

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

IRRIGATION SYSTEM, SPRINKLER

(No. and Acre)
CODE 442

DEFINITION

A planned irrigation system in which all necessary facilities are installed for efficiently applying water by means of perforated pipes or nozzles operated under pressure.

Scope

This standard applies to the sprinkler irrigation system through which water is distributed by means of sprinklers or spray nozzles. It applies to all components of the on-farm system except for special structures such as permanently installed mains and laterals (irrigation pipeline, 430, and pumping plants, 533). It does not include trickle irrigation systems (441).

PURPOSES

To efficiently and uniformly apply irrigation water to maintain adequate soil moisture for optimum plant growth without causing excessive water loss, erosion, or reduced water quality.

CONDITIONS WHERE PRACTICE APPLIES

Sprinkler irrigation plans shall be based on an evaluation of the site and the expected operating conditions. The soils and topography shall be suitable for irrigation for the proposed crops.

Enough good-quality water must be available for practical irrigation of the crops to be grown.

The sprinkler method of water application is suited to most crops, to most irrigable lands, and to most climatic conditions where irrigated agriculture is feasible.

CRITERIA

Depth of application

The net depth of application shall be based on the available moisture capacity of the soil in the root zone

of the crop irrigated or a lesser amount consistent with the land user's operation plan. The gross depth shall be determined by using field application efficiencies consistent with the conservation of water resources.

Capacity

In regularly irrigated areas, sprinkler irrigation systems shall have either (1) a design capacity adequate to meet the moisture demands of all crops to be irrigated in the design area or (2) enough capacity to meet the requirements of several selected irrigations during critical crop growth periods when less than full irrigation is planned. In computing capacity requirements, allowance must be made for reasonable water losses during application periods.

Systems for special-purpose irrigation shall have the capacity to apply a stated amount of water to the design area in a specified net operating period.

Design application rate

The design rate of application shall be within a range established by the minimum practical application rate under local climatic conditions and the maximum rate consistent with the intake rate of the soil and the conservation practices used on the land. If two or more sets of conditions are in the design area, the lowest maximum application rate for areas of significant size shall apply.

Distribution patterns and spacing

A combination of sprinkler spacing, nozzle sizes, and operating pressure that most nearly provides the design application rate and distribution shall be selected. The velocity of prevailing winds and other conditions must be considered.

If available from the manufacturers, uniformity coefficient data shall be used in selecting sprinkler spacing, nozzle sizes, and operating pressure. The uniformity coefficient shall be not less than as shown below:

70% for orchards
 75% for deep-rooted (4 ft or more) field and forage crops
 85% for high-value or shallow-rooted crops and for any crop where fertilizer or pesticides are applied through the system.

In the absence of such data, sprinkler performance tables provided by the manufacturers shall be used in selecting nozzle sizes, operating pressure, and wetted diameter for the required sprinkler discharge. The maximum spacing shall comply with the following criteria:

1. For low, intermediate, and moderate-pressure sprinklers, the spacing along lateral lines (S1) shall not exceed 50 percent of the wetted diameter, as given in the manufacturer's performance tables, when the sprinkler is operating under optimum pressure. The spacing of laterals along the main line (Sm) shall not exceed 65 percent of this wetted diameter. If winds that can affect the distribution pattern are likely, spacing (Sm) shall be reduced to 60 percent for average velocities of 5 mi/h, to 50 percent for average velocities of 10 mi/h, and to 30 percent for average velocities greater than 10 mi/h.
2. For high-pressure sprinklers and for the giant hydraulic type, the maximum distance (diagonal) between two sprinklers on adjacent lateral lines shall not exceed two-thirds of the wetted diameter under favorable operating conditions. If winds that can affect the distribution pattern are likely, the diagonal spacing shall be reduced to 50 percent of the wetted diameter for average velocities of 5 mi/h and to 30 percent for average velocities greater than 10 mi/h.
3. For perforated pipelines, the spacing recommendations of the manufactures for the design application rate, number and size of perforations, and operating pressure shall be followed.

