NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

IRRIGATION SYSTEM, MICROIRRIGATION
(No. and Ac.)

CODE 441

DEFINITION
An irrigation system for frequent application of small quantities of water on or below the soil surface: as drops, tiny streams or miniature spray through emitters or applicators placed along a water delivery line.

PURPOSE
This practice may be applied as part of a conservation management system to support one or more of the following purposes.

• To efficiently and uniformly apply irrigation water and maintain soil moisture for plant growth.
• To prevent contamination of ground and surface water by efficiently and uniformly applying chemicals.
• To establish desired vegetation.

CONDITIONS WHERE PRACTICE APPLIES
This standard applies on sites where soils and topography are suitable for irrigation of proposed crops and an adequate supply of suitable quality water is available for the intended purpose(s).

Microirrigation is suited to vineyards, orchards, field crops, windbreaks, gardens, greenhouse crops, and residential and commercial landscape systems. Microirrigation is also suited to steep slopes where other methods would cause excessive erosion, and areas where other application devices interfere with cultural operations.

Microirrigation is suited for use in providing irrigation water in limited amounts to establish desired vegetation such as windbreaks, living snow fences, riparian forest buffers, and wildlife plantings.

This practice standard applies to systems with design discharge less than 60 gal/hr at each individual lateral discharge point. Refer to Indiana (IN) Field Office Technical Guide (FOTG) Standard (442) Irrigation System, Sprinkler for systems with design discharge of 60 gal/hr or greater at each individual lateral discharge point.

CRITERIA
General Criteria Applicable to All Purposes
Use of this standard requires compliance with all applicable federal, state, and local laws and regulations.

The system will be designed to uniformly apply water and/or chemicals while maintaining soil moisture within a range for good plant growth without excessive water loss, erosion, reduction in water quality, or salt accumulation.

Provide backflow prevention devices on all microirrigation systems equipped for chemical injection. Locate and install injectors (chemical, fertilizer, or pesticides) and other automatic operating equipment in accordance with manufacturer’s recommendations and include integrated back flow prevention protection.

Microirrigation systems consist of point-source emitter (drip, trickle, and bubbler), surface or subsurface line-source emitter, basin bubbler, and spray or mini sprinkler systems.

The system will include all irrigation appurtenances necessary for proper operation. Appurtenances will be sized and positioned in

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accordance with sound engineering principles and site-specific features.

Appurtenances include but are not limited to totalizing flow measurement devices, water filtration, air vent valves, vacuum relief valves, pressure relief valve(s), water control valve(s), pressure gauges, pressure regulators, and pressure reducers.

**Water Quality.** The irrigation water supply will be tested and assessed for physical, chemical and biological constituents commonly encountered in the area that may cause clogging of microirrigation system emitters. Use water test results to determine irrigation suitability and treatment requirements.

**Emitter discharge rate.** The design discharge rate of applicators will be determined based on manufacturer’s data for expected operating conditions. The discharge rate will not create runoff within the immediate application area.

For bubbler irrigation, a basin beneath the plant canopy will be required for water control, and applications will be confined to the basin area.

**Number and spacing of emitters.** The number and spacing of emitters along a lateral line will be adequate to provide water distribution to the plant root zone and percent plant wetted area (Pw). Procedures found in Reference 4 will be used to calculate Pw.

**Operating pressure.** The design operating pressure in any lateral or manifold during any phase of operation will be in accordance with published manufacturer recommendations. The system operating pressure must compensate for pressure losses through system components and field elevation effects.

**Emitter manufacturing variability.** The manufacturer’s coefficient of variation (Cv) will be obtained and used to assess the acceptability of a particular product for a given application.

The Cv will be less than 0.05 for point source emitters and less than 0.07 for line source emitters.

**Allowable pressure variations.**

**Manifold and lateral lines.** Manifold and lateral lines, operating at the design pressure, will be designed to provide discharge to any applicator in an irrigation subunit or zone operated simultaneously such that they will not exceed a total variation of 20 percent of the design discharge rate. Internal pressure will not exceed manufacturer recommendations during any phase of operation.

**Main and submain lines.** Main and submain lines will be designed to supply water to all manifold and lateral lines at a flow rate and pressure not less than the minimum design requirements of each subunit. Adequate pressure will be provided to overcome all friction losses in the pipelines and appurtenances (valves, filters, etc.). Mains and submains will maintain flow velocities less than 5 ft/sec during all phases of operation, unless special consideration is given to flow conditions and measures taken to adequately protect the pipe network against surge.

Only the main and submain lines will be designed and installed according to criteria in reference 3.

**Emission Uniformity.** Pipe sizes for mains, submains, and laterals will maintain subunit (zone) emission uniformity (EU) within recommended limits as determined by procedures contained in Reference 4.

**Filters.** A filtration system (filter element, screen, strainer, or filtration) will be provided at the system inlet. Under clean conditions, filters will be designed for maximum head loss of 5 pounds per square inch (psi). Maximum design head loss across a filter before cleaning will be based on manufacturer recommendations. In the absence of manufacturer data maximum permissible design head loss across a filter is 7 psi before filter cleaning is required.

The filter will be sized to prevent the passage of solids in sizes or quantities that might obstruct the emitter openings. Filtration systems will be designed to remove solids based on emitter manufacturer recommendations. In the absence of manufacturer data or recommendations, filtration systems will be designed to remove solids equal to or larger than one-tenth the emitter opening diameter.

Ensure filter back flush does not cause discharge of media material, excessive flush water, or unacceptable EU. Ensure design provides for disposal and utilization of filter.
back flush water. Back flush water should not cause erosion or chemical contamination.

The filter system will provide sufficient filtering capacity so that backwash time does not exceed 10% of the system operation time. Within this 10% time period, the pressure loss across the filter will remain within the manufacturer's specification and not cause unacceptable EU.

Filter/strainer systems designed for continuous flushing will not have backwash rates exceeding 1.0% of the system flow rate or exceeding the manufacturer's specified operational head loss across the filter.

**Air/Vacuum relief valves.** Design and install air and vacuum relief valves at system manifolds and lateral summits. Vacuum relief will be designed and installed to prevent ingestion of soil particles if there are summits in system laterals.

Air/vacuum relief valves will be installed on both sides of all subunit block or manifold water supply control valves.

**Pressure regulators.** Pressure regulators will be used where topography and the type of applicator dictate their use. Pressure regulators will not be planned to compensate for improperly designed pipelines.

**System flushing.** Appropriate fittings will be installed above ground at the ends of all mains, submains, and laterals to facilitate flushing. The system will be designed and installed to provide a minimum flow velocity of 1 ft/sec during flushing. During flushing submain and manifold (pipelines located downstream from a control valve) velocities will not exceed 7 ft/sec velocity. Each flushing discharge outlet will include a pressure gauge and/or Schrader valve tap.

Make provisions for flush water discharged from flush valves. Locate flush valves such that flows are directed away livestock, electrical equipment, and other control valves or hook-ups. Ensure discharge of flush water is in a non-erosive manner.

**Water Management Plan.** Develop an Irrigation Water Management Plan meeting the requirements of IN FOTG Standard (449) Irrigation Water Management, for use with this practice.

**Additional Criteria Applicable to Efficiently and Uniformly Apply Irrigation Water**

**Depth of application.** Net depth of application will be sufficient to replace the water used by the plant during the plant peak use period or critical growth stage. Gross depth of application will be determined by using field application efficiencies consistent with the type of microirrigation system planned. Applications will include adequate water for leaching to maintain a steady state salt balance.

