TABLE 6-2
Backflow Prevention Devices, Assemblies and Methods

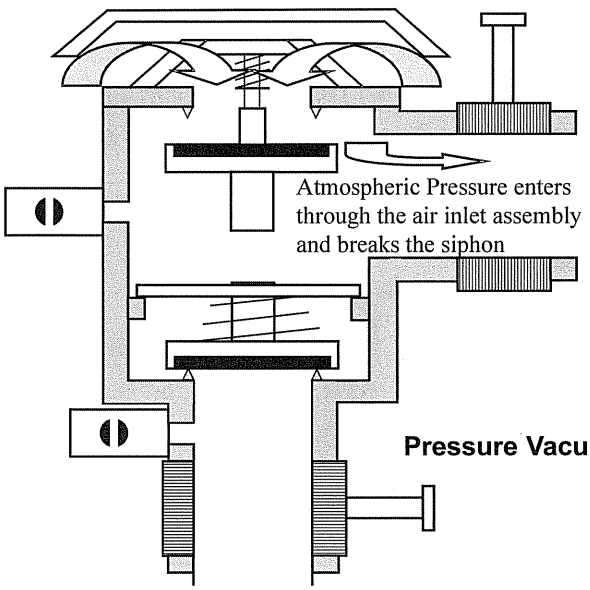
Device, Assembly or Method[1]	Degree of Hazard				Installation [2,3]
	Pollution (Low Hazard)		Contamination (High Hazard)		
	Back Siphonage	Back Pressure	Back Siphonage	Back Pressure	
Air gap	X		X		See Table 6-3
Atmospheric Vacuum Breaker	X		X		Upright position. No valves downstream. Minimum of six (6) inches (152 mm) or listed distance above all downstream piping and flood level rim of receptor. [4,5]
Spill-Proof Pressure-Type Vacuum Breaker	X		X		Upright position. Minimum of six (6) inches (152 mm) or listed distance above all downstream piping and flood level rim of receptor. [5]
Double Check Valve Backflow Preventer	X	X			Horizontal, unless otherwise listed. Requires one (1) foot (305 mm) minimum clearance at bottom for maintenance. May need platform/ladder for test and repair. Does not discharge water.
Pressure Vacuum Breaker	X		X		Upright position. May have valves downstream. Minimum of twelve (12) inches (305 mm) above all downstream piping and flood level rim of receptor. May discharge water.
Reduced Pressure Principle Backflow Preventer	X	X	X	X	Horizontal unless otherwise listed. Requires one (1) foot (305 mm) minimum clearance at bottom for maintenance. May need platform/ ladder for test and repair. May discharge water.

1. See description of devices and assemblies in this chapter.
2. Installation in pit or vault requires previous approval by the administrative authority.
3. Refer to general and specific requirements for installation.
4. Not to be subjected to operating pressure for more than 12 hours in any 24 hour period.
5. For deck-mounted and equipment-mounted vacuum breakers, see Section 603.4.16.

TABLE 6-3
Minimum Air Gaps for Water Distribution[4]

Fixtures	When not affected by side walls[1] inches (mm)	When affected by side walls[2] inches (mm)
Effective openings[3] not greater than one-half (½) inch (12.7mm) in diameter	1 (25.4)	1½ (38)
Effective openings[3] not greater than three-quarter (3/4) inch (19.1mm) in diameter	1½ (38)	2¼ (57)
Effective openings[3] not greater than one (1) inch (25.4mm) in diameter	2 (51)	3 (76)
Effective openings[3] greater than one (1) inch (25.4mm) in diameter	Two (2) times diameter of effective opening	Three (3) times diameter of effective opening

1. Side walls, ribs or similar obstructions do not affect air gaps when spaced from the inside edge of the spout opening a distance greater than three times the diameter of the effective opening for a single wall, or a distance greater than four times the effective opening for two intersecting walls.
2. Vertical walls, ribs or similar obstructions extending from the water surface to or above the horizontal plane of the spout opening other than specified in Note 1 above. The effect of three or more such vertical walls or ribs has not been determined. In such cases, the air gap shall be measured from the top of the wall.
3. The effective opening shall be the minimum cross-sectional area at the seat of the control valve or the supply pipe or tubing which feeds the device or outlet. If two or more lines supply one outlet, the effective opening shall be the sum of the cross-sectional areas of the individual supply lines or the area of the single outlet, whichever is smaller.
4. Air gaps less than one (1) inch (25.4mm) shall only be approved as a permanent part of a listed assembly that has been tested under actual backflow conditions with vacuums of 0 to 25 inches (635mm) of mercury.