Lateral lines

Lateral lines shall be so designed that the total pressure variation at the sprinkler heads, resulting from friction head and static head, does not exceed 20 percent of the design operating pressure of the sprinklers.

Except for under tree operation, riser pipes used in lateral lines shall be long enough to prevent interference with the distribution pattern when the tallest crop is irrigated . Riser lengths shall not be less than shown below:

Sprinkler discharge gal/min	Riser length in
Less than 10.....	6
10-25	9
25-50.....	12
50-120.....	18
More than 120.....	36

Main lines

The design of main lines, submains, and supply lines shall insure that the quantities of water required are conveyed to all lateral lines at the maximum required pressure.

If the pressure required for sprinkler system operation is provided by pumping, main line pipe sizes shall insure that there is an economical balance between the capitalized cost of the pipe and annual pumping costs.

Pump and power unit

The pump capacity and the power unit shall be adequate to operate the sprinkler system efficiently when maximum capacity is being pumped against maximum total dynamic head

Design Criteria: Hand-Move Aluminum Tubing

Working Pressure: The maximum working pressure shall be as shown in Table 1.

Table 1.

Pipe size (in.)	Pressure (psi)
3-6	150
8	100
10	80
12	70

Friction Losses: For design purpose, friction head losses shall be no less than those computed by the Hazen-Williams equation, using a roughness coefficient of C=130 for mainlines, and C=120 for laterals (to account for joint losses). A multiple outlet factor can be used in computing losses when it affects the design pipe size.

Flow Velocity: The design velocity in the pipeline when operating at system capacity shall not exceed 7ft./sec.

Risers and Sprinkler Heads: All risers and sprinklers shall be as recommended by the manufacturer.

CONSIDERATIONS

Water Quantity

1. Effects on the water budget, especially the volume and rate of runoff, infiltration, evaporation, transpiration, and deep percolation, and ground water recharge.
2. Potential for changes in plant growth and transpiration because of changes in the volume of soil water.
3. Effects on downstream flows or aquifers that would affect other water uses or users.
4. The effect on the water table of the field in providing suitable rooting depth for anticipated land uses.
5. Potential ability to manage irrigation water through control of water in the root zone.

Water Quality

1. Effects on erosion and the movement of sediment, and soluble and sediment-attached substances carried by runoff.
2. Effects of nutrients and pesticides on surface and ground water quality.
3. Potential effects on the movement of dissolved substances below the root zone or to ground water.
4. Effects of soil water levels on such nutrient processes as nitrification and denitrification.
5. Effects of soil water levels in controlling the salinity of soils, soil water or downstream water quality.
6. Effects on the visual quality of downstream water resources.

Endangered Species Considerations

Determine if installation of this practice with any others proposed will have any effect on any federal or state listed Rare, Threatened or Endangered species or their habitat. NRCS's objective is to benefit these species and others of concern or at least not have any adverse effect on a listed species. If the Environmental Evaluation indicates the action may adversely affect a listed species or result in adverse modification of habitat of listed species which has been determined to be critical habitat, NRCS will advise the land user of the requirements of the Endangered Species Act and recommend alternative conservation treatments that avoid the adverse effects. Further assistance will be provided only if the landowner selects one of the alternative conservation treatments for installation; or at the request of the landowners, NRCS may initiate consultation with the Fish and Wildlife Service, National Marine Fisheries Service and/or California Department of Fish and Game. If the Environmental Evaluation indicates the action will not affect a listed species or result in adverse modification of critical habitat, consultation generally will not apply and usually would not be initiated. Document any special considerations for endangered species in the Practice Requirements Worksheet.

PLANS AND SPECIFICATIONS

Plans and specifications for constructing irrigation sprinkler systems shall be in keeping with this standard and shall describe the requirements for properly installing the practice to achieve its intended purpose.

OPERATION AND MAINTENANCE

An operation and maintenance plan must be prepared for use by the owner or others responsible for operating the system. The plan should provide specific instructions for operating and maintaining the system to insure that it functions properly. It should also provide for periodic inspections and prompt repair or replacement of damaged components.