IRRIGATION WATER CONVEYANCE FLEXIBLE MEMBRANE DITCH AND CANAL LINING SPECIFICATIONS

INSTALLATION

Preparing subgrades. Subgrades on which flexible membranes will be placed shall be raked to remove all large clods, roots, brush, sod, or rocks that might endanger the membrane. Rolling the subgrade is recommended to provide an extra measure of safety against punctures. In rocky areas, a cushion layer of fine soil shall be provided as a protection against irregularities that cannot be removed by rolling.

Placing membranes. Plastic and rubber membranes shall be carefully spread in a relaxed condition over the raked and smoothed subgrade. Rubber sheets may be pulled out smooth, but all liners shall be installed in a relaxed state. For polyethylene film, care shall be taken to insure that at least 5 percent slack is provided. Prefabricated asphalt membranes shall be pulled out so that they lay flat on the subgrade.

If the width or length of the lining specified requires placing sheets together, all joints shall be watertight, and the strength of the bonded seam in any direction shall not be less than 80 percent of breaking strength (ultimate tensile strength) of the membrane when the specimen is pulled in shear.

Anchoring membranes. Small anchor trenches about 10 in. (254 mm) wide and 12 in. (304 mm) deep shall be used to anchor the sides of the membrane. These trenches shall be located along the berm on both sides of the canal. They shall be a minimum of 4 in. (101 mm) back on the berm from the top of the side slope and at the elevation required to maintain the specified freeboard. The membrane shall conform to the trench shape and shall extend a minimum of 8 in. (203 mm) up the side opposite the canal. The trenches shall be carefully backfilled and compacted after the membrane is in place.

The upstream end of each section of plastic or rubber membrane shall be anchored in a trench dug across the canal. This trench shall be about 10 in. (254 mm) wide and 12 in. (304 mm) deep and shall connect with the two side anchor trenches. The upstream end of the membrane section shall lap down a minimum of 12 in. (304 mm) into this transverse trench. After the membrane is in place, the trench shall be carefully backfilled with selected compacted material. Prefabricated asphalt membranes shall be anchored at the upstream end of the lining section and at such intermediate points as are specified for individual jobs.

No anchors shall be required at the downstream end of membrane sections. The downstream end of the membrane shall be lapped a minimum of 3 ft (0.9 m) over the anchored upstream end of the next section. Placement of the protective cover material will secure the joint.

Placing protective cover. Material to be used as protective cover on membrane linings shall be free of large clods and sharp rocks and shall be carefully placed to the specified depth without damaging the membrane.

Construction operations. Construction operations shall be done in such a manner that erosion and air and water pollution are minimized and held within legal limits. The completed job shall be workmanlike and present a good appearance.

MATERIALS

The flexible sheets or films to be used as buried membrane linings in irrigation ditches or canals shall be suitably constructed of high-quality ingredients and shall be certified by the manufacturer to be suitable for this intended use. Pigmented polyvinyl or polyethylene plastic, rubber, asphalt, or similar materials that are highly resistant to bacteriological deterioration shall be acceptable base materials for buried membrane linings.

The fabricated membranes shall be uniform throughout and shall be free from dirt, oil, foreign matter, pits, tears, holes, or other defects that can affect their serviceability. They shall be packaged so as to prevent damage from rough handling during shipment and so as to facilitate placement at the job site. Each package shall be marked with the name of the material, the manufacturer's name or symbol, the quantity contained therein, and the thickness or unit weight of the material.

Flexible membrane liners of the materials shown shall equal or exceed the physical requirements listed in Table 1 (polyethylene and ethylene copolymer plastic film); Table 2 (reinforced rubber sheeting); and Table 3 (unreinforced rubber sheeting). Polyvinyl chloride plastic sheeting shall meet the requirements indicated in ASTM-D-3083, Table 4, Table 5 (unreinforced chlorisulfonated polyethylene), and Table 6 (reinforced chlorisulfonated polyethylene).

Table 1. Requirements for polyethylene and ethylene copolymer plastic film.

Test description		Requirements		Test method
		Type I polyethylene	Type II copolymer	
Tensile strength				
Each direction, minimum average	*lb/in.*^{2}	1,800	2,000	ASTM-D-882, Method "A"
Ultimate elongation				
Each direction, minimum average	*pct*	500	500	ASTM-D-882, Method "A"
Impact resistance				
Minimum average	*g/mil*	45	65	ASTM-D-1709, Method "B"
Water vapor permeability	*perm-mil*	0.7	1.5	ASTM-E-96
Tear resistance (Elmendorf)				
Each direction, minimum	*g/mil*	80	80	ASTM-D-1922
Soil burial				
Tensile retained, each direction, minimum	*pct*	95	95	ASTM-D-3083
Elongation retained, each direction, minimum	*pct*	80	80	
Luminous transmittance, maximum	*pct*	1.0	1.0	National Bureau of Standards Publication PS-17

Table 2. Requirements for reinforced rubber sheeting

Test description		Requirements		Test method
		As much as 20 mils thick	20 mils thick and greater	
Breaking strength, minimum				
Warp direction	*lb/in.*	75	100	ASTM-D-751
Fill direction	*lb/in.*	75	100	ASTM-D-751
Ultimate elongation, maximum				
Warp direction	pct	30	30	ASTM-D-751
Fill direction	pct	30	30	ASTM-D-751
Ozone resistance, procedure "B"				
50 pphm, 100 ^{o}F	*days*	7	7	ASTM-D-1149 and ASTM-D-518
Hydrostatic strength retained after				
ozone exposure, 7 days (Mullen)	*pct*	100	100	Federal Specification CCC 191 b, Method 5512
Heat aging, 7 days at 212 ^{o}F				
Tensile strength retained	*pct*	90	90	ASTM-D-573
Elongation retained	*pct*	90	90	ASTM-D-573
Tear resistance, minimum, warp or				
fill direction	*lb*	8	8	ASTM-D-751 (tongue)
Hydrostatic burst (Mullen), minimum	*lb/in.*^{2}	100	175	ASTM-D-751
Dimensional stability, 7 days at 212 ^{o}F,				
change in length or width	*pct*	$\pm$ 1.0	$\pm$ 1.0	([1])
Low temperature flexibility (optional)				
No cracking or flaking		- 40 ^{o}F	- 40 ^{o}F	Federal Specification CCC 191 b, Method 5874
Commercial field splice strength				
Shear force, minimum tensile	*pct*	75	75	Commercial field splice 1-inch wide strip, pulled in shear at 10 in./min, after 7 days cure room temperature

[1]A 1-ft2 sample, 10 in. bench marks in warp and fill direction, placed on aluminum or stainless plate in changing air over.

Table 3. Requirements for unreinforced rubber sheeting

Test description		Requirements		Test method
		Type A	Type B	
Tensile strength, minimum	*lb/in.*^{2}	1,200	1,200	ASTM-D-412
Modulus at 300% elongation, minimum	*lb/in.*^{2}	600	600	ASTM-D-412
Ultimate elongation, minimum	*pct*	300	300	ASTM-D-412
Shore "A" hardness		60 ± 10	60 ± 10	ASTM-D-2240
Ozone resistance, procedure A				ASTM-D-1149
No cracks, 50 pphm at 100 °F, 20% elongation	*days*	7	—	ASTM-D-518
No cracks, 100 pphm at 100 °F, 50% elongation	*days*	—	7	ASTM-D-518
Heat aging, 7 days at 212 °F				ASTM-D-573
Tensile strength retained	*pct*	75	75	
Elongation retained	*pct*	75	75	
Water vapor permeability at 80 °F	*perm mil*	0.002	0.05	ASTM-E-96 (procedure BW)
Tear resistance, minimum	*lb/in.*^{2}	150	150	ASTM-D-624 Die "B"
Dimensional stability, 7 days at 212 °F, change in length or width	*pct*	± 0.5	± 0.5	
Commercial field splice strength shear force, minimum tensile	*pct*	60	60	Commercial field splice, 1-inch-wide strip pulled in shear at 10 in./min, after a 7-day cure at room temperature.

NOTE: Type A sheeting is recommended for general-purpose outdoor use. Type B sheeting is suggested if an extreme outdoor environment makes a highly wearable lining necessary.

Table 4. Requirements of polyvinyl chloride plastic sheeting

Test description		Requirements	Test method
Tensile strength, each direction, minimum average	*lb/in.*^{2}	2,000	ASTM-D-882
Elongation at break, minimum	*pct*	250	ASTM-D-882, Method A
Volatile loss, maximum	*pct*	0.7	ASTM-D-1203, Method A
Water extraction, maximum weight loss	*pct*	0.5	ASTM-D-1239
Tear resistance, each direction, minimum	*g/mil*	160	ASTM-D-1922
Resistance to soil burial (percent change max. in original value)			(120-day soil burial)
Breaking factor	*pct*	-5	
Elongation at break	*pct*	-20	
Modulus at 100% elongation	*pct*	± 10	
Bonded seam strength, percent breaking factor	*pct*	80	ASTM-D-3083 Para. 9.3 (1-inch width)

Table 5. Unreinforced chlorisulfonated polyethylene

Test description		Requirements	Test method
Tensile strength, minimum psi	*pct*	1,000	ASTM-D-412
Ultimate elongation, minimum	*pct*	250	ASTM-D-412
Ozone resistance, 50 pphm, 20% strain, 100 °F, 8,000 hrs	*pct*	± 0	ASTM-D-1149
Heat aging, 14 days at 212 °F			
Tensile strength, minimum psi	*pct*	1,000	
Elongation at break	*pct*	150	
Tear resistance, minimum	*lb/in*	250	ASTM-D-624 Die B
Commercial field splice			ASTM-D-882, Method A
Strength, shear force, minimum tensile	*pct*	60	(7 days cure)
Weight change after 7 days at 70 °C in water, maximum	*pct*	5	ASTM-D-471

Table 6. Reinforced chlorisulfonated polyethylene

Test description		Minimum requirements 30 mil thick and greater	Test method
Breaking strength, minimum			ASTM-D-751
Rubber	*lb/in*	100	
Fabric	*lb/in*	75	
Ultimate elongation, maximum			
Rubber	*pct*	150	
Fabric	*pct*	20	
Ozone resistance, 50 pphm, 20% strain at 100 °F, 8,000 hrs	*pct*	± 0	ASTM-D-1149
Hydrostatic strength after ozone exposure, 7 days (Mullen), % retained	*pct*	100	Fed. Spec. CCC 191b Method 5512, ASTM-D-518
Heat aging, 14 days at 212 °F of original			
Tensile strength	*pct*	90	
Elongation % retained of original	*pct*	90	
Tear resistance, lbs minimum			ASTM-D-751
Warp or fill direction	*pct*	10	(tongue)
Puncture resistance, lbs minimum	*pct*	120	FTMS-101B, Method 2031
Commercial field splice Strength—shear force, % of minimum break	*pct*	75	ASTM-D-882, 7 days cure