Department of Pesticide Regulation

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Chemigation Safety Devices: Pesticide Label Requirements and Allowable Alternative Equipment

Date Established June 7, 2001

Enforcement Letter ENF 01-28

Distribution County Agricultural Commissioners

Referrals If you have any questions pertaining to this document, please contact your Senior Pesticide Use Specialist liaison.

Approval *original signed by*

Scott Paulsen, Chief
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Background This letter states the Department of Pesticide Regulation's (DPR's) policy pertaining to the use of chemigation safety devices required by registered pesticide labeling and the use of comparable, alternative equipment.

Policy It is a violation of the Food and Agricultural Code (FAC) section 12973 to use a registered pesticide in a manner inconsistent with its labeling. Handlers must comply with the specific chemigation equipment requirements shown on the registered labels of the pesticides they use.

DPR will consider handlers in compliance with FAC section 12973 when they use the chemigation equipment specified on the product label or when they use alternative chemigation equipment according to the specifications and requirements stated in this policy

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Chemigation Safety Devices: Pesticide Label Requirements and Allowable Alternative Equipment, continued

Adoption of the U.S. EPA Chemigation Compliance Policy

DPR adopts the U.S. Environmental Protection Agency (U.S. EPA) Interim Final Federal Insecticide, Fungicide, Rodenticide Act (FIFRA) Compliance Program Policy No. 12.7, Enforcement of the Label Improvement Program for Pesticides Applied Through Irrigation Systems (Chemigation), issued in 1989. FIFRA section 2 (ee) (6) [1] allows the Administrator of the U.S. EPA to establish policies concerning the enforcement of pesticide label requirements provided those policies remain consistent with the purposes of federal law. FIFRA does not grant States the same authority. Therefore, DPR will implement the following policy until it is amended or rescinded by the Administrator of the U.S. EPA.

Alternative Chemigation Safety Devices

U.S. EPA Pesticide Registration (PR) Notice 87-1[2, 3], the Label Improvement Program for Chemigation, requires pesticide registrants to include certain types of safety devices on the labels of agricultural pesticides intended for application through irrigation systems to protect ground water from pesticide contamination (attached). As a result of information received following implementation of PR Notice 87-1 in 1988, the U.S. EPA approved a list of chemigation equipment that could be used as an alternative to some equipment required by pesticide product labeling. In some cases, the alternative equipment was less expensive, more reliable, or more available than some of the equipment included on the label. Any chemigation equipment that is required on pesticide product labeling but has no listed alternative(s) is still required as a component of the chemigation system. All of the equipment included in PR Notice 87-1 is still acceptable and the PR Notice is, in its entirety, still in effect. The original equipment required in PR Notice 87-1 and its corresponding alternative(s) are listed below:

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[1] FIFRA section 2 (ee) (6): The term "to use any registered pesticide in a manner inconsistent with its labeling" means to use any registered pesticide in a manner not permitted by the labeling, except that the term shall not include any use of a pesticide in a manner that the Administrator determines to be consistent with the purposes of FIFRA.

[2] US EPA Pesticide Registration Notices provide instructions to pesticide registrants concerning registration issues, including required label language. PR Notice 87-1 was issued on March 11, 1987. Excerpts are attached and the full text is available at: http://www.epa.gov:80/PR_Notices/.

[3] Some pesticide labels registered by the U.S. EPA, and subsequently by DPR, may deviate from the requirements of PR Notice 87-1. For example, some pesticide labels require the use of an "Alternative Device" found in U.S. EPA's Compliance Program Policy No. 12.7 rather than the original device found in the PR Notice. While slight deviations from PR Notice 87-1 do occur, CACs should discuss significant label deviations found during field activities with their Senior Pesticide Use Specialist.

Chemigation Safety Devices: Pesticide Label Requirements and Allowable Alternative Equipment continued

Alternative Chemigation Safety Devices, continued

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.

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Chemigation Safety Devices: Pesticide Label Requirements and Allowable Alternative Equipment continued

Alternative Chemigation Safety Devices, continued

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 of 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.

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Chemigation Safety Devices: Pesticide Label Requirements and Allowable Alternative Equipment continued

Alternative Chemigation Safety Devices, continued

Original Device:
Vacuum relief valve.

Alternative Device
Combination air and vacuum relief valve.

Backflow Prevention Devices In Chemigation Systems

Per federal law, pesticide labels require the use of backflow prevention equipment when applying pesticides through chemigation systems. Pesticide handlers who use the backflow prevention equipment required on the pesticide product labeling, or the allowable alternative equipment specified in this policy, will be considered in compliance with the requirements of 3CCR section 6610, Backflow Equipment. (Reference: Enforcement Letter 2001-12, Backflow Prevention Regulatory Requirements and Policy.)

Generic Chemigation System Diagrams and Equipment Descriptions

Due to the complexity of chemigation system designs, this policy letter includes a generic chemigation system diagram that shows proper chemigation equipment placement, whether an original device or an allowable alternative. A copy of the American Society of Agricultural Engineers (ASAE) standard titled "Safety Devices for Chemigation" (ASAE EP409.1 DEC 97. Copyright © ASEA. All Rights Reserved.) is also provided as an additional resource. The device descriptions included in ASEA EP 409.1 are advisory only.

Please note: DPR purchased a membership to ASAE to distribute this copyrighted standard to the CACs for the sole purpose of pesticide use enforcement. DPR requests that CACs respect ASAE's copyright and obtain permission from ASAE prior to distributing copies of this standard to persons not employed by a CAC.

Attachments

- Excerpts from U.S. EPA Pesticide Registration Notice 87-1, "Label Improvement Program for Pesticides Applied Through Irrigation Systems (Chemigation)". http://www.epa.gov:80/PR_Notices/
- Generic Chemigation System Diagram
- Safety Devices for Chemigation, ASAE EP409.1 DEC97, American Society of Agricultural Engineers.

cc: Mr. Daniel J. Merkley, Agricultural Commissioner

Excerpts from Pesticide Registration Notice 87-1

Background

Pesticide Registration (PR) Notice 87-1 required registrants to revise the labeling of pesticide products registered under Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and intended for application through irrigation systems to include additional use directions and other statements. The excerpted material includes the U.S. Environmental Protection Agency's (U.S. EPA's) rationale for requiring these changes and the label statements that are required on pesticide labels that allow chemigation.

Portions of the excerpted material were reformatted and rewritten to improve readability. The original text is available at: <http://www.epa.gov:80/PR_Notices/>.

Rationale

Pesticide labels are required to contain directions for use, which are necessary for effecting the purpose for which the product is intended and are adequate to protect health and the environment. The label revisions required by this Notice, if adhered to by the users, will decrease environmental risks of pesticide contamination of ground water and will decrease direct human exposure to pesticide-treated irrigation water by providing appropriate use directions and restrictions or prohibitions. Although the Agency has received indirectly only very limited accounts of water source contamination or personal injury resulting from pesticide application through irrigation systems (chemigation), there is potential for such situations due to the increasing popularity of this application method, lack of public awareness that pesticides may be contained in irrigation water, lack of broad-based or uniform regulation by individual states, and the absence of directions for use on pesticide labels. This last factor is due in part to the recent development of this application technology and equipment, and in part to FIFRA section 2 (ee)(3) which allows "any method of application not prohibited by labeling."

The Agency has received accounts of members of the general public intentionally using irrigation water in a variety of ways which could result in direct human exposure to pesticides if the system was being used for chemigation. The required label revisions, particularly those requiring posting to inform persons that irrigation water may contain pesticides, will decrease the likelihood of direct human exposure.

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Excerpts from Pesticide Registration Notice 87-1, continued

Rationale, continued

The required labeling will benefit users by providing them use directions for this relatively new method of application or will indicate that certain pesticides or application equipment should not be used and do not have the support of the registrant. In addition there will be uniform label requirements at the Federal level to address environmental concerns for this method of pesticide application. The Agency will also enhance its ability to enforce the requirements under the misuse provisions of FIFRA section 12(a)(2)(G) which will encourage compliance by users.

Pesticidesaffected by PR Notice 87-1

- Products that may legally be applied through any type of irrigation system including any sprinkler, flood, furrow, drip or greenhouse system (pesticide products whose labels are silent on chemigation, i.e., neither recommend nor prohibit this application method, do legally allow this use);
- Products labeled for agricultural uses, nursery uses, turf farm uses, golf course uses or greenhouse uses; and
- Products subject to FIFRA section 3 Registration, section 5 Experimental Use Permit, section 18 Emergency Use, or section 24(c) Special Local Need Regulation.

