Grower Training Manual for Backflow Prevention in Chemigation of Pesticides

Revised 3/17/03

By

The Center for Irrigation Technology
California Agricultural Technology Institute
California State University, Fresno

David F. Zoldoske, Director
Tim Jacobsen, Education Specialist
Edward M. Norum, Agricultural Engineer

For

Environmental Monitoring Branch
Department of Pesticide Regulation
California EPA

March 2003

California Environmental Protection Agency
Department of Pesticide Regulation

DPR Grower Training Manual for Backflow Prevention

Table of Contents

Introduction…….3
Pesticide Label Requirements for Chemigation…….....3
Alternatives Devices that also Comply with the Label ….……7
Maintenance, Calibration, and Safety…….11
Appendix…….13

Introduction

The purpose of this manual is to familiarize those involved with injecting pesticides into irrigation systems with the equipment requirements mandated by the federal government and stated on the pesticide label. The manual will cover the legal requirements as well as discuss practical ways to satisfy the requirements.

Chemigation, or the addition of chemicals to irrigation water, has probably been around for as long as both irrigation and chemicals have been used in agriculture. Chemigation became more widely used in the 1970's with the adoption of center pivot irrigation systems in the Midwest. The federal government began regulating chemigation in 1988 when the EPA adopted a label improvement program for labeled agricultural pesticides. That program requires labels that permit chemigation to contain specific language describing equipment the application system must contain to prevent backflow into the water supply. Backflow prevention is necessary to prevent pesticide contamination of surface water supplies as well as ground water. Since 1988, the EPA has approved additional alternative backflow prevention equipment and many states have instituted guidelines to help growers come into compliance with the federal requirements.

Pesticide Label Requirements for Chemigation

The following is the actual text of the language found on every EPA label for pesticides that are approved for application by chemigation.

1. "The system must contain a functional check valve, vacuum relief valve, and low pressure drain appropriately located on the irrigation pipeline to prevent water source contamination from backflow." "Chemigation valves" are available that have been designed to satisfy these three requirements (Figure 1). A chemigation valve consists of an air/vacuum relief valve and a low pressure drain valve located immediately upstream of a check valve. This valve should be mounted immediately adjacent to the discharge head of the pump.

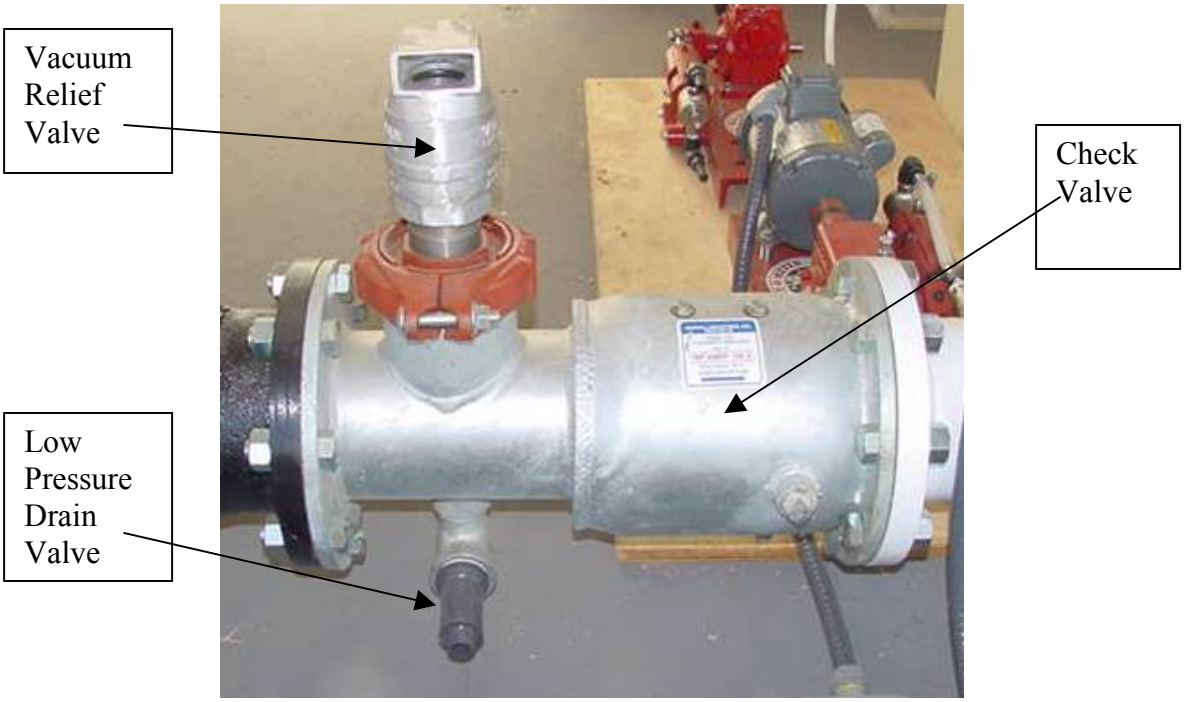


Figure 1: "Chemigation valve" (mainline check valve, vacuum relief valve, and low pressure drain)

2. "The pesticide injection pipeline must contain a functional, automatic, quick-closing check valve to prevent the flow of fluid back toward the injection pump." This smaller check valve is located in the line between the pesticide injection pump and the irrigation pipeline (Figure 2). It functions to prevent the flow of water back towards the pesticide supply tank and prevents pollution spills.

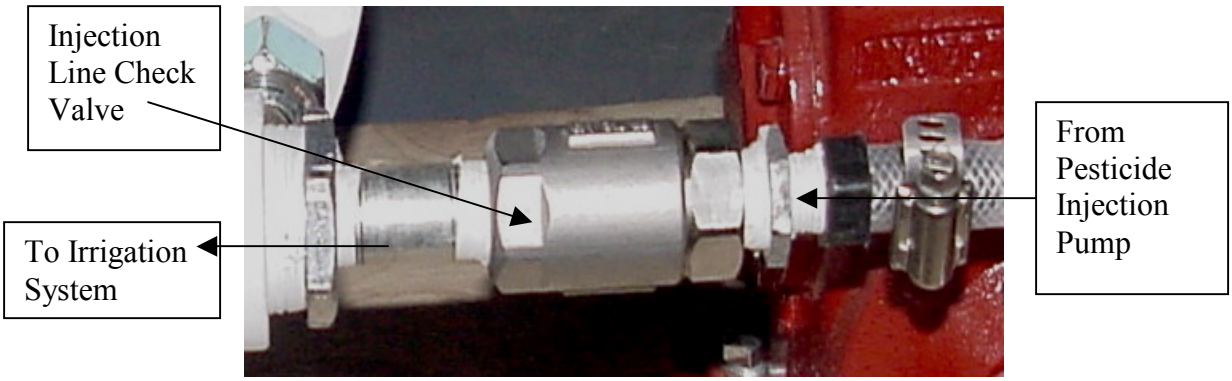


Figure 2: Quick-closing check valve on pesticide injection line

3. "The pesticide injection pipeline must also contain a functional, normally closed, solenoid-operated valve located on the intake side of the injection pump and electrically connected to the system interlock. The purpose of this valve is to prevent fluid from being withdrawn from the supply tank when the irrigation system is either automatically or manually shut down." The valve also will

prevent water from entering the pesticide tank when the injection pump is not operating. The valve is to be located at the pesticide tank to isolate the tank from the irrigation line and prevent accidental spills (Figure 3).

Figure 3: Normally closed solenoid valve

4. "The irrigation pipeline must include a functional pressure switch which will stop the water pump motor when the water pressure decreases to the point where pesticide distribution is adversely affected." Pressure switches come in many configurations and prices and are commonly available from an irrigation supply store. An example of one type is shown in Figure 4.

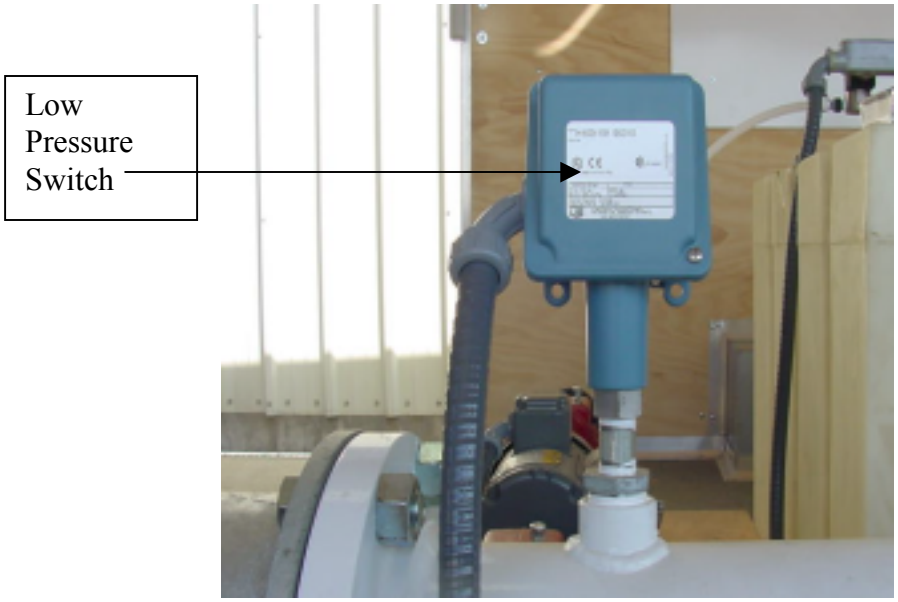


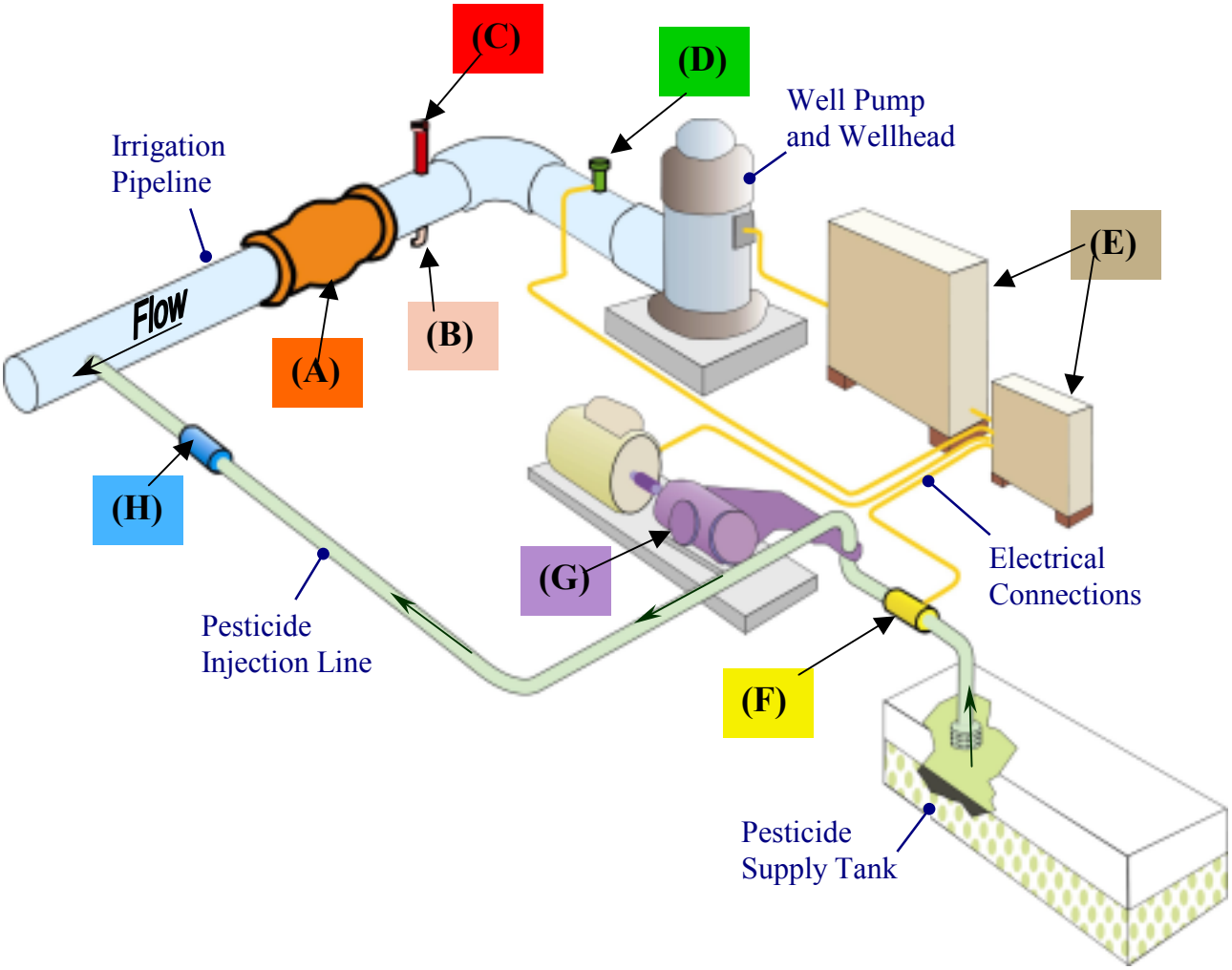
Figure 4: Pressure switch

5. "The system must contain functional interlocking controls to automatically shut off the pesticide injection pump when the water pump motor stops." These controls shut off the injection pump when the pressure switch indicates a drop in

irrigation system pressure that will affect the distribution uniformity of the pesticide application. The interlock can be electrical or hydraulic.

6. "Systems must use a metering pump, such as a positive displacement injection pump (e.g., diaphragm or piston pump) effectively designed and constructed of materials that are compatible with pesticides and capable of being fitted with a system interlock." Most pesticide injection pumps meet these criteria. Centrifugal pumps do not meet these criteria for a metering pump.

Figure 5: Schematic of a pesticide injection system with the eight required items.



(A) Mainline Single Check Valve	**(E) Interlocking System Controls**
(B) Low Pressure Drain	**(F) Solenoid Operated Valve**
(C) Air/Vacuum Relief Valve	**(G) Pesticide Injection Pump**
(D) Pressure Switch	**(H) Injection Line Check Valve**

Alternative Devices that also Comply with the Label

EPA allows for some modifications of the equipment list, which, in some cases, may simplify the system. The following is a list of required devices and the approved alternatives for those devices.

Air Gap – The most reliable form of backflow prevention is an air gap, a physical air separation between the pesticidally treated water and the water supply. No additional backflow protection is required if the water for the irrigation system leaves the pump discharge head and flows into a standpipe before the pesticide injection point. The disadvantage to an air gap is that any pressure built by the water system is lost to atmosphere at the point of discharge. The end of the pipe must be two pipe diameters above the level of the standpipe to qualify as a proper air gap (Figure 6).

Figure 6: Air gap

Gooseneck Pipe Loop – Another alternative is a gooseneck pipe loop structure with a vacuum relief valve located 24" above the highest water emission point in the field. This structure will also serve as adequate backflow protection and takes the place of the chemigation valve (mainline check valve, vacuum relief valve, and low pressure drain valve). The gooseneck pipe loop must be located in the main water line immediately downstream of the water pump. The bottom side of the pipe at the loop apex must be at

least 24” above the sprinkler or any other type of water emitting device. The loop must contain a vacuum relief valve on the top of the pipe at the apex of the pipe loop. The pesticide injection port must be located downstream of the apex of the pipe loop and at least 6” below the bottom side of the pipe at the loop apex.

Venturi – A venturi can replace the positive displacement pesticide injection pump to draw pesticides into the irrigation water (Figure 7). A venturi is a non-mechanical device that uses negative pressure created in the body of the device to introduce liquids into the irrigation pipe. A 15 to 40 psi pressure drop across the venturi is required to make the unit function. Normally the venturi is installed across a pressure reducing valve or a booster pump and takes advantage of the difference in pressure between the inlet and outlet. The venturi can also be installed in a bypass configuration with a small booster pump. See Appendix for complete details.

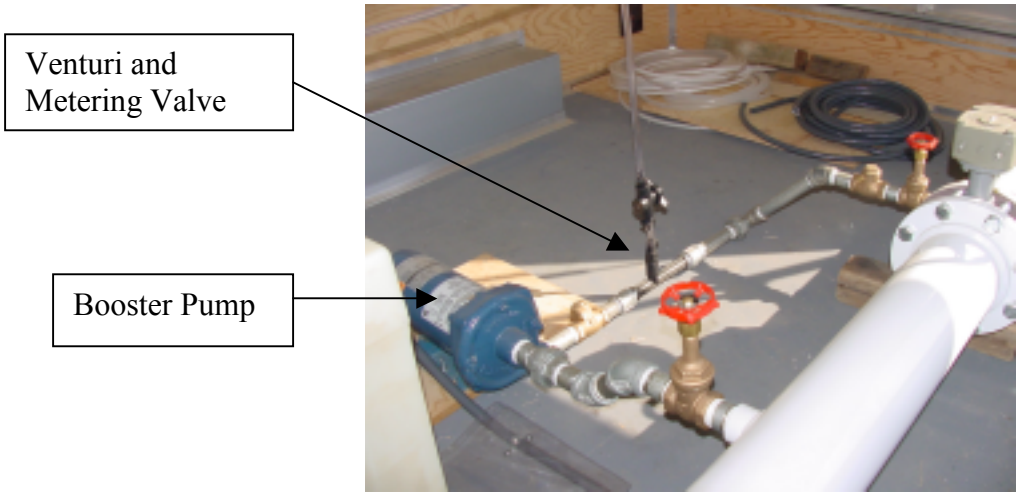


Figure 7: Venturi installed in bypass configuration

Additional Vacuum Relief – The solenoid controlled valve on the pesticide tank may be eliminated if an additional vacuum relief valve is installed between the positive displacement pesticide injection pump and the pesticide injection line check valve (Figure 8). This valve must be elevated at least 12” above the highest fluid level in the pesticide supply tank and must be the highest point in the pesticide injection line. The valve must open at 6” water vacuum or less and must be spring-loaded or otherwise constructed such that it does not leak on closing. It must prevent leakage from the pesticide supply tank on shutdown. The valve must be constructed of pesticidally resistant materials. This alternative is not an option with a venturi injection system.

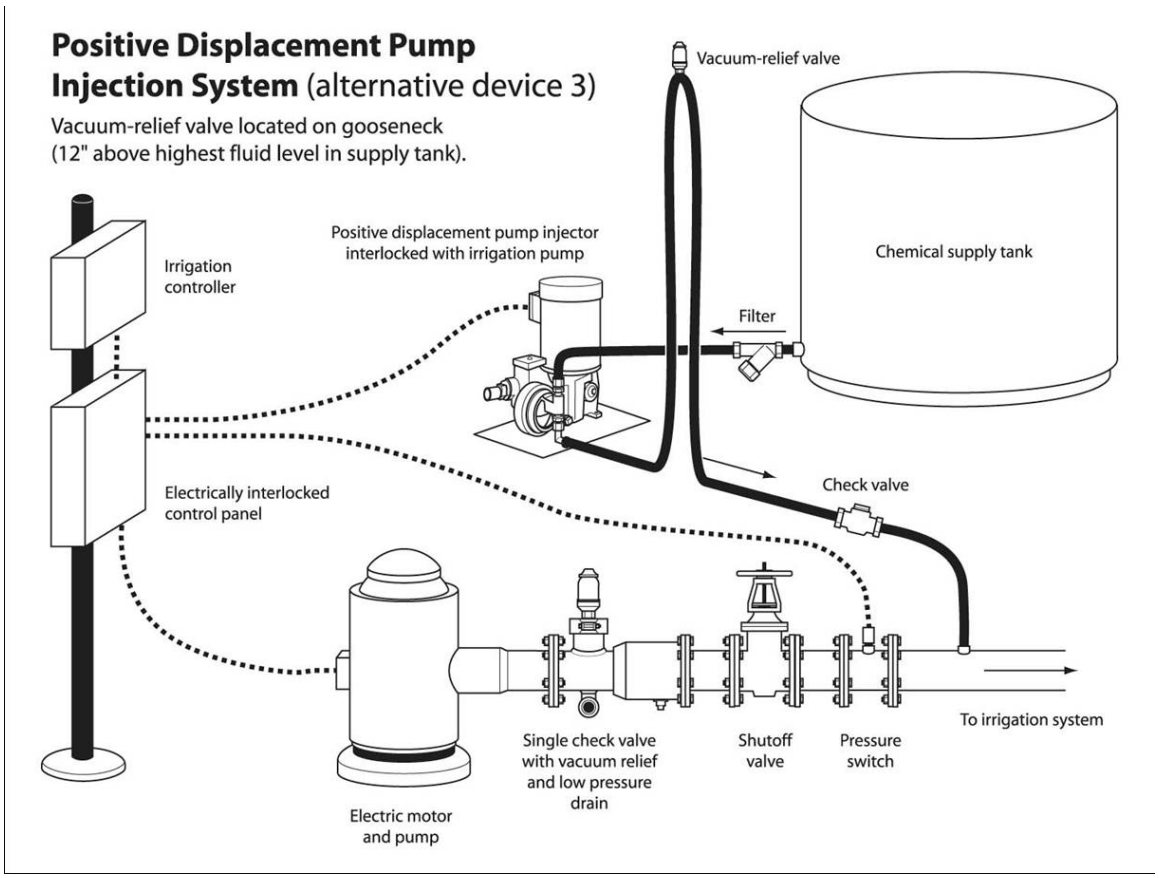


Figure 8: Vacuum relief on pesticide injection pipeline

High Spring Rate Check Valve – A functional spring loaded check valve with a minimum of 10 pounds per square inch (psi) cracking pressure in the pesticide injection line can replace the solenoid valve on the pesticide injection line and the quick-closing check valve. The valve must prevent irrigation water under pressure from entering the pesticide injection line and must prevent leaking from the pesticide supply tank on system shutdown. This valve must be constructed of pesticidally resistant materials. This device cannot be used with a venturi injection system. The higher spring rate on the check valve will not affect on the performance of the injection pump. The pumps are designed to overcome system operating pressures of much more than 10 psi. Some pesticide labels require an injection quill to place the pesticide in the middle of the irrigation pipeline. This quill (sometimes referred to as a "sparger") may also be fitted with a check valve using a 10 psi spring, which will then take the place of the solenoid valve and the low spring rate check valve (Figure 9).

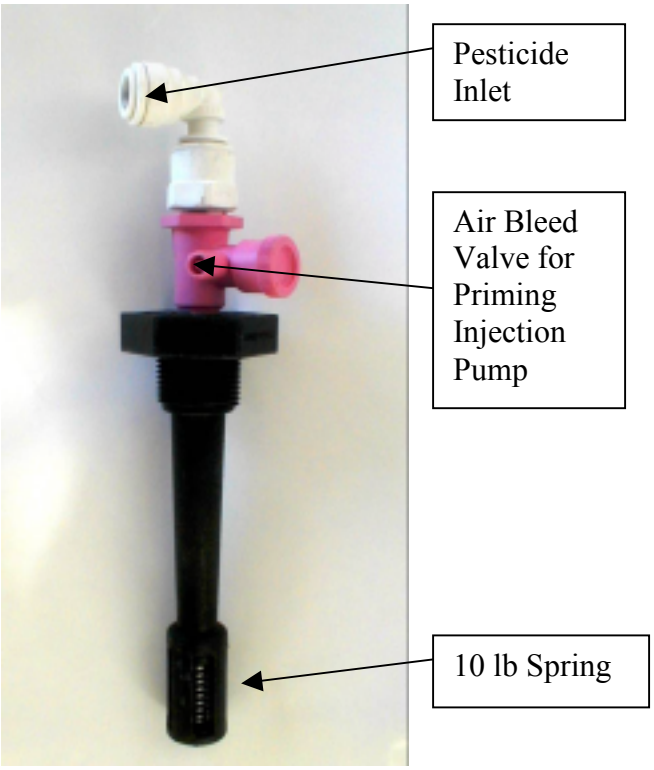


Figure 9: Injection quill with check valve

Hydraulic Check Valve – A functionally normally closed, hydraulically operated check valve may be used in place of the solenoid controlled valve on the pesticide tank (Figure 10). The control line for the valve must be connected to the main water line such that the valve opens only when the main water line is adequately pressurized. This valve must prevent leakage from the pesticide supply tank on system shut down. The valve must be constructed of pesticidally resistant materials.

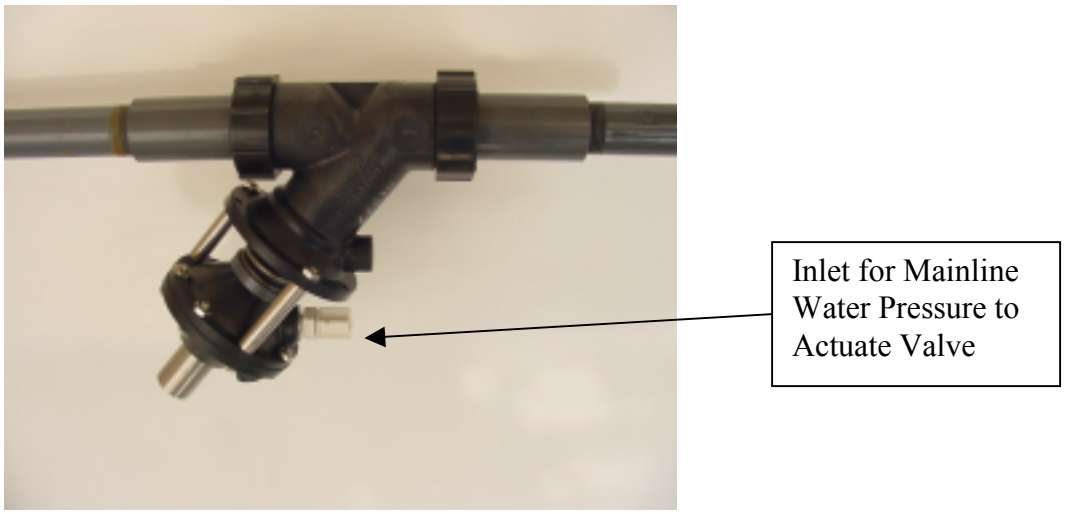


Figure 10: Normally closed, hydraulically operated check valve

Maintenance, Calibration, and Safety

Irrigation System

Chemigation practices are impacted by the following considerations related to the irrigation systems:

- The irrigation system should have a demonstrated ability to apply water in a controlled and uniform manner. This ability can be inherent in the system design as with center pivots, linear move, side-wheel role, sprinklers or drip-micro systems, or as provided by properly designed, graded, and operated surface irrigation systems. A system of scientifically based water management should also be in place.
- System must be operated to minimize field runoff and deep percolation.
- Do not operate sprinkler systems when wind speed favors drift beyond the area intended for treatment.
- Do not apply through systems that have a low coefficient of uniformity. Crop injury, lack of effectiveness or illegal pesticide residues in the crop can result from non-uniform water distribution.
- Do not cross connect an irrigation system used for pesticide applications to a potable water system.

Chemigation System Operation and Calibration

Calibration involves precisely determining the pesticide injection device output that when combined with the irrigation system characteristics results in the recommended application to the field. Output rates must be set to complete the required application in one continuous irrigation event. Calibration involves knowledge of the following factors:

- Net area irrigated by the system, acres.
- Time required for an irrigation event, minutes.
- Determine the volume of pesticide required to cover the area by multiplying the area times the rate of application recommended, in gallons.
- Calculate the required pesticide injection rate by dividing the gallons by the time for the irrigation event (minutes), in gallons per minute.

The pesticide injection device must be calibrated with a backpressure equal to the irrigation system pressure at the point of injection. If a positive displacement pump is used, by design it will be relatively insensitive to irrigation pipeline pressure. It is also recommended that a volumetric check be made comparing the calculated pumped volume required to the volume removed from the tank over a fixed time interval. A calibration check before and after the application is suggested. This is best accomplished by pumping into a container of known volume using a stopwatch.

Questions about pump calibration should be referred to state extension service specialists, equipment manufacturers or other experts.

A person knowledgeable in the operation of chemigation systems, or a person under the supervision of a knowledgeable person, shall be responsible for calibrating and operating the system.

Caution: It is a violation of both federal and state laws to use any pesticide in a manner inconsistent with its labeling. Before injecting any pesticide (including herbicides, insecticides, fungicides or nematicides) through an irrigation system, read and understand the entire label and follow all label instructions and precautions, including procedures for storage, worker protection, posting of treated areas when required and disposal of pesticide and containers. Contact local and state regulatory officials for specific regulations and requirements related to chemigation.

Chemigation System Safety

Safety precautions required when practicing chemigation are as follows:

- All components that come into direct contact with pesticides should be pesticide and sunlight resistant and capable of withstanding the system working pressure.
- Operating instructions for the chemigation systems should be prominently displayed
- Safety precautions should be taken to protect workers against accidental discharge or spillage of pesticides.
- All bulk pesticides, whether in concentrated or diluted form, should be clearly labeled with their identity and directions for use and stored in secure areas.
- A water source should be provided near the pesticide supply tank and injection pump for washing off any pesticides that contact the skin. The fresh water outlet from the irrigation system must be located between the backflow prevention device and the water supply. Protective goggles, face shields, and pesticide-resistant clothing should be worn when making pesticide dilutions. Eye protection must be worn. Concentrated pesticides should generally be added to water in preparing dilutions in a pesticide supply tank unless directions specify otherwise.
- Do not allow irrigation water to collect or run off and pose a hazard to livestock, wells, bodies of water, or adjoining cropped areas.
- Allow foliage to dry before reentering the field.

Appendix

Required Chemigation Safety Devices

U.S. EPA Pesticide Registration Notice 87-1
http://www.epa.gov/PR_Notices/pr87-1.html

1. "The system must contain a functional check valve, vacuum relief valve, and low pressure drain appropriately located on the irrigation pipeline to prevent water source contamination from back flow."
2. "The pesticide injection pipeline must contain a functional, automatic, quick-closing check valve to prevent the flow of fluid back toward the injection pump."
3. "The pesticide injection pipeline must also contain a functional, normally closed, solenoid-operated valve located on the intake side of the injection pump and connected to the system interlock to prevent fluid from being withdrawn from the supply tank when the irrigation system in either automatically or manually shut down."
4. "The system must contain functional interlocking controls to automatically shut off the pesticide injection pump when the water pump motor stops."
5. "The irrigation line or water pump must include a functional pressure switch which will stop the water pump motor when the water pressure decreases to the point where pesticide distribution in adversely affected."
6. "Systems must use a metering pump, such as a positive displacement injection pump (e.g., diaphragm pump) effectively designed and constructed of materials that are compatible with pesticides and capable of being fitted with a system interlock."

Acceptable Alternatives to Required Chemigation Safety Devices

DPR Enforcement Letter ENF 01-28
http://www.cdpr.ca.gov/docs/enfcmpli/penfltrs/penf2001/2001028.pdf

Original Device:

Functional normally closed, solenoid-operated valve located on the intake side of the injection pump.

Alternative Device 1

Functional spring-loaded check valve with a minimum of 10 pounds per square inch (psi) cracking pressure. The valve must prevent irrigation water under pressure from entering the pesticide injection line and must prevent leakage from the pesticide supply tank on system shutdown. This valve must be constructed of pesticidally resistant materials. [Note: this single device can substitute for both the solenoid-operated valve and the functional, automatic, quick-closing check valve in the pesticide injection line.]

Alternative Device 2

Functional normally closed, hydraulically operated check valve. The control line must be connected to the main water line such that the valve opens only when the main water line is adequately pressurized. This valve must prevent leakage from the pesticide supply tank on system shutdown. The valve must be constructed of pesticidally resistant materials.

Alternative Device 3
Functional vacuum relief valve located in the pesticide injection line between the positive displacement pesticide injection pump and the check valve. This alternative is appropriate for only those chemigation systems using a positive displacement pesticide injection pump and is not for use with venturi injection systems. This valve must be elevated at least 12 inches above the highest fluid level in the pesticide supply tank and must be the highest point in the injection line. The valve must open at 6 inches water vacuum or less and must be spring loaded or otherwise constructed such that it does not leak on closing. It must prevent leakage from the pesticide supply tank on system shutdown. The valve must be constructed of pesticidally resistant materials.

Original Device:
Functional main water line check valve and main water line low pressure drain.
Alternative Device
Gooseneck pipe loop located in the main water line immediately downstream of the irrigation water pump. The bottom side of the pipe at the loop apex must be at least 24 inches above the sprinkler or other type of water emitting device. The loop must contain either a vacuum relief or combination air and vacuum relief valve at the apex of the pipe loop. The pesticide injection port must be located downstream of the apex of the pipe loop and at least 6 inches below the bottom side of the pipe at the loop apex.

Original Device:
Positive displacement pesticide injection pump.
Alternative Device
Venturi systems including those inserted directly into the main water line, those installed in bypass systems, and those bypass systems boosted with an auxiliary water pump. Booster or auxiliary water pumps must be connected with the system interlock such that they are automatically shut off when the main line irrigation pump stops or in cases where there is no main line irrigation pump, when the water pressure decreases to the point where pesticide distribution is adversely affected. Venturi systems must be constructed of pesticidally resistant materials. The line from the pesticide supply tank to the venturi must contain a functional, automatic, quick-closing check valve to prevent the flow of the liquid back toward the pesticide supply tank. This valve must be located immediately adjacent to the venturi pesticide inlet. This same supply line must also contain either a functional normally closed solenoid-operated valve connected to the system interlock or a functional normally closed hydraulically operated valve which opens when the main water line is adequately pressurized. In bypass systems, as an option to placing both valves in the line from the pesticide supply tank, the check valve may be installed in the bypass immediately upstream of the venturi water inlet and either the normally closed solenoid or hydraulically operated valve may be installed immediately downstream of the venturi water outlet.

Original Device:
Vacuum relief valve.
Alternative Device
Combination air and vacuum relief valve.