve for tightness against reverse flow.

Requirement — Valve must be tight against reverse flow under all pressure differentials.

Steps

1. Blow down test cocks to remove any foreign materials. Do not stand directly in front of test cocks when turning them off or on; they may blow off and inflict injury.

2. Install duplex pressure gauge, attaching hoses to test cocks No. 2 and No. 3.

3. Open control cocks and bleed air from hoses.

   (NOTE: Bleeding air from the hoses is important. Entrapped air could result in false readings.)

4. Close shutoff valve No. 2.

5. Close shutoff valve No. 1.

6. Drain slowly from control cock No. 2 until gauge at test cock No. 2 reads 2 psi less than gauge at test cock No. 3. Close control cock. If both gauges hold the established differential pressure, the check valve shall be noted in the report as "Closed Tight".

NOTE: If both gauges drop simultaneously and no differential is maintained, the check valve may be leaking. Confirm by:

a. Adjust the pressure within the backflow device (by opening gate valve No. 1, or bleeding from a control cock) to be about 10 psi less than the supply line pressure.

b. Install bypass between test cock No. 1 and control cock (shut) at gauge on test cock No. 3.

c. Open test cock No. 1.

d. Slowly open both control cocks simultaneously so the 10 psi lower pressure is maintained on gauge at test cock No. 2. If a continuous flow of water occurs from the control cock at test cock No. 2, the check valve is leaking.

TEST NO. 2

Purpose — To test No. 2 check valve for tightness against reverse flow.

Requirement — Valve must be tight against reverse flow under all pressure differentials.

Steps

1. Open shutoff valve No. 1 and re-establish pressure in the device.
2. Attach hoses to test cocks No. 3 and No. 4.
3. Follow same procedure as in Test No. 1, starting with Step No. 3 and substituting test cocks No. 3 and No. 4 for test cocks No. 2 and No. 3.
4. Return shutoff valves to original positions and remove test equipment.