Pesticides excluded from PR Notice 87-1

- Products intended solely for residential use (such as indoor, yard or garden);
- Products intended solely for direct injection into plants;
- Products intended solely for post harvest application to produce; or
- Products intended to be applied only as a gas or only as a solid, such as a pellet, tablet, granule, or dust formulation.

Required Label Statements

The U.S. EPA requires pesticide registrants to include the following statements on pesticide product labeling intended for use through any type of chemigation system.

Chemigation Prohibition

For pesticide products affected by this Notice, the U.S. EPA requires pesticide registrants to either explicitly allow or prohibit chemigation. For products that are not intended for use through a chemigation system, the registrant must include the following statement: "Do not apply this product through any type of irrigation system."

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Excerpts from Pesticide Registration Notice 87-1, continued

Generic Statements

- "Apply this product only through [choose one or more of the following types of systems: sprinkler including center pivot, lateral move, end tow, side (wheel) roll, traveler, big gun, solid set, or hand move; flood (basin); furrow; border or drip (trickle)] irrigation & system(s). Do not apply this product through any other type of irrigation system."
- "Crop injury, lack of effectiveness, or illegal pesticide residues in the crop can result from non-uniform distribution of treated water."
- "If you have questions about calibration, you should contact State Extension Service specialists, equipment manufacturers or other experts."
- "Do not connect an irrigation system (including greenhouse systems) used for pesticide application to a public water system unless the pesticide label-prescribed safety devices for public water systems are in place."
- "A person knowledgeable of the chemigation system and responsible for its operation or under the supervision of the responsible person, shall shut the system down and make necessary adjustments should the need arise."

Chemigation Systems Connected to Public Water Systems

- "Public water system means a system for the provision to the public of piped water for human consumption if such system has at least 15 service connections or regular serves an average of at least 25 individuals daily at least 60 days out of the year."
- "Chemigation systems connected to public water systems must contain a functional, reduced-pressure zone, back flow preventer (RPZ) or the functional equivalent in the water supply line upstream form the point of pesticide introduction. As an option to the RPZ, the water from the public water system should be discharged into a reservoir tank prior to pesticide introduction. There shall be a complete physical break (air gap) between the flow outlet end of the fill pipe and the top or overflow rim of the reservoir tank of at least twice the inside diameter of the fill pipe."
- "The pesticide injection pipeline must contain a functional, automatic, quick-closing check valve to prevent the flow of fluid back toward the injection."
- "The pesticide injection pipeline must 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 is either automatically or manually shut down."

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Excerpts from Pesticide Registration Notice 87-1, continued

Chemigation Systems Connected to Public Water Systems, continued

- "The system must contain functional interlocking controls to automatically shut off the pesticide injection pump when the water pump motor stops, or in cases where there is no water pump, when the water pressure decreases to the point where pesticide distribution is adversely affected."
- "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."
- "Do not apply when wind speed favors drift beyond the area intended for treatment."

Sprinkler Chemigation

- "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."
- "The pesticide injection pipeline must contain a functional, automatic, quick-closing check valve to prevent the flow of fluid back toward the injection pump."
- "The pesticide injection pipeline must also contain a functional, normally dosed, 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 is either automatically or manually shut down."
- "The system must contain functional interlocking controls to automatically shut off the pesticide injection pump when the water pump motor stops."
- "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 is adversely affected."
- "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."
- "Do not apply when wind speed favors drift beyond the area intended for treatment."

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Excerpts from Pesticide Registration Notice 87-1, continued

Floor (Basin), Furrow and Border Chemigation

- "Systems using a gravity flow pesticide dispensing system must meter the pesticide into the water at the head of the field and downstream of a hydraulic discontinuity such as a drop structure or weir box to decrease potential for water source contamination from back flow if water flow stops."
- "Systems utilizing a pressurized water and pesticide injection system must meet the following requirements:
    - "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."
    - "The pesticide injection pipeline must contain a functional, automatic, quick-closing check valve to prevent the flow of fluid back toward the injection pump."
    - "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 is either automatically or manually shut down."
    - "The system must contain functional interlocking controls to automatically shut off the pesticide injection pump when the water pump motor stops."
    - "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 is adversely affected."
    - "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."