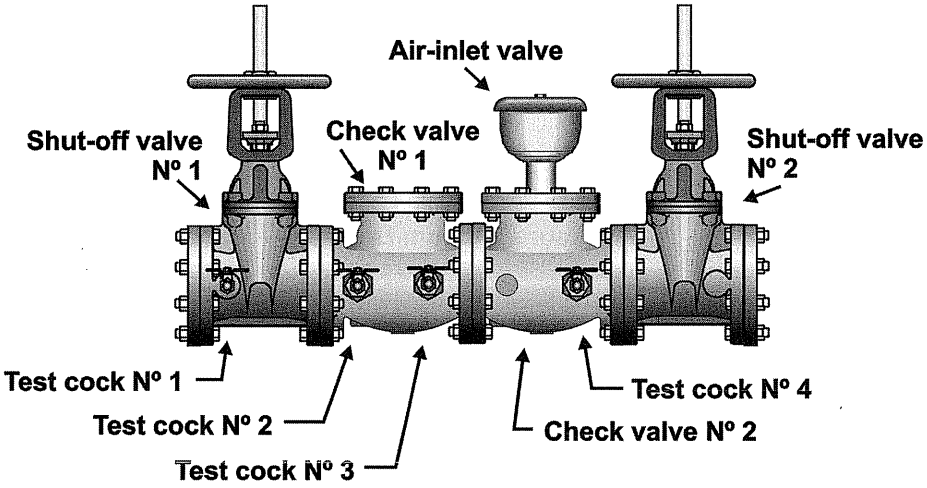
Pressure Vacuum Breaker — Backsiphonage Condition
Figure 8-6

8.10 PRESSURE VACUUM BREAKER INSTALLATION

1. May be installed where the device is under continuous supply pressure.
2. May be installed where the device will not be subjected to backpressure, regardless of the degree of hazard.
3. Typically installed in irrigation systems, saturators, and commercial dish washing systems.
4. The assembly is tested and repaired without removal from the system.
5. Pressure vacuum breakers typically come in sizes ranging from 1/2 inch through 2 inch. Figure 8.4 shows the typical configuration for assemblies up through 2 inches. Although no longer manufactured, PVBs in sizes greater then 2" may be found on some older lawn irrigation systems. Two and one-half (2½) inch diameter and larger pressure vacuum breakers have a shut-off valve at each end of the assembly and four test cocks. Test cock No. 1 will be on the inlet side of shut-off valve number 1, and senses supply pressure. Test cock No 2 senses the pressure between shut-off valve number one and check valve number one. Test cock No. 3 senses the pressure between the two check valves. Test cock number four senses pressure at the outlet of check valve number 2 and is used to determine the air-inlet valve opening point. See Figure 8-7 on the following page.
6. Pressure vacuum breakers can only be used as isolation assemblies for any degree of hazard.
7. Must be installed so that the critical level may be no less than twelve inches above the highest point of use, or associated piping located downstream of the assembly. The plumbing code requires the assembly to be no more than five feet above the ground unless provided with a perma-

nent platform. This requirement has to do with the ease of testing and maintenance. The unit will operate properly at greater heights.