TEST PROCEDURE FOR
DCV
USING DUPLEX GAGE*

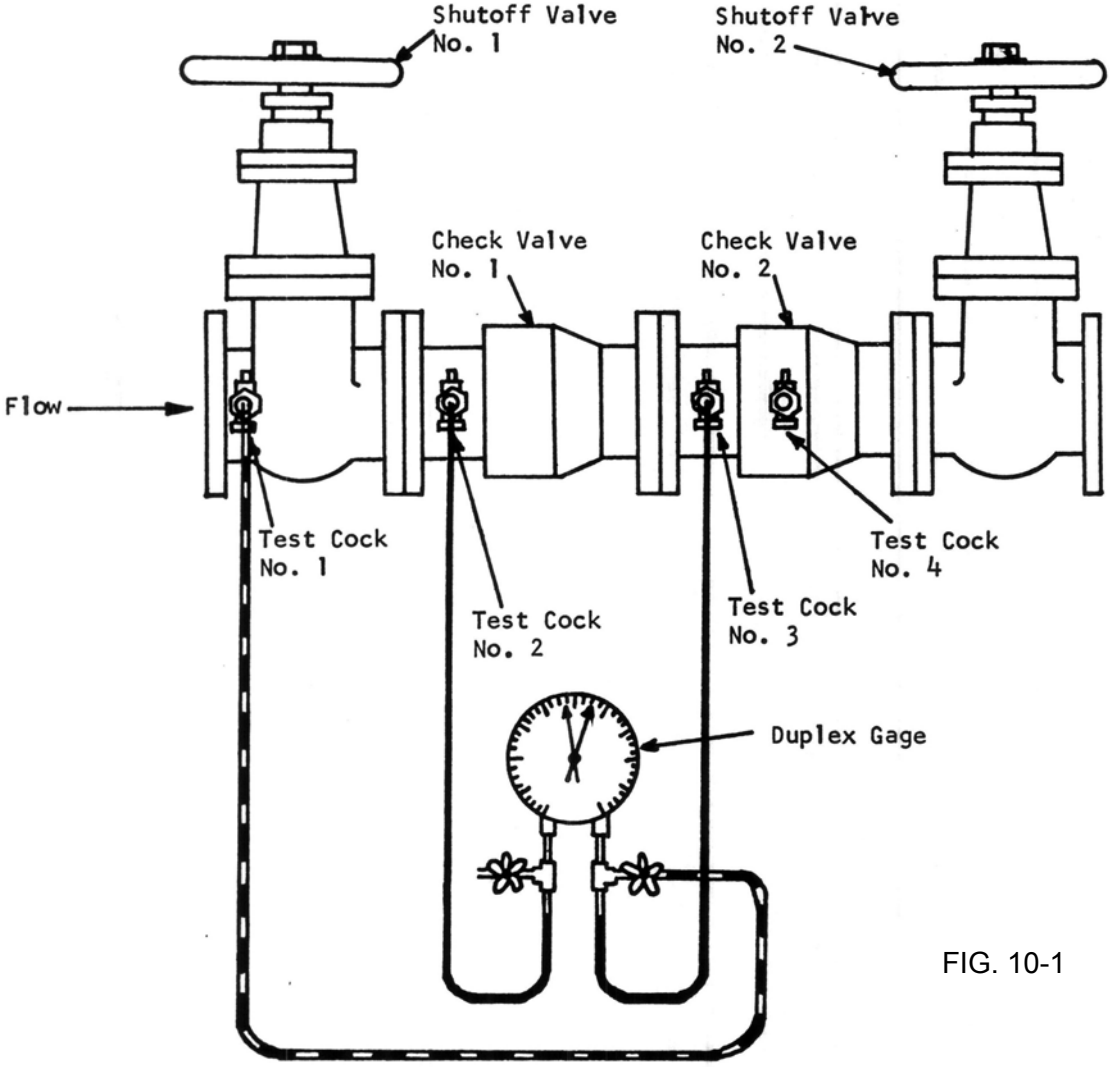


FIG. 10-1

RECOMMENDED EQUIPMENT

1. 0 to 150 lb. duplex pressure gauge with 2 lb. increments. *
2. Three 5-foot rubber hoses.
3. Adaptors to connect hoses to gauge and test cocks on the device.
4. Leak compound or tape.
5. Sufficient wrenches to install test equipment.

* Duplex gauge may be replaced with two 0-150 lb. gauges mounted side by side.

* Accepted Procedure and Practice in Cross-Connection Control Manual, July 1973, Second Edition, CROSS-CONNECTION CONTROL COMMITTEE PACIFIC NORTHWEST SECTION – AMERICAN WATER WORKS ASSOCIATION.

C. Test Procedure for RPZ

TEST NO. 1

Purpose — To test check valve No. 1 for tightness against reverse flow and operation of pressure differential relief valve.

Requirement — Check valve must be tight against reverse flow under all pressure differentials and relief valve must operate to maintain the zone between the two check valves at least 2 psi less than the supply pressure.

Steps

1. Blow down test cocks No. 2, No. 3 and No. 4 to remove any foreign material. Do not stand directly in front of test cocks when turning them off or on; they may blow off and inflict injury.
2. Connect test equipment to device by attaching hose from high pressure side of gauge to test cock No. 2 and hose from low pressure side of gauge to test cock No. 3.
3. Open test cocks No. 2 and No. 3 and bleed air through control valves on gauge.
4. Close shutoff valve No. 2 and note differential pressure reading on gauge. Gradually increase pressure in zone of reduced pressure by bypassing water from test cock No. 2 through control valve to test cock No. 3 until water begins to drip from the pressure differential relief valve. Note pressure differential reading on gauge. If water is released from the relief valve at or above a differential pressure of 2 psi, the relief valve is operating properly.
5. Re-establish pressure across check valve No. 1 by opening and closing test cock No. 4 or shutoff valve No. 2. I f there is no drainage from pressure differential relief valve at this point, check valve No. 1 is closed tight.

TEST NO. 2

Purpose — To test check valve No. 2 for tightness against reverse flow.

Requirement — Check valve must be tight against reverse flow under a1 1 pressure differentials.