Drip (Trickle) Chemigation

- "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."
- "The pesticide injection pipeline must contain a functional, automatic, quick-closing check valve to prevent the flow of fluid back toward the injection pump."

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Excerpts from Pesticide Registration Notice 87-1, continued

Drip (Trickle) Chemigation, continued

- "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 is either automatically or manually shut down."
- "The system must contain functional inter-locking controls to automatically shut off the pesticide injection pump when the water pump motor stops."
- "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 is adversely affected."
- "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."

GENERIC CHEMIGATION SYSTEM DIAGRAM

1) MAIN WATER LINE:

- **Backflow prevention device**
  - Located between water source and point of pesticide injection
  - Prevents contamination of water source
  - Shown: Functional check valve, vacuum relief valve, low pressure drain
  - **ALTERNATIVE EQUIPMENT ALLOWED BY LABEL OR POLICY**

2) PESTICIDE INJECTION PIPELINE:

- **Automatic, quick closing check valve**
  - Located between main water line and pesticide injection pump
  - Prevents flow of fluid back towards pesticide injection pump
    - **NO ALTERNATIVE EQUIPMENT ALLOWED**
- **Normally closed, solenoid-operated check valve**
  - Located between pesticide injection pump and pesticide container or mix tank
  - Check valve connected to system interlock
  - Prevents pesticide from being withdrawn when irrigation systems shuts down
    - **ALTERNATIVE EQUIPMENT ALLOWED BY POLICY**

3) PESTICIDE METERING PUMP:

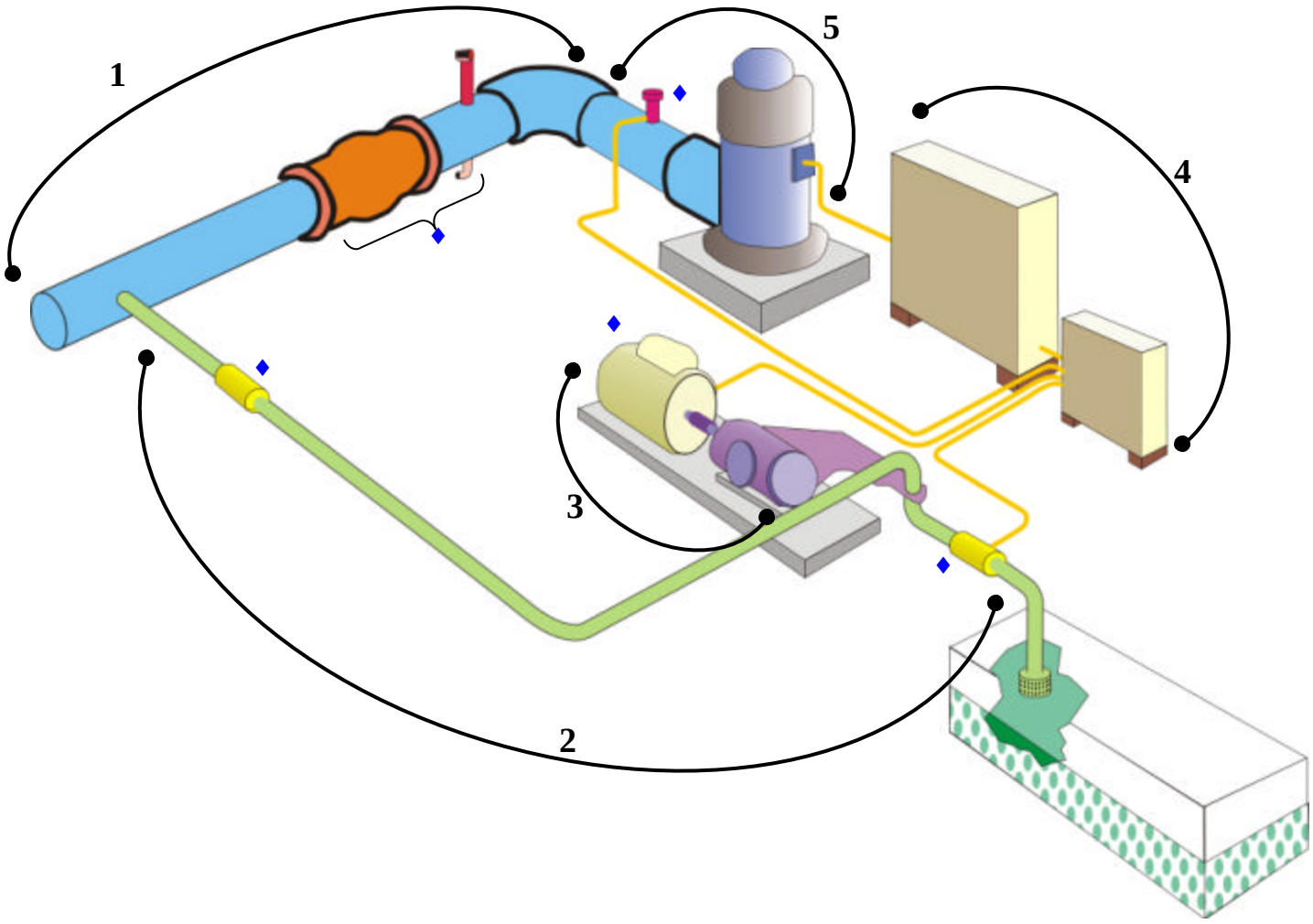
- **Positive displacement injection pump**
  - Connected to system interlocking controls and pesticide injection pipeline
  - Assures proper rate of pesticide injection
    - **ALTERNATIVE EQUIPMENT ALLOWED BY POLICY**