**System capacity.** The system will have either (1) a design capacity adequate to meet peak water demands of all crops to be irrigated in the design area, or (2) enough capacity to meet water application requirements during critical crop growth periods when less than full irrigation is planned. The rationale for using a design capacity less than peak daily irrigation water requirement will be fully explained and agreed upon by the end user. Design capacity will include an allowance for reasonable water losses (evaporation, runoff, deep percolation, and system deterioration over time), and auxiliary water needs such as leaching, frost protection, and cooling.

The system will have the capacity to apply a specified amount of water to the design area within the net operation period. Minimum system design capacity will be sufficient to deliver the specified amount of water in 90% of the time available, but not to exceed 22 hours of operation per day.

**Subsurface Drip Irrigation (SDI).** Tubing depth and spacing are soil and crop dependent. Emitter line depth will consider the auxiliary irrigation methods used for leaching, germination, and initial development. Maximum lateral line distance from the crop row will be 24 inches for annual row crops and 48 inches for vineyard and orchard crops. EU will be designed for a minimum of 85 percent.

**Surface Microirrigation Systems (SI).** Install surface drip lateral lines on the ground along the plant row(s). Provide 2 percent extra length to surface laterals to allow for expansion and contraction of the line. Pin or anchor above-ground drip lines to prevent dislodging or movement of the line away from the plants or pots. In lieu of pins, laterals may be buried
(2–4") below the soil surface and under mulch or plastic row covers.

When lateral emitter spacing or capacities vary with each row, design the laterals separately. Design and install main and submain lines to have safe velocities. Anchor mains, submains, manifolds, and laterals as needed to prevent undesired movement.

**Additional Criteria Applicable to Preventing Contamination of Ground and Surface Water**

**Chemigation and Chemical Water Treatment.** System EU will not be less than 85 percent where fertilizer or pesticides, or treatment chemicals are applied through the system.

Backflow prevention devices will be provided on all microirrigation systems equipped for chemical injection.

Injectors (chemical, fertilizer or pesticides) and other automatic operating equipment will be located and installed in accordance with manufacturer’s recommendations and include integrated back flow prevention protection.

Chemigation will be accomplished in the minimum length of time needed to deliver the chemicals and flush the pipelines. Application amounts will be limited to minimum amount necessary, and rate will not exceed maximum rate recommended by chemical label.

Proper maintenance and water treatment will be followed to prevent clogging based upon dripper and water quality characteristics.

Irrigation water supply tests will be used to plan for addressing or avoiding chemical reactions with injected chemicals to prevent precipitate or biological plugging.

**Additional Criteria Applicable to Establishing Desired Vegetation**

**System capacity.** The system will have design capacity adequate to provide supplemental water at a rate that will ensure survival and establishment of planned vegetation for a period of at least 3 years. The system will have the capacity to apply the specified amount of water to the design area within the net operation period.

Gross application volume per plant will be determined using field application efficiency consistent with the type of microirrigation system planned. If a need is indicated by water test results, applications will include adequate water for leaching to maintain a steady state salt balance.

Microirrigation systems installed solely to deliver supplemental water for establishment of windbreaks or riparian vegetation will be designed to deliver a minimum of eight gallons per tree or shrub per week to assist in the establishment process. Design net application volumes per plant are dependent on the species of tree or shrub and the age (first, second, or third year).

Drip lateral lines installed on the ground surface will be placed along the plant row(s) in a serpentine pattern to allow for expansion and contraction of the line while keeping the emitter close to the tree or shrub. Above ground drip line will be pinned or anchored to prevent the line from being dislodged or moved away from the trees or shrubs. Systems may utilize manual flush screen filters and manual flush valves or fittings at individual lateral ends.

Windbreaks will be planned, designed, and installed according to IN FOTG Standard (380) Windbreak/Shelterbelt Establishment.

When lateral emitter spacing or capacities vary with each row, the laterals must be designed separately.

Operation and maintenance items specific to vegetation establishment are included in Chapter 6 of reference.

**CONSIDERATIONS**

In the absence of local experience field application efficiency (E) of 90% should used to estimate system capacity.

System operation should not exceed 6 days per week.

Potential rodent damage should be considered when selecting materials and deciding on above or below ground system installation.

Chemigation may or may not be required at the same time the plant requires irrigation, which may affect the economics of chemigation. Weather conditions should be considered before applying chemicals. Chemicals should not be applied if rainfall is imminent. Pest or nutrient management planning should address the timing and rate of
chemical applications. Field shape and slope often dictate the most economical lateral direction. Laying laterals down slope can allow for longer lateral run lengths and/or lateral size reduction. Uneven topography may require use of pressure compensating emitters.

For terrain slopes steeper than 5%, lateral lines should be laid along the field contour and pressure-compensating emitters specified or pressure control devices used along downslope submains at lateral inlets. Economic assessments of alternative designs should include equipment and installation as well as operating costs. Longer, less frequent irrigations of windbreaks during establishment are recommended to encourage deeper root development that increases drought tolerance.

Installation and operation of microirrigation systems have the potential to save energy as a result of reduced seasonal irrigation application, and in some situations reduced operating pressures.

Organic farmers may apply less soluble fertilizers through the microirrigation system. Take precautions against potential emitter clogging.

It is preferable to have an air/vacuum relief with continuous air release function on the mainline side of zone valves.

Include secondary screen filters following the media filters or a rinse cycle valve to prevent release of contaminants following the backwashing process.

Use irrigation water supply tests and/or the jar test to help avoid reactions with injected chemicals and prevent precipitate or biological plugging.

Place laterals upslope of crop rows when they are on the contour to assure even wetting patterns within the root zone.

PLANS AND SPECIFICATIONS

Plans and specifications for the microirrigation system will be in keeping with this standard and will describe the requirements for properly installing the practice to achieve its intended purpose. Include in the plan:

- A plan map showing the location, key elevations, system layout documenting material, and sizes of all pipelines, control valves, air/vacuum valves, pressure regulating valves, wellhead components, and other appurtenances.
- System design pressure and flow rate.
- Subunit location, dimensions, and layout.
- Emitter type, design operating pressure, and flow rate.
- Appurtenance location, type, size, and installation requirements.

Provide site specific construction specifications that describe in detail installation of the irrigation system and all associated components.

Additional information regarding operation of the system will be included in the Irrigation Water Management Plan, Waste Utilization Plan and/or Nutrient Management Plan, as applicable for the practice purpose.

OPERATION AND MAINTENANCE

A site specific operation and maintenance (O&M) plan will be developed and reviewed with the landowner/operator. The O&M plan will provide specific instructions for operating and maintaining the system to ensure that it functions properly, including reference to periodic inspections and the prompt repair or replacement of damaged components.

Operation and Maintenance Plan should include but is not limited to:

- Inspect flow meter, if applicable, and monitor water application.
- Clean or backflush filters, as needed.
- Flush lateral lines at least annually.
- Perform visual inspection of crop performance and emission device flows if visible and replace applicators, as necessary.
- Measure pressure often on installed gauges or at Schrader valves with a handheld gauge to ensure proper system operation. A pressure drop (or rise) may indicate a problem.
- Check pressure gauges to ensure proper
operation. Repair or replace damaged gauges.

- Follow proper maintenance and water treatment to prevent clogging based upon dripper and water quality characteristics.
- Inject chemicals as required to prevent precipitate buildup and algae growth.
- Check chemical injection equipment regularly to ensure it is operating properly.
- Check and assure proper operation of backflow protection devices.
- Make provisions for the complete removal of water from the pipeline by gravity or other means when:
  - Freezing temperatures are a hazard,
  - The pipe manufacturer requires draining,
  - Draining of the pipeline is otherwise specified.
- The water drained from pipelines will not cause water quality, soil erosion, or safety problems upon release.

REFERENCES