Steps

1. Bleed air from bypass hose and connect to test cock No. 4, open test cock No. 4.
2. Bypass water from test cock No. 2 to test cock No. 4. If pressure differential between zone of RPZ and test cock No. 2 remains constant and there is no discharge from relief valve. No. 2 check valve is closed tight.
3. Return shutoff valves to original position and remove test equipment.

TEST PROCEDURE FOR
RPZ
USING DIFFERENTKC PRESSURE GAGE*

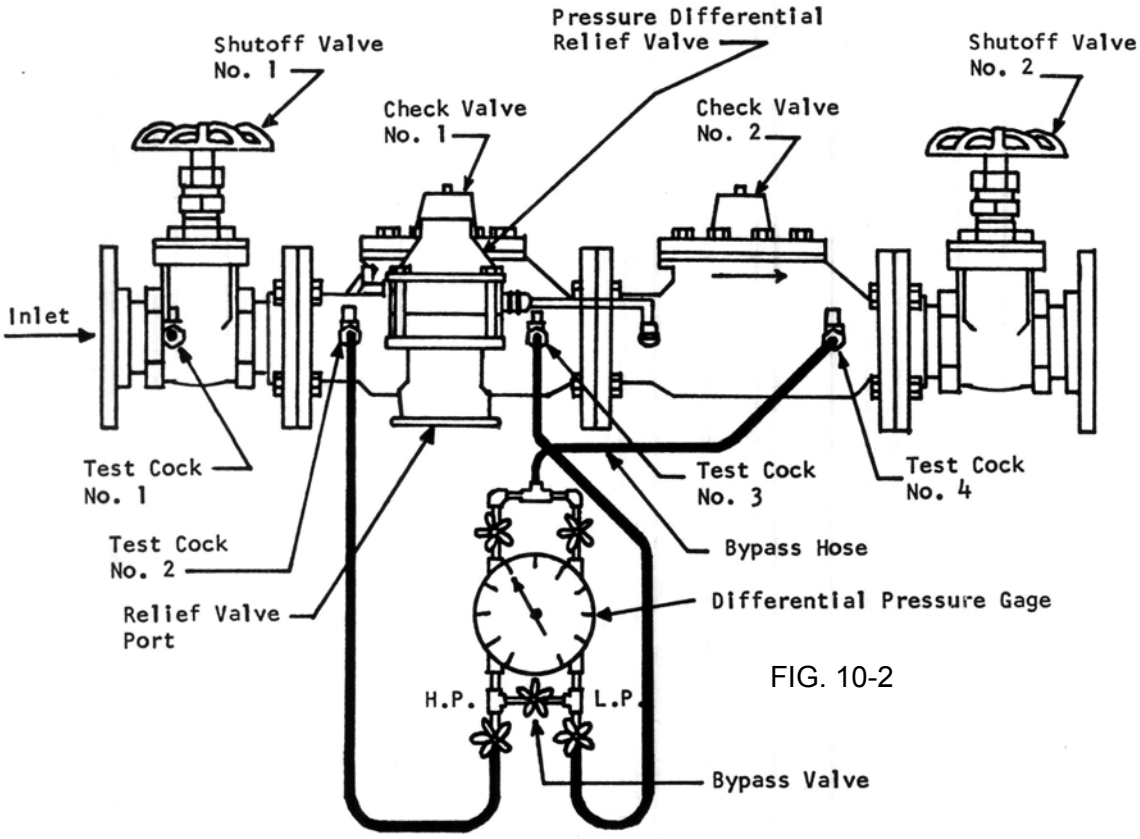


FIG. 10-2

RECOMMENDED EQUIPMENT

1. 0 to 15 lb. differential pressure gauge.
2. Three 5-foot rubber hoses.
3. Adaptors to connect hoses to gauge and test cocks on the device.
4. Leak compound or tape.
5. Sufficient wrenches to install test equipment.

* Accepted Procedure and Practice in Cross-Connection Control Manual, July 1973, Second Edition, CROSS-CONNECTION CONTROL COMMITTEE PACIFIC NORTHWEST SECTION – AMERICAN WATER WORKS ASSOCIATION.

D. Maintenance

Any defective backflow prevention device should be immediately repaired or replaced. The water supplier should be notified of all corrective repairs.