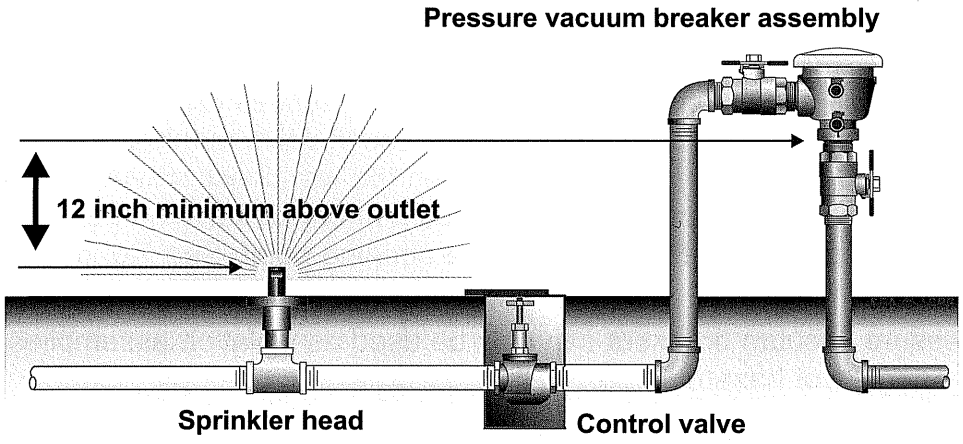
NOTE: *Pressure vacuum breakers may be used as a containment assembly only on irrigation systems where served by a separate service line and when meeting all other installation specifications.*



Pressure Vacuum Breaker Assembly — Larger than 2 inch in size

Figure 8-7

8. PVBs are recommended for outdoor use or where water spillage is not a problem.
9. PVBs should be protected from freezing and vandalism. If the freeze protection materials obstruct the air inlet, the assembly may not operate properly.
10. PVB's should not be used in looped lawn sprinkler systems with more than one water feed.



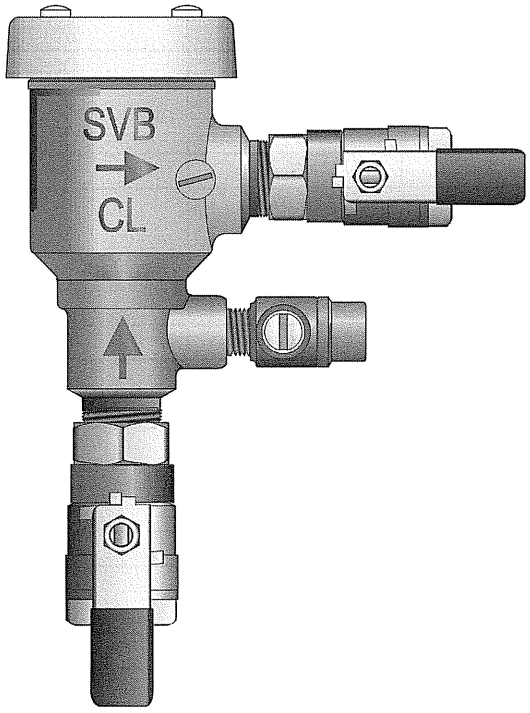
Irrigation sprinkler system

Figure 8-8

8.11 ANTI-SPILL PRESSURE VACUUM BREAKER

ASSE Standard 1056
In Sizes: 3/8", ½", ¾" and 1"

The anti-spill pressure vacuum breaker (Figure 8-9) is designed for indoor point of use applications to prevent backsiphonage of contaminated water into the potable water supply. Separation of the water supply from the air inlet is accomplished by means of a diaphragm seal. This feature protects against any spillage during start-up operation. The anti-spill pressure vacuum breaker is designed for health hazard applications.



Spill resistant pressure vacuum breaker

Figure 8-9

8.12 LIST FOR VACUUM BREAKER INSTALLATION

TYPE OF USE	FOOD ESTABLISH-MENT	SCHOOLS	COMMERCIAL	RESIDENTIAL
Auxiliary water supply	**NO**	**NO**	**NO**	**NO**
Bath tubs	X	X	X	X
Cooling towers	X	X	X	X
Cookers	X	X	X	X
Construction	X	X	X	X
Drinking fountains	X	X	X	X
Display fountains	X	X	X	X
Drains to Sewer	X	X	X	X
Fountains	X	X	X	X
Fish tanks	X	X	X	X
Fire sprinkler drain	X	X	X	X
Grease traps	X	X	X	X
Glue pots	X	X	X	X
Garbage disposals	X	X	X	X
Hand held shower heads	X	X	X	X
Hose bibs	X	X	X	X
Hot tubs	X	X	X	X
Ice cream dipper well	X	X	X	X
Irrigation systems	X	X	X	X
Kitchen equipment	X	X	X	X
Main water supply	**NO**	**NO**	**NO**	**NO**
Photo processing	X	X	X	X
Potato peeler	X	X	X	X
Steam tables	X	X	X	X
Sinks (hand, janitor, dish)	X	X	X	X
Swimming pool	X	X	X	X
Science sinks	X	X	X	X
Swamp coolers	X	X	X	X
Storage tanks for fire water	X	X	X	X
Sewer cleaning equipment	X	X	X	X
Toilet tanks	X	X	X	X
Tanks, vats and vessels	X	X	X	X
Washers(Bottle,Dish)	X	X	X	X

X = Acceptable

Note: The applications listed in the table above are acceptable only if the installation procedures are followed for each type of assembly.