4) INTERLOCKING SYSTEM CONTROLS:

- Located between the pesticide metering pump and the water pump motor
- Automatically shuts off pesticide metering pump when water pump motor stops
  - **NO ALTERNATIVE EQUIPMENT ALLOWED**

5) IRRIGATION LINE OR WATER PUMP:

- **Functional pressure switch**
  - Located on irrigation pipeline
  - Stops water pump when drop in water pressure adversely affects pesticide distribution
    - **NO ALTERNATIVE EQUIPMENT ALLOWED**



ASAE EP409.1 DEC99
Safety Devices for Chemigation

American Society of Agricultural Engineers

STANDARD

ASAE is a professional and technical organization, of members worldwide, who are dedicated to advancement of engineering applicable to agricultural, food, and biological systems. ASAE Standards are consensus documents developed and adopted by the American Society of Agricultural Engineers to meet standardization needs within the scope of the Society; principally agricultural field equipment, farmstead equipment, structures, soil and water resource management, turf and landscape equipment, forest engineering, food and process engineering, electric power applications, plant and animal environment, and waste management.

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Safety Devices for Chemigation

Developed by the ASAE Irrigation Management Committee; approved by the Soil and Water Division Standards Committee; adopted by ASAE January 1982; reconfirmed December 1986; revised March 1989; reaffirmed December 1993, December 1994, December 1995, December 1996, December 1997, December 1998; reaffirmed for one year December 1999; revised editorially March 2000.

1 Purpose and scope

1.1 This Engineering Practice specifies necessary safety devices to be used when injecting liquid chemicals into irrigation systems. Many irrigators apply fertilizers, herbicides, insecticides, fungicides, nematicides and other chemicals through irrigation systems. This process is known as chemigation. Chemicals which are properly formulated can be uniformly and safely applied by injecting them into water flowing through a properly engineered irrigation and injection system.

1.2 Pollution of a water supply can occur if proper safety devices are not installed and maintained on the chemical injection and irrigation equipment. Three specific hazards to guard against are: (1) an unexpected shutdown of the irrigation pumping plant due to mechanical or electrical failure while it is unattended, causing concentrated chemicals or a mixture of chemicals and water to be drawn into the water supply, (2) an irrigation pumping plant shutdown failure while the injection equipment continues to operate, possibly causing concentrated chemicals or a mixture of water and chemicals to backflow into the water source, and/or cause an undesirably high concentration of chemicals in the irrigation system, and (3) the chemical injection system stopping while the irrigation pump continues to operate, possibly causing water to backflow through the chemical supply tank and overflow chemical onto the ground.

1.3 This Engineering Practice describes safety devices which will prevent the hazards described in paragraph 1.2 for a dedicated irrigation water source. It is not intended that this Engineering Practice apply for irrigation systems connected to a public or private water distribution system used as a municipal, industrial, or residential water supply. All irrigation systems used for chemigation should be equipped with a loss-of-pressure shutdown safety device to avoid continued operation following a system malfunction. Equipment required for mixing or storing the chemicals is not covered in detail by this Engineering Practice.

2 Definitions

E **2.1 backflow prevention device:** A safety device used to prevent water pollution or contamination by preventing flow of a mixture of water and/or chemicals in the opposite direction of that intended.

E **2.2 check valve:** A device to provide positive closure which effectively prohibits the flow of material in the opposite direction of normal flow when operation of the irrigation system pumping plant or injection unit fails or is shut down.

E **2.3 interlock devices:** Safety equipment used to insure that if the irrigation pumping plant stops, the chemical injection pump will also stop. Devices may also be used to shut down the irrigation system if the injection system fails.

3 Backflow prevention system

3.1 A backflow prevention system is required in the irrigation supply line to prevent chemical backflow to the water source in case the irrigation pump shuts down. This can be accomplished with one of the systems discussed in paragraphs 3.3.1–3.3.7. The backflow prevention system should be installed between the water supply pump outlet and the point of chemical injection. The point of chemical injection and backflow prevention devices shall not be located on the suction side of a water pump. Any check valve(s) used in backflow prevention should be positioned and oriented according to the manufacturer's specifications to ensure proper functioning.

3.2 Backflow prevention is also required in the chemical injection line to prevent water from flowing from the irrigation system into the chemical supply tank. A check valve located in the chemical injection line meets this need. In addition, a normally closed solenoid valve at the chemical supply tank outlet, placed in the suction line of the injection pump and energized (i.e., open) only when there is power to both the injection pump and the irrigation pump, will help guard against backflow and prevent tank outflow under shutdown conditions.

3.3 Selection of the proper backflow prevention system for the irrigation mainline depends upon the characteristics of the chemical that can backflow, the water source and the geometry of the irrigation system. Concerns include whether injected material is toxic and whether there can be backpressure or backsiphonage. Different types of irrigation mainline backflow prevention systems are available for use. State and local regulations and codes must be followed in selecting from the systems described in paragraphs 3.3.1–3.3.5. Backflow prevention systems shall be maintained to keep all check valves, low pressure drains and vacuum breakers free of corrosion or other build-up and functioning properly any time the system is operating.

3.3.1 Check valve with vacuum relief and low pressure drain. This system, as shown in Fig. 1, is primarily an antisiphon device and should be constructed with corrosion-resistant materials. The check valve should be spring-loaded with a chemically resistant sealing surface capable of preventing leakage. Generally metal-to-metal seal surfaces would not be acceptable. The direction of flow should be clearly indicated on the outside of the device. The vacuum relief valve is installed on top of the pipe on the inlet side of the check valve to provide for vacuum relief when flow discontinues. The vacuum relief should be 19 mm (3/4 in.) in diameter or be sized according to ASAE Standard S376, Design, Installation and Performance of Underground, Thermoplastic Irrigation Pipelines, if underground thermoplastic pipeline is used. The low pressure drain is for monitoring check valve performance and bleeding off any leakage. It must be located on the inlet side of the check valve at the lowest point, usually directly under the vacuum relief valve. The drain must be mounted in the pipe such that any check valve leakage enters the drain rather than flowing toward the water supply. The drain should be at least 19 mm (3/4 in.) in diameter with a closing pressure of

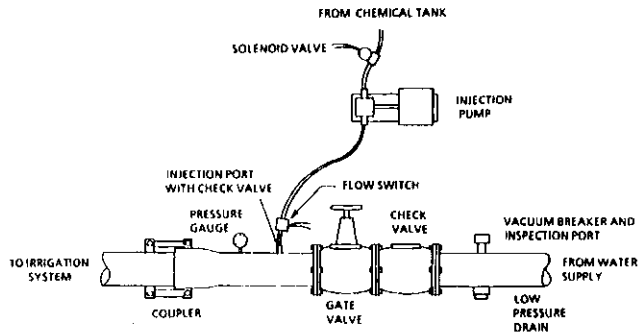

Figure 1 – Backflow prevention device using check valve with vacuum relief and low pressure drain

at least 7 kPa (1 psi) and not exceeding 35 kPa (5 psi). If the drain is within 6 m (20 ft) of the water source, provide a trough or conduit to carry the drainage away, and grade the surface to assure drainage away from the water source. Shutoff valves should not be located on the outlet side of the drain. An inspection port of at least 102 mm (4 in.) diameter should be provided to check for malfunction of the check valve and drain where the irrigation pipeline is 102 mm (4 in.) or larger. This inspection port can be combined with the mounting of the vacuum relief valve.

3.3.2 Air gap. An air gap is a physical separation between the free-flowing discharge end of a water pipeline and an open or nonpressurized receiving vessel. To have an acceptable air gap, the end of the discharge pipe must be located a distance of at least twice the diameter of the pipe above the topmost rim of the receiving vessel. In no case can this distance be less than 25 mm (1 in.). This is a simple and effective type of protection. However, an additional pump is required downstream of the receiving vessel to pressurize the water before it enters the irrigation system.

3.3.3 Pressure-vacuum breaker. The pressure-vacuum breaker contains, within a single body, a spring-loaded check valve and a spring-loaded, air-entry valve which opens to admit air whenever the pressure within the body upstream of the check valve approaches atmospheric. The pressure-vacuum breaker should not be installed where there can be backpressure, only where there can be backsiphonage. The pressure-vacuum breaker can have shutoff valves downstream of the device. It must be installed at least 300 mm (12 in.) above the highest downstream outlet.

3.3.4 Double check valve. The double check valve assembly is composed of two single, independently acting check valves and can handle both backsiphonage and backpressure. A low pressure drain and inspection port as described in paragraph 3.3.1, should be installed immediately upstream of this system.

3.3.5 Reduced-pressure-principle device. This device consists of two independently acting check valves, plus a pressure differential relief valve that is located between the two check valves. It can be used for both backsiphonage and backpressure control and can handle most toxic chemicals. A minimum clearance of 300 mm (12 in.) above the ground level or grade is suggested to ensure an air gap between the relief valve and any water that might puddle beneath the device. If the relief valve is within 6.1 m (20 ft) of the water source, provide a trough or conduit to carry valve discharge away from the water source.

3.3.6 Atmospheric vacuum breaker. An atmospheric vacuum breaker has a movable element or plunger which prevents spilling from the device during pressurized flow and opens to provide an air inlet following cessation of flow if a vacuum (backsuction) occurs. This system cannot be installed where backpressure persists and can be used only to prevent backsiphonage. An atmospheric unit should not be used with shutoff valves downstream and must be installed at least 150 mm (6 in.) above the highest outlet or the topmost overflow rim of a nonpressurized tank. These units are installed primarily in lawn and turf irrigation systems that are connected to potable water supplies, but in some instances will work for field irrigation systems.

3.3.7 Other backflow prevention systems which are at least as effective as the above and meet the backflow prevention requirements described in this Engineering Practice for the irrigation water supply line may be used.

3.4 Injection port location. The injection port in the irrigation system must be located downstream from the mainline backflow prevention device and preferably located higher than the top of the chemical tank. It should be as close as possible to the irrigation machine to minimize the volume of water in the pipe between the point of injection and the irrigation system.

3.5 Backflow prevention in the chemical line. An injection line backflow prevention device is required at the injection port of the irrigation system to prevent water from flowing from the irrigation system into the chemical supply tank when the injection pump is stopped. This will prevent the chemical supply tank from overflowing. This device shall

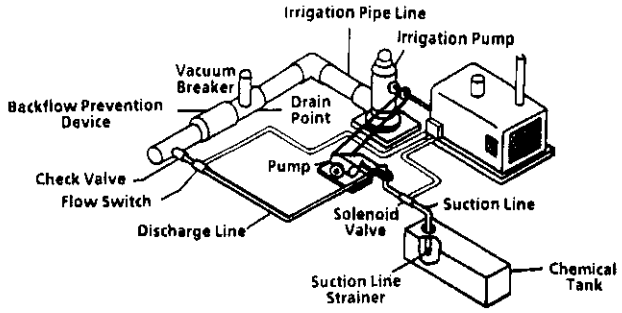

Figure 2 – Safety devices for injection of chemicals in irrigation systems using a belt driven injection pump and engine power units

be a spring-loaded, chemically-resistant check valve having a minimum opening pressure of 69 kPa (10 psi).

4 Interlock irrigation and chemigation devices

4.1 For an irrigation pump driven by an internal combustion engine, an easy and adequate method of interlocking the injection pump with the irrigation pump is to drive the chemical injection pump by belt from the drive shaft of the irrigation pump or an accessory pulley of the engine (see ASAE Standard S318, Safety for Agricultural Equipment, for shielding recommendations). This will ensure that the chemical injection pump stops operating if the irrigation pump stops. Interlocking of pumps is shown in Fig. 2 for an internal-combustion-engine powered system. Additional interlocking is required to satisfy the recommendations of paragraphs 4.3 and 4.4.

4.2 For an electric motor-driven irrigation pump, a separate electric motor is usually used to power the chemical injection pump. The electric controls for the irrigation pump, irrigation system, and injection system should be wired so that all three systems will be shut down if any one of these fails. Fig. 3 illustrates this configuration.

4.3 For an injection pump remotely situated from the irrigation pump and irrigation pump power source, a direct shutdown interlock of the irrigation and injection pumps may be impractical. In this case an irrigation line flow sensor is recommended on the irrigation line immediately upstream of the point of chemical injection. The device should be wired to assure injection pump shutdown in the event flow is lost in the irrigation line.

4.4 An injection line flow sensor is recommended on the pressure side of the injection pump just upstream from the chemical line check valve. This device should be wired to assure system shutdown in case flow in the injection line ceases. This will safeguard against continued operation after rupture or disconnection of injection line, injection pump failure, loss of prime, chemical tank is emptied, or injection port becomes plugged.

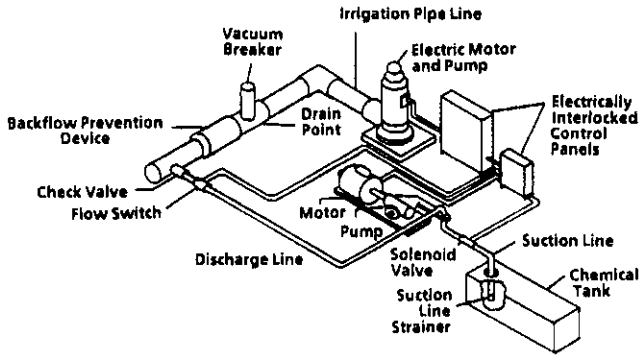

Figure 3 – Safety devices for injection of chemicals into irrigation systems having electric power

4.5 A normally closed solenoid valve is recommended on the suction side of the injection pump at the chemical tank. This solenoid valve should be wired to assure closure if either the irrigation system or the injection system is not in operation. This will safeguard against flow to or from the tank if either pump ceases operation and prevent chemical drainage from the tank if damage occurs to the chemical lines between the tank and the injection port on the irrigation system. A normally closed solenoid valve should not be used as a total shutoff backflow prevention device on the discharge side of the injection pump because the line may burst due to extremely high pressures if the valve malfunctions.

5 Additional safety precautions

5.1 All components which come into direct contact with chemicals must be chemical and sunlight resistant and capable of withstanding the maximum pressure expected.

5.2 A water source should be provided near the chemical supply tank and injection pump for washing off any chemicals 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 chemical-resistant clothing should be worn when making chemical dilutions. Concentrated chemicals should generally be added to water in preparing dilutions in a chemical supply tank unless directions specify otherwise.

5.3 A strainer should be provided on the chemical suction line to protect the injection system components. This device should be inspected after each use.

5.4 All chemical supply and mixing tanks, injection pumps, etc., should be located a safe distance from sources of electric arc or spark to reduce the explosion hazard caused by flammability of some chemicals.

5.5 The surface topography in the vicinity of the well or water source should be graded so that any spilled chemical runs away from rather than toward the water supply. Should a spill or backflow situation occur into a well, the pump and the irrigation system should be started and kept running while seeking assistance from local water quality control authorities to evaluate the severity of the situation.

5.6 Safety precautions should be taken to protect workers against accidental discharge or spillage of chemicals. Operating instructions for the injection device should be prominently displayed.

5.7 All bulk chemicals, whether in concentrated or diluted form, should be clearly labeled with their identity and directions for use and always stored in a secure area.

5.8 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 (herbicide, insecticide, fungicide or nematicide) 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 chemicals and containers. Contact local and state regulatory officials for specific regulations and requirements related to chemigation.