The customer should be required to keep an inspection log and a formal record in a manner and frequency acceptable to the water supplier.

A simplified form combining testing and maintenance data is illustrated as Form DOH-1013 New York State Department of Health. Similar forms may be utilized. (See Section 9).

Normal maintenance of DCV and RPZ is similar to, but more frequent than, that given control valves, meters, etc. Check the manufacturer's literature and instructions for specific maintenance instructions. Special tools may be required.

General maintenance inspections should also check for continued protection against freezing, continued accessibility, and adequate drainage provisions. Piping checks should also be made frequently to insure that the protective devices have not been bypassed or rendered ineffective.

RPZ and DCV should be disassembled and overhauled every five years.

APPENDIX A

Internal Plumbing Control Program for the Elimination of Cross-Connections

The supplier of water should be familiar with the basics of internal cross-connection control so that the effectiveness of a total cross-connection control program in your community can be evaluated. Such knowledge assists those water users who seek to form an internal cross-connection control program of their own.

The principal reference source for internal cross-connection control is the State Building Construction Code Applicable to Plumbing, as promulgated by the State Building Code Council.

The Building Code is concerned with regulations for building construction and the installation of plumbing equipment. The Code seeks to establish safeguards for the health, safety and welfare of the occupants and users of buildings.

The Code is applicable only in those communities which have adopted it.

Internal Cross-Connection Control Inspection

Inspection of a customer's piping system for the purpose of cross-connection control is a time consuming, complex task. It should be performed by an individual with a thorough understanding of the hydraulics of piping systems and the potential for creating backpressure and/or backsiphonage conditions given variations in piping arrangements and water use within a facility.

An inspection should begin at the customer is water meter. The objective is to follow every water line in the facility back to the most remote water outlet on that particular line. As the inspection progresses, every outlet, every water connection to equipment, and every branch line, must be investigated to determine the potential for allowing the backflow of contaminants into the customer's piping system. Some items to determine at each water use point are:

1. whether or not pressurized equipment is in use.
2. what chemicals, if any, are used in the manufacturing process.
3. whether booster pumping equipment is used.
4. possibility of creating submerged inlets through the use of hoses, etc.
5. whether existing cross-connection control equipment is being correctly used for its intended purpose, is properly installed, has been compromised by repiping arrangements, has been recently inspected, etc.

Each potential cross-connection must be eliminated or properly protected. This inspection process must be frequently repeated since changes in piping create the potential for totally different hydraulic forces within the system.

Internal Cross-Connection Control Devices

The principle devices used are vacuum breakers and air gaps built in to receiving vessels.

A vacuum breaker is a mechanical device used to prevent backsiphonage. When a vacuum or negative pressure creates a siphoning action in a piping system, the vacuum breaker acts to break the siphon by admitting atmospheric pressure to that system.

Vacuum breakers work to prevent backflow by backsiphonage only and are not effective where backflow due to a backpressure exists. A vacuum breaker should be installed as near as possible to the source of contamination anticipated since vacuums can be created at many places throughout a users piping system. The vacuum breaker should be installed to preclude flooding and in an area where it will not be subjected to corrosive fumes or other atmospheric pollutants. A hot water type vacuum breaker must be used to protect a water line which will reach a temperature of 160°F.

Vacuum breakers are not acceptable backflow protection installed on a customer's service connection for the purpose of containment as required by Part 5-1.31 of the State Sanitary Code.

There are basically two types of vacuum breakers. The atmospheric vacuum breaker allows atmospheric pressure to enter a line under a backsiphonage condition through a gravity operated vent valve (poppet).

The pressure vacuum breaker has incorporated in its design a spring loaded vent valve. When the water pressure in the line approaches atmospheric pressure, the spring forces the vent valve open.

Atmospheric Vacuum Breaker (AVB) (FIG. A-1)

Because the vent valve of an AVB is gravity operated, it must not be subjected to continuous line pressure since there is a tendency for the poppet to stick in the closed position due to corrosion or the build-up of lime deposits on the valve poppet seat.

Consequently, an AVB must be installed on the downstream side of the last control valve in the piping system and be at least six inches above the flood level of the receiving vessel or the highest outlet served.