10. REDUCED PRESSURE ASSEMBLY

ASSE Standard 1013

10.1 REDUCED PRESSURE ASSEMBLY TABLE

Installation:	Hazard Applications	Backpressure	Backsiphonage	Containment	Isolation	Continuous line pressure
1. 12" above floor. 2. Permanent platform if higher than 5 feet. 3. Adequate clearance for testing & repairs. 4. Manhole, vault or pit installation discouraged but okay with drain to daylight 2 times the pipe diameter. 5. Basement installation OK provided proper drainage or high water alarm exists.						
Reduced Pressure Type (RP, RPA, RPZ, RPZA, RPPZ, RPPA)	**High & Low**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

1. Installers: check with local jurisdiction for additional/special requirements.
2. Water supply & plumbing officials: determine installation requirements for program implementation.

10.2 APPLICATIONS

1. Health hazard and pollution hazard
2. Containment or isolation
3. May be subjected to backpressure and/or backsiphonage.

10.3 COMPONENTS

See Figure 10-1 on the following page.

1. **TWO SHUT-OFF VALVES**
   - A. Located on inlet and outlet sides of assembly
   - B. Resilient seated (USC FCCC&HR requirement)
2. **TWO CHECK ASSEMBLIES**
   - A. Independently operated
   - B. Internally loaded
   - C. Resilient seated disc
   - D. Designed to close tightly during a no-flow condition.

3. FOUR TEST COCKS

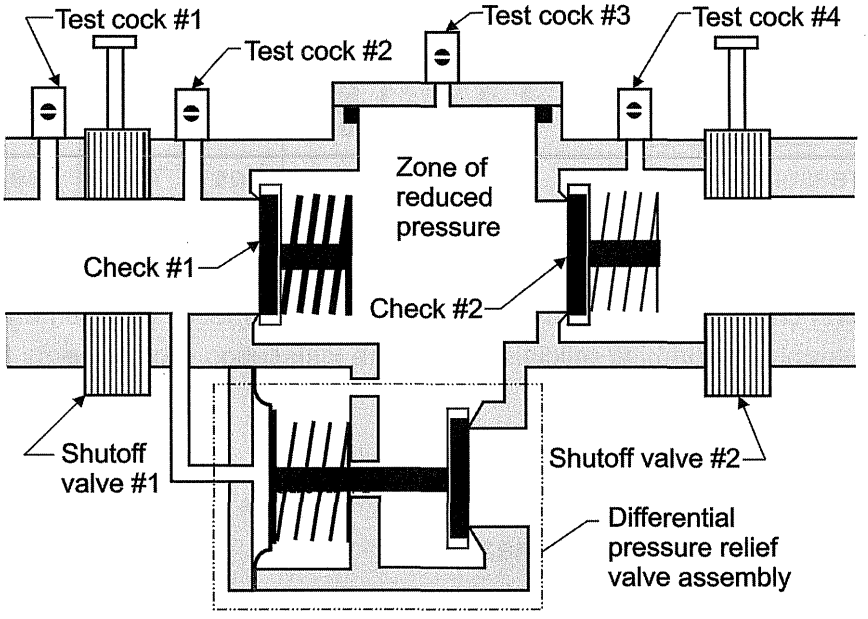
A. Test cock No. 1 is located upstream of the first shut-off valve. This test cock will give line or static pressure.

B. Test cock No. 2 is located downstream of the first shut-off valve and upstream of the first check assembly. This test cock will give line or static pressure.

C. Test cock No. 3 is located between the check assemblies. This test cock will give the pressure in the "zone of reduced pressure".

D. Test cock No. 4 is located downstream of the second check assembly and upstream of the second shut-off valve. This test cock will give the pressure downstream of the backflow assembly.

4. HYDRAULICALLY DEPENDENT PRESSURE DIFFERENTIAL RELIEF VALVE



Reduced Pressure Principle Assembly - No Flow Condition (Static)

Figure 10-1

10.4 OPERATION

1. NORMAL OPERATION DURING A NO-FLOW CONDITION (FIGURE 10-1).

A. Both check assemblies are forced closed by the check springs.

B. The relief valve assembly is forced closed by the supply pressure on the high-pressure side of the diaphragm. Pressure in the "reduced pressure zone" plus the force of a 2-psi minimum spring pressing on the low-pressure side of the diaphragm is attempting to open the relief valve assembly.

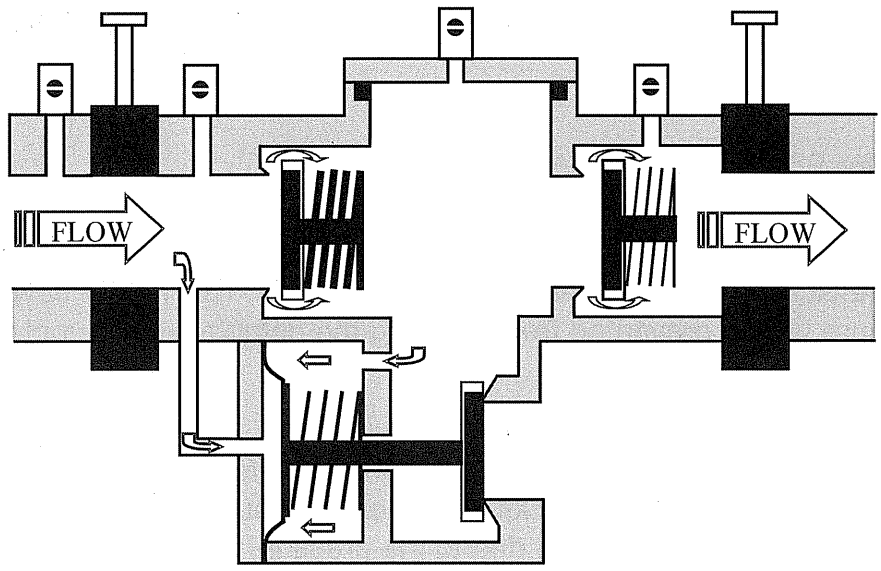
C. As long as the supply pressure on the high-pressure side of the diaphragm is greater then the total force on the low-pressure side of the diaphragm, the relief valve will stay closed.

D. In all distribution systems, supply pressure varies due to use. If the total pressure in the "zone of reduced pressure" is greater then the supply pressure, the relief valve will open and discharge the excess water pressure. ASSE requires that the pressure drop across the first check be at least 3-psi greater than the pressure required to open the relief valve. This "buffer" allows for a small supply pressure fluctuation without causing the relief valve to open.

2. NORMAL OPERATION DURING A FLOW CONDITION (FIGURE 10-2)

A. Both check assemblies are forced open by the supply pressure. The force of the compressed check springs causes the water pressure to decrease equal to the force of the springs.

B. The relief valve assembly is forced to the closed position by the supply pressure on the high-pressure side of the diaphragm. Pressure in the zone of reduced pressure plus the force of a 2 psi minimum spring pressing on the low-pressure side of the diaphragm is attempting to open the relief valve assembly. Since the total pressure in the zone of reduced pressure must be less then supply pressure, the relief valve stays closed.

