WSP Engineering of New York, P.C.

October 27, 2011

Karen A. Cahill
Division of Environmental Remediation
New York State Department of Environmental Conservation
Region 7
615 Erie Boulevard West
Syracuse, NY 13204-2400

Re: AOC-1 Soil Design Report and Work Plan
Emerson Power Transmission, Ithaca, New York
Order on Consent #A7-0125-87-09

Dear Ms. Cahill:

Enclosed please find two copies of the Soil Design Report and Work Plan for Area of Concern No. 1 (AOC-1) at the Emerson Power Transmission (EPT) site in Ithaca, New York. The plan provides the scope of work and design details for the capping system to be installed outside the former degreaser area of the plant.

Please contact me if you have any questions.

Sincerely yours,

James P Bulman

James P. Bulman
Senior Vice President

JPB:DAR:paw
K:\EMERSON\127491 Ithaca\AOC1 Soil Remedy\Trans letter 2011-10272011.docx

Enclosures

cc/encl.: Derek E. Chase

WSP Engineering of New York, P.C.
750 Holiday Drive, Suite 410
Pittsburgh, PA 15220
Tel: (412) 604-1040
Fax: (412) 920-7455

AOC-1 Soil Design Report and Work Plan
Emerson Power Transmission
Ithaca, New York
Site No. 755010

October 27, 2011

WSP Engineering of New York, P.C.
750 Holiday Drive
Suite 410
Pittsburgh, PA 15220

Tel: +1 412 604 1040
Fax: +1 412 920 7455
http://www.wspenvironmental.com/usa

WSP Engineering of New York, P.C.

Contents

1 Introduction

On behalf of Emerson and its subsidiary, Emerson Power Transmission Corp. (EPT), WSP Engineering of New York, P.C., has prepared this Soil Design Report and Work Plan for Area of Concern 1 (AOC 1) at the Emerson Power Transmission (EPT) site in Ithaca, New York. This report was prepared in connection with the Record of Decision Amendment (June 2009) and the Administrative Order on Consent (Index #A7-0125-87-09) entered into by the New York State Department of Environmental Conservation (NYSDEC) and EPT on July 13, 1988. This report presents a summary of the investigation results at AOC 1, a description of the selected remedy as identified in the Pre-Design Investigation and Alternatives Analysis Report dated December 5, 2008, and the work plan for construction of the selected remedy. The design and work plan for the AOC 1 groundwater remedy has been submitted separately.

AOC 1 is located near the Former Department 507 Degreaser area, an area on the basement level of Building No. 4 of the largest of the three main facility structures. Methylene chloride and vinyl chloride were detected in soil at concentrations above the NYSDEC Restricted Use Soil Cleanup Objectives (SCOs) for protection of groundwater in one sample located inside the building. As described in the Pre-Design Investigation and Alternatives Analysis Report, a Containment/Institutional Controls remedy has been selected as the remedy for soils at AOC 1. While the one affected boring was located inside the building, the potential exists for infiltration outside the former degreaser area to affect the source materials inside the building. Therefore, the remedy for AOC 1 soils includes the outside areas immediately adjacent to the degreaser room.

The selected remedy involves inspection and maintenance of the concrete slab within the former degreaser area inside the building and construction of a low-permeability cap outside the building to mitigate potential exposure to impacted soils, to minimize surface water infiltration, and to reduce transport of affected materials. Institutional controls in the form of deed restrictions that are conveyed with the land will be placed to prevent future development of the affected area.

2 Background

2.1 SITE LOCATION

The EPT facility is located at 620 South Aurora Street in Ithaca, New York (Figure 1). The site consists of three main buildings along the northeast and southwest portions of South Hill. The facility buildings are located at an elevation of approximately 600 feet above mean sea level. The main building is flanked by a number of smaller buildings to the southwest and a series of access roads and parking lots that terrace the hillside above the plant to the east. Further uphill and to the east are South Aurora Street and the campus of Ithaca College. Undeveloped woodland borders the site to the southwest along the steep embankments of the hill. West Spencer Street, which runs parallel to the EPT property, marks the western edge of the wooded area and the base of South Hill. Beyond Spencer Street to the west and in areas along the steep northern approach to South Hill and the EPT property are residential areas. Those neighborhoods are bordered by Six Mile Creek, which flows north along the base of South Hill and eventually empties into Cayuga Lake approximately 2 miles northwest of the site. Figure 1 shows the facility layout and the surrounding areas.

The former degreaser area is located on the basement level of Building No. 4 of the main plant structure (Figure 2). The degreaser equipment has been removed and the room is currently vacant. The area outside of the former degreaser area contains several underground utilities including a valve and water line associated with the fire water loop, electric, natural gas, sanitary and storm water lines, and manholes. Ammonia, oxygen, coolant lines remaining in this area from historical plant operations are inactive. Surface features that remain include heating and cooling units, protective guide rails and bollards, a fixed ladder, loading dock ramp, a fire hydrant, fencing, and a retaining wall. The surface features and underground utilities are shown on Figure 2.

2.2 SITE HISTORY

The original building at the EPT site was built in 1906 by Morse Industrial Corporation, which manufactured steel roller chain for the automobile industry. From approximately 1928 to 1983, Borg-Warner Corporation owned the property and manufactured automotive components and power transmission equipment using similar processes, but not necessarily the same materials, as those currently conducted by EPT. Up until the late 1970s, Borg-Warner Corporation used trichloroethene (TCE), a widely-used solvent at the time for degreasing metal parts. In 1983, Morse Industrial Corporation was purchased from Borg-Warner Corporation by Emerson and became known as Emerson Power Transmission. EPT manufactured industrial roller chain, bearings, and clutching for the power transmission industry until ceasing operations in 2009. Investigations conducted by Emerson in 1987 identified onsite groundwater contamination, originating from a fire-water reservoir located on the western portion of the property. Emerson promptly reported these findings to the NYSDEC. The remediation of this contamination was the subject of the July 1987 Consent Order (Index # A7-0125-87-09) referenced above.

2.3 SITE GEOLOGY AND HYDROGEOLOGY

The EPT site is located on the northern edge of the Appalachian Plateau Physiographic Province, which is characterized in central New York by deeply dissected hilly uplands and glacially gouged stream valleys. The EPT site lies on the limits of one of the dissected hills and overlooks the Cayuga Lake basin, which is formed in a former stream valley eroded and enlarged by the advance of glaciers. Underlying the site is a thin, discontinuous veneer of glacial till and man-made fill. The soil is classified as the “A-zone” in the site conceptual model and hydrogeologic framework presented in the Revised

Supplemental Remedial Program/Alternatives Analysis Report dated September 23, 2008. It is typically a silty or clayey gravel and ranges in depth from 2.5 to 33 feet thick, though most of the EPT site and the western slope of South Hill is covered by less than 15 feet of soil. Soil depths generally increase with decreasing elevation and eventually merge with glacio-lacustrine silt and clay that lines the bottom of the valley floor below South Hill. In the vicinity of AOC 1, the A-zone soil consists of clayey silt and lean clay with a thickness of several feet located just above the top of bedrock.

Beneath the overburden lies bedrock of the Ithaca Siltstone, a member of the Genesee Formation. The bedrock is typically well-cemented with generally non-fossiliferous beds ranging in thickness from 0.1 inch to 2.5 feet in thickness. Based on core logs recovered from boreholes drilling during investigation activities, the rock was differentiated into three zones based on the frequency of bedding plane fractures and joints: an upper “stress relief zone” (B-zone), a middle “transitional zone” (C-zone), and a lower “lithologically controlled zone” (D-zone).

The uppermost B-zone is characterized as very highly to highly fractured weathered bedrock. Onsite the B-zone extends to a maximum depth of approximately 22 feet below ground surface (ft-bgs) and has an average thickness of approximately 8 to 10 feet on the western portion of the site where the current remediation system is located. The transitional zone (C-zone) extends from the base of the B-zone to a maximum depth of approximately 55 ft-bgs at the EPT site. The lower lithologically controlled zone (D-zone) extends from the bottom of the C-zone to a minimum depth of 145 ft-bgs.

Groundwater flow direction within the overburden and underlying B-zone generally mimics surface topography, which slopes to the northwest. Groundwater flow direction within the siltstone bedrock (C and D zones) is significantly affected by vertical and horizontal distribution of vertical joint sets and horizontal bedding plane fractures within the upper sections of bedrock.

3 Investigation Results for AOC 1

Soil sampling was conducted in AOC 1 to determine the extent of soil impact in the former degreaser area. Four soil borings, SB-1a and SB-1b outside the building and SB-1c and SB-1d inside the building, were installed in August 2007. One sample (SB-1d) inside the building exceeded NYSDEC Subpart 375-6 - Protection of Groundwater criteria for methylene chloride and vinyl chloride. Two additional borings, SB-1e and SB-1f both outside the building, were installed in June 2008 to further delineate soil impact near SB-1d. Soil samples collected from borings SB-1e and SB-1f did not contain site related VOCs above the NYSDEC Protection of Groundwater criteria. VOCs in soil within AOC-1 are restricted to an area immediately around SB-1d. Soil boring locations are shown on Figure 2.

During sampling activities, a petroleum odor and oily sheen were noted on the soils between 10 to 12 feet bgs in SB-1e and 12 to 12.6 feet bgs in SB-1f. Fingerprinting analysis identified the petroleum product as motor oil, and the hydrocarbon concentrations were 2,800 milligrams per kilogram (mg/kg) in SB-1e and 680 mg/kg in SB-1f.

4 AOC 1 Recommended Remedial Alternative

The recommended alternative identified by the Alternatives Analysis Report for addressing soil in AOC 1 is capping and institutional controls (Alternative 2 of the December 5, 2008 report). Capping and institutional controls will achieve the remedial action objective of preventing exposure to affected soil and limiting future contact. Also, the Site Management Plan (SMP), to be developed under separate cover, will outline the procedures necessary for maintaining the containment system and control potential exposure in the event of future actions in this AOC.

The selected remedy includes maintaining the existing concrete floor inside the building where degreasing operations historically occurred and installing a low-permeability cap over the areas outside the building where surface water infiltration could influence contaminant migration. Because contamination will be left in place as part of this remedy, institutional controls will be implemented to restrict future use of the area comprising AOC 1. The SMP will identify the required inspection and maintenance measures, required actions should the affected area be redeveloped, and the required actions if a breach in the containment system occurs for any reason. The SMP will also include a groundwater monitoring program.

5 Capping System Design and Work Plan

This section describes the capping system design and work plan for the containment actions to be implemented outside the former degreaser area.

5.1 EXISTING CONDITIONS

The room where degreasing operations were historically conducted is currently vacant. The room has a concrete floor that is reportedly approximately 3 inches thick. Any cracks that may have been present in this area were sealed in April 2009 as part of the site-wide floor sealing work.

Existing surface features in the outdoor portion where capping is planned includes a loading dock, a man door, a valve for the fire wire loop, protective bollards, heating and air conditioner units, a fixed ladder, guide rails, chain-link fencing, and a retaining wall. Existing subsurface features include concrete sumps and vaults, manholes, several monitoring wells, water lines, sanitary and storm water lines, natural gas and electric lines, and ammonia, oxygen, and coolant lines from past facility process operations.

The existing pavements are a combination of concrete and asphalt that appear to have been placed at various times. The access road appeared to have been overlaid at least once. Several asphalt patches were observed. The pavements show various degrees of deterioration.

Two concrete sanitary sewer vaults are present within the proposed cap area, one with a standard round cast iron manhole lid and one with a square hinged lid. Influent and effluent lines were observed in both vaults. One grated utility sump contained the ammonia, oxygen, and gas lines and a pass-through roof drain. This sump is dry with no influent or effluent discharge lines.

The existing features are shown on Figure 2.

5.2 SITE PREPARATION

A general contractor will be selected to perform the remedial action based on the type of work and experience. After mobilization, site preparation activities will be performed including utility location (Dig Safely New York) and verification (private utilities locator), setup of work zone and traffic control, and establishment of erosion controls. Due to the nature of the work, contaminated materials are not expected to be generated. Erosion controls will be limited to storm water inlet protection to prevent sediments from entering the site's storm water conveyances system. If existing pavements and subbase cannot be direct loaded to transport carriers, a temporary staging area will be established. Removed materials will be staged on polyethylene sheeting and covered until reuse or removal from the site. Existing fencing and other removable obstructions will be removed and replaced in kind following completion of site work.

Health and safety procedures shall be established during the site preparation phase. A health and safety plan (HASP) will be prepared by the general contractor should potentially hazardous materials be encountered during the work. Material safety data sheets for the products used during cap construction shall be included in the HASP and are provided in the appendices of this report.

5.3 PAVEMENT REMOVAL

Existing pavements and subbase within the cap area will be removed to a depth of at least 18 inches to accommodate the proposed thickness of the asphalt cap. Pavements will be saw cut to produce smooth edges. Concrete in designated areas including the area beneath the heating and air conditioning units, the concrete loading dock ramp, and the sanitary sewer vaults will be protected. These existing concrete surfaces will become part of the cap as described in Section 5.4.2.

The pavements will be transported offsite for recycling or proper disposal. Subbase materials may be reused if determined to be clean (photoionization detector readings less than 1 part per million) and of the proper gradation and stone type to prevent damage to the capping layers. Excess soil that is removed to accommodate the full thickness of the cap will be characterized and properly disposed of offsite. The inactive ammonia, oxygen, and coolant conduit will be removed if encountered during pavement removal activities.

5.4 CAP CONSTRUCTION

The capping system will be installed after pavement and subbase removal. An asphalt cap consisting of a geosynthetic clay liner and two courses of asphalt with a geotextile interlay will be constructed where the pavements were removed. The existing concrete within the proposed cap area will be sealed with a waterproof coating and will serve as a concrete cap. The limits of the asphalt and concrete cap are shown on Figure 2. The following sections describe the cap construction details.

5.4.1 Asphalt Cap Construction

After pavement removal, the subgrade will be proof rolled to ensure adequate compaction and to provide a smooth surface for protection of the geosynthetic clay liner. A layer of sand may be applied as a cushioning layer, if necessary, based on the condition of the subgrade.

The geosynthetic clay liner (GCL) shall be CETCO Bentomat® ST. Bentomat® ST consists of a layer of volclay sodium bentonite encapsulated between woven and non-woven geotextiles, which are needle-punched together to provide internal reinforcement. The internal reinforcement minimizes clay shifting, thus allowing the GCL to maintain consistent low permeability. The GCL shall be installed in accordance with CETCO's standard installation guidelines (Appendix A). Figure 3 provided details for GCL overlaps and installation around penetrations (wells, utility conduit, manholes, and sumps), at wall terminations, and at transitions to existing pavements.

A minimum of 12 inches of aggregate subbase shall be placed and compacted over the GCL. The aggregate subbase serves to provide minimum cover over the GCL and to provide a stable base for the asphalt pavement. Depending on the quality of the removed subbase, a layer of sand may be placed first to prevent damage to the GCL. Imported aggregate shall conform to Type 4 gradation as defined in NYSDOT standard construction specifications. The subbase surface shall be graded to a minimum 1 percent grade sloping away from the building and toward existing storm water collection basins.

An asphalt base course shall be placed over the prepared subbase. The base course shall be a 25 mm Superpave mix placed to a compacted thickness of 4 inches. After allowing base course to cure and cool for at least 12 hours, a tack coat conforming to NYSDOT standard construction specifications shall be applied to the surface of the base course followed by installation of a geotextile interlay. A 2-inch compacted thickness of 12.5 mm Superpave mix shall be placed over the interlay as the final wearing course layer of the asphalt cap. Asphalt materials and workmanship shall conform to NYSDOT standard construction specifications.

The geotextile interlay shall be Propex Petromat® 4598 and shall be installed in accordance with Propex's standard installation guidelines (Appendix B). The geotextile interlay will serve to:

- Provide a waterproof barrier for subgrade protection
- Provide a stress-relieving interface to improve fatigue resistance
- Retard crack propagation
- Extend useful life of the pavement structure
- Strengthen entire pavement section

5.4.2 Concrete Cap

The concrete surfaces inside the building in the former degreaser area will be inspected. Any identified cracks and joints that have not already been treated shall be sealed with 3M™ Scotchweld™ DP-600 self-leveling sealant that is applied in accordance with manufacturer recommendations (Appendix C).

Portions of the existing concrete slab and existing utility vaults outside the former degreaser area will form a portion of the overall capping system. The limits of the concrete cap, shown on Figure *2,* may be expanded or reduced based on the inspected condition of the slab. Concrete that is generally free of cracks, surface deterioration, patches, spalling, or other deformities are satisfactory to serve as a capping medium.

The existing concrete, cracks, and joints will be cleaned of dust and debris using compressed air. Old surface coatings, oil, and grease, if present, shall be removed by pressure washing. After drying, cracks and construction joints shall be sealed with 3M™ Scotchweld™ DP-600 self-leveling sealant. After the prescribed sealant curing time, the entire exposed concrete surface shall be sealed with Sikagard® 62 that is installed in accordance with manufacturer recommendations (Appendix D). Sikagard 62 is a solvent-free two component high build thixotropic industrial coating based on epoxy resin. When fully cured, it forms an impervious water and vapor proof protective barrier. Sikadur Silica Aggregate shall be applied with the final coat to provide an anti-skid surface.

5.4.3 Joint Sealing

As a final measure, asphalt joints, asphalt/concrete transitions, and masonry wall terminations shall be sealed with a joint sealer that complies with standard NYSDOT standard construction specifications. Utility conduit and other cap penetrations such as fence posts, guide rail supports, HVAC supports, and manhole and vault covers will be similarly sealed.

6 Schedule

There are no known exceedences of NYSDEC Subpart 375-6 - Protection of Groundwater criteria currently present in soil beneath the proposed cap area outside the degreaser area. The in-situ chemical oxidation injection program for the groundwater portion of the AOC-1 is pending and has the potential to affect the capping system. For these reasons, the cap construction work will be performed after implementation of the groundwater remedy, likely in the spring of 2012 after the asphalt mix plants open after the winter season.

The cap construction work is expected to take 2 weeks to complete. The following task durations are anticipated:

Utility Location	3 days
Mobilization and Site Preparation	1 day
Pavement Removal	2 days
Asphalt Cap Construction	5 days
Concrete Cap Construction	2 days
Joint Sealing	1 day

7 Engineering Certification

ENGINEER'S CERTIFICATION
AOC-1 SOIL DESIGN REPORT AND WORK PLAN
EMERSON POWER TRANSMISSION
620 SOUTH AURORA STREET
ITHACA, NEW YORK
SITE NO. 7-55-010

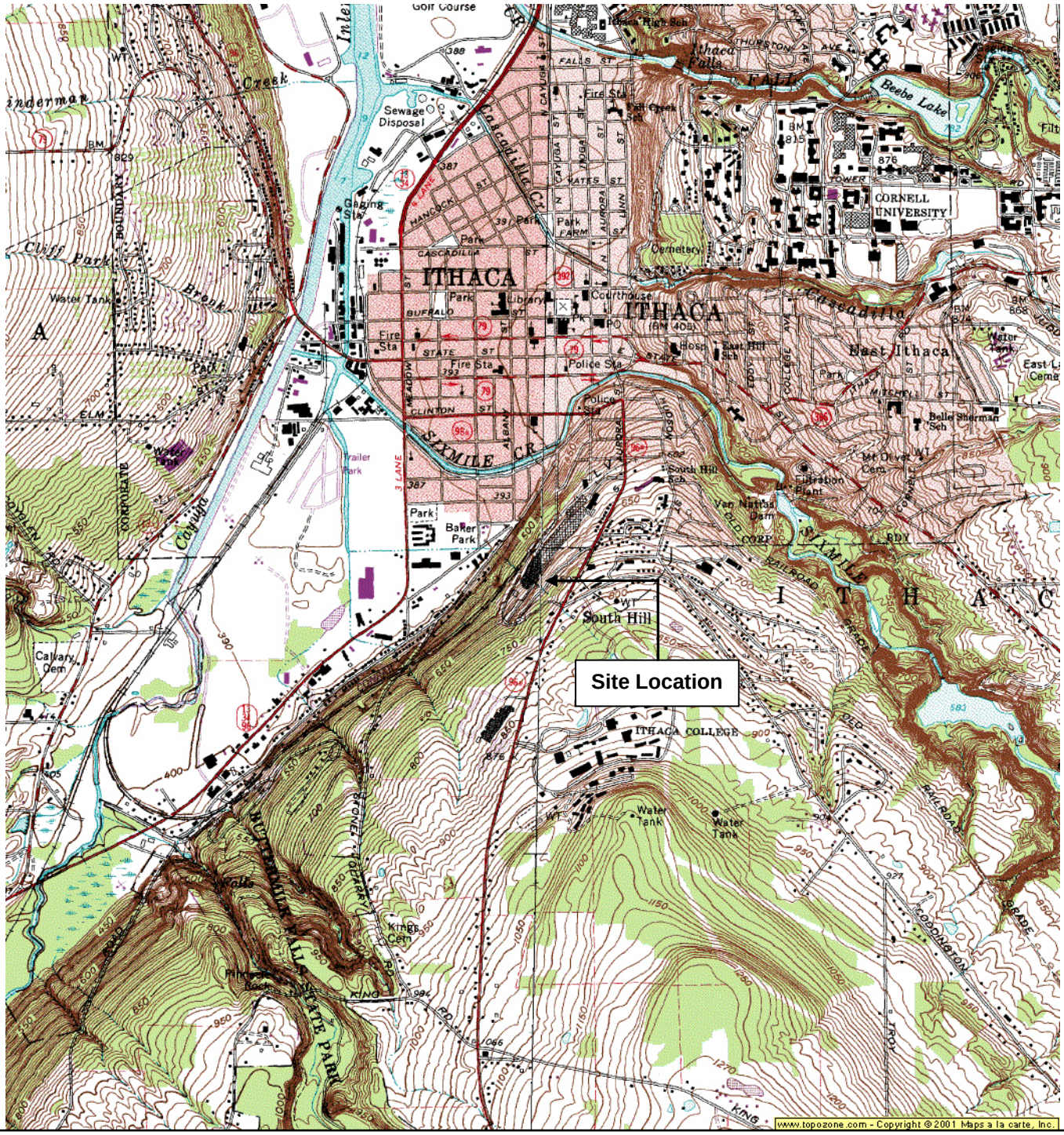
I, Kevin D. Sullivan, P.E., certify that I am currently a NYS registered professional engineer as defined in NYCRR Part 375 and that this AOC-1 Soil Design Report and Work Plan was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10).

26 OCT 2011

Kevin D. Sullivan
New York State P.E. No. 073712
2360 Sweet Home Rd, Suite 3
Amherst, New York 14228

Date

Figures



Reference
7.5 Minute Series Topographic Quadrangle
Ithaca East, New York
Photorevised 1976 Scale 1:25,000 Metric

N

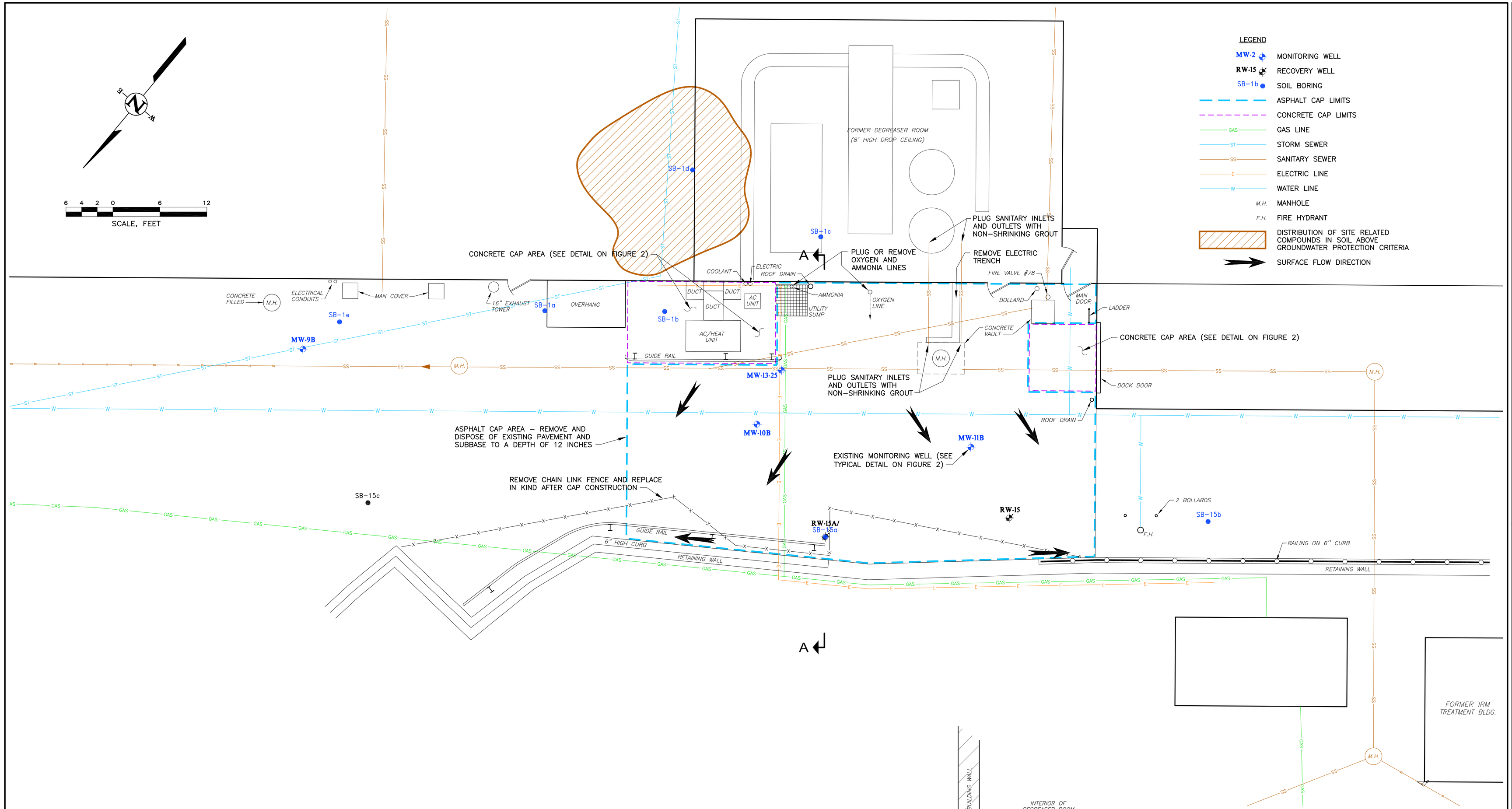
Quadrangle Location

Scale in Meters
0 500 1000

0 1000 2000
Scale in Feet

WSP Engineering of New York, P.C.
11190 Sunrise Valley Drive, Suite 300
Reston, VA 20191
(703) 709-6500

Figure 1
Site Location
Emerson Power Transmission
Ithaca, New York



NOTES:

1. SEALANTS SHALL BE APPLIED IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS.

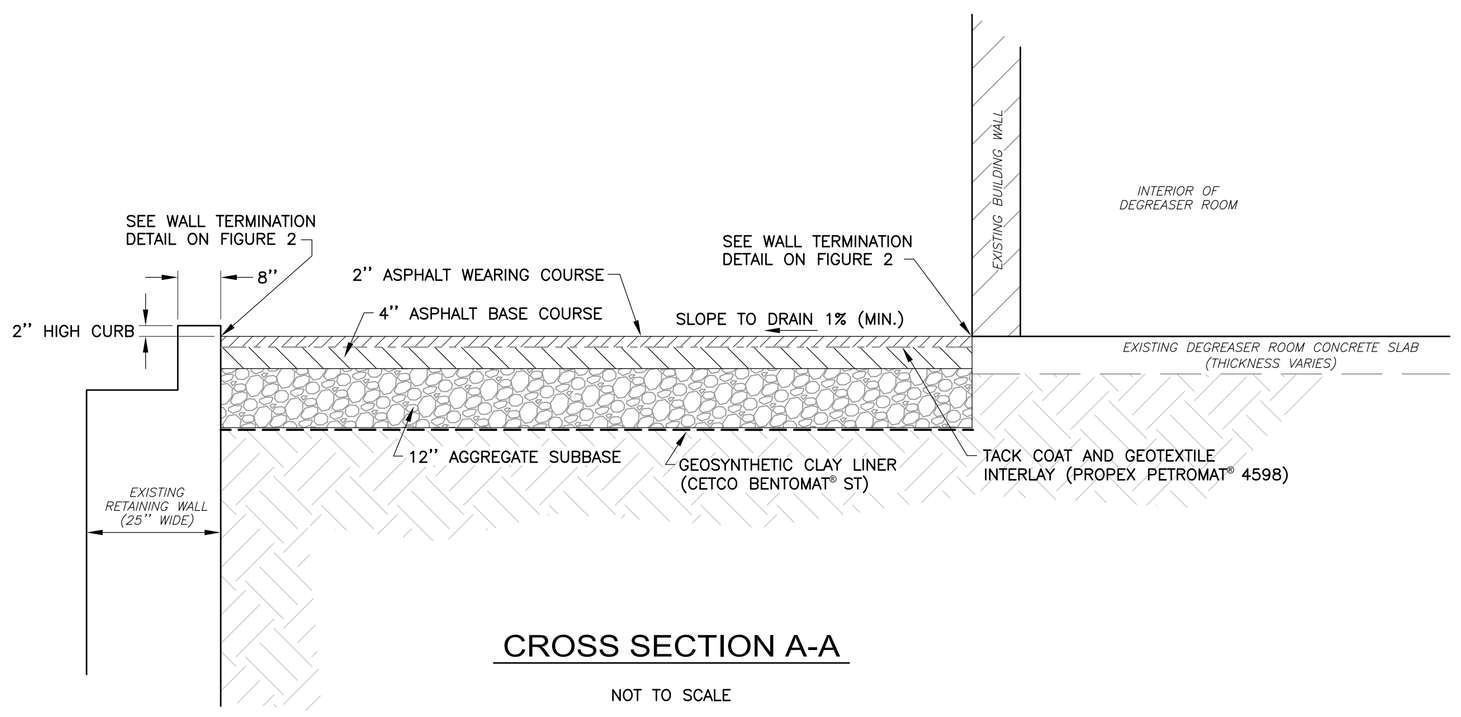
2. ASPHALT BASE COURSE SHALL BE 25 mm SUPERPAVE MIX. ASPHALT WEARING COURSE SHALL BE 12.5 mm SUPERPAVE MIX. AGGREGATE SUBBASE SHALL BE NYSDOT TYPE 4. ASPHALT AND SUBBASE MATERIALS AND WORKMANSHIP SHALL CONFORM TO NYSDOT STANDARD CONSTRUCTION SPECIFICATIONS.

3. GEOSYNTHETIC CLAY LINER (GCL) SHALL BE CETCO BENTOMAT® ST (OR APPROVED EQUIVALENT). INSTALLATION SHALL BE IN ACCORDANCE WITH CETCO'S STANDARD INSTALLATION GUIDELINES.

4. ADDITIONAL UTILITIES MAY BE ABANDONED IF CONFIRMED BY PLANT PERSONNEL TO BE PERMANENTLY OUT OF SERVICE. FIRE HYDRANTS, BOLLARDS, DOORS, LADDERS, RETAINING WALLS, FOUNDATIONS, MONITORING WELLS, FENCES, CONCRETE SLABS, GUIDE RAILS, AND OTHER UTILITIES DESIGNATED TO REMAIN SHALL BE PROTECTED THROUGHOUT THE WORK.

5. THE LIMITS OF THE CONCRETE CAP MAY BE EXPANDED BASED ON THE INSPECTED CONDITION OF THE EXISTING CONCRETE SLABS.

6. SOIL BORING SB-1F IS BEYOND THE LIMITS OF THIS FIGURE.



CROSS SECTION A-A

NOT TO SCALE

D

THE ORIGINAL VERSION OF THIS DRAWING IS IN COLOR. BLACK & WHITE REPRODUCTION MAY NOT ACCURATELY DEPICT CERTAIN INFORMATION.

REVISIONS

REV	DESCRIPTION	Revised:	Chkd:	Appr.:
1				
2				
3				

SEAL

DATE

DRAWN BY RAE 10/19/2011

CHECKED SAR 10/20/2011

APPROVED KDS 10/20/2011

AOC 1 CAPPING PLAN

EMERSON POWER TRANSMISSION
ITHACA, NEW YORK

PREPARED FOR
EMERSON
ST. LOUIS, MISSOURI

WSP Engineering of New York, P.C.
750 Holiday Drive, Suite 410
Pittsburgh, Pennsylvania 15220
(412) 604-1040
www.wspenvironmental.com/usa

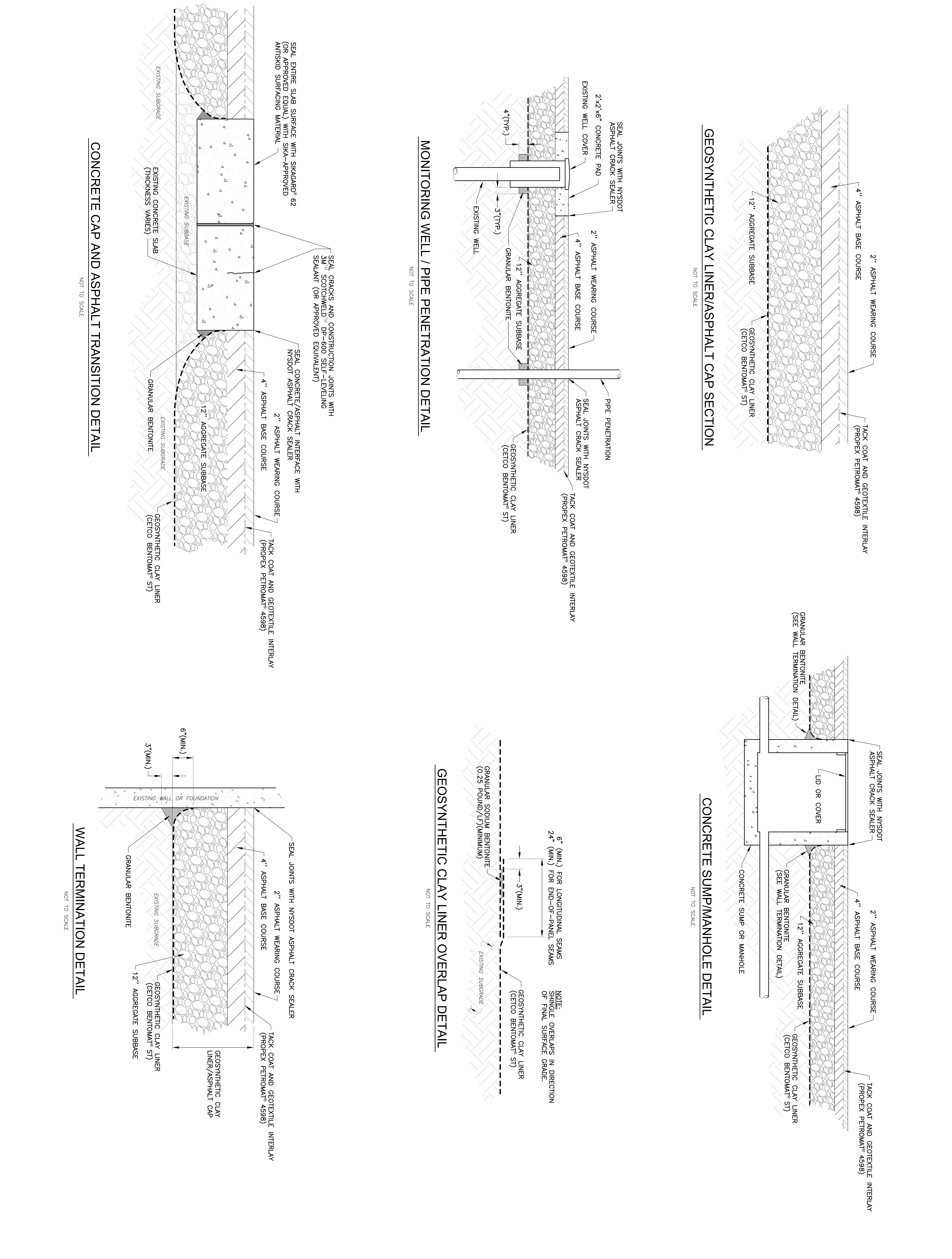
FIGURE 2

Drawing Number
00004507–D04

R:\Acad\CADD\00004\00004507-Ithaca_NY\CAD\00004507-D05.dwg, 10/26/2011 8:11:15 AM, usrz01165

D

THE ORIGINAL VERSION OF THIS DRAWING IS IN COLOR. BLACK & WHITE REPRODUCTION MAY NOT ACCURATELY DEPICT CERTAIN INFORMATION.



DRAWN BY	RZ 08152011
CHECKED	SAR 10252011
APPROVED	KDS 10262011

PROPERTY OF WSP ENGINEERING OF NEW YORK, P.C. IMPORTANT: THIS DRAWING PRINT IS LOANED FOR MUTUAL ASSISTANCE AND AS SUCH IS SUBJECT TO RECALL AT ANY TIME. INFORMATION CONTAINED HEREON IS NOT TO BE DISCLOSED OR REPRODUCED IN ANY FORM FOR THE BENEFIT OF PARTIES OTHER THAN NECESSARY SUBCONTRACTORS AND SUPPLIERS WITHOUT THE WRITTEN CONSENT OF WSP ENGINEERING OF NEW YORK, P.C.

NOTICE: THIS DRAWING HAS BEEN PREPARED UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER, IT IS A VIOLATION OF STATE LAW FOR ANY PERSONS, UNLESS ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER, TO ALTER THIS DOCUMENT IN ANY WAY.

SEAL

DATE

AOC 1 CAPPING DETAILS

EMERSON POWER TRANSMISSION
ITHACA, NEW YORK
PREPARED FOR
EMERSON
ST. LOUIS, MISSOURI

WSP Engineering of New York, P.C.
750 Holiday Drive, Suite 410
Pittsburgh, Pennsylvania 15220
(412) 604-1040
www.wspenvironmental.com/usa

FIGURE 3

Drawing Number
00004507-D05

REVISIONS

REV	DESCRIPTION		
1	Revised:	Chkd:	Appr.:
2	Revised:	Chkd:	Appr.:
3	Revised:	Chkd:	Appr.:

Tables

Table 1

Soil Sample Results for AOC-1
Emerson Power Transmission Facility
Ithaca, New York

Sample ID:	NYSDEC Subpart 375-6 - Industrial	NYSDEC Subpart 375-6 - Protection of Groundwater	SB-1a	SB-1b	SB-1c	SB-1d	SB-1e	SB-1e (b)	SB-1F	SB-1F (b)
Sampling Date:			**08/21/07**	**08/21/07**	**08/21/07**	**08/21/07**	**06/03/08**	**06/03/08**	**06/03/08**	**06/03/08**
Depth (feet):			**8-10**	**12-13.3**	**8-9**	**11-12**	**8-10**	**10-12**	**8-10**	**12-12.6**
VOCs (µg/kg)										
Acetone	1,000,000	50	30 U	25 U	11 J	710 U	**120**	**77**	**92**	**140**
Carbon disulfide	NT	NT	2 J	1 J	2 J	150	5.6 U	5.2 U	5.5 U	5.7 U
cis-1,2-Dichloroethylene	1,000,000	250	6 U	2 J	5 U	130 J	5.6 U	12 U	5.5 U	11
Isopropyl Benzene	NT	NT	6 U	5 U	5 U	140 U	5.6 U	5.2 U	5.5 U	5.7 U
Methyl Acetate	NT	NT	6 U	5 U	5 U	210	5.6 U	12 U	5.5 U	5.7 U
Methylene chloride	1,000,000	50	27	23	11	**170**	11 U	12 U	9.3 U	8 U
Tetrachloroethene	300,000	1,300	1 J	2 J	2 J	140 U	5.6 U	12 U	5.5 U	5.7 U
Toluene	1,000,000	700	6 U	5 U	5 U	140 U	5.6 U	7.1	180	7.7
Trichloroethene	400,000	470	12	28	6	73 J	5.6 U	5.2 U	5.5 U	9.2
Vinyl chloride	27,000	20	12 U	10 U	10 U	**290**	11 U	10 U	11 U	11 U
Hydrocarbons (mg/kg)										
Fuel oil no. 2	NT	NT	NA	NA	NA	NA	NA	120 U	NA	12 U
Other-1	NT	NT	NA	NA	NA	NA	NA	120 U	NA	12 U
TPH (Motor Oil Range)	NT	NT	NA	NA	NA	NA	NA	2,800	NA	680

a/ NA - not analyzed J - estimated value
NT - no standard U - not detected
b/ A petroleum odor and oily sheen were noted on the soils during installation of the boring
c/ SB-15 was re-named MW-15 following well installation
SB-15a was re-named MW-15a following well installation
d/ Only product samples (product saturated soils) were collected and analyzed from these borings.

Note: **Bold** values exceed a New York State Subpart 375-6 criteria

Table 1

Soil Sample Results for AOC-1
Emerson Power Transmission Facility
Ithaca, New York

Sample ID:	NYSDEC Subpart 375-6 - Industrial	NYSDEC Subpart 375-6 - Protection of Groundwater	SB-15	SB-15 (c,d)	SB-15a	SB-15a (c,d)	SB-15b	SB-15c
Sampling Date:			**06/05/08**	**06/05/08**	**06/03/08**	**06/04/08**	**06/04/08**	**06/09/08**
Depth (feet):			**12-14**	**24-25.4**	**10-12**	**22-22.4**	**16-18**	**12-14**
VOCs (µg/kg)								
Acetone	1,000,000	50	**310**	**54**	**52**	**79**	**74**	41
Carbon disulfide	NT	NT	5.7 U	5.4 U	5.8 U	10 U	5.8 U	5.6 U
cis-1,2-Dichloroethylene	1,000,000	250	5.7 U	5.4 U	5.8 U	42	5.8 U	5.6 U
Isopropyl Benzene	NT	NT	5.7 U	5.4 U	5.8 U	38	5.8 U	5.6 U
Methyl Acetate	NT	NT	5.7 U	5.4 U	5.8 U	10 U	5.8 U	5.6 U
Methylene chloride	1,000,000	50	22	7	8.8 U	10 U	9.2 U	6.6
Tetrachloroethene	300,000	1,300	5.7 U	5.4 U	5.8 U	10 U	5.8 U	5.6 U
Toluene	1,000,000	700	5.7 U	5.4 U	5.8 U	7.5 U	5.8 U	5.6 U
Trichloroethene	400,000	470	7	5.4 U	8.2	13	5.8 U	5.6 U
Vinyl chloride	27,000	20	11 U	11 U	12 U	**21**	12 U	11 U
Hydrocarbons (mg/kg)								
Fuel oil no. 2	NT	NT	NA	580 U	NA	590 U	NA	NA
Other-1	NT	NT	NA	1,300	NA	590 U	NA	NA
TPH (Motor Oil Range)	NT	NT	NA	5,700	NA	13,000	NA	NA

a/ NA - not analyzed J - estimated value
NT - no standard U - not detected
b/ A petroleum odor and oily sheen were noted on the soils during insta
c/ SB-15 was re-named MW-15 following well installation
SB-15a was re-named MW-15a following well installation
d/ Only product samples (product saturated soils) were collected and ar

Note: **Bold** values exceed a New York State Subpart 375-6 criteria

Appendix A – CETCO Bentomat® ST Product Information

TECHNICAL REFERENCE 401-BMST

BENTOMAT® ST
CERTIFIED PROPERTIES

MATERIAL PROPERTY	TEST METHOD	TEST FREQUENCY	REQUIRED VALUES
Bentonite Swell Index[1]	ASTM D 5890	1 per 50 tonnes	24 mL/2g min.
Bentonite Fluid Loss[1]	ASTM D 5891	1 per 50 tonnes	18 mL/2g min.
Bentonite Mass/Area[2]	ASTM D 5993	40,000 ft^2 (4,000 m^2)	0.75 lb/ft^2 (3.6 kg/m^2) min.
GCL Tensile Strength[3]	ASTM D 6768	200,000 ft^2 (20,000 m^2)	30 lb/in (53 N/cm) MARV
GCL Peel Strength[3]	ASTM D 6496	40,000 ft^2 (4,000 m^2)	3.5 lbs/in (6.1 N/cm) min.
GCL Index Flux[4]	ASTM D 5887	Weekly	1 X 10^{-8} m^3/m^2/sec max.
GCL Hydraulic Conductivity[4]	ASTM D 5887	Weekly	5 X 10^{-9} cm/sec max.
GCL Hydrated Internal Shear Strength[5]	ASTM D 5321 ASTM D 6243	Periodic	500 psf (24 kPa) typical @200 psf

Bentomat ST is a reinforced GCL consisting of a layer of sodium bentonite between a woven and a nonwoven geotextiles, which are needlepunched together.

Notes

1 Bentonite property tests performed at a bentonite processing facility before shipment to CETCO GCL production facilities.

2 Bentonite mass/area reported at 0 percent moisture content.

3 All tensile strength testing is performed in the machine direction using ASTM D 6768. All peel strength testing is performed using ASTM D 6496. Upon request, tensile and peel results can be reported per modified ASTM D 4632 using 4 inch grips.

4 Index flux and permeability testing with deaired distilled/deionized water at 80 psi (551kPa) cell pressure, 77 psi (531 kPa) headwater pressure and 75 psi (517 kPa) tailwater pressure. Reported value is equivalent to 925 gal/acre/day. Actual flux values vary with field condition pressures. The last 20 weekly values prior the end of the production date of the supplied GCL may be provided.

5 Peak value measured at 200 psf (10 kPa) normal stress for a specimen hydrated for 48 hours. Site-specific materials, GCL products, and test conditions must be used to verify internal and interface strength of the proposed design.

CETCO has developed an edge enhancement system that eliminates the need to use additional granular sodium bentonite within the overlap area of the seams. We call this edge enhancement, SUPERGROOVE™, and it comes standard on both longitudinal edges of BENTOMAT® ST. It should be noted that SUPERGROOVE™ does not appear on the end-of-roll overlaps and recommend the continued use of supplemental bentonite for all end-of-roll seams.

LAST UPDATED MAY 2007

IMPORTANT: The information contained herein supersedes all previous printed versions, and is believed to be accurate and reliable. For the most up-to-date information, please visit www.CETCO.com. CETCO accepts no responsibility for the results obtained throught application of this product. CETCO reserves the right to update information without notice.

CETCO®
www.CETCO.com
2870 Forbs Avenue Hoffman Estates, IL 60192
847.851.1800 | 800.527.9948

BENTOMAT® INSTALLATION GUIDELINES

GEOSYNTHETIC CLAY LINERS

CETCO®

BENTOMAT®

GEOSYNTHETIC CLAY LINERS

CONTENTS

NOTICE: THIS DOCUMENT IS INTENDED FOR USE AS A GENERAL GUIDELINE FOR THE INSTALLATION OF CETCO GCLS. THE INFORMATION AND DATA CONTAINED HEREIN ARE BELIEVED TO BE ACCURATE AND RELIABLE. CETCO MAKES NO WARRANTY OF ANY KIND AND ACCEPTS NO RESPONSIBILITY FOR THE RESULTS OBTAINED THROUGH APPLICATION OF THIS INFORMATION. INSTALLATION GUIDELINES ARE SUBJECT TO PERIODIC CHANGES. PLEASE CONSULT OUR WEBSITE @ WWW.CETCO.COM/LT FOR THE MOST RECENT VERSION.

2870 Forbs Avenue Hoffman Estates, IL 60192
847.851.1800 | 800.527.9948

SECTION 1
INTRODUCTION

1.1
This document provides procedures for the installation of CETCO GCLs in a manner that maximizes safety, efficiency, and the physical integrity of the GCL.

1.2
These guidelines are based upon many years of experience at a variety of sites and should be generally applicable to any type of lining project using CETCO GCLs. Variance from these guidelines is at the engineer's discretion.

1.3
The performance of the GCL is wholly dependent on the quality of its installation. It is the installer's responsibility to adhere to these guidelines, and to the project specifications and drawings as closely as possible. It is the engineer's and owner's responsibility to provide construction quality assurance (CQA) for the installation. This will ensure that the installation has been executed properly. This document covers only installation procedures.

1.4
For additional guidance, refer to ASTM D5888 (Standard Guide For Storage and Handling of Geosynthetic Clay Liners) and ASTM D 6102 (Standard Guide For Installation of Geosynthetic Clay Liners).

SECTION 2
EQUIPMENT REQUIREMENTS

2.1
CETCO GCLs are delivered in rolls typically 2,600-2,950 lbs (1180-1340 kg). Roll dimensions and weights will vary with the dimensions of the product ordered. It is necessary to support this weight using an appropriate core pipe, as indicated in Table 1. For any installation, the core pipe must not deflect more than 3 inches (75 mm), as measured from end to midpoint when a full GCL roll is lifted.

2.2
Lifting chains or straps appropriately rated should be used in combination with a spreader bar made from an I-beam, as shown in Figure 1.

2.3
The spreader bar ensures that lifting chains or straps do not chafe against the ends of the GCL roll, allowing it to rotate freely during installation. Spreader bar and core pipe kits are available through CETCO.

2.4
A front end loader, backhoe, dozer, or other equipment can be utilized with the spreader bar and core pipe or slings. Alternatively, a forklift with a "stinger" attachment may be used for on-site handling. A forklift without a stinger attachment should not be used to lift or handle the GCL rolls. Stinger attachments (Figures 2-4) are specially fabricated to fit various forklift makes and models.

Table 1: Core Requirements

Product	Nominal GCL Roll Size Lenth X Diameter	Typical GCL Roll Weight	Interior Core Size	Core Pipe Length x Diameter	Minimum Core Pipe Strength
BENTOMAT DN, SDN	16' x 24" (4.9 m x 610 mm)	2,650 lbs. (1204 kg)	3 3/4" (100 mm)	20' x 3.5" O.D. (6.1 m x 89 mm)	XXH
BENTOMAT ST	16' x 24" (4.9 m x 610 mm)	2,650 lbs. (1204 kg)	3 3/4" (100 mm)	20' x 3.5" O.D. (6.1 m x 89 mm)	XXH
BENTOMAT STM	16' x 32" (4.9 m x 814 mm)	2,500 lbs. (1130 kg)	3 3/4" (100 mm)	20' x 3.5" O.D. (6.1 m x 89 mm)	XXH
BENTOMAT 200R	16' x 24" (4.9 m x 610 mm)	2,650 lbs. (1204 kg)	3 3/4" (100 mm)	20' x 3.5" O.D. (6.1 m x 89 mm)	XXH
BENTOMAT CLT	16' x 26" (4.9 m x 660 mm)	2,650 lbs. (1204 kg)	3 3/4" (100 mm)	20' x 3.5" O.D. (6.1 m x 89 mm)	XXH
BENTOMAT CL	16' x 25" (4.9 m x 635 mm)	2,650 lbs. (1204 kg)	3 3/4" (100 mm)	20' x 3.5" O.D. (6.1 m x 89 mm)	XXH
BENTOMAT 600 CL	16' x 25" (4.9 m x 635 mm)	2,700 lbs. (1227 kg)	3 3/4" (100 mm)	20' x 3.5" O.D. (6.1 m x 89 mm)	XXH

BENTOMAT®

GEOSYNTHETIC CLAY LINERS

FIGURE 1 -SPREADER BAR ASSEMBLY

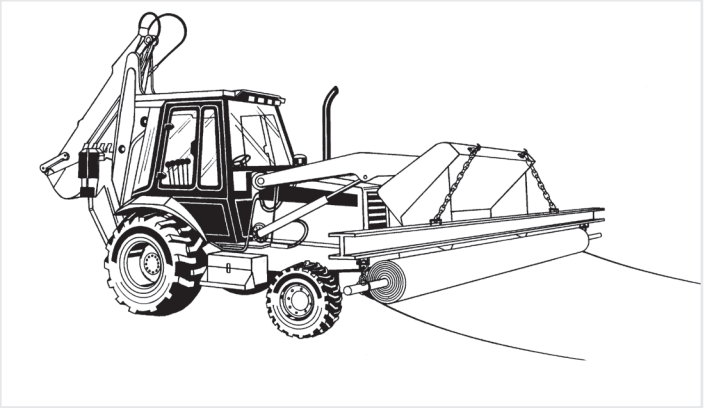


FIGURE 2 - HOOK MOUNT

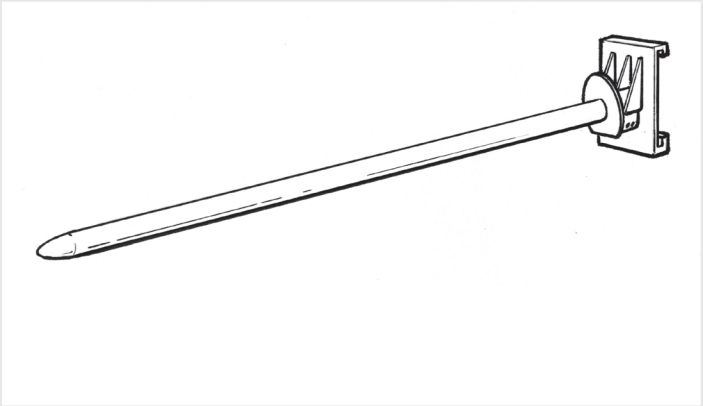


FIGURE 3 - FORK MOUNT (WITH FORK POCKETS)

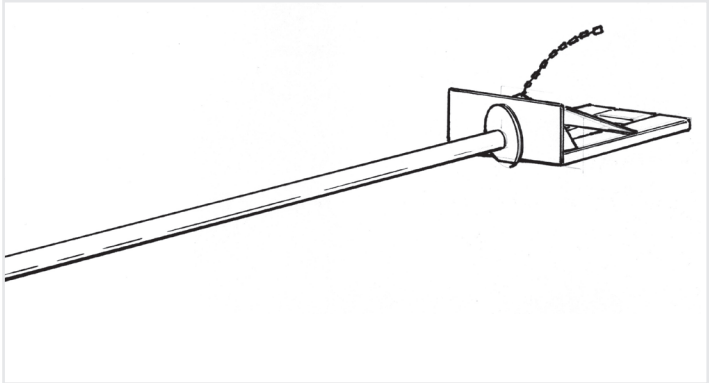
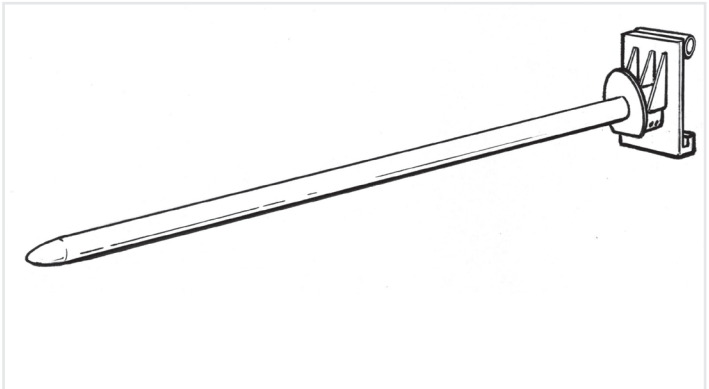


FIGURE 4 - PIN MOUNT



2.5

When installing over certain geosynthetic materials, a 4 wheel, all-terrain vehicle (ATV) can be used to deploy the GCL. An ATV can be driven directly on the GCL provided that no sudden stops, starts, or turns are made.

2.6

Additional equipment needed for installation of CETCO GCLs includes:

- ► Utility knife and spare blades (for cutting the GCL)
- ► Granular bentonite for end-of-roll GCL seams and for sealing around structures and details
- ► Waterproof tarpaulins (for temporary cover on installed material as well as for stockpiled rolls)
- ► Optional flat-bladed vise grips (for positioning the GCL panel by hand)

2.7

The CETCO EASY ROLLER™ GCL Deployment System is a preferred method of installing geosynthetic clay liners. Use of the EASY ROLLER system eliminates the need for spreader bars and heavy core pipes. Installation speed and worker safety are also significantly increased. For further details, contact CETCO.

SECTION 3
SHIPPING, UNLOADING, & STORAGE

3.1
All lot and roll numbers should be recorded and compared to the packing list. Each roll of GCL should also be visually inspected during unloading to determine if any packaging has been damaged. Damage, whether obvious or suspected, should be recorded and the affected rolls marked.

3.2
Major damage suspected to have occurred during transit should be reported to the carrier and to CETCO immediately. The nature of the damage should also be indicated on the bill of lading, with specific lot and roll numbers noted. Accumulation of some moisture within roll packaging is normal and does not damage the product.

3.3
The party directly responsible for unloading the GCL should refer to this manual prior to shipment to ascertain the appropriateness of their unloading equipment and procedures. Unloading and on-site handling of the GCL should be supervised.

3.4
In most cases, CETCO GCLs are delivered on flatbed trucks. There are three methods of unloading: core pipe and spreader bar, slings, or stinger bar. To unload the rolls from the flat-bed using a core pipe and spreader bar, first insert the core pipe through the core tube. Secure the lifting chains or straps to each end of the core pipe and to the spreader bar mounted on the lifting equipment. Hoist the roll straight up and make sure its weight is evenly distributed so that it does not tilt or sway when lifted.

3.5
All CETCO GCLs are delivered with two 2'x 12' (50 mm x 3.65 mm) Type V polyester endless slings on each roll. Before lifting, check the position of the slings. Each sling should be tied off in the choke position, approximately one third (1/3) from the end of the roll. Hoist the roll straight up so that it does not tilt or sway when lifted.

3.6
In some cases, GCL rolls will be stacked in three pyramids on flatbed trucks. If slings are not used, rolls will require unloading with a stinger bar and extendible boom fork lift. Spreader bars will not work in this situation because of the limited access between the stacks of GCL. Three types of stingers are available from CETCO, a hook mount, fork mount and pin mount (Figures 2-4). To unload, guide the stinger through the core tube before lifting the GCL roll and removing the truck.

3.7
An extendable boom fork lift with a stinger bar is required for unloading vans. Rolls in the nose and center of the van should first be carefully pulled toward the door using the slings provided on the rolls.

3.8
Rolls should be stored at the job site away from high-traffic areas but sufficiently close to the active work area to minimize handling. The designated storage area should be flat, dry, and stable. Moisture protection of the GCL is provided by its packaging; however, based on expected weather conditions, an additional tarpaulin or plastic sheet may be required for added protection during prolonged outdoor storage.

3.9
Rolls should be stacked in a manner that prevents them from sliding or rolling. This can be accomplished by chocking the bottom layer of rolls. Rolls should be stacked no higher than the height at which they can be safely handled by laborers (typically no higher than four layers of rolls). Rolls should never be stacked on end.

SECTION 4
SUBGRADE PREPARATION

4.1
Subgrade surfaces consisting of granular soils or gravels are not acceptable due to their large void fraction and puncture potential. In applications where the GCL is the only barrier, subgrade soils should have a particle-size distribution of at least 80 percent finer than the #60 sieve (0.25 mm). In other applications, subgrade soils should range between fines and 1 inch (25 mm). In high-head applications (greater than 1 foot or 30.48 cm), CETCO recommends a membrane-laminated GCL (BENTOMAT CLT, BENTOMAT CL, or BENTOMAT 600 CL).

4.2
When the GCL is placed over an earthen subgrade, the subgrade surface must be prepared in accordance with the project specifications. The engineer's approval of the subgrade must be obtained prior to installation. The finished surface should be firm and unyielding, without abrupt elevation changes, voids, cracks, ice, or standing water.

BENTOMAT®

GEOSYNTHETIC CLAY LINERS

4.3

The subgrade surface must be smooth and free of vegetation, sharp-edged rocks, stones, sticks, construction debris, and other foreign matter that could contact the GCL. The subgrade should be rolled with a smooth-drum compactor to remove any wheel ruts greater than 1 inch in depth, footprints, or other abrupt grade changes. Furthermore, all protrusions extending more than 0.5 inch (12 mm) from the subgrade surface shall be removed, crushed, or pushed into the surface with a smooth-drum compactor. The GCL may be installed on a frozen subgrade, but the subgrade soil in the unfrozen state should meet the above requirements.

SECTION 5
INSTALLATION

5.1

GCL rolls should be taken to the work area of the site in their original packaging. The orientation of the GCL (i.e., which side faces up) may be important if the GCL has two different types of geosynthetics. Check with the project engineer to determine if there is a preferred installation orientation for the GCL. If no specific orientation is required, allow the roll to unwind from the bottom rather than pulling from the top (Figure 5A). The arrow sticker on the plastic sleeve indicates the direction that the GCL will naturally unroll when placed on the ground (Figure 6). Prior to deployment, the packaging should be carefully removed without damaging the GCL.

5.2

Equipment which could damage the GCL should not be allowed to travel directly on it. Therefore, acceptable installation may be accomplished whereby the GCL is unrolled in front of backwards-moving equipment (Figure 7). If the installation equipment causes rutting of the subgrade, the subgrade must be restored to its originally accepted condition before placement continues.

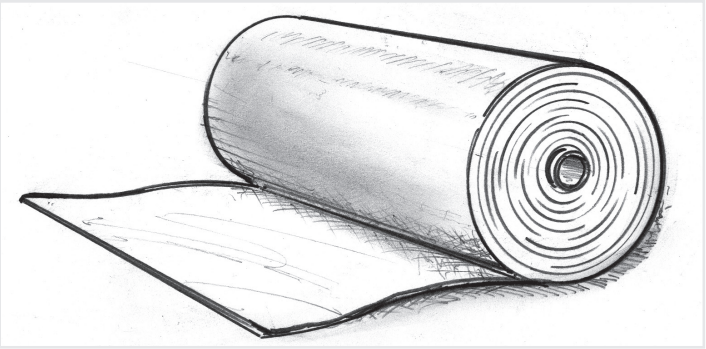
5.3

If sufficient access is available, GCL may be deployed by suspending the roll at the top of the slope, with a group of laborers pulling the material off of the roll, and down the slope (Figure 8).

5.4

GCL rolls should not be released on the slope and allowed to unroll freely by gravity.

FIGURE 5 A & B
"NATURAL' ORIENTATION (5A)



TOP OF THE ROLL (5B)

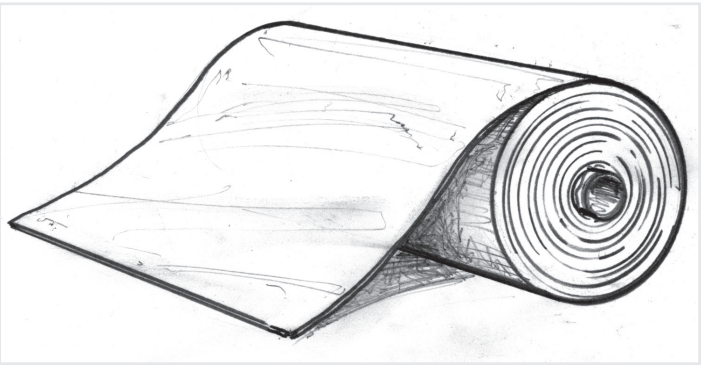
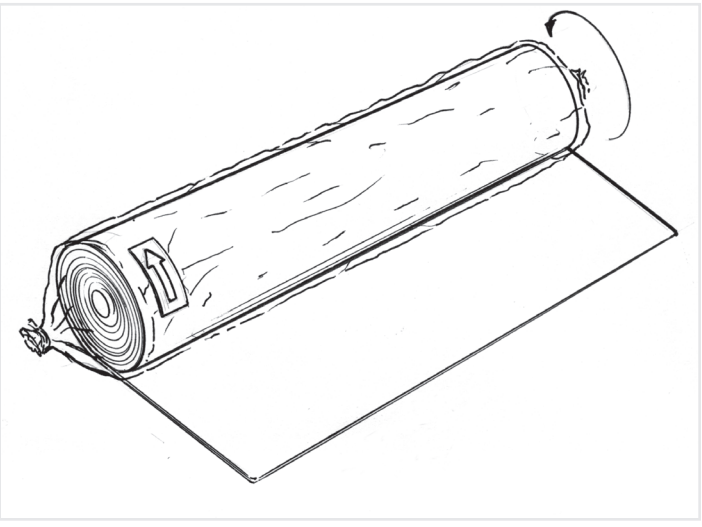


FIGURE 6 - DIRECTION TO UNROLL GCL ON GROUND PER FIGURE 5A



2870 Forbs Avenue Hoffman Estates, IL 60192
847.851.1800 | 800.527.9948

FIGURE 7 - TYPICAL BENTOMAT® INSTALLATION TECHNIQUE

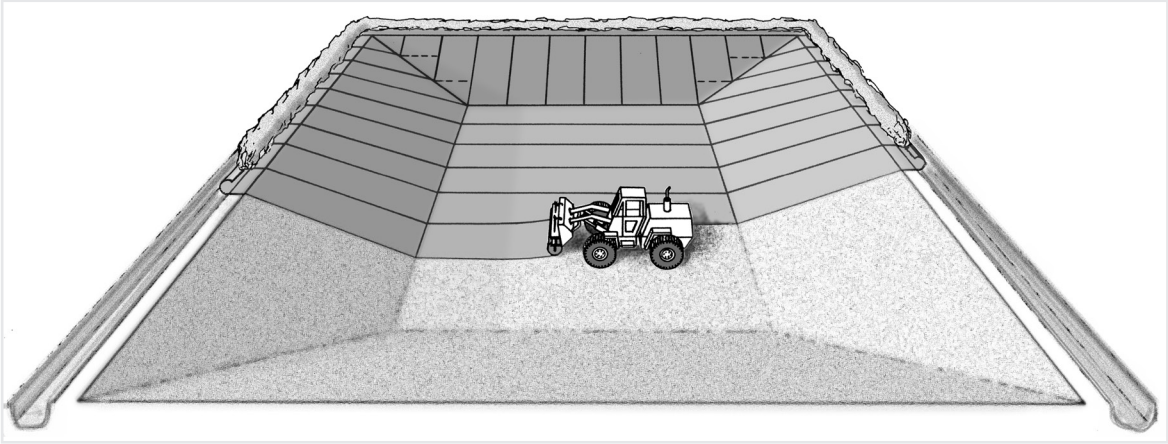
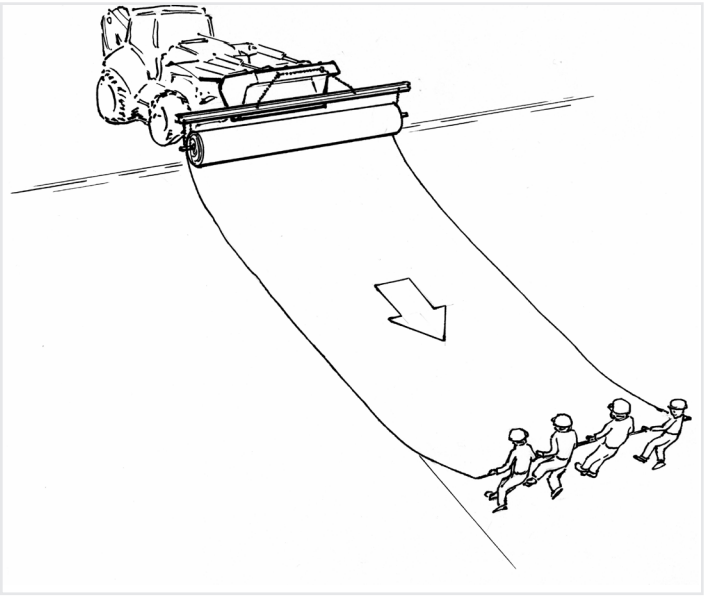


FIGURE 8 - UNROLLING BENTOMAT



5.5

Care must be taken to minimize the extent to which the GCL is dragged across the subgrade to avoid damage to the bottom surface of the GCL. Care must also be taken when adjusting BENTOMAT CLT panels to avoid damage to the geotextile surface of one panel of GCL by the textured sheet of another panel of GCL. A temporary geosynthetic subgrade cover commonly known as a slip sheet or rub sheet may be used to reduce friction damage during placement.

5.6

The GCL should be placed so that seams are parallel to the direction of the slope. End-of-panel seams should also be located at least 3 ft (1 m) from the toe and crest of slopes steeper than 4H:1V. End-of-roll seams on slopes should be used only if the liner is not expected to be in tension.

5.7

All GCL panels should lie flat, with no wrinkles or folds, especially at the exposed edges of the panels. When BENTOMAT geosynthetic clay liners with SUPERGROOVE® is repositioned, it should be gripped inside the SUPERGROOVE by folding the edge.

5.8

The GCL should not be installed in standing water or during rainy weather. Only as much GCL shall be deployed as can be covered at the end of the working day with soil, geomembrane, or a temporary waterproof tarpaulin. The GCL shall not be left uncovered overnight. If the GCL is hydrated when no confining stress is present, it may be necessary to remove and replace the hydrated material. CETCO recommends that premature hydration be evaluated on a case-by-case basis. The project engineer, CQA inspector, and CETCO TR-312 should be consulted for specific guidance if premature hydration occurs. The type of GCL, duration of exposure, degree of hydration, location in the liner system, and expected bearing loads should all be considered.

BENTOMAT®

GEOSYNTHETIC CLAY LINERS

In many instances, a needlepunch reinforced GCL may not require removal/replacement if the following are true:

- The geotextiles have not been separated, torn, or otherwise damaged
- There is no evidence that the needlepunching between the two geotextiles has been compromised
- The GCL does not leave deep indentations when stepped upon
- Overlapped seams with bentonite enhancement (see Section 7) are intact

5.9

For the convenience of the installer, hash marks are placed on BENTOMAT goesynthetic clay liners every 5' (1.5 m) of length.

SECTION 6
ANCHORAGE

6.1

If required by the project drawings, the end of the GCL roll should be placed in an anchor trench at the top of a slope. The front edge of the trench should be rounded to eliminate any sharp corners that could cause excessive stress on the GCL. Loose soil should be removed or compacted into the floor of the trench.

6.2

If a trench is used for anchoring the end of the GCL, soil backfill should be placed in the trench to provide resistance against pullout. The size and shape of the trench, as well as the appropriate backfill procedures should be in accordance with the project drawings and specifications. Typical dimensions are shown in Figure 9.

6.3

The GCL should be placed in the anchor trench such that it covers the entire trench floor but does not extend up the rear trench wall.

6.4

Sufficient anchorage may alternately be obtained by extending the end of the GCL roll back from the crest of the slope, and placing cover soil. The length of this "runout" anchor should be prepared in accordance with project drawings and specifications.

SECTION 7
SEAMING

7.1

GCL seams are constructed by overlapping adjacent panel edges and ends. Care should be taken to ensure that the overlap zone is not contaminated with loose soil or other debris. BENTOMAT 200R, BENTOMAT ST, BENTOMAT DN, and BENTOMAT SDN have SUPERGROOVE® which provides self-seaming capabilities in their longitudinal overlaps, and therefore do not require supplemental bentonite. However, for pond applications, supplemental bentonite must be used in longitudinal seams, regardless of the CETCO GCL.

FIGURE 9 - TYPICAL ANCHOR TRENCH DESIGN

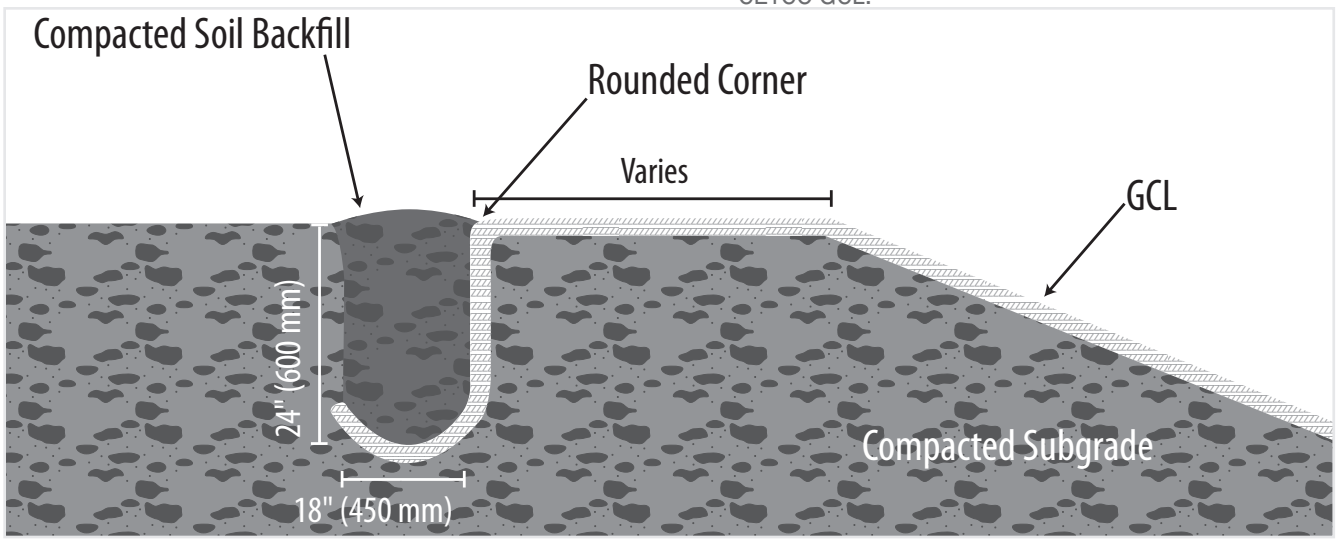
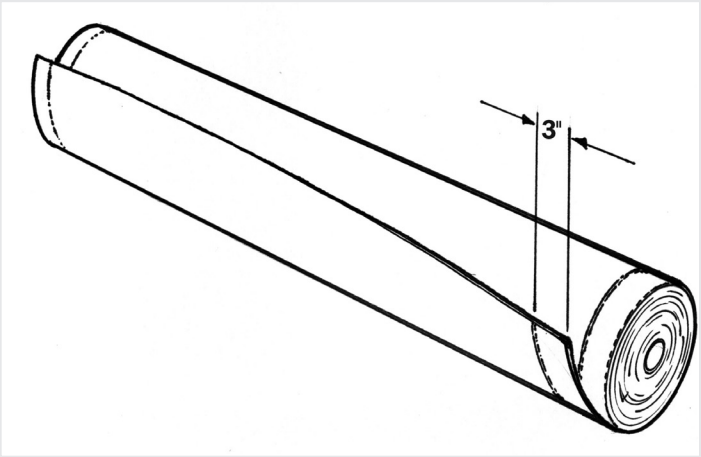


FIGURE 10 - SUPERGROOVE®



7.2

Longitudinal seams should be overlapped a minimum of 6 inches (150 mm) for BENTOMAT geosynthetic clay liners. For high-head applications (greater than 1 foot or 20.48 cm) involving BENTOMAT CL, BENTOMAT CLT, or BENTOMAT 600 CL, a minimum longitudinal seam overlap of 12 inches (300 mm) and supplemental bentonite (per Section 7.6) is recommended.

7.3

End-of-panel overlapped seams should be overlapped 24 inches (600 mm) for BENTOMAT geosynthetic clay liners.

7.4

End-of-panel overlapped seams are constructed such that they are shingled in the direction of the grade to prevent runoff from entering the overlap zone. End-of-panel seams on slopes are permissible, provided adequate slope stability analysis has been conducted (i.e., the GCL is not expected to be in tension). Bentonite-enhanced seams are required for all BENTOMAT end-of-panel overlapped seams.

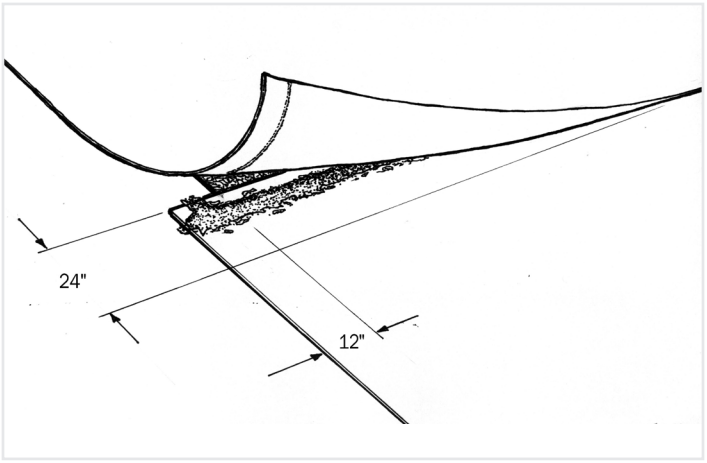
7.5

BENTOMAT end-of-panel, bentonite-enhanced, overlapped seams are constructed first by overlapping the adjacent panels, exposing the underlying panel, and then applying a continuous bead or fillet of granular sodium bentonite 12" from the edge of the underlying panel (Figure 11). The minimum application rate at which the bentonite is applied is one-quarter pound per linear foot (0.4 kg/m).

7.6

If longitudinal bentonite enhanced seams are required for BENTOMAT 200R, BENTOMAT ST, BENTOMAT DN, or BENTOMAT SDN, they are constructed by overlapping the adjacent panels a minimum 6 inches (150 mm), exposing the underlying edge, and applying a continuous bead of granular bentonite approximately 3 inches (75 mm) from the edge. For pond applications involving BENTOMAT CL or BENTOMAT CLT, longitudinal seams are constructed by overlapping adjacent panels by 12 inches (300 mm), exposing the underlying edge, and applying a continuous bead of bentonite approximately 6 inches (150 mm) from the edge. The minimum application rate for the granular bentonite is one quarter pound per linear foot (0.4 kg/m).

FIGURE 11
BENTOMAT END-OF-PANEL OVERLAPPED SEAM



SECTION 8
SEALING AROUND PENETRATIONS AND STRUCTURES

8.1

Cutting the GCL should be performed using a sharp utility knife. Frequent blade changes are recommended to avoid irregular tearing of the geotextile components of the GCL during the cutting process.

8.2

The GCL should be sealed around penetrations and structures embedded in the subgrade in accordance with Figures 12 through 14. Granular bentonite shall be used liberally (approximately 0.25 lbs/ln. ft. or 0.4 kg/m) to seal the GCL to these structures.

BENTOMAT®

GEOSYNTHETIC CLAY LINERS

FIGURE 12 A CROSS-SECTION OF A HORIZONTAL PIPE PENETRATION

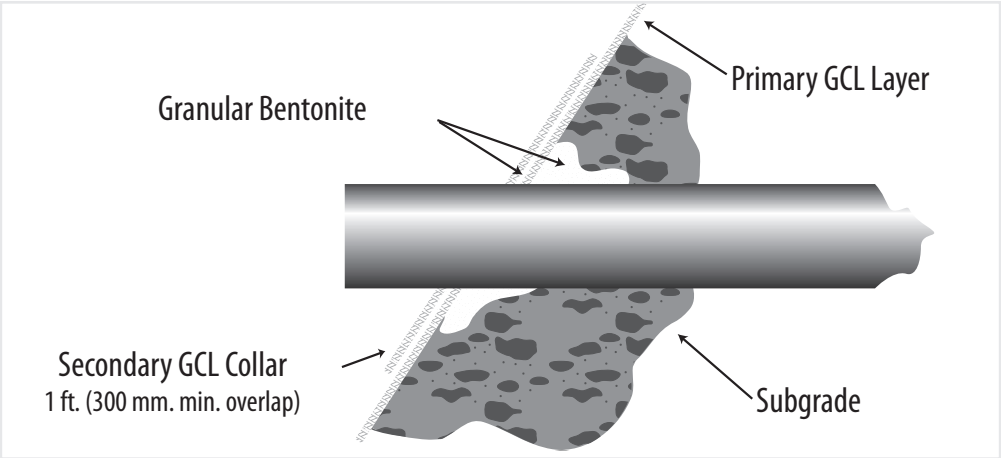


FIGURE 12 B ISOMETRIC VIEW OF A COMPLETED HORIZONTAL PIPE PENETRATION

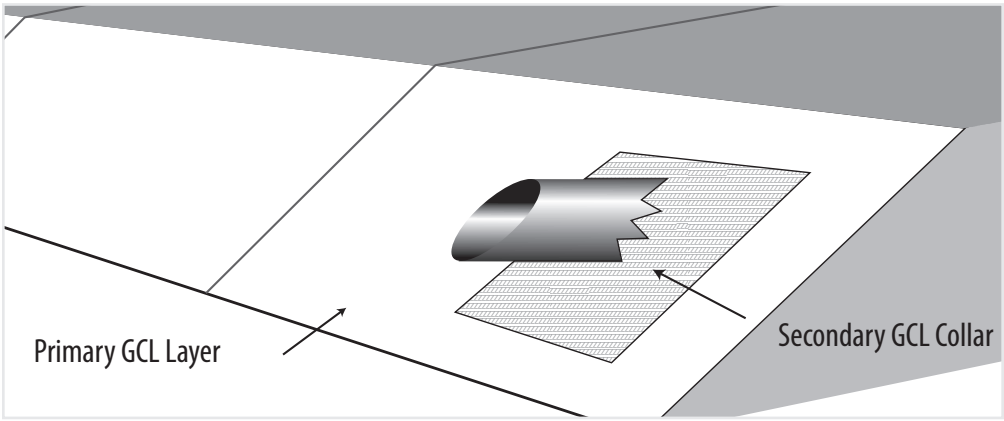


FIGURE 13 A CROSS-SECTION OF A VERTICAL PENETRATION

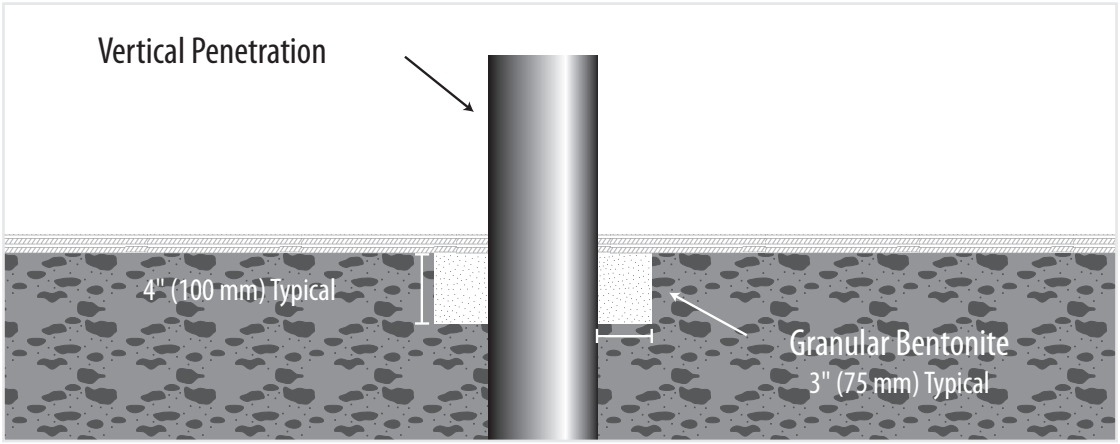


FIGURE 13B ISOMETRIC VIEW OF THE COMPLETED VERTICAL PENETRATION

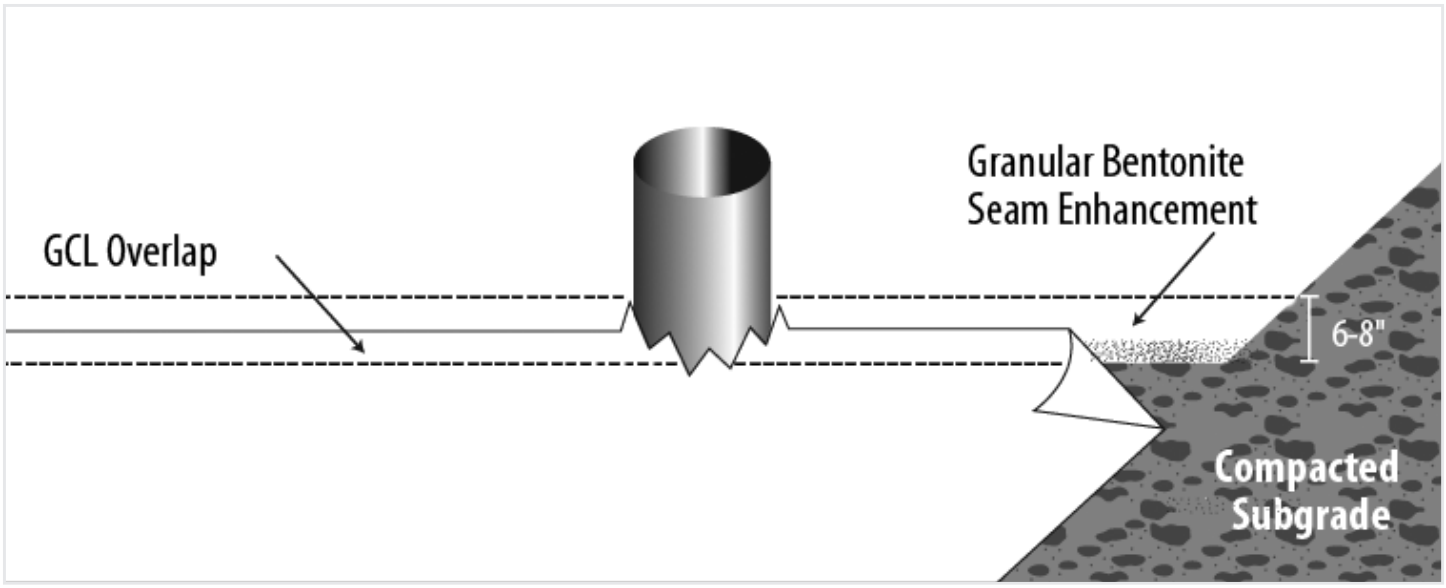
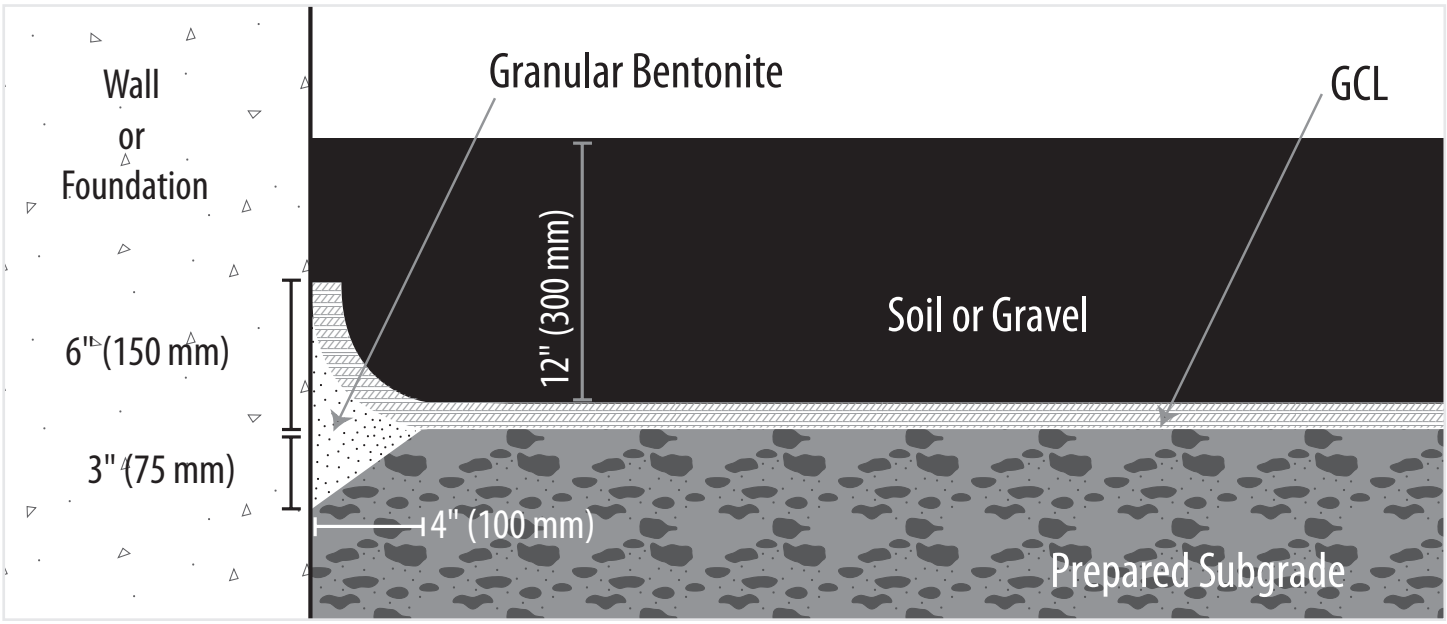


FIGURE 14 CROSS-SECTION OF GCL SEAL AGAINST AN EMBEDDED STRUCTURE OR WALL



BENTOMAT®

GEOSYNTHETIC CLAY LINERS

8.3
When the GCL is placed over a horizontal pipe penetration, a "notch" should be excavated into the subgrade around the penetration (Figure 12a). The notch should then be backfilled with granular bentonite. A secondary collar of GCL should be placed around the penetration, as shown in Figure 12b. It is helpful to first trace an outline of the penetration on the GCL and then cut a "star" pattern in the collar to enhance the collar's fit to the penetration. Granular bentonite should be applied between the primary GCL layer and the secondary GCL collar.

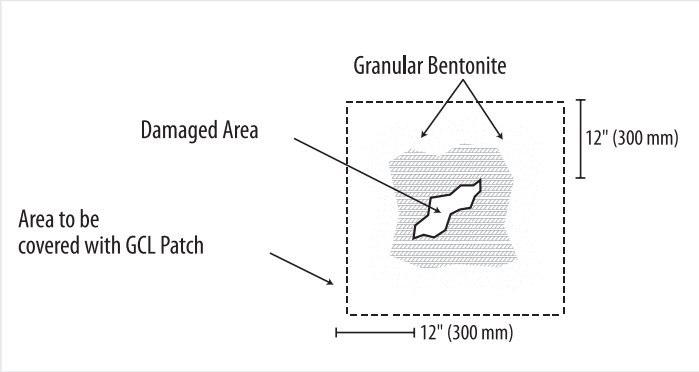
8.4
Vertical penetrations are prepared by notching into the subgrade as shown in Figure 13a. The penetration can be completed with two separate pieces of GCL as shown in Figure 13b. Alternatively, a secondary collar can be placed as shown in Figure 12a or 12b.

8.5
When the GCL is terminated at a structure or wall that is embedded into the subgrade on the floor of the containment area, the subgrade should be notched, as described in Sections 8.3 and 8.4. The notch is filled with granular bentonite; the GCL should be placed over the notch and up against the structure (Figure 14). Connection to the structure can be accomplished by placement of soil or stone backfill in this area. When structures or walls are at the top of a slope, additional detailing may be required. Contact CETCO for specific guidance.

SECTION 9
DAMAGE REPAIR

9.1
If the GCL is damaged (torn, punctured, perforated, etc.) during installation, it may be possible to repair it by cutting a patch to fit over the damaged area (Figure 15). The patch should be cut to size such that a minimum overlap of 12 inches (300 mm) is achieved around all parts of the damaged area. Granular bentonite should be applied around the damaged area prior to placement of the patch. It may be necessary to use an adhesive such as wood glue to affix the patch in place so that it is not displaced during cover placement. Smaller patches may be tucked under the damaged area to prevent patch movement.

FIGURE 15 DAMAGE REPAIR BY PATCHING



SECTION 10
COVER PLACEMENT

10.1
The final thickness of soil cover on the GCL varies with the application. A minimum cover layer must be at least 1 foot (300 mm) thick to provide confining stress to the GCL, eliminate the potential for seam separation and prevent damage by equipment, erosion, etc.

10.2
Cover soils should be free of angular stones or other foreign matter that could damage the GCL. Cover soils should be approved by the engineer with respect to particle size, uniformity, and chemical compatibility. Consult CETCO if cover soils have high concentrations of calcium (e.g. limestone, dolomite, gypsum, seashell fragments).

10.3
Recommended cover soils should have a particle size distribution ranging between fines and 1 inch (25 mm), unless a cushioning geotextile is specified.

10.4
Soil cover shall be placed over the GCL using construction equipment that minimizes stresses on the GCL. A minimum thickness of 1 foot (300 mm) of cover soil should be maintained between the equipment tires/tracks and the GCL at all times during the covering process. In high-traffic areas such as on roadways, a minimum thickness of 2 feet (600 mm) is required.

10.5
Soil cover should be placed in a manner that prevents the soil from entering the GCL overlap zones. Soil cover should be pushed up on slopes, not down slopes, to minimize tensile forces on the GCL.

10.6
When a textured geomembrane is installed over the GCL, a temporary geosynthetic covering known as a slip sheet or rub sheet should be used to minimize friction during placement and to allow the textured geomembranes to be more easily moved into its final position.

10.7
Cyclical wetting and drying of GCL covered only with geomembrane can cause overlap separation. Soil cover should be placed promptly whenever possible. Geomembranes should be covered with a white geotextile and/or operations layer without delay to minimize the intensity of wet-dry cycling. If there is the potential for unconfined cyclic wetting and drying over an extended period of time, the longitudinal seam overlaps should be increased based on the project engineer's recommendation.

10.8
To avoid seam separation, the GCL should not be put in excessive tension by the weight or movement of textured geomembrane on steep slopes. If there is the potential for unconfined geomembrane expansion and contraction over an extended period of time, the longitudinal seam overlaps should be increased based upon the project engineer's recommendation.

SECTION 11
HYDRATION

11.1
Hydration is usually accomplished by natural rainfall and/or absorption of moisture from soil. However, in cases where the containment of non-aqueous liquid is required, it may be necessary to hydrate the covered GCL with water prior to use.

11.2
If manual hydration is necessary, water can be introduced by flooding the covered lined area or using a sprinkler system. If flooding, care must be taken to diffuse the energy of the water discharge so that the cover material is not displaced.

11.3
If the GCL is hydrated when no confining stress is present, it may be necessary to remove and replace the hydrated material.

As discussed in Section 5.8, in many instances a needlepunch reinforced GCL may not require removal/replacement if the following are true:

- The geotextiles have not been separated, torn or otherwise damaged
- There is no evidence that the needlepunching between the two geotextiles has been compromised
- The GCL does not leave deep indentations when stepped upon
- Any overlapped seams with bentonite enhancement (see Section 7) are intact

2870 Forbs Avenue Hoffman Estates, IL 60192
847.851.1800 | 800.527.9948

CETCO®

www.CETCO.com

AMCOL® INTERNATIONAL HEADQUARTERS

Headquartered in Hoffman Estates, IL, AMCOL International Corporation (AMCOL) operates over 68 facilities in Africa, Asia, Australia, Europe, North America and South America. AMCOL employs more than 1,750 employees in 26 countries. The company, established in 1927, currently trades on the New York Stock Exchange under the symbol "ACO". AMCOL produces and markets a wide range of specialty mineral products used for industrial, environmental and consumer-related applications. With more than 68 world-wide locations, AMCOL manages a global supply chain to deliver world-class quality. Our full range of products and services allow us to bring value to our customers, but ultimately, our commitment to understanding customer's needs is what sets us apart in our industry.

AMCOL® INTERNATIONAL

amcol.com

DECEMBER 2010

2870 Forbs Avenue, Hoffman Estates, IL 60192
847.851.1800 | 800.527.9948 | cetco.com

CETCO®

CETCO, a wholly owned subsidiary of AMCOL International Corp.

CETCO GCL

CONSTRUCTION QUALITY ASSURANCE (CQA) MANUAL

Version 6.0, August 2008

800.527.9948 Fax 847.851.1899

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

LIST OF APPENDICES

800.527.9948 Fax 847.851.1899

SECTION 1
INTRODUCTION

1.1 Definitions

Construction Quality Assurance. For the purposes of this manual, construction quality assurance (CQA) is defined as a planned system of activities that provides assurance that *installation* of the geosynthetic clay liner (GCL) proceeds in accordance with the project design drawings and specifications. In general, these activities include continuous inspection of the installation, testing of materials and procedures, and overall documentation.

Construction Quality Control. Again, for the purposes of this manual, construction quality control (CQC) is defined as a planned system of activities that provides assurance that the properties of the GCL *materials* meet the requirements of the project specifications. These activities primarily include materials testing and documentation.

There is a great deal of overlap in the nature of CQA and CQC, and from a practical standpoint, CQA and CQC activities are often performed by the same party. For this reason, we will use the term CQA to describe *all* of the quality-oriented tasks relating to the GCL and its installation.

1.2 Scope and Purpose of the CQA Manual

This manual is written to address third-party CQA activities and is *not* intended as a guide for GCL installation. Installation guidelines are available separately from CETCO (see Technical References TR-402). This manual is also not intended to describe the various *manufacturing* quality assurance and quality control (MQA/MQC) activities performed by CETCO at the GCL manufacturing facilities (see Technical Reference No. TR-403).

The purpose of the CQA Manual is provide the project CQA personnel with a general format for assuring that the GCL delivered to the job meets the requirements of the specifications and that this material is installed in accordance with the design drawings and specifications. This manual should be modified as necessary by the design or CQA engineer in order to account for site-specific or project-specific concerns and conditions. Any such changes, however, should be discussed with CETCO before they are introduced into the final version of the project CQA plan.

For the convenience of the CQA personnel, an overall CQA Checklist is provided in Appendix A. This checklist or a similar version thereof is designed to be used on a daily basis to document that all CQA activities are consistently executed throughout the project. The checklists should be maintained at the job site and should be included chronologically in the final CQA documentation package (Section 7).

SECTION 2
PERSONNEL QUALIFICATIONS AND RESPONSIBILITIES

It is vital that all parties involved in the installation of the GCL are in close communication with each other throughout the project, and that they fully understand the requirements of the project CQA plan. For the purposes of this manual, the qualifications and responsibilities of the various parties are delineated as follows:

Installing Contractor

Responsible for installing the GCL. The contractor should appoint an on-site Construction Supervisor to coordinate the installation effort and to interact with the other parties on the job site. The installing contractor should have prior experience in GCL installation and should staff the project with qualified technicians.

On-Site Engineer

Usually the design engineer or designee, this person is responsible for general oversight of the installation. Provides assurance that construction is performed as designed, although not formally responsible for CQA. Primary contact when the installing contractor is in need of clarification of design issues. Primary contact for dispute/problem resolution. This person should be a registered professional engineer.

CQA Engineer

Charged with CQA for Bentomat installation as well as for any other liner system components. Oversees all CQA inspection, testing, and documentation. This person should be a registered professional engineer or a certified geosynthetics installation technician. This person must also be independent of the other parties on site.

Manufacturer's Representative

CETCO may provide on-site start-up assistance, especially those in which the installer has little or no prior experience or where unusual site conditions exist. The on-site engineer or installer is responsible for notifying CETCO of the intended installation schedule such that CETCO may provide timely guidance during the start-up process. CETCO's GCL installation experience may provide valuable insights to the uninitiated engineer and/or installer.

CETCO also acts as the liaison between the manufacturing plant and the installer and coordinates the release of GCL from the plant in accordance with the installer's schedule. CETCO's *on-site* involvement is typically lessened when it is determined that the installer is sufficiently capable of installing GCL without CETCO's continuous assistance. CETCO remains available throughout the project should questions or problems arise.

CQA Laboratory

The GCL conformance tests in this manual are designed to be performed at the job site to facilitate real-time response as test results are generated. In some projects where additional testing is required, however, it may be necessary to utilize the services of an off-site laboratory. The on-site engineer should verify that the selected laboratory has ample experience in the testing of GCLs and is aware of the general content of the project CQA plan as well as its specific testing requirements. The CQA engineer should establish a key contact at the laboratory to coordinate sample delivery procedures, confirm testing parameters and methods, and arrange the timely reporting of test results.

It is recommended that a preconstruction meeting be held between the above parties in order to establish working relationships with one another and to review the design drawings and specifications prior to deployment of the GCL. Thereafter, regular meetings on a daily or weekly basis are recommended as the project continues.

SECTION 3
ON-SITE HANDLING

This section describes the procedures and equipment to be used in handling the GCL when it arrives at the job site. Proper execution of these procedures will ensure that the GCL is not damaged prior to installation. It should be noted that ASTM D 5888 also provides guidelines for GCL handling. The recommendations included herein are consistent with all ASTM guidelines.

CETCO's GCLs are produced in slightly different sizes depending upon the product selected. Weights and dimensions of these products and their corresponding core pipe sizes required for safe handling are provided in Table 1 below.

Product	Panel Size (m)	Roll Diam. (mm)	Typ. Roll Weight (kg)	Core Diam. (mm)	Core Pipe Diameter (mm)	Core Pipe Length (m)	Minimum Core Pipe Strength
Bentomat	4.57 x 45.7	610	1,200	100	89	6.1	XXH
Claymax	4.57 x 45.7	510	1,250	100	89	6.1	XXH

Table 1. GCL panel sizes and corresponding core pipe requirements.

It should be recognized that the weight of the GCL rolls will dictate what type of core pipe will be sufficiently strong for unloading and handling activities. Experience has shown that the type of steel from which the pipe was produced will influence its ability to sustain the weight of the roll. The strongest steel available should be used to prevent pipe bending. A core pipe that deflects more than 75 mm as measured from end to midpoint when the roll is lifted can cause damage to the GCL and is *not acceptable.* The pipes used to unload or deploy the GCL *must not bend* at any time.

3.1 Unloading Procedures

The GCL may be delivered to the job site in one of two ways: by flatbed truck or by closed trailer/container. Regardless of the delivery method, all unloading activities should take place away from main roadways and high-traffic areas at the site. The designated unloading area should be flat, dry, and stable, and should provide adequate peripheral access for the unloading equipment. Different techniques for unloading the GCL are used accordingly. Using the procedures and equipment described below will minimize unloading time.

3.1.1 Flatbed Truck Delivery

A front-end loader or backhoe is typically used to remove the rolls from the flatbed truck. Starting from the top rolls on the truck, the core pipe is inserted through the roll core. The core has an inside diameter of 100 mm but may be slightly bowed upon arrival to the job site. In this case, it may be necessary to assist the core pipe insertion process by using the back of the loader bucket to carefully

push the pipe through the core.

After the core pipe has been inserted, straps or chains are looped around each end of the pipe protruding from the roll. The other ends of the chains should be connected to a spreader bar (typically an I-beam) of equal length to the core pipe. The spreader bar itself is suspended from the loader bucket. The purpose of the spreader bar is to prevent the chains from chafing the ends of the roll as it is lifted. It is recommended that the chains or straps be secured by the placing a pin through each end of the pipe. The GCL roll should then be lifted and slowly carried from the flatbed to the temporary storage area.

GCL rolls can also be provided with a pair of slings to facilitate lifting and handling.

3.1.2 Trailer or Container Delivery

The GCL may also be delivered in closed trailers or shipping containers. In these cases, different unloading equipment and techniques must be employed. Because of limited access to the GCL rolls, it is usually necessary to utilize an extendable-boom forklift with a "stinger" attachment. The forklift dealer or manufacturer can provide details on selecting the proper stinger for the type of forklift used at the job site.

The rolls are placed inside the trailer or container in the same way that they are positioned on a flatbed truck. The rolls are removed by inserting the stinger through the roll cores and lifting/pulling the rolls from the trailer/container.

3.2 Materials Handling

The equipment used to unload the GCL from the delivery vehicle may also be used to handle the material on site and to convey it to work areas. All unloading and handling activities must be undertaken with great care to avoid damage to the GCL. The GCL should never be handled in ways that could affect its performance. Some activities to avoid:

- Dropping the rolls from the edge of the delivery truck or container.
- Pushing or pulling the rolls on the ground surface.
- Lifting the roll without a core pipe.
- Bending the rolls by using a core pipe that cannot bear the weight of the roll.
- Forcing a bent core pipe through the core.
- Carrying the GCL over excessively rutted, bumpy terrain, causing the roll to bend and bounce in transit.

Adherence to these common-sense precautions will prevent handling-related damage to the Bentomat.

The CQA engineer or designee should supervise the unloading and storage operations. It is the duty of the CQA engineer to maintain records of the shipments and to verify that the roll numbers on the labels match the roll numbers on the bills of lading. Any apparent discrepancies should be noted and reported to CETCO.

At this time, all of the rolls should also be visually inspected for damage. Damaged rolls should be clearly marked and set aside where they will not be immediately used. Major damage suspected to have occurred during shipment should *immediately* be reported to the carrier and to CETCO (see Section 4.8.1).

3.3 On-Site Storage

The GCL may be stored at a project site indefinitely, provided that proper storage procedures are followed. First, a dedicated storage area should be identified. This area should be level, dry, well drained, and located away from high-traffic areas of the job site.

For reasons of safety and material integrity, GCL rolls must never be stored on end. Rolls should be stored horizontally, in small stacks not to exceed four rolls in height. It is preferred that the bottom rolls be placed on plywood, on an arrangement of pallets, or on some other man-made surface, to promote drainage and to prevent damage by contact with the ground surface. If the rolls are to be placed directly on the ground, the local ground surface should be carefully prepared and proof-rolled to minimize the potential for damage. It is good practice to cover the stored rolls with a tarpaulin or plastic sheeting for supplemental protection from the elements.

The polyethylene sleeves of the GCL rolls should be examined for any obvious rips or tears. Sleeve damage should be repaired immediately with adhesive tape or additional plastic sheeting. At this time it is also recommended that the labels be examined and taped to the roll if they were displaced in transit.

SECTION 4
INSTALLATION

This section of the CETCO GCL CQA Manual covers the techniques and procedures to be used for ensuring the quality of a GCL installation. Although some installation techniques are described, this section is *not* an installation guide. Refer instead to CETCO GCL Technical Reference TR-402 for specific GCL installation guidelines. ASTM D 6102 also contains sound GCL installation guidelines.

4.1 Start-Up Assistance

CETCO or its representatives can provide on-site start-up assistance, especially where the installer has no prior GCL installation experience or in which the application is relatively unique. CETCO will work with the on-site engineer and CQA engineer in order to verify that the proper unloading, installation and conformance testing procedures are utilized. CETCO's input is based on extensive experience with GCL installation and on intimate knowledge of the physical characteristics of GCLs. It should be recognized, however, that it is the site engineer's responsibility to implement CETCO's recommendations.

4.2 Equipment

In many projects, the equipment used for unloading the GCL can also be used to install it. Most applications require a vehicle to lift and suspend the roll as it is deployed. Front-end loaders, bulldozers, boom cranes, forklifts, and tracked excavators all have been successfully used for this task. Other, more specialized equipment exists for these operations and may also be used. The equipment for unrolling the GCL should be able to lift the roll and suspend it *freely* such that it does not chafe against the vehicle or the ground. The vehicle must also have the ability to accommodate a spreader bar above the roll of GCL.

The spreader bar should be sufficiently strong to bear the full weight of the GCL roll without bending. Readily available I-beams or T-beams made of structural steel are typically used for this purpose, although steel pipes have also been successfully used. The chains or straps should be checked for their strength before the installation begins and should continually be inspected for wear as the installation continues.

The core pipe should be of the dimensions and strength indicated in Table 1. It has been CETCO's experience that the schedule of the core pipe is not always an accurate indicator of its strength. The type of steel from which the pipe is made, the presence of a longitudinal weld, and the overall length of the pipe all have an influence on its ability to sustain the weight of the GCL. It is essential that the core pipe *does not bend* when the full roll of GCL is suspended from it. Lastly, it is recommended that the core pipe have a means to prevent the chains or straps from slipping off the ends of the pipe. This can be accomplished by using pins or clamps.

It will often be necessary to cut the GCL before the end of the roll or to cut it to fit in certain confined areas. Cutting the GCL requires a *sharp* utility knife. It is very important to maintain the sharpness of the knife blades used for cutting the GCL, in order to prevent tearing its geosynthetic components and damaging the GCL where the cut is made. Frequent blade changes for the utility knives are strongly

recommended.

For construction of the bentonite enhanced overlapped seams of the Bentomat products, an acceptable fillet of bentonite can be poured directly from the bags of granular bentonite supplied with each roll of Bentomat, but a watering can (without a sprinkler head) is easier to use and produces a more controlled seam enhancement. A line chalker, such as those used for marking athletic fields, may also be used.

4.3 Field Conditions

At the beginning of each working day, the CQA engineer should confirm that there are no ambient site conditions which could affect the quality of the installation. Specifically, the presence at the job site of excessively high winds, rain, standing water, or snow may be construed as unsuitable weather for GCL installation. There are no temperature restrictions for installing the GCL, however.

Bentomat is not as susceptible as Claymax to damage due to "premature hydration" (i.e., hydration before a confining stress is applied). Although Bentomat will not delaminate when wetted, CETCO nevertheless recommends that it be installed in dry weather as with Claymax. This lessens the potential for damage to the material and ensures that its integrity is not compromised by the swelling of the bentonite. Should the GCL become prematurely hydrated, it urged that CETCO be contacted in order to recommend a project-specific and product-specific recommendation as to whether the GCL must be removed and replaced. CETCO's Technical Reference TR-312 provides a checklist for evaluating GCL that has been hydrated when no confining pressure is present.

4.4 Site Inspection

Prior to each day's installation activities, the site engineer and/or CQA engineer should inspect the work area to ensure that it has been prepared in accordance with the specification and design drawings. Specifically, the design grades should be verified, the slope length and steepness should be checked, the anchor trench dimensions should be measured, and the subgrade should be inspected and approved. Any deviations from the specifications or design drawings should be noted and rectified before the GCL is installed.

The anchor trench is especially important in applications where slopes are present. The anchor trench must meet or exceed the design dimensions but must also be free of any sharp corners or protrusions which could put excessive stress on the GCL. The CQA engineer must ensure that the anchor trench is as carefully prepared as the rest of the subgrade.

4.5 Panel Placement

The unrolling and placement of the GCL should be performed in such a way that the GCL is not damaged or unduly stretched, folded, or creased. The GCL rolls are typically suspended from the front of the vehicle while it travels backwards along the intended path of placement. During this activity, the roll should be able to rotate freely around the core pipe. Excessive friction due to a bent or large-diameter core pipe, or due to contact between the roll and the deployment equipment, may cause undesirable levels of tension to develop. It is necessary that the GCL be deployed in a fully

relaxed (but not wrinkled) state.

A common deployment technique when the GCL is placed on slopes is to suspend the roll at the top of the slope while several laborers unroll it as they walk downslope. This is an acceptable technique, but the CQA engineer should verify that excessive tension does not develop on the material and that the underside of the panel is not damaged by friction with the subgrade. Unless the subgrade is acceptably smooth, the GCL should be unrolled over an already-placed panel and then moved laterally into its correct position. Flat-bladed vise grips are very useful for handling and moving unrolled panels.

It is important to ensure that, at the top of a slope, the GCL is properly placed in the anchor trench. After confirming that the trench has been constructed according to the specifications, the GCL should be placed in the trench such that it extends across the trench floor but not up the rear wall of the trench. Excess material if any, should be cut off, *not* folded over on top of the existing material. Proper anchorage will be achieved if and only if the GCL is placed within the trench in this manner.

The orientation of the GCL panels is important. When working in sloping areas, the panels should be positioned such that their long dimension is parallel to the direction of the slope. Panels may only be placed across the slope when the slope is less steep than 4H:1V or when the slope length is very short (less than or equal to 3 m).

4.6 Seaming

Proper field seaming is vital for the liner to function to its maximum abilities. There are three elements of CQA for this important task:

- Verification of the minimum acceptable overlap.
- Verification of the continuity of the accessory bentonite (Bentomat only).
- Verification that there is no dirt in the overlap zone or on the bottom geotextile of the overlying GCL panel.

These elements for field seam CQA are straightforward and require only visual inspection by the CQA engineer. The upper surface of the GCL has two heavy dashed lines on both sides of the panel. The lap lines are 150 mm from the edges of the panel, and the match lines are 250 mm from the edges of the panel. The minimum acceptable overlap is 150 mm. Thus, the installer's objective is to place the overlying panel *between* the two lines of the underlying panel. The CQA engineer needs only to visually verify that the 150-mm lap line of the underlying panel is not visible. A properly executed seam, therefore, is verified when three dashed lines (not four) are visible at the overlap, as shown in Figure 1.

The hydraulic performance of Bentomat is maximized when the accessory bentonite is placed *continuously* within the overlap zone. Continuity is best achieved when a watering can or other similar device is used. Pouring the bentonite directly from the bag is less effective in this regard. Verification of continuity should be performed visually by the CQA engineer. The CQA engineer should observe the accessory bentonite as it is being placed within the overlap zone and should give verbal approval of the seam before the overlap is flipped back into place.

Bentomat ST, DN, and SDN with Supergroove® have self-seaming capabilities in their longitudinal overlaps (Figure 2) and do not require supplemental bentonite. For these Bentomat products, supplemental bentonite is required for the end-of-panel overlapped seams. For pond applications, supplemental bentonite must be used in longitudinal seams regardless of the CETCO GCL used.

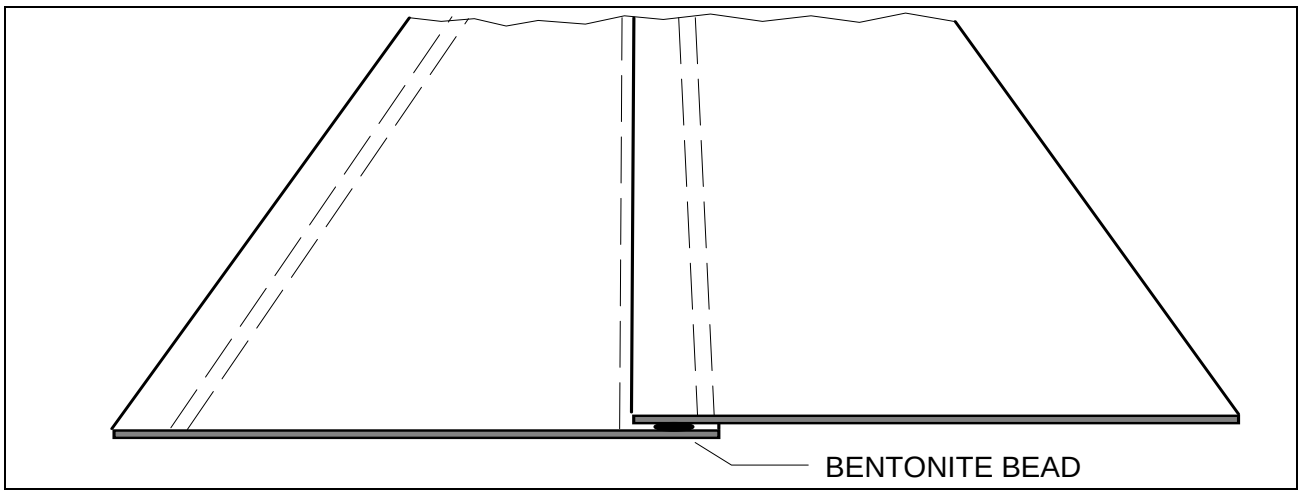


Figure 1. Schematic representation of a properly executed Bentomat field seam.

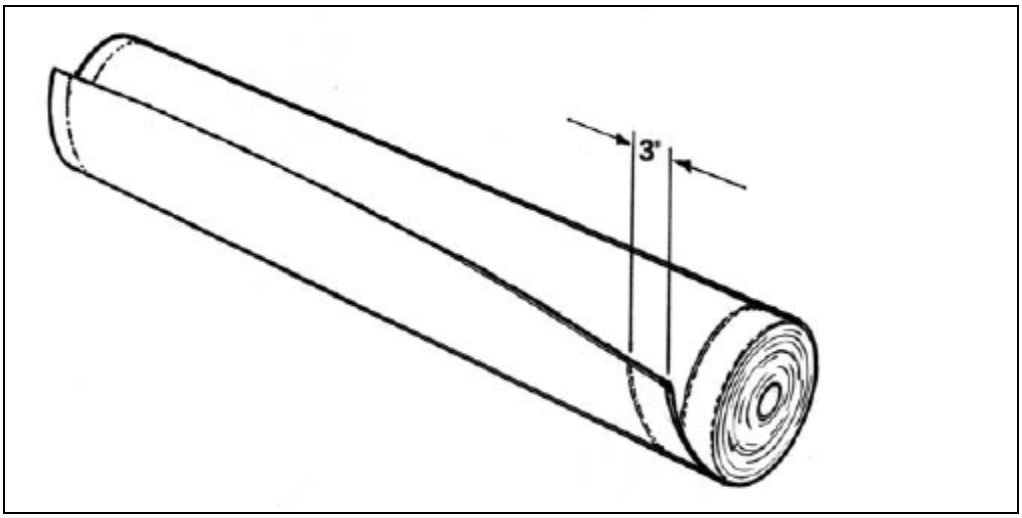


Figure 2. Supergroove Bentomat field seam.

Verification of the cleanliness of the overlap is also required, because dirt can enter the overlap and create a conduit for excessive lateral leakage. This is one reason CETCO recommends that the overlying panel is placed and then its edge flipped back to reveal the overlap zone. Exposing the overlap in this manner forces extra attention on the seam and reveals the presence of loose dirt that

800.527.9948 Fax 847.851.1899

may have inadvertently entered the overlap zone or may have become adhered to the bottom geotextile of the overlying panel. The CQA engineer should either verify that no dirt is present or ensure that the dirt is swept out of the overlap.

Verification of the *amount* of bentonite placed at the seam may be achieved by ensuring that one full 22.5 kg bag of granular bentonite is used for the lateral and longitudinal seaming of each roll of GCL. CETCO recommends that a minimum of 375 grams of granular bentonite be applied per lineal meter of seam. If the installer places bentonite at the rate of one bag per roll, this target application rate will be achieved.

The longitudinal overlap for the GCL should be at least 150 mm (Bentomat) and 300 mm (Claymax). Overlaps at the *ends* of the rolls, however, ("transverse" overlaps) should be at least 300 mm (Bentomat) and 600 mm (Claymax) to account for any incidental loss of bentonite that could occur due to excessive handling of this portion of the roll or to stress relaxation after placement. Overlap distances can be increased if unusual site conditions (such as a soft subgrade, or GCL covered only with geomembrane) exist.

4.7 Detail Work

The term "detail work" refers to the placement of GCL around structures such as vertical walls, gas vents, drainage basins, and pipe penetrations. In all of these cases, it is necessary to utilize granular bentonite or a bentonite mastic to create a seal between the GCL and the structure. CQA of these areas involves a visual inspection of the methods used to make the seal. Specific items requiring inspection include:

- Dimensions of the "notch" excavated around the structure.
- Amount of bentonite applied to the detail
- Condition of the GCL at its cut edge (the cut should be clean, not frayed, with little or no bentonite edge loss from the GCL)
- Integrity of the detail as cover material is placed over and around it.

When cutting the GCL, it is important to ensure that the cut is made where the GCL hangs from the roll or where it rests on the subgrade . The GCL cut should *never* be made on the roll itself or when it rests on any other liner system component.

4.8 Damage and Damage Repair

Even when all reasonable protective measures are taken, the GCL may still become damaged during shipping and handling or during installation. This section provides instructions on assessing and managing the damaged materials.

4.8.1 Damage From Shipping and Handling

Occasionally, a GCL roll will arrive at a job site with its protective plastic sleeve torn due to movement during transit. This roll should be inspected for damage in the area where the sleeve was torn. If the geotextile under the torn sleeve is also torn, The outermost wrap of GCL on the roll should be unwound and discarded when the roll is installed. It is not necessary to consider the entire roll unusable. It is important, however, to mark the roll in order to alert the installer that the initial wrap should be cut away and discarded, because the damaged geotextile may be hidden from view when the GCL is unrolled. It is remotely possible that further layers of GCL on the roll could be similarly damaged. If this happens, additional wraps may be unrolled and discarded prior to placement.

Damage due to poor handling may occur as a result of accidentally dropping a suspended roll onto the ground or using weak core pipes that bend when the GCL is lifted. These activities can cause damage not just to the outer wrap of GCL but to the entire roll. If such damage occurs, the rolls should be clearly marked and moved away from the storage area. The CQA engineer should ensure that procedures are immediately implemented in order to prevent the recurrence of this problem. The CQA engineer should also contact CETCO to help make a determination as to whether the mis-handled GCL is acceptable for use on the project.

4.8.2 Damage From Installation Activities

The more commonly observed incidents of damage occur during installation, as a result of inadvertent contact by heavy equipment. Because this type of damage will potentially have the largest overall effect on the integrity of the liner system, CETCO strongly recommends that equipment operating on or near the GCL *be monitored continuously.*

Equipment operators should be made fully aware of the importance of their actions and should be encouraged to notify the CQA engineer directly if they suspect at any time that the liner may have become damaged by their equipment. Close communication among everyone involved in the installation will help to ensure that this type of damage is reported and repaired.

Repeated passes by loaded dump trucks over GCL, which has minimal cover, can cause damage. It is therefore preferred to prevent potential for such damage by placing the GCL over these high-traffic areas *after* cover material delivery is largely completed. If this is not possible, then extra cover should be placed over high-traffic areas. At least 600-900 mm of screened, cohesive soil is recommended.

Should damage occur to the already-installed GCL, the following procedures should be followed:

1. Remove equipment from the damaged area and notify the CQA engineer.
2. *Manually* clean away all cover material within a 600-mm radius of the damaged area. Use a broom to sweep away the remaining dirt in order to make the area as clean as possible.
3. If necessary, repair the subgrade to its original conditions. Replace the torn/damaged GCL as closely as possible to its original position.
4. Place a bead of granular bentonite or bentonite paste at the minimum rate of 500 g per lineal meter around the damaged area.
5. Cut a patch of new GCL to fit over the damaged area and extending 600 mm beyond it.

6. Place the patch over the damaged area and carefully backfill over the patch.

Note that it is necessary only to repair the damaged portion of the GCL. It is usually not necessary to remove and replace the entire panel, unless the damage has occurred on a slope. In this case, slope stability may be compromised and the site engineer should be contacted to help determine whether a repair is acceptable.

SECTION 5
PLACEMENT OF COVER MATERIALS

As mentioned previously, the proper placement of cover on the GCL is crucial to the overall success of the installation. This section of the Bentomat CQA manual includes recommended materials and procedures, which will help to ensure that the integrity of the GCL is not compromised when it is covered.

Regardless of the nature of the cover material used, it should be placed as soon as possible after the GCL has been deployed. The efforts of placing the GCL and placing the final cover should be coordinated to the extent that only as much GCL as can be covered should be deployed in one working day. This will prevent premature hydration and will greatly reduce the chances for incidental damage to the GCL during other activities.

5.1 Soil/Stone Cover

When a GCL is the sole liner system component, soil or stone cover *must* be placed over it to provide protection from physical damage, erosional forces, and degradation by UV light. The presence of cover also provides a confining stress, which allows the overlapped seam to perform properly and enhances the long-term physical integrity of the material. Lastly, the cover may provide a base for vehicular traffic. Because it serves so many functions, proper placement and CQA of the soil/stone cover is essential.

Frequently used cover materials include sand, gravel, crushed stone, and common earth fill. Regardless of the type of material selected for the cover, it should be free of large stones (greater than 50 mm in diameter), sticks, and any other materials, which could cause puncture or tearing. The source of all cover material should be identified in order to ascertain its suitability well in advance of the installation.

In addition to particle size, the *angularity* of a crushed stone or gravel will impact the construction survivability of the GCL. It is preferred that relatively rounded materials be utilized. If these materials are not available, then extra caution must be taken during cover placement. Dumping the cover from a loader bucket positioned high above the GCL is unacceptable. The cover should be gently placed from as low a height as possible. Vehicular traffic should also be restricted if particularly angular or abrasive material is used. If there is some doubt as to the suitability of a potential cover material, a representative sample should be submitted to CETCO for analysis.

With respect to the equipment used to place the protective cover, it is strongly recommended that no heavy equipment come in direct contact with the GCL. Obviously, tracked equipment will damage the liner. In some cases, however it is necessary to drive equipment directly on the GCL. This can be accomplished with low-pressure, *rubber-tired* equipment. Permission to do so will be granted by CETCO through the CQA engineer on a case-by-case basis *only* and will include restrictions on the equipment itself and on the type of movements the vehicle may make on the GCL.

The chemical nature of the cover soil must also be considered. The use of fine-grained, calcareous soil or stone is strongly discouraged due to the potential for an adverse reaction with the sodium

bentonite contained in the GCL.

The cover material placed as backfill in the anchor trench should be of the same quality as the rest of the backfill. It is especially important that the anchor trench backfill be compacted either by hand tamping or by the use of a small walk-behind compactor. Compaction should be performed over each 150-mm lift of backfill placed in the anchor trench.

5.2 Geosynthetic Cover

A geomembrane or other geosynthetic liner system component is often placed over the GCL. Caution must be used during this activity to prevent GCL damage. Again, it is strongly recommended that no heavy equipment directly contact the GCL, but exceptions can be made on a project-specific basis.

A special precaution should be taken when textured geomembrane is installed directly over the GCL in a composite liner system. Because considerable friction may develop between the geomembrane and the GCL, it is difficult to pull the geomembrane into position for welding to adjacent sheets. A smooth "slip sheet" can be used to provide a low-friction sliding surface for the geomembrane until it is in position for welding.

SECTION 6
CONFORMANCE TESTING

Conformance testing is necessary in order to verify that the materials installed meet the requirements set forth in the specification. Although CETCO performs regular testing on its GCLs as part of its manufacturing QA/QC program, the engineer may require additional testing at the job site. This section lists several tests, which may be utilized to verify the quality of the delivered materials and the quality of the installation of those materials.

6.1 Bentonite Mass Per Unit Area

A relatively simple test to verify that the specified amount of bentonite has been encapsulated in the GCL is to measure the bentonite mass per unit area of representative samples cut from delivered rolls. The results of this test may be used in conjunction with the results of the bentonite swell test described in Section 6.2 to arrive at an indirect verification of the hydraulic performance of the GCL.

ASTM D 5993 provides procedures for performing the mass per unit area test. After the correction for geotextile mass is made, there should be at least 3,600 g of bentonite contained within the GCL per square meter. This is CETCO's minimum average roll value (MARV) for bentonite content of all of its GCLs. These values are always subject to change, so please refer to GCL Technical Reference No. TR-404 for the most recent list of certified physical GCL properties.

If for any reason the resulting mass per unit area values do not meet the required MARVs, the corresponding rolls should be set-aside for additional inspection and testing. CETCO should be notified to assist in resolving the problem if it persists.

6.2 Bentonite Swell Index and Fluid Loss

The swell index and fluid loss of the bentonite are two of the most important indicators of its ability to function as a barrier material. ASTM D 5890 provides a detailed free swell testing procedure used by CETCO. CETCO's MARV requirement for the bentonite is 24 mL/2g. ASTM D5891 provides a detailed fluid loss testing procedure. CETCO’s maximum requirement for fluid loss of the bentonite is 18 ml. As with the mass per unit area test described in Section 6.1, if these values are not achieved in conformance testing, the corresponding rolls should be set aside for additional inspection and testing. CETCO should be notified to assist in resolving the problem if it persists.

6.3 Other Conformance Tests

Other conformance tests may be conducted at the request of the on-site engineer or the CQA engineer on a project specific basis. ASTM D6495 suggests grab tensile strength and index flux/permeability (as per ASTM D 5887), although it should be cautioned that rapid "real-time" results of index flux/permeability are not possible due to the time required to achieve steady-state permeability values. Thus, it is difficult to use permeability testing as a pass/fail criterion for GCL acceptance at the job site.

Also, the laminated GCLs are not easily tested for index flux/permeability due to potential sidewall leakage around the membrane. CETCO has a special setup procedure for its laminated GCLs in TR-302.

Lastly, it should be recognized that field-scale test pads and infiltrometer tests are typically *not* performed in GCL projects. This contrasts with compacted clay liner (CCL) projects, in which, for two reasons, field-scale data is almost always required. First, field data for CCL projects is necessary because there are many variables involved in their construction (compactor weight, speed, number of passes; soil type; moisture content; lift thickness; etc.). It is therefore necessary to build a test pad to ensure that the construction materials and methods intended for the project will provide the required level of performance. Second, laboratory test results and field test results may vary significantly with CCLs due to the difficulties in retrieving representative, undisturbed samples. This factor also warrants that field data be obtained for CCL projects.

With GCL installations, however, there are very few construction-related variables. Additionally, the GCL that is tested for permeability in the laboratory is the *same* material deployed in the field. For this reason, a GCL such as Bentomat or Claymax does not require a field permeability test.

800.527.9948 Fax 847.851.1899

SECTION 7
DOCUMENTATION

Thorough documentation of all CQA activities and tests is necessary in order to provide a written record that the GCL has been properly installed. The CQA documentation package for a GCL installation should include the following items:

- Bills of lading and corresponding packing list confirming receipt of all GCL installed at the site.
- A panel layout drawing in which the GCL roll numbers are keyed to their location in the field. Locations where damage was encountered and repaired should also be marked.
- The roll numbers from which samples were taken for conformance tests, along with the results of those tests.
- A daily report or diary of the activities undertaken at the site during construction.
- Certification that the requirements for the subgrade and for the cover material were achieved.
- A compilation of all CQA checklists completed during the installation.
- The manufacturing quality control (MQC) certification and accompanying test data.
- A description of deviations, if any, made to the original CQA plan during the installation.
- Photographs of the GCL during installation.

CETCO provides the MQC certification. All other items on the above list are the responsibility of the CQA engineer.

APPENDIX A
List of Applicable ASTM Standards

ASTM D 5887, "Standard Test Method for Measurement of the Index Flux Through Saturated Geosynthetic Clay Liner Specimens Using a Flexible Wall Permeameter," *Annual Book of ASTM Standards, Vol. 4.09,* American Society for Testing and Materials, W. Conshohocken, PA.

This method describes the specimen preparation, stress and gradient conditions, and testing procedures to be used for determining the flux (flow per unit area) through GCLs. Adherence to the specimen preparation procedures presented will help to minimize sidewall leakage, a common problem when testing thin barriers. This is an index test designed to determine product acceptability and uses a maximum confining stress of 35 kPa (5 psi) and a hydraulic gradient of 14 kPa (2 psi).

ASTM D 5888, "Standard Guide for Storage and Handling of Geosynthetic Clay Liners," *Annual Book of ASTM Standards, Vol. 4.09,* American Society for Testing and Materials, W. Conshohocken, PA.

This is a guide for the safe handling of GCL rolls at a job site, identifying the equipment and techniques typically employed to unload the material from delivery trucks and to place it in a dedicated storage area. Procedures are also presented for proper storage of the GCL in order to minimize the potential for product damage while in storage.

ASTM D 5889, "Standard Practice for Quality Control of Geosynthetic Clay Liners," *Annual Book of ASTM Standards, Vol. 4.09,* American Society for Testing and Materials, W. Conshohocken, PA.

Test methods and testing frequencies are presented for manufacturing quality control (MQC) of GCLs. This standard practice includes conformance tests to be performed on the GCL components (bentonite and geotextiles and/or geomembranes) as well as tests to be performed on the finished GCL product. Special procedures for GCL permeability/flux testing require the manufacturer to provide an historical database to demonstrate the consistency of the hydraulic performance of the finished product and to justify the reduced need for frequent MQA permeability testing.

ASTM D 5890, "Standard Test Method for Swell Index Measurement of Clay Mineral Component of Geosynthetic Clay Liners," *Annual Book of ASTM Standards, Vol. 4.09,* American Society for Testing and Materials, W. Conshohocken, PA.

This test method was adapted from the basic elements of a swell test presented in the USP/NF (United States Pharmacopeia/National Formulary). Two grams of dried and powdered bentonite are slowly dropped into a graduate cylinder containing 100 mL of distilled water. The swell value in mL is recorded after 24 hours, by reading the value on the graduate cylinder at the clay/water interface.

APPENDIX A (continued)
List of Applicable ASTM Standards

ASTM D 5891, "Standard Test Method for Measurement of Fluid Loss of Clay Mineral Component of Geosynthetic Clay Liners."

This test method was adapted from the API (American Petroleum Institute) Procedure 13A/13B for bentonite. A bentonite slurry is created, aged, and then filtered in a pressurized cell. The amount of water passing through the filter cake in a specified time interval is recorded as the filtrate loss or fluid loss. The test indicates the clay's general ability to function as a barrier to liquids.

ASTM D 5993, "Standard Test Method for Measuring the Mass per Unit Area of Geosynthetic Clay Liners."

This test method describes how to measure the bentonite mass per unit area of a GCL sample. A GCL specimen of a certain minimum area is weighed, oven-dried, and weighed again. The dry weight of the specimen, minus the nominal weight of the geosynthetic component(s), is then divided by the area of the specimen. The moisture content of the specimen is determined by subtracting the dry weight from the wet weight.

ASTM D 6072, "Standard Guide for Obtaining Samples of Geosynthetic Clay Liners."

Presents procedures for obtaining representative samples of GCL material for laboratory testing purposes. These samples may be obtained either at the factory or in the field. Procedures for packaging and protecting the sample are also included to prevent the possibility of damage in transit to the laboratory.

ASTM D 6102, "Standard Guide for Installation of Geosynthetic Clay Liners."

Provides detailed recommendations for the proper installation of GCLs. Discusses the necessary site conditions, equipment, and techniques for installing GCLs without damaging them. Includes recommendations on panel placement, overlaps, and special considerations for slopes. Also discusses the preferred types of soil cover and equipment used to apply this cover.

ASTM D 6243, "Standard Test Method for Determining the Internal and Interface Shear Resistance of Geosynthetic Clay Liner by the Direct Shear Method."

This test method covers a procedure for determining the internal shear resistance of a GCL or the interface shear resistance between the GCL and an adjacent material under a constant rate of displacement or constant stress.

ASTM D 6496, "Standard Test Method for Determining Average Bonding Peel Strength Between Top and Bottom Layers of Needle-Punched Geosynthetic Clay Liners."

This test method was adapted from ASTM D 4632 for grab strength testing of geotextiles. The method covers the laboratory determination of the average bonding strength between the top and bottom layers of a sample of a GCL. These results provide an indication of a GCL's internal reinforcement and internal shear strength.

APPENDIX A (continued)
List of Applicable ASTM Standards

ASTM D 6768, "Standard Test Method for Tensile Strength of Geosynthetic Clay Liners."

This test method was adapted from ASTM D 4632 for grab strength testing of geotextiles. The test method establishes the procedures for the measurement of tensile strength of a GCL. This test method is strictly an index test method to be used to verify the tensile strength of GCLs. Results from this test method should not be considered as an indication of actual or long-term performance of the geosynthetic in field applications.

ASTM D 6495, "Standard Guide for Acceptance Testing Requirements for Geosynthetic Clay Liners".

Provides guidelines for acceptance testing requirements for GCLs, including test methods and verifications.

800.527.9948 Fax 847.851.1899

APPENDIX B
CETCO GCL Construction Quality Assurance Checklist

Project Name/Number:_____

CQA Inspector:_____

Date:_____ Weather:_____

STORAGE AREA

_____ Rolls covered/tarped
_____ Rolls labeled
_____ No standing water present
_____ Packaging intact/repaired
_____ Accessory bentonite protected

MATERIALS RECEIVED TODAY

_____ Packaging intact
_____ Rolls inspected for damage--
none found
_____ Damage suspected (indicate
roll numbers and nature of
damage _____

_____

_____

SITE INSPECTION

_____ Subgrade surface acceptable
_____ Installation area dry
_____ Anchor trenches acceptable
_____ Design grades achieved
_____ Cover soil acceptable (as applicable)

INSTALLATION

_____ Number of rolls deployed today
(attach list of roll numbers)
_____ Anchor trench fill compacted
_____ Min. seam overlap achieved
_____ All seams visually inspected
_____ Seam bentonite added (as applicable)
_____ All detail work inspected
_____ Downslope panel orientation
_____ All mat covered at end of day
_____ Storage area maintained

INSTALLATION EQUIPMENT

_____ Core pipe straight
_____ Spreader bar straight
_____ Chains/Straps inspected
_____ Knife blades replaced
_____ Seaming clay supply available

CONFORMANCE TESTING

Bentonite Mass/Area:

Bentomat Roll No.	Bentonite (g/sm)	Pass/ Fail?

Bentonite Swell:

Bentomat Roll No.	Final Swell Value (mL/2g)	Pass/ Fail?

NOTES/OBSERVATIONS

_____
_____
_____

NOTE:
This checklist is intended to serve as a *guideline* for the CQA engineer to use in the development of a project-specific or company-specific CQA plan. The checklist is not all-inclusive. The items presented in this list are those that CETCO feels are the most important for the proper installation of Bentomat.

800.527.9948 Fax 847.851.1899

MATERIAL SAFETY DATA SHEET

1. Product and Company Identification

Material name BENTOMAT® ST

Version # 21

Revision date 18-August-2009

Chemical description Geosynthetic Clay Liner

CAS # Mixture

Company

CETCO
Lining Technologies Group
2870 Forbs Avenue
Hoffman Estates, IL 60192 US
safetydata@amcol.com
http://www.cetco.com/LT/
General Information (800) 527-9948
Emergency (800) 424-9300

2. Hazards Identification

Emergency overview This product has the potential for generation of respirable dust during handling and use. Dust may contain respirable crystalline silica.

Potential health effects

Routes of exposure Inhalation. Eye contact.

Eyes Dust or powder may irritate eye tissue. Symptoms include itching, burning, redness and tearing.

Skin Non-irritating to the skin.

Inhalation Repeated or prolonged inhalation may cause toxic effects. For additional information on inhalation hazards, see Section 11 of this safety data sheet.

Ingestion No hazard in normal industrial use. No significant adverse effects are expected upon ingestion of the product.

Target organs Lungs.

Chronic effects Overexposure to dust may result in pneumocononiosis, a respiratory disease caused by inhalation of mineral dust, which can lead to fibrotic changes to the lung tissue, or silicosis, a respiratory disease caused by inhalation of silica dust, which can lead to inflammation and fibrosis of the lung tissue.

3. Composition / Information on Ingredients

The manufacturer lists no ingredients as hazardous according to OSHA 29 CFR 1910.1200.

Composition comments This product contains naturally occurring crystalline silica (not listed in Annex I of Directive 67/548/EEC) in quantities less than 6%. Occupational Exposure Limits for impurities are listed in Section 8.

4. First Aid Measures

First aid procedures

Eye contact Flush eyes immediately with large amounts of water. Get medical attention if irritation develops or persists.

Skin contact No special measures required. Get medical attention if irritation develops or persists.

Inhalation If symptoms are experienced, remove source of contamination or move victim to fresh air. If the affected person is not breathing, apply artificial respiration. If breathing is difficult, give oxygen. Call a physician if symptoms develop or persist.

Ingestion No special measures required. If ingestion of a large amount does occur, seek medical attention.

Notes to physician Provide general supportive measures and treat symptomatically.

5. Fire Fighting Measures

Flammable properties None known.

Extinguishing media

Suitable extinguishing media Use any media suitable for the surrounding fires. Dry chemