

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

IRRIGATION WATER CONVEYANCE

FLEXIBLE MEMBRANE DITCH AND CANAL LINING

(feet)
CODE 428B

DEFINITION

A fixed lining of impervious material installed in an existing or newly constructed irrigation field ditch or irrigation canal or lateral.

Scope

This standard applies to buried membrane linings made of flexible materials, such as plastic, rubber, or asphalt. It includes design and construction criteria for the ditch section that affects the installation of the lining as well for the lining itself.

PURPOSES

To prevent waterlogging of land, to maintain water quality, and to reduce water loss.

CONDITIONS WHERE PRACTICE APPLIES

Ditches and canals to be lined shall serve as an integral part of an irrigation water distribution or conveyance system designed to facilitate the conservation use of soil and water resources on a farm or group of farms.

Water supplies and irrigation deliveries for the areas served shall be sufficient to make irrigation practical for the crops to be grown and the irrigation water application methods to be used.

Lined ditches and canals shall either be located where they are not susceptible to damage from side drainage flooding or they shall be protected from such damage.

CRITERIA

Capacity

A lined ditch or canal shall have enough capacity to meet its requirement as part of the planned irrigation water distribution system without danger of

overtopping. Design capacity shall be based on the following, whichever is greater:

1. The capacity shall be enough to deliver the water needed for irrigation to meet the design peak consumptive use of crops in the area served.
2. Capacity shall be enough to provide an adequate irrigation stream for all methods of irrigation planned for use in the area served.

Velocity

The velocity in canals or ditches lined with flexible membranes shall not exceed the non-erosive velocity for the soil material used for the protective cover or the material through which the canal or ditch passes, whichever is less. Local information on velocity limits for specific soils may be used if available. If such information is not available, the maximum design velocity shall not exceed those shown in figure 6-2, chapter 6, SCS TR-25, except that the design velocity shall not exceed 3 ft/s.

The velocity in ditch reaches from which water is to be delivered onto the field through turnouts, siphon tubes, or similar means shall be less than supercritical and sufficiently low to permit operation of the planned takeout structure or device.

Canals and laterals lined with flexible membranes must be designed with enough capacity to carry the required flows at the velocity that will be developed under the maximum probable retardance conditions.

For capacity design, the value n shall be selected according to the material in which the canal or lateral is constructed, the alignment, the hydraulic radius, and the potential weed and moss hazard.

For checking designs to see that velocities do not exceed permissible values in erodible soils, a Manning's n no greater than 0.025 shall be used.

Freeboard

The required freeboard varies according to the size of the ditch or canal, the velocity of the water, the horizontal and vertical alignment, the amount of storm or waste water that may be intercepted, and the change in the water surface elevation that may occur when any control structure is operating. The minimum freeboard for any lined ditch or canal shall provide 3 in. of lining above the designed water surface. This minimum freeboard requirement is based on the assumption that the finished channel bottom elevation will vary no more than 0.1 ft from the design elevations. If a construction deviation greater than 0.1 ft is permitted, the minimum freeboard shall be increased.

Side slopes

Canals and ditches with buried membrane linings must be constructed with side slopes that will be statically stable. Slope requirements vary according to the type

of cover material, but the side slopes shall not be steeper than 3:1.

Protective cover

Membrane linings shall be protected by an earth or an earth and gravel covering not less than 6 in. thick and must extend not less than 6 in. above the top edge of the lining. In areas subject to traffic by livestock, the minimum thickness of the protective cover shall be 9 in. The material on the bottom 3 in. of cover shall not be coarser than silty sand.

Membrane thickness

The required membrane thickness depends on the expected subgrade conditions, the hydrostatic forces that will be acting on the membrane, and the susceptibility of the lining to damage during or after installation. The minimum nominal thickness shall be as shown in Table 1.

Table 1:

Material	Asphalt	Sheeting	Non-reinforced Rubber	Reinforced rubber
	mil	mil	mil	mil
Coarse soils (SM-SP-SW)	225	8	30	20
Gravel (GC-GM-GP-GW)	-	12	30	30

Anchoring membranes

All structures in the ditch shall be sealed off by the use of adhesive and pressure sensitive tape, or by other acceptable means.

Water surface elevations

All lined ditches and canals shall be designed so that the water surface elevations at field takeout points are high enough to provide the required flow onto the field surface. If ditch checks or other control structures are to provide the necessary head, the backwater effect

must be considered in computing freeboard requirements. The required elevation of the water surface above the field surface varies according to the type of takeout structure or device used and the amount of water to be delivered. A minimum head of 4 in. (101 mm) shall be provided.

Related structures

Plans for ditch or canal lining installations shall provide for adequate inlets, outlets, turnouts, checks, crossings, and other related structures needed for successful conservation irrigation. These structures

can be installed before, during, or after the lining placement. They must be constructed or installed in such a way as to not damage or impair the effectiveness of the lining.

Materials

Flexible membrane liners shall equal or exceed the physical requirements indicated for materials as set forth in 428B Material Specification.

CONSIDERATIONS

Water Quantity

1. Effects on the water budget, especially effects on volumes and rates of runoff, infiltration, evaporation, transpiration, deep percolation, and ground water recharge.
2. Effects on downstream flows or aquifers that would affect other water uses or users.
3. Potential uses for irrigation water management.
4. Potential changes in growth and transpiration of vegetation located next to the conveyance because of the elimination of leakage from the system.

Water Quality

1. Effects of installing the lining on the erosion of the earth conveyance and the movement of sediment and soluble and sediment-attached substances carried by water.
2. Effects of the practice on the movement of dissolved substances to ground water.
3. Effects of wetlands or water-related wildlife habitats.
4. Effects on the visual quality of 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 specification for installing flexible membrane irrigation ditch and canal lining shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purposes.

OPERATION AND MAINTENANCE

An operation and maintenance plan must be prepared by the Designer for use by the owner or other responsible for operating this practice. 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 damage components.