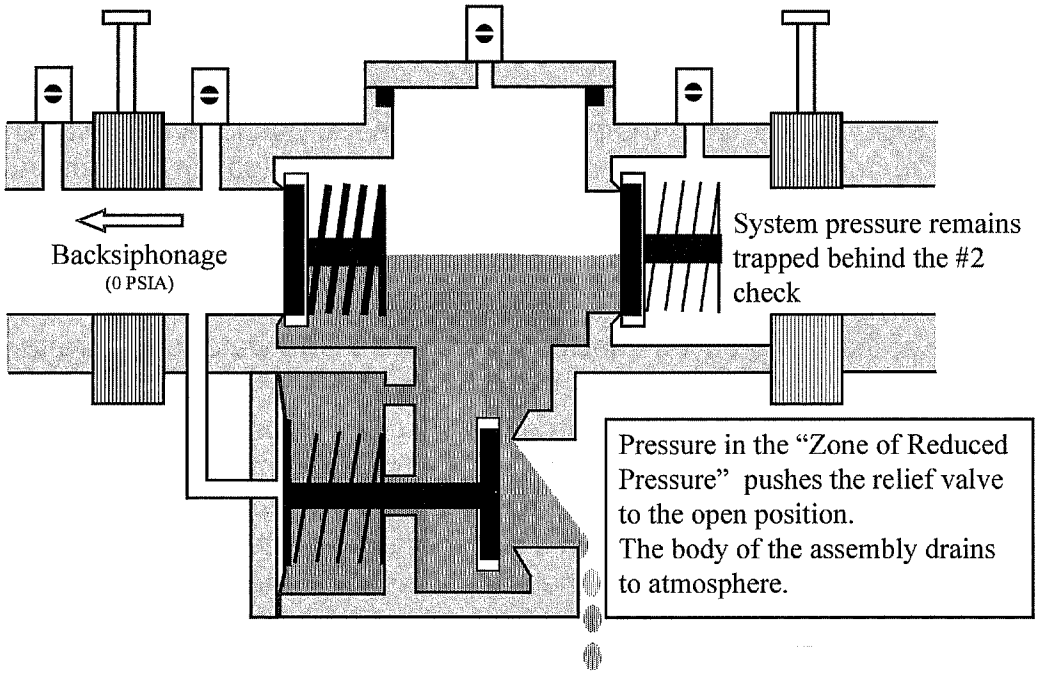


Reduced Pressure Principle Assembly — Flow Condition
Figure 10-2

3. NORMAL OPERATION DURING A BACKSIPHONAGE EVENT (FIGURE 10-3)

A. Both checks close by the force of the springs.

B. When the total pressure in the "zone of reduced pressure" exceeds supply pressure the relief valve opens and discharges the water pressure between the two checks.



Reduced Pressure Principle Assembly — Backsiphonage Condition
Figure 10-3

4. NORMAL OPERATION DURING A BACKPRESSURE EVENT.

A. Both checks close by the force of the springs.

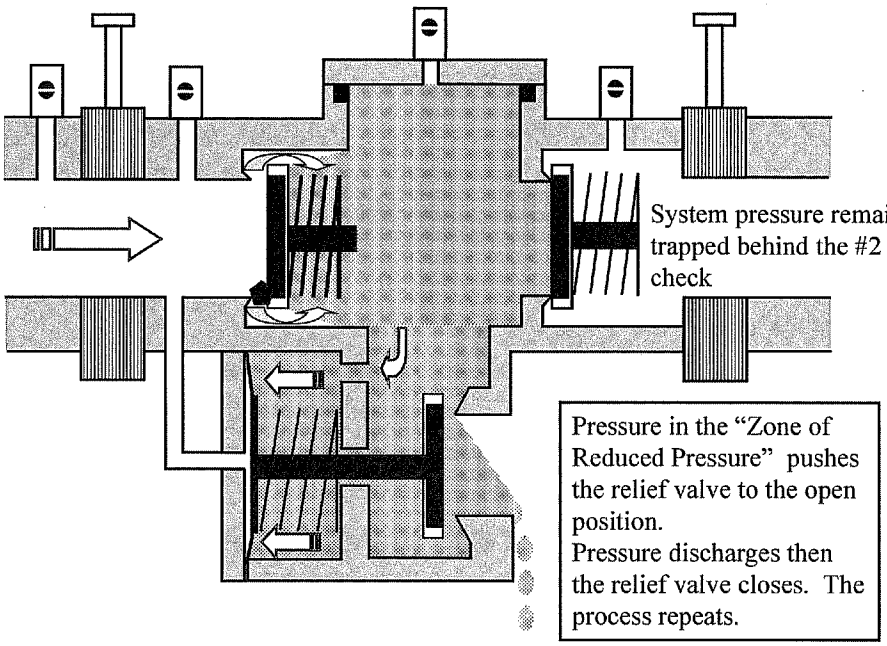
B. When the pressure downstream of the backflow assembly exceeds supply pressure, a backpressure event is occurring. This higher downstream pressure will be prevented from entering the potable water supply by the tightly closing second check.

