

CONSTRUCTION AND CONSTRUCTION MATERIAL SPECIFICATION

Irrigation Water Conveyance (MT-428-B)

Flexible Membrane Ditch and Canal Lining

---

(Owner/Operator)

---

(Project Title)

1. SCOPE

The work covered by this specification includes the furnishing of all materials, equipment, and labor, and performing all operations specified herein, including preparation of site, construction of ditch pad, construction of earth ditch section, and placing, anchoring, and covering the flexible membrane lining.

2. INSTALLATION

2.1 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.

2.2 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.

### 2.3 Anchoring membranes

Small anchor trenches about 10 inches wide and 12 inches 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 inches 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 inches 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 inches wide and 12 inches deep and shall connect with the two side anchor trenches. The upstream end of the membrane section shall lap down a minimum of 12 inches 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 feet over the anchored upstream end of the next section. Placement of the protective cover material will secure the joint.

### 2.4 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.

### 2.5 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.

3. MATERIALS

The flexible sheets shall be of the material specified on the drawings and shall meet the requirements stated herein. Thickness of the sheets shall equal or exceed the minimum thickness shown on the drawings.

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 co-polymer 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).

4. TABLES: Continued on Page 428-B-4

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 <sup>2</sup> .....	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	
Ultimate elongation, maximum			
Warp direction.....pct....	30	30	ASTM-D-751
Fill direction.....pct....	30	30	
Ozone resistance, procedure "B"			
50 ppm, 100°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 and ASTM-D-518
Heat aging, 7 days at 212°F			
Tensile strength retained.....pct....	90	90	ASTM-D-573
Elongation retained.....pct....	90	90	
Tear resistance, minimum, warp or fill direction.....lb.....	8	8	ASTM-D-751 (tongue)
Hydrostatic burst (Mullen), minimum.....lb/in <sup>2</sup> .	100	175	ASTM-D-751
Dimensional stability, 7 days at 212°F, change in length or width.....pct....	+1.0	+1.0	(1)
Low temperature flexibility (optional)			
No cracking or flaking.....	-40°F	-40°F	Federal Specification CCC 191 b, Method 5874
Commercial field splice strength			
Shear force, minimum tensile.....pct....	75	75	Commercial field splice 1-in. wide strip, pulled in shear at 10 in./min, after 7 days cure at room temperature.

1A 1-ft<sup>2</sup> 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 <sup>2</sup> .....	1,200	1,200	ASTM-D-412
Modulus at 300% elongation, minimum...lb/in <sup>2</sup> .....	600	600	ASTM-D-412
Ultimate elongation, minimum.....pct.....	300	300	ASTM-D-412
Shore "A" hardness.....	60 <sub>+10</sub>	60 <sub>+10</sub>	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-518
Tensile strength retained.....pct.....	75	75	ASTM-D-573
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. <sup>2</sup> .....	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-in.-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 for polyvinyl chloride plastic sheeting

Test description	Requirements	Test method
<b>Tensile strength</b>		
Each direction, minimum, average.....lb/in <sup>2</sup>	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.....	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)		ASTM-D-3083 (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 in. width)

Table 5. Unreinforced chlorisulfonated polyethylene

Test description	Requirements	Test method
Tensile strength, minimum psi.....	1,000	ASTM-D-412
Ultimate elongation, minimum.....	250	ASTM-D-412
Ozone resistance, 50 ppm, 20% strain, 100°F, 8000 hrs.....	±0	ASTM-D-1149
Heat aging, 14 days at 212°F		ASTM-D-412
Tensile strength, minimum psi.....	1,000	
Elongation at break.....	150	
Tear resistance, minimum.....	250	ASTM-D-624 Die B
Commercial field splice		ASTM-D-882, Method A
Strength, shear force, minimum tensile.....	60	7 days cure
Weight change after 7 days at 70°C in water, maximum.....	5	ASTM-D-471

Table 6. Reinforced chlorisulfonated polyethylene

Test description	Minimum requirements 30 mils thick and greater	Test method
Breaking strength, minimum		
Rubber.....	100 lb/in...	ASTM-D-751
Fabric.....	75 lb/in...	
Ultimate elongation, maximum		
Rubber.....	150 pct.....	ASTM-D-751
Fabric.....	20 pct.....	
Ozone resistance, 50 pphm, 20% strain at 100°F, 8000 hrs.....	+0 pct.....	ASTM-D-1149
Hydrostatic strength after ozone exposure, 7 days (Mullen), % retained.....	pct.....	Fed. Spec. CCC 191 b Method 5512 ASTM-D-518
Heat aging, 14 days at 212°F of original		
Tensile strength.....	90 pct.....	
Elongation % retained of original.....	90 pct.....	
Tear resistance, lbs minimum		
Warp or fill direction.....	pct.....	ASTM-D-751 (Tongue)
Puncture resistance, lbs minimum.....	120 pct.....	FTMS 101B Method 2031
Commercial field splice		
Strength, shear force, % of minimum break.....	75 pct.....	ASTM-D-882 7 days cure

5. ADDITIONAL SPECIFICATIONS

The following Montana Construction and Construction Material Specifications are hereby included as a part of this specification and are attached.

- MT-1 General Construction
- MT-2 Non-plastic Pipe Materials and Installation
- MT-3 Reinforced Concrete
- MT-3A Concrete for Minor Structures
- MT-4 Earth Fill
- MT-5 Compacted Earth Fill
- MT-6 Gates, Valves, and Miscellaneous Metalwork
- MT-9 Plastic Pipe Materials and Installation
- Others \_\_\_\_\_

6. SPECIAL PROVISIONS

- None
- See attached sheet(s) \_\_\_\_\_

\*\*\*\*\*

This set of specifications has been compiled for the \_\_\_\_\_ project.  
(Project Title)

SCS Approval By:

\_\_\_\_\_  
(Name and Title)

\_\_\_\_\_  
(Date)