AVB designed for installation within a piping system must meet the American Society of Sanitary Engineers (ASSE) 1001 Standard (latest revision).

A specialized AVB is the hose bibb type of vacuum breaker (FIG. A-2) which is mounted on a wash basin or laboratory faucet or on ordinary hose bibbs. This device is readily subjected to backpressure since the attached hosing may be raised to a level higher than the faucet. Additionally, it is often improperly installed under a condition of continuous pressure as in the case of a garden hose with a nozzle shutoff at the end.

It is generally agreed that in spite of its shortcomings, this device is better than no protection at all. Its chief advantage is the fact that it is inexpensive and readily available.

Hose bibb vacuum breakers must meet ASSE 1011 Standard (latest revision).

Each installation of an AVB requires continued re-inspections since they are often improperly installed or a proper installation is compromised by:

a. installing a shutoff valve downstream of the AVB thereby subjecting it to continuous line pressure.
b. repiping creates a potential for backpressure, a condition under which a vacuum breaker is not intended to be used.

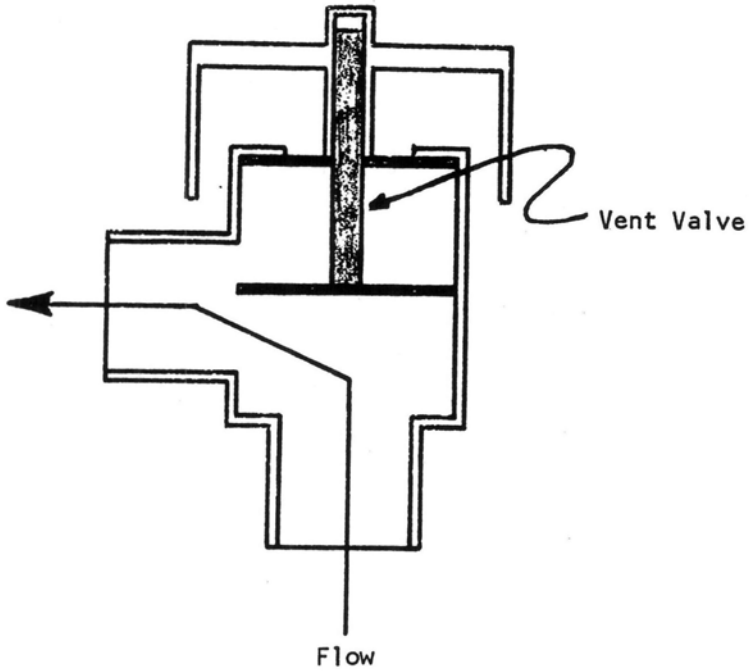
Pressure Vacuum Breaker (PVB) (FIG. A-3)

The vent valve on a PVB is spring loaded, thus overcoming the tendency for the poppet to stick closed when the device is subjected to continuous line pressure.

Therefore, shutoff valves may be installed downstream from PVBs.

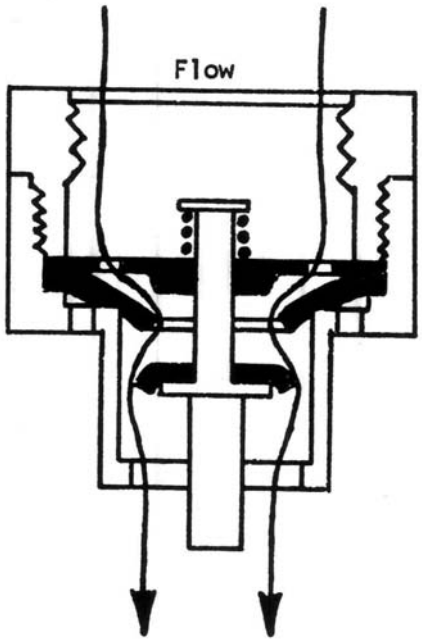
PVB should be installed at a minimum of twelve inches above the highest outlet served or the flood level of a receiving vessel. PVB must meet the requirements of ASSE 1020 Standard (latest revision).

Each PVB installation must be continually re-inspected to assure that repiping arrangements have not created a potential for backpressure on the device, a condition for which its use is not intended. Additionally, PVBS should be routinely disassembled, visually inspected, tested and rebuilt as necessary.



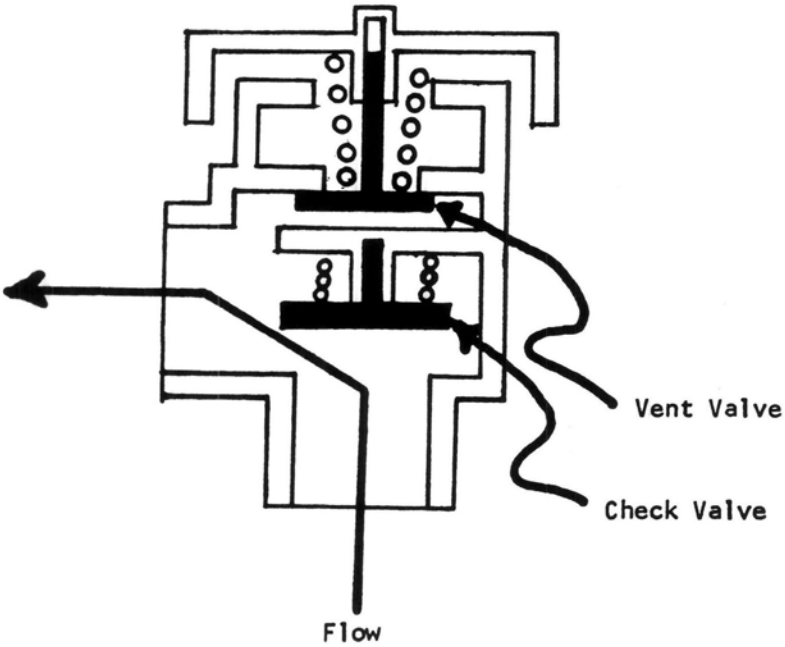
ATMOSPHERIC VACUUM BREAKER

FIG. A-1



HOSE BIBB VACUUM BREAKER

FIG. A-2



PRESSURE VACUUM BREAKER

FIG. A-3

TYPICAL PLUMBING VIOLATIONS

The following listing contains typical examples of plumbing violations. The existence or absence of these violations is a fair indication of the effectiveness of local plumbing or building code enforcement.

- Any direct connection between potable and non-potable water pipes, even though separated by shutoff valves.
- Aspirators on surgical, dental or industrial equipment operated by water ejectors.
- Automatic water-supplied siphon flush tanks with inlet below the water line (including public sewer flush tanks).
- Baptistries with below-the-rim water inlets.
- Bath tubs with below-the-rim water inlets.
- Bedpan washers and sterilizers with below-the-rim water inlets.
- Bottle washers with below-the-rim water inlets.
- Cellar drains of the water-ejector type.
- Coffee urns with direct water supply and sewer connections.
- Dental cuspidors and saliva ejectors with direct water supply connections.
- Dishwashing sinks or machines with below-the-rim water inlets.
- Drains from fire sprinklers connected directly to sewers.
- Drinking fountains with below the rim drinking orifice or with the water supply line passing through the fixture drain.
- Ejectors actuated by direct water supply connections.
- Fire hydrants with drain connections to sewers.
- Flushometer valves on water closet bowls without a siphon breaker on the water supply line downstream from the flushometer valve.
- Garbage can washers with submerged inlets.
- Glass-tumbler washers in beverage sinks having submerged inlets.
- Grease traps having direct water supply connections for flushing.

- Hose for sinks, laundry trays, soap kettles, etc., with direct water supply connection.
- Hospital, dental and laboratory equipment such as autoclaves, instrument sterilizers, utensil sterilizers, water sterilizers, etc., with submerged inlets and with direct connections to a sewer.
- Hydraulic machinery with direct water supply connection and waste connection to a sewer.
- Industrial vats, tanks, etc., which have an inverted water supply connection, or a water supply connection below the top of the spill rim, or in which a hose filler is used.
- Industrial water supplied process appliances with direct water supply connections without adequate air gaps.
- Jet-action water closets with a pressure tank having a flush valve in or attached to the bowl.
- Laboratory equipment with below-the-rim water supply connections.
- Laundry machinery with common waste and supply lines.
- Laundry trays or tubs with submerged inlets.
- Lavatories with submerged inlets or with a hose connection extending into the fixture such as those used by barbers and beauticians with hair-washing apparatus.
- Lawn water sprinkling systems (subsurface) without vacuum breakers.
- Pump pits with direct drain connection to sewer line, cesspool, etc.
- Pumps used for dual purposes with one safe and one unsafe supply.
- Pumps used for unsafe materials having a direct water supply connection for priming.
- Refrigeration equipment with water cooling connected directly to a sewer.
- Sewage lifts with direct water supply connections.
- Sinks with faucets or water supply inlets below-the-rim.
- Siphon flush tanks with water supply connection below the overflow rim.
- Spray vats with below-the-rim water supply connections.
- Steam tables with water supply connections entering the bottom of the table.
- Swimming pools with water supply (makeup) inlets below the overflow rim or having a direct connection between the public water supply and the pool recirculating system.

- Therapeutic baths with submerged inlets.
- Urinals having flushometer valves without a siphon breaker on the water supply line downstream from the flushometer valve.
- Wash basins with below-the-rim water inlets.
- Water coolers using a toxic refrigerant with a connection to the public water supply.
- Water-operated aspirators on suction flasks in laboratories, undertaking establishments, etc.
- Water supplied cleaning brushes with direct water supply connections.
- X-ray and photographic development tanks with submerged water supply inlets.
- Yard hydrants or fire hydrants installed with unplugged weep hole located below the groundwater table.

APPENDIX B

References

1. Legal Aspects of Cross Connection Inspections,
   Ernest H. Campbell, p409, Journal of American Water Works Association, August 1969.

2. Recent Cases of Water-Utility Liability,
   Brice W. Rhyne, p82, Journal of American Water Works Association, February 1972.

3. Manual of Cross-Connection Control;
   latest edition; Bookstore, University of Southern California, University Park, Los Angeles, California 90007.

4. Cross Connections and Backflow Prevention;
   Gustave J. Angele, Sr., AWWA No. S106, Publications Sales, 6666 West Quincy Avenue, Denver, Colorado 80235.

5. Recamended Practice for Backflow Prevention and Cross-Connection Control,
   M 14 (1970) American Water Works Association, 6666 West Quincy Avenue, Denver, Colorado 80235.

6. Implementation of an Effective Cross-Connection Control Program,
   Roy O. Van Meter, Consulting Sanitary Engineer, Hersey-Sparling Meter Company, Beeco Products, 250 Elm Street, Dedham, Massachusetts 02026.

7. Handbook: Cross Connection Control;
   Edwin Reinecke, M.E., Febco, 909 West Neilsen Avenue, Fresno, California 93708.

8. Water Supply and Plumbing Cross-Connections,
   Hazards in Household and Community Systems; U.S. Environmental Protection Agency; Public Health Service publication No. 957; Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

9. State Building Construction Code – Plumbing,

January 1, 1973; Bulletin #23, Executive Department, Division of Housing and Community Renewal, Housing & Building Codes Bureau, 393 Seventh Avenue, New York, New York 10001.

10. "Water Quality Criteria",
latest edition, State Water Quality Control Board, Sacramento, California 95314.

11. Dangerous Properties of Industrial Materials; 1957; N. Irving Sax; Reinhold Publishing Corporation; New York, New York.

12. The Merck Index;
1968; Merck & Company, Inc., Rahway, New Jersey.

13. Accepted Procedure and Practice in Cross Connection Control Manual,
July 1973, Second Edition, CROSS CONNECTION CONTROL COMMITTEE PACIFIC NORTHWEST SECTION – AMERICAN WATER WORKS ASSOCIATION.

14. National Fire Codes,
Volumes 1 and 2, 1977, National Fire Protection Association, 470 Atlantic Avenue, Boston, Massachusetts 02210.

15. Guide for Sprinkler Plan Review,
1977, National Automatic Sprinkler and Fire Control Association, Inc.

Publication 3230