5. NORMAL CONDITIONS WITH FOULED CHECK.

A. During a flow condition, fouled checks will not effect the operation of the assembly. That is, both checks will be open to supply the demand and the relief valve will be closed due to the pressure loss across the first check.

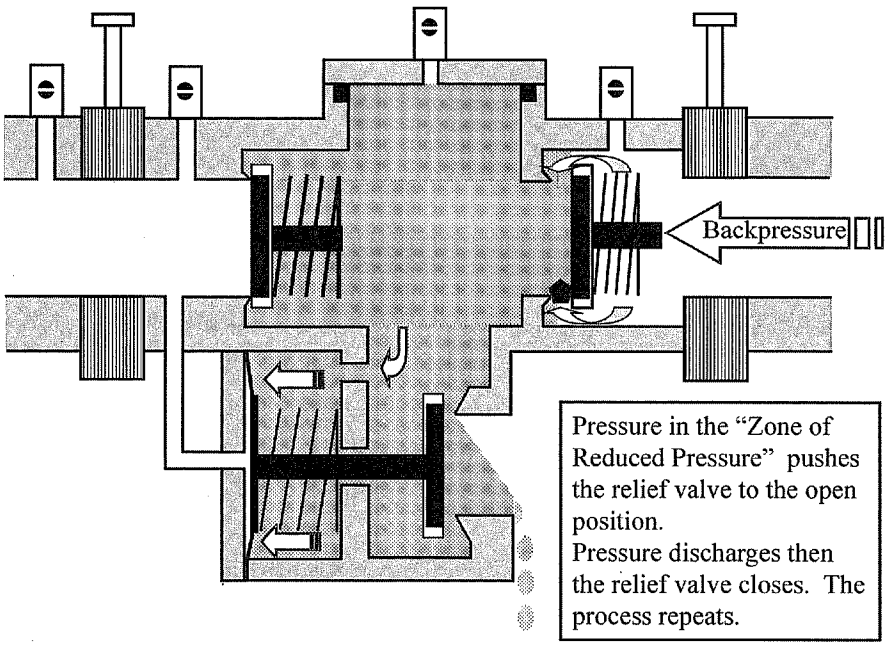
B. During a no flow condition, a fouled first check will allow supply pressure to leak into the "zone of reduced pressure". When the total pressure within the "zone of reduced pressure" exceeds supply pressure, the relief valve will open discharging the excess pressure. This will continue until the check is repaired. (Figure 10-4).

C. A **fouled second check** will allow water pressure to leak toward the lower pressure. If backpressure exists, water pressure will leak into the "zone of reduced pressure". When the total pressure within the "zone of reduced pressure" exceeds supply pressure, the relief valve will open dis-



Reduced Pressure Principle Assembly — Check No. 1 Fouled
Figure 10-4

charging the excess pressure. This will continue until the check is repaired. If backpressure does not exist, water pressure will leak into the system (the normal direction of flow) until the system pressure equals the pressure within the "zone of reduced pressure" (See Figure 10-5).



Reduced Pressure Principle Assembly — Check No. 2 Fouled
Figure 10-5

10.5 INSTALLATION

1. *STATE PLUMBING CODE* (UPC), 1997, SECTION 603.3.3

A. Section 603.3.3 of the 1997 UPC states as follows: Access and clearances not less than the minimum state requirements shall be provided for the required testing, maintenance and repair of assemblies. Access and clearance shall require not less than the state requirements of a minimum of one (1) foot (305mm) between the lowest portion of the assembly and grade, floor or platform.

B. Assemblies installed higher than 5 feet above the floor must have a permanent platform adequate to test and repair the assembly.

C. Assemblies must have adequate clearances around the assembly so that testing and repairs can be made.

2. LOCAL PLUMBING CODES & WATER SUPPLIER'S REQUIREMENTS

A. Local codes and requirements may be different from the *State Plumbing Code*. The local code requirements may be more stringent and therefore supercede all other requirements.

B. Backflow assembly installers must check with local plumbing departments and water suppliers before beginning installation. Permits may be required.

3. MANUFACTURER'S INSTALLATION RECOMMENDATIONS

A. All backflow assembly manufacturers recommend minimum clearances around their assemblies necessary for proper testing and repair.

B. Failure to comply with these minimum clearances may result in added testing and repair costs to the customer or moving the assembly when testing or repair is required.

10.6 INSTALLATION RESTRICTIONS

The following are locations where reduced pressure backflow prevention assemblies should NOT be installed:

1. In direct connections between potable systems and sewage.
2. Areas that are subject to toxic or corrosive fumes or vapors.
3. Areas where the assembly may become submerged.
4. Above electrical outlets, circuit breakers, electric space heaters or any other electrical use where discharge from the relief valve may cause a hazard.

   Backflow prevention assemblies must be installed in compliance with the most current adopted edition of the ***National Electric Code*** (NEC). Check with the local administrative authority for their most current electrical codes.

5. Above false ceilings or other areas where the assembly is out of sight. Installer should check with the local jurisdiction prior to installation.
6. Crawl spaces. Installer should check with the local jurisdiction prior to installation.
7. Manholes, vaults or other confined spaces. Installer should check with the local jurisdiction prior to installation.
8. Basements, unless there is drainage equal to two times the pipe diameter and/or a high water alarm is installed near the assembly. Sump pumps may be acceptable if approved by the water supplier or the administrative authority. Appendix D contains Relief Valve Discharge Flow Rate examples.
9. Any area where discharge from the relief valve during normal operation could cause a problem.
10. Any area where discharge from the relief valve or water spillage during normal testing and repair could pose a problem.

10.7 ORIENTATION

1. Either horizontal or vertical orientation is allowed for reduced pressure assemblies. However, in order to work properly in a vertical installation RP assemblies must meet certain criteria established by USC FCCC&HR and ASSE.
2. USC FCCC&HR and ASSE provide third party endorsement of product in specific orientation. If the assembly manufacturer wants their product certified in an orientation other than horizontal, it must be evaluated in that orientation. Assemblies installed in an orientation other than ones endorsed are not certified.
3. The local jurisdiction (water district or plumbing official) has final approval of an assembly's orientation and may allow an installation that does not have third party endorsement.
4. Reduced pressure assemblies are approved in the horizontal position by both USC FCCC&HR and ASSE.
5. Some reduced pressure assemblies are approved in the vertical orientation by either USC FCCC&HR or ASSE.
6. Reduced pressure assemblies should not be installed on its side or the orientation of the shutoff valves changed unless approved.
7. Installers should check with the local jurisdiction prior to installing an RP assembly in the vertical orientation.

10.8 LIST FOR INSTALLATION OF REDUCED PRESSURE ASSEMBLIES

TYPE OF USE	FOOD ESTABLISH-MENT	SCHOOLS	COMMERCIAL	RESIDENTIAL
Auxiliary water supply	X	X	X	X
Bath tubs	X	X	X	X
Cooling towers	X	X	X	X
Cookers	X	X	X	X
Construction	X	X	X	X
Drinking fountains	X	X	X	X
Display fountains	X	X	X	X
Drains to sewer	X	X	X	X
Fountains	X	X	X	X
Fish tanks	X	X	X	X
Fire sprinkler drain	X	X	X	X
Grease traps	X	X	X	X
Glue pots	X	X	X	X
Garbage disposals	X	X	X	X
Hand held shower heads	X	X	X	X
Hose bibs	X	X	X	X
Hot tubs	X	X	X	X
Ice cream dipper well	X	X	X	X
Irrigation systems	X	X	X	X
Kitchen equipment	X	X	X	X
Main water supply	X	X	X	X
Photo processing	X	X	X	X
Potato peeler	X	X	X	X
Steam tables	X	X	X	X
Sinks (hand, janitor, dish)	X	X	X	X
Swimming pool	X	X	X	X
Science sinks	X	X	X	X
Swamp coolers	X	X	X	X
Storage tanks for fire water	X	X	X	X
Sewer cleaning equipment	X	X	X	X
Toilet tanks	X	X	X	X
Tanks, vats and vessels	X	X	X	X
Washes (Car,Bottle,Dish, etc.)	X	X	X	X

X = Acceptable

Note: The applications listed in the table above are acceptable only if the installation procedures are followed for each type of assembly.