

**WISCONSIN FIELD OFFICE TECHNICAL GUIDE  
450 – 11 – TECHNICAL GUIDE  
FOTG NOTICE WI-98**

**October 30, 2019**

**Purpose.** Revisions to Wisconsin Conservation Practice Standards and Specifications.

**Effective Date.** This notice is effective upon receipt.

**Explanation of Changes.**

Wisconsin construction specification updates are detailed below. The date of the revised specification will be the current date of this notice and will replace the previous specification.

**Section IV: Conservation Practice Standards and Specifications:**

**Corrugated Metal Pipe Conduits (WCS-6)**

- ASTM A885 has been withdrawn with no replacement. Reference has been removed from WCS-6.

**Timber Fabrication & Installation (WCS-14)**

- Updated criteria based on updates to the national material specifications.

**Plastic Pipe Conduits (WCS-15)**

- Updated ASTM title changes.
- Updated criteria to allow bell and spigot pipe to be laid with the bell pointed downstream if existing infrastructure dictates this.

**Geosynthetic Clay Liner (WCS-203)**

- Updated criteria based on updates to the national material specifications.

These revisions have been posted on the Wisconsin eFOTG website:

**Remove the following from any printed copies of the WI FOTG:**

- Index

**Add the following to any printed copies of the WI FOTG:**

- Index dated 10/2019

A link to the Wisconsin FOTG is located on the NRCS website at:

<https://www.nrcs.usda.gov/wps/portal/nrcs/main/wi/technical/cp/>

ANGELA L. BIGGS  
Wisconsin State Conservationist  
Attachments

DIST: Wisconsin Statewide



**INDEX**  
**Wisconsin Field Office Technical Guide, Section IV**  
**Wisconsin Construction Specifications**

<b>Practice Name</b>	<b>Code</b>	<b>Discipline</b>	<b>Date</b>
Clearing	001	Engineering	5/2018
Excavation	002	Engineering	5/2018
Earthfill	003	Engineering	5/2018
Earthfill (Ditch Fills or Partial Filling)	003A	Engineering	5/2018
Concrete	004	Engineering	3/2019
Embedded or Expansive Waterstop	004-WS	Engineering	5/2018
Construction Site Pollution Control	005	Engineering	5/2018
Corrugated Metal Pipe Conduits	006	Engineering	5/2019
Mobilization and Demobilization	007	Engineering	5/2018
Drainfill	008	Engineering	5/2018
Rock Riprap	009	Engineering	5/2018
Fences	010	Engineering	5/2018
Small Rock Aggregate (Non-Concrete)	011	Engineering	5/2018
Geotextiles	013	Engineering	12/2016
Timber Fabrication & Installation	014	Engineering	10/2019
Plastic Pipe Conduits	015	Engineering	10/2019
Stream Clearing and Snagging	016	Engineering	6/2018
Wire Mesh Gabions or Mattresses	017	Engineering	6/2018
Sack or Tubular Gabion	018	Engineering	6/2018
Drilled Well Abandonment/Decommissioning	019	Engineering	7/2018
Soil Bioengineering	020	Engineering	6/2018
Structural Measures for Streambank and Shorelines	021	Engineering	6/2018
Temporary Wave Barrier (Breakwaters)	022	Engineering	6/2018
Aluminum or Steel Roof Gutters	023	Engineering	9/2018
Construction Surveys	024	Engineering	6/2018
GPS Machine Control Construction	025	Engineering	3/2015
Topsoiling	026	Engineering	7/2018
Corrugated Polyethylene Tubing	044	Engineering	9/2018
Organic Fill for Ditch Fills or Filling	050	Engineering	9/2018
Organic Fill for Embankments and Ditch Plugs	051	Engineering	9/2018
Poultry Carcass Composter	100	Engineering	4/2009
Grouted Rock Riprap	200	Engineering	6/2018
Steel Sheet Piling	201	Engineering	7/2018
Polyethylene Geomembrane Lining	202	Engineering	3/2019
Geosynthetic Clay Liner	203	Engineering	10/2019
Earthfill for Waste Storage Facilities	204	Engineering	9/2018

<b>Practice Name</b>	<b>Code</b>	<b>Discipline</b>	<b>Date</b>
Ethyl Propylene Diene Terpolymer (EPDM) Geomembrane Lining	205	Engineering	1/2018
Vinyl Sheet Piling	211	Engineering	7/2018
Clay Liner	300	Engineering	4/2018
Polyethylene (PE) Pressure Pipe and Tubing for Livestock Pipeline	516	Engineering	12/2016
Waste Transfer Pipe	634	Engineering	3/2015

# WISCONSIN CONSTRUCTION SPECIFICATION

## 6. CORRUGATED METAL PIPE CONDUITS

### 1. SCOPE

The work shall consist of furnishing and placing circular, arched, or elliptical corrugated metal pipe and the necessary fittings.

### 2. MATERIALS AND FABRICATION

Steel pipe and fittings shall be zinc-coated, aluminum-coated, or aluminum-zinc alloy-coated conforming to the current requirements of ASTM A 742, A 760, A 761, A 762, A 849, A 875, A 929, or AASHTO M 218 and M 274 as appropriate for the coating specified.

Clad aluminum pipe and fittings shall conform to the current requirements of ASTM B 745, B 746, or B 790 or AASHTO M 197.

The thickness of the corrugated metal shall be as shown on the drawings.

#### Pipe Conduit

Unless otherwise specified, all riveted corrugated metal pipe used in conduits shall be close-riveted with caulked seams. Close-riveted pipe shall be fabricated so that the rivet spacing in the circumferential seams shall not exceed 3 inches, except that 12 rivets will be sufficient to secure the circumferential seams in 12-inch pipe. In those portions of the longitudinal seams that will be covered by coupling bands, the rivets shall have finished flat heads or the holes and rivets shall be omitted and the seams connected by welding to provide a minimum of obstruction to the seating of the coupling bands.

The caulking compound shall consist of a mastic combined with fibers and other inert filler material to form a heavy-bodied compound that will not sag or run out of the seam. The compound shall contain a minimum of 60 percent solids by weight.

The caulking of riveted seams shall be accomplished by applying a uniform bead (1/4-inch minimum diameter) of the mastic compound to the inner lap surface before riveting such that when the rivets are in place, all voids are filled and a coating of mastic is between the lap surfaces.

#### Coupling Bands and Hardware

Hardware consisting of coupling bands and band fastening devices such as connecting bolts, rods, lugs, and angles used in conjunction with zinc-coated iron or steel pipe shall be galvanized by the hot-dip method. Hardware used in conjunction with aluminum pipe and aluminum or aluminum-zinc alloy-coated iron and steel pipe shall be of the same material as the pipe except that hot-dip galvanized or cadmium plated fasteners may be used.

Watertight coupled joints shall use a rod and lug band and provide joint sealing by using one of the following materials.

- Caulking compound as specified above.
- A butyl rubber compound that will not sag or run out of the seam. The compound shall contain a minimum of 60 percent solids by weight.
- A sleeve or strip of 3/8 inch thick flat closed cell neoprene installed between the conduit and coupling band. The sleeve(s) or strip(s) shall envelop the conduit for the full width of the coupling band.

### 3. LAYING AND BEDDING THE PIPE

The Contractor shall furnish equipment necessary to place the pipe without damaging the pipe or coatings. The pipe shall be transported and handled in a manner to prevent damage to the pipe or coating.

Pipe shall be installed to the grades shown on the drawings. The pipe shall be laid with the outside laps of the circumferential joints pointing upstream and with longitudinal laps at the sides at about the vertical mid-height of the pipe. Field welding of corrugated galvanized iron or steel pipe will not be permitted. Unless otherwise specified, the pipe sections shall be joined with watertight coupling bands and caulked as specified on the drawings. The pipe shall be firmly and uniformly bedded throughout its entire length to the depth and in the manner specified on the drawings.

Coupling bands shall be installed to provide straight alignment of the connecting pipe ends. The bands shall be positioned to overlap adjacent pipe ends equally. The coupling bands shall be corrugated to match the corrugations of the pipe section ends being connected.

Perforated pipe shall be laid with the perforations down and oriented symmetrically about a vertical centerline. Perforations shall be clear of any obstructions at the time the pipe is laid.

Unless otherwise specified, earth backfill shall be placed in the manner stated in Wisconsin Construction Specification 3, Earthfill, for fill adjacent to structures. Special care shall be taken to prevent lifting the pipe from the bedding by pressures exerted by tamping material under the haunches of the pipe.

### 4. REPAIR OF DAMAGED COATINGS

When the metallic coating is damaged in any individual area larger than 12 square inches, or if more than 0.2 percent of a total surface area of a length of pipe is damaged, that section of pipe will be rejected.

Any damage to the metallic coating shall be repaired by cleaning the damaged surface area to bright metal by sand blasting, power disk sanding, or wire brushing. All loose and cracked coating, dirt, oil or grease, and any products of corrosion shall be removed prior to the application of two (2) coats of the paint noted below. The surface shall be clean and dry during the painting period and until the coating has dried.

Aluminum pipe shall be painted with a chromate-rich primer.

Painting steel pipe shall be accomplished by one of the following options based upon installed exposure conditions of the pipe as approved by the Engineer.

Normal exterior or interior atmospheric exposure:

- a. Zinc dust - zinc oxide primer, ASTM D 79 and D 520.
- b. Single package, moisture cured urethane primer in silver metallic color, or
- c. Zinc-rich cold galvanized compound, brush, or aerosol application.

Submergence in water exposure:

- a. Zinc dust - zinc oxide primer, ASTM D 79 and D 520
- b. Zinc dust paint, ASTM D 4146

# WISCONSIN CONSTRUCTION SPECIFICATION

## 14. TIMBER FABRICATION AND INSTALLATION

### 1. SCOPE

This work shall consist of furnishing all materials, equipment, and the labor necessary for the installation of timber structures and timber portions of composite structures.

### 2. MATERIALS

Materials for timber and composite structures shall conform to the following requirements:

#### A. Wood

All wood shall be Grade 2 which has been pressure treated with an oil-base or waterborne preservative listed in Table 1. The following species are applicable to this specification:

Douglas Fir-Larch (North)  
Douglas Fir South  
Hem-Fir (North)  
Red Oak  
Ponderosa Pine  
Red Pine  
Southern Yellow Pine  
Western White Pine  
White Oak\*  
White Woods (Western Woods)

White Oak, while not normally treated, is included in this specification as an applicable wood species because of its application in timber construction.

The wood shall be sound, new and free of decay. No pieces of exceptionally light weight shall be accepted.

All lumber and timber dimensions refer to nominal size and the material furnished shall be in American Standard dressed sizes. Posts and planks used in the construction shall be relatively straight throughout their length.

Planks shall have square ends and shall be of uniform width and thickness.

#### B. Preservatives and Treatment

Unless otherwise specified on the construction plans, all wooden posts and planks, except white oak, shall be treated by a method listed in Table 1. The method used shall meet the applicable American Wood Protection Association (AWPA) Standard or possess an Evaluation Service Report (ESR) recognized by the International Code Council (ICC). A complete list of ICC recognized ESRs can be found at <http://www.icc-es.org>.

Unless otherwise specified on the construction plans, the minimum retention values shall be as listed in Table 1.

**Table 1  
Preservative Treatment Retention (lbs/ft<sup>3</sup>)**

Treatment Method	UC4A Retention (lbs/ft <sup>3</sup> ) <sup>2</sup>	UC3B Retention (lbs/ft <sup>3</sup> )	Applicable Standard or ESR <sup>2</sup>
	Posts & Planks with Ground Contact	Planks with No Ground Contact	
Creosote Solution <sup>1</sup>	10.0	8.0	AWPA P1
Copper Napthenate (CuN)	0.06	0.04	AWPA P9
Pentachlorophenol	0.40	0.30	AWPA P8
Alkaline Copper Quaternary (ACQ), Type B, C, D	0.40	0.15	AWPA P5
Chromated Copper Arsenate (CCA), Type A, B, or C	0.40	0.25	AWPA P5
Copper Azole – Type B (CA-B)	0.21	0.10	AWPA P5
Micronized Copper Azole (MCA)	0.15	0.06	ESR
Micronized Copper Quaternary (MCQ)	0.34	0.15	ESR

<sup>1</sup> Oil-base preservatives containing creosote-petroleum are not recommended with the wood species identified in this specification.

<sup>2</sup> ESR numbers are dependent on supplier and must be listed on the ICC website: <http://www.icc-es.org/reports/index.cfm?list=list>.

At a minimum, posts and planks for general use with ground contact shall meet AWPA Use Category UC4A\*. Planks for exposed, no ground contact applications shall, at a minimum, meet AWPA Use Category UC3B\*. Posts and planks for structural building components shall be as specified by the designer.

*\*AWPA U1-10 Use Category System: User Specification for Treated Wood, May 2010.*

### C. Hardware

Stainless steel fasteners and connectors shall be used if the wood has preservative treatments ACQ, MCQ, CA-B or MCA. Fasteners, connectors, and any other metal contacting other wood preservative treatment may be galvanized or stainless steel. Galvanizing for fasteners shall conform to ASTM A153. Galvanizing for connectors made from steel sheet shall conform to ASTM A653, Class G185. Galvanizing for all other metal in contact with preservative treated wood shall conform to ASTM A123. Stainless steel shall be AISI Type 304 or 316.



#### D. Marking

Each treated wood item delivered to the job site shall be identified with a label, brand, or stamp that lists: the product name or logo or treatment company name, name of the preservative, treatment end use category, minimum retention, and the applicable AWWPA treatment standard or the number of the ESR. If the label, brand, or stamp is missing, acceptable documentation that the wood item meets the requirements of this specification must be provided to the Technician prior to installation.

### 3. HANDLING AND STORING WOOD MATERIALS

Lumber stored on the work site shall be close stacked off the ground. The ground beneath the stacked lumber shall be cleared of weeds and rubbish. Materials stacked on the work site for more than seven days shall be protected by a suitable waterproof covering.

### 4. CONSTRUCTION

Care shall be exercised during installation to avoid damage to the treated surface. All abrasions, saw cuts, and drill holes shall be treated with 3 coats of the same preservative used in the original treatment process, if available, or a wood preservative product that contains a minimum of 2 percent copper metal. The treatment material may be applied by brushing, spraying, or swabbing the entire surface in 3 successive applications.

Posts that have a field-cut and treated end should be installed with the treated end placed into the ground.

Backfill materials placed around the post shall be well consolidated. Sand/gravel backfill shall be compacted in layers not thicker than 4 inches. Concrete backfill shall be placed in layers not thicker than 12 inches before consolidation.

Planks used in wood walls, pumping docks, etc. shall have the end joints staggered except at a point of grade change in any adjacent concrete slab. If the drawings specify that the planks be double thickness, the joints shall not be at the same location. All joints shall be at a post. Nails shall be driven so the heads are flush with the surface of the wood. Deep setting shall be avoided.

Treated wood requires careful handling and disposal. Shirts with long sleeves, full length pants, and waterproof gloves should be worn to minimize skin contact with the wood during handling and installation. A dust mask and eye protection is recommended when sawing treated wood. Dispose of treated wood by ordinary trash collection or burial. The wood shall not be burned in open fires.

# WISCONSIN CONSTRUCTION SPECIFICATION

## 15. Plastic Pipe Conduits

### 1. SCOPE

The work shall consist of furnishing and installing polyvinyl chloride (PVC), acrylonitrile-butadienestyrene (ABS), and polyethylene (PE) plastic pipe and the necessary fittings as shown on the drawings. **This specification does not apply to corrugated polyethylene tubing used for subsurface drainage systems.**

### 2. MATERIALS

Polyvinyl chloride (PVC) pipe and fittings shall conform to the requirements of the following ASTM and AWWA specifications unless otherwise stated on the drawings.

#### Pressure Rated:

- a. ASTM D-1785 Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- b. ASTM D-2241 Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
- c. ASTM D-2464 Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
- d. ASTM D-2466 Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
- e. ASTM D-2467 Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
- f. ASTM D-2855 Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets.
- g. ASTM D-3139 Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
- h. AWWA C 900 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in. through 12 in.

#### Non-Pressure Rated:

- i. ASTM D-2729 Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- j. ASTM D-2855 Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets.
- k. ASTM D-3034 Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- l. ASTM D-3212 Joints for Drain and Sewer Plastic Pipes using Flexible Elastomeric Seals.
- m. ASTM F-679 Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
- n. ASTM F-794 Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings, Based on Controlled Inside Diameter.
- o. ASTM F-949 Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings.
- p. ASTM F-1760 Coextruded Poly (Vinyl Chloride) (PVC) Non-Pressure Plastic Pipe having Reprocessed-Recycled Content.

Acrylonitrile-butadiene-styrene (ABS) plastic pipe and fittings shall conform to the requirements of the following ASTM specifications unless otherwise stated on the drawings.

Non-Pressure Rated:

- a. ASTM D-2661 Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings.

Polyethylene (PE) plastic pipe and fittings shall conform to the requirements of the following ASTM specifications unless otherwise stated on the drawings.

Pressure Rated:

- a. ASTM D-2239 Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter.
- b. ASTM D-2683 Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.
- c. ASTM D-3035 Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
- d. ASTM D-3261 Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
- e. ASTM F-714 Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter.
- f. ASTM F-2620 Heat Fusion Joining of Polyethylene Pipe and Fittings.

Non-Pressure Rated:

- g. ASTM F-667 3 through 24 in. Corrugated Polyethylene Pipe and Fittings.
- h. ASTM F-2306 12 to 60 in. Annular Corrugated Profile-Wall Polyethylene (PE) Pipe and Fittings for Gravity-Flow Storm Sewer and Subsurface Drainage Applications.

The pipe shall be homogeneous throughout and free from visible cracks, holes, foreign matter, or other defects. The pipe shall be as uniform in color, opacity, density, and other physical properties as is commercially practicable.

3. JOINTS AND FITTINGS

Joints and fittings shall be of the same or similar materials as the pipe and equal to or exceeding that specified for the pipe to which it is attached.

Joints may be bell and spigot type with elastomeric gaskets, coupling type with elastomeric gaskets on each end or solvent cemented. The joints shall be installed according to the manufacturer's recommendations unless otherwise specified.

When a lubricant is required to facilitate joint assembly, it shall be a type having no detrimental effect on the gasket or pipe material.

4. HANDLING AND STORAGE

Pipe shall be delivered to the job site and handled by means which provide adequate support to the pipe and does not subject it to undue stresses or damage. When handling and placing plastic pipe, care shall be taken to prevent impact blows, abrasion damage, and gouging or cutting. All special handling requirements of the manufacturer shall be strictly observed. Special care shall be taken to avoid impact when the pipe must be handled at temperatures of 40°F or less.

Pipe shall be stored on a relatively flat surface so that the barrels are evenly supported. Unless the pipe is specifically coated to withstand exposure to ultraviolet radiation, it shall be covered with an opaque material when stored outdoors for a period of 15 days or longer.

#### 5. LAYING AND BEDDING THE PIPE

The pipe shall be laid to the lines and grades as shown on the drawings and specified herein. The pipe shall be laid so that there is no reversal of grade between joints, unless otherwise shown on the drawings. The pipe shall not be dropped or dumped on the bedding or into the pipe trench. The ground surface near the pipe trench shall be free of loose rocks and stones greater than 1 inch in diameter. This ensures that rock will not be displaced and impact the pipe.

Just before placement, each pipe section shall be inspected to ensure that all foreign material is removed from inside the pipe. The pipe ends and the couplings shall be free of foreign material when assembled. At the completion of a work shift, all open ends of the pipeline shall be temporarily closed off using a suitable cover or plug.

Care shall be taken to prevent distortion and damage during unusually hot (over 90°F) or cold weather (under 40°F). After the pipe has been assembled in the trench, it shall be allowed to reach ground temperature before backfilling to prevent pull out of joints due to thermal contraction.

Bell and spigot pipe shall be laid with the bell pointed upstream, unless existing infrastructure dictates otherwise. The pipe ends and couplings shall be free of foreign material when assembled.

Perforated pipe shall be laid with the perforations down and oriented symmetrically about the vertical centerline. Perforations shall be clear of any obstructions when the pipe is laid and before the pipe is approved for backfill.

The pipe shall be firmly and uniformly bedded throughout its entire length. The bedding depth and materials to be used will be as shown on the drawings. For pipe with bell joints, the bedding material shall be excavated at the locations of the bells to prevent the pipe from being supported by the bells.

#### 6. PIPE EMBEDMENT

Earth bedding – The pipe shall be firmly and uniformly placed on compacted earthfill bedding or an in-place earth material bedding of ample bearing strength to support the pipe without noticeable settlement. The earth material on which the pipe is placed shall be of uniform density to prevent differential settlement.

Unless otherwise specified, a groove that closely conforms to the outside surface of the pipe shall be formed in the bedding. The depth of the groove shall be equal to or greater than 0.3 of the pipe diameter.

Earth bedding shall be compacted to a density not less than adjacent undisturbed in-place earth material or be compacted earth backfill. Earthfill material used for compacted earth bedding shall be free of rocks or stones greater than 1 inch in diameter and earth clods greater than 2 inches in diameter. The pipe shall be loaded sufficiently during the compaction of bedding under the haunches and around the sides of the pipe to prevent displacement from its final approved placement.

Sand, gravel, or crushed rock bedding – When sand, gravel, or crushed rock bedding is specified, the pipe shall be firmly and uniformly placed on the bedding material. Material for bedding shall not exceed 1 inch in diameter. Unless otherwise shown on the drawings, the coarse-grained bedding material shall be carefully placed and compacted to a depth equal to or greater than 0.3 of the diameter of the pipe above the bottom of the pipe. The pipe shall be loaded sufficiently during backfilling and compaction around the sides to prevent displacement of the pipe from its final approved placement.

Pipe encased in drainfill – The pipe shall be firmly and uniformly placed on bedding of specified drainfill. Drainfill shall be placed and compacted as specified in Wisconsin Construction Specification 8, Drainfill or as shown on the drawings. The pipe shall be loaded sufficiently during backfilling around the sides and during compaction to prevent displacement of the pipe.

Pipe encased in concrete – Concrete encasement shall be carefully placed to form a continuous uniform support around the entire circumference of the pipe or as shown on the drawings. Pipes encased in concrete shall be securely anchored to prevent movement of the pipe during concrete placement. A clear distance of 1.5 inches shall be maintained between the pipe and any reinforcing steel.

## 7. BACKFILL

Initial backfill – Unless otherwise specified or shown on the drawings, initial backfill to 6 inches above the top of the conduit is required. Earth haunching and initial backfill material shall consist of soil material that is free of rocks, stones, or hard clods more than 1 inch in diameter. Coarse backfill material shall be the specified sand, gravel, crushed rock, or drainfill material.

Initial backfill shall be placed in two stages. In the first stage (haunching), backfill is placed to the pipe spring line (center of pipe). In the second stage, it is placed to 6 inches above the top of the pipe.

The first stage material shall be worked carefully under the haunches of the pipe to provide continuous support throughout the entire pipe length. The haunching backfill material shall be placed in layers that have a maximum thickness of about 6 inches and are compacted as shown on the drawings or as stated in the Wisconsin Construction Specification appropriate for the backfill material. During compaction operations, care shall be taken to ensure that the tamping or vibratory equipment does not come in contact with the pipe and the pipe is not deformed or displaced.

Final backfill – Final backfill shall consist of placing the remaining material required to complete the backfill from the top of the initial backfill to the ground surface, including mounding at the top of the trench. Final backfill material within 2 feet of the top of the pipe shall be free of debris or rocks larger than 3 inches nominal diameter. Coarse backfill material shall be the specified sand, gravel, crushed rock, or drainfill. Final backfill shall be placed in approximately uniform, compacted layers. Final backfill compaction and layer thickness requirements shall be as shown on the drawings or as stated in the Wisconsin Construction Specification appropriate for the backfill material.

## WISCONSIN CONSTRUCTION SPECIFICATION

### 203. GEOSYNTHETIC CLAY LINER (GCL)

#### 1. SCOPE

The work shall consist of furnishing and installing a geosynthetic clay liner (GCL) with the necessary appurtenances as shown on the drawings.

#### 2. MATERIALS

The GCL shall consist of a layer of high shrink-swell sodium bentonite clay encapsulated between two geosynthetics and shall comply with the criteria in Table 1.

For purposes of strength, performance, and integrity, the GCL shall be manufactured by mechanically bonding the geotextile using a needle-punching process without the use of any chemical binders as adhesives. Needle-punched GCLs are those which, by the use of a needling board, have fibers of the non-woven geotextile pushed through the bentonite clay layer and integrated into a woven or non-woven geotextile.

The bentonite sealing compound or bentonite granules used to seal penetrations and make repairs shall be made of the same natural sodium bentonite as the GCL and shall be as recommended by the GCL Manufacturer.

All GCL shall be free of damage or defect. Each package delivered to the job site shall bear the name of the material, the Manufacturer's name or symbol, lot number and roll number, roll length and width, and the total roll weight of the material.

#### 3. SHIPPING AND STORAGE

The GCL shall be transported to the job site in a manner not to damage the rolls. The liner rolls shall be stored so they are protected from puncture, dirt, grease, water, moisture, mechanical abrasion, excessive heat, ultraviolet light exposure, or other damage. The rolls shall be stored on a smooth surface (not wooden pallets). Rolls shall be stacked to a height no higher than the height which the lifting apparatus can be safely handled (typically no higher than four).

#### 4. SUBGRADE PREPARATION

The area to be lined shall be drained and allowed to dry until the surface is firm. The subgrade surface must be firm, unyielding, and able to support people and equipment that must travel over it during installation of the GCL. All cut and fill slopes shall be constructed in accordance with the drawings. Required subgrade fill shall be placed in layers with a maximum thickness of 6 inches prior to compaction. The fill soils shall be disked or worked in such a manner as to obtain a maximum clod size of 4 inches prior to compaction. Each layer shall be compacted by a minimum of one pass over the entire surface of the fill by a fully-loaded rubber-tired scraper or a tamping roller. Operation of the compaction equipment will be continuous over the entire area during fill operations. Fill materials shall have a moisture content sufficient to insure the required compaction is achieved. The adequacy of fill moisture content and compaction will be approved by the Technician.

Irregularities and any abrupt grade changes shall be eliminated from the surface prior to placing the GCL. When the GCL is placed, the subgrade shall be dry, smooth, and free of debris, roots, ruts, and stones or any projection of more than 0.5 inch. All projections of more than 0.5 inches shall be removed, crushed, or pushed into the surface with a smooth-drum roller. No equipment tracks or footprint indentations shall be present in the subgrade.

An anchor trench for the liner shall be excavated and backfilled in accordance with the drawings. No loose soil shall be allowed at the bottom of the trench and no sharp corners or protrusions shall exist in the trench. Minimum trench dimensions shall be 18 inches deep and 12 inches wide.

## 5. PLACEMENT

The contractor shall confine the work to an area that can be completely installed and covered by the end of the normal working day in a manner that will prevent the occurrence of hydration prior to being covered with the specified cover soils. Daily completion shall be defined as the full installation of the liner, covering around appurtenances, and placement of the specified cover soils.

The GCL rolls shall be deployed using a spreader bar assembly attached to a loader bucket or by other methods approved by the liner Manufacturer. The method chosen to unroll the panels shall not cause wrinkles, folds, or crimps in the GCL and shall not damage the supporting soil. The rolls shall be carefully rolled down the slope and not allowed to unroll freely and out of control. When it is necessary to drag liner panels, a geosynthetic subgrade covering known as a rub sheet shall be used to reduce friction and protect the GCL during placement.

The GCL shall not be deployed during periods of heavy precipitation, in the presence of excessive winds, or in areas of ponded water.

GCL panels shall be placed with the non-woven geotextile side against the subgrade. On slope areas exceeding a steepness of 4H:1V, the long dimension of all panels shall go up and down the slope. This panel orientation shall apply to all covered slopes including corner slopes. Panels on flat areas require no particular orientation. Panels should be placed from the highest elevation to the lowest in the area to be lined to facilitate drainage in the event of precipitation. Panels shall be placed free of tension or stress yet without wrinkles or folds. It is not permissible to stretch the GCL in order to fit a designated area. Panels shall not be dragged across the subgrade into position except where necessary to obtain the correct overlap for adjacent panels.

The top edge of the liner shall be placed in the anchor trench and anchored with compacted backfill. Compact the backfill by wheel rolling with light rubber-tired equipment or a manually directed power tamper.

## 6. SEAMING

All GCL seams shall be formed by executing a bentonite enhanced overlap to ensure a continuous seal is achieved between panels.

A 6-inch to 9-inch side overlap shall exist at seam locations. The lap line and match lines printed on the liner panels shall be used to assist in obtaining this overlap. The edges of the GCL panels should be adjusted to smooth out any wrinkles, creases, or “fishmouths” in order to maximize contact with the underlying panel.

Seams at the ends of panels should be constructed such that they are shingled in the direction of the grade to prevent flow from entering the overlap zone. The end of roll overlap shall be a minimum of 24 inches. End-of-roll seams shall be located at least 3 feet from the toe or crest of the slope. Panel overlap seams at the base of the slope shall be a minimum of 6 feet from the toe. All seam areas or runs shall be augmented with granular bentonite. Granular bentonite shall be dispersed evenly to cover the entire lapped area from the panel edge to the lap line at a minimum rate of 1 pound per 2 square feet of area covered. Seams shall remain closed during the backfill operation in order to prevent contamination of the bond surface and to ensure the panels remain in intimate contact, where jointed, at all times.

After the overlying panel is in place, its edge shall be pulled back to expose the overlap zone. Any soil or debris present in the overlap zone or entrapped in the geotextiles shall be removed. A fillet of granular bentonite shall then be poured in a continuous manner along the overlap zone (between the edge of the panel and the overlap line), at a rate of at least one-quarter pound per linear foot. The use of a watering can or line chalker is recommended to improve the uniformity and consistency of the bentonite fillet. This process shall be conducted in accordance with the Manufacturer's instructions.

For penetrations or structures the liner will contact, a 3-inch by 3-inch notch shall be cut or dug in the subgrade around the penetration or structure.

For penetrations, the liner shall be brought up to the penetration and trimmed to fit into the notch. Granular bentonite or a compact mixture of 1 part bentonite to 4 parts soil (by volume), blended dry, shall be placed into the bottom half of the notch. The liner shall then be inserted into the notch, with the remaining area in the notch filled with the granular bentonite or the 1 to 4 mixture, and compacted. A secondary GCL collar shall be placed around horizontal penetrations. The collar shall overlap the GCL a minimum of 12 inches in each direction.

For liner terminated at a structure, granular bentonite or a compact mixture of one part bentonite to four parts soil (by volume), blended dry, shall be placed in the notch and against the structure. The liner shall extend over the notch and a minimum of 3 inches vertically adjacent to the structure.

## 7. REPAIRS

GCL that has begun to hydrate before being covered with soil shall be removed and replaced with dry GCL.

All damaged or flawed material shall be repaired as follows:

- Completely expose the affected area.
- Remove all soil or other foreign objects.
- Place a GCL patch over the exposed area with a minimum overlap of 12 inches on all edges.
- Place granulated bentonite between overlap at the rate of 1 pound per 2 square feet of area covered, and spread to a minimum width of 6 inches.
- On a sloping surface, fasten augment the bentonite-enhanced seam with construction adhesive.

## 8. PLACEMENT OF OVERLYING MATERIALS

Cover soils shall be mineral soil, free of angular stones or other foreign matter which could damage the GCL. Cover soils with high concentrations of calcium (e.g. limestone, dolomite) are not acceptable.



Soil cover shall be placed with low ground pressure equipment. The final thickness of soil cover shall be at least 1 foot over the GCL or as shown on the drawings. For high-traffic areas or roadways, a minimum of 2 feet is required. To prevent damage to the GCL, the initial lift(s) of soil cover shall not be compacted in excess of 85 percent of Modified Proctor density.

No vehicles should be driven directly on the GCL until the proper thickness of cover has been placed. Care should be taken to avoid damaging the GCL by making sharp turns or pivots with equipment.

When covering GCL installed on sloped areas steeper than 4H:1V, the soil cover shall be pushed upslope to minimize tension on the GCL.

If the cover material is a geomembrane or other geosynthetic, precautions shall be taken to prevent damage to the GCL by restricting heavy equipment traffic. Unrolling the geomembrane can be accomplished through the use of lightweight, rubber-tired equipment such as a 4-wheel all-terrain vehicle (ATV). This vehicle can be driven directly on the GCL, provided the ATV makes no sudden stops, starts, or turns.

The leading edge of GCL panels left uncovered at the end of the working day shall be protected with a waterproof sheet which is adequately secured with sandbags or other ballast.

#### 9. LINER HYDRATION FOR MANURE CONTAINMENT FACILITIES

In installations where containment of manure, barnyard runoff, milking center wastes containing manure, etc., is required, the GCL must be hydrated with water prior to introducing the liquids containing manure.

The GCL on the bottom of the containment facility shall be hydrated by flooding or the use of a sprinkler system. Hydration of the side slopes shall be accomplished by the use of a sprinkler system if adequate rainfall is not anticipated prior to contact with the liquids containing manure.

#### 10. FINAL TESTS AND INSPECTION

Upon completion of the work, the installation shall be subjected to a final inspection. All work in the system therein being tested shall be complete, cleaned and ready for use. The work shall meet the requirements as to the lines, grades, cleanliness and workmanship. Any discrepancies shall be repaired.

#### 11. BASIS OF ACCEPTANCE

The acceptability of the geomembrane shall be determined by inspections to check compliance with all the provisions of this specification, with respect to the drawings, markings, the appurtenances, and the minimum installation requirements.

The installing Contractor shall certify that the materials and installation complies with the requirements of this specification.

**TABLE 1**  
**Requirements for Geosynthetic Clay Liner (GCL)**

<b>Material</b>	<b>Property</b>	<b>Test Method</b>	<b>Value<sup>1</sup></b>
Bentonite <sup>2</sup>			
	Swell Index	ASTM D 5890	24 ml/2g min.
	Moisture Content (dry weight)	ASTM D 2216	40% max.
	Fluid Loss	ASTM D 5891	18 ml max.
Finished GCL			
	Bentonite Content <sup>3</sup> Mass/Area	ASTM D 5993	0.75 lb/sq ft
	Grab Strength	ASTM D 6768	45 lbs./in.
	Peel Strength	ASTM D 6496	3.5 lbs./in.
	Hydraulic Conductivity <sup>4</sup>	ASTM D 5887	5 X 10 <sup>-9</sup> cm/sec max.
	Hydrated Internal Shear Strength <sup>5</sup>	ASTM D 5321 or D 6243	500 psf
	Index Flux	ASTM D 5887	1 X 10 <sup>-8</sup> m <sup>2</sup> /m <sup>2</sup> /sec

<sup>1</sup> All values, unless specified otherwise, are minimum average roll values (MARVs) as reported by the specified test methods.

<sup>2</sup> These parameters are for the bentonite as delivered to the GCL manufacturer, not for the bentonite in the finished product.

<sup>3</sup> Bentonite mass per unit area at 0% moisture content.

<sup>4</sup> At 5 psi confining pressure.

<sup>5</sup> Specimen hydrated for 24 hours and sheared at a 200 psf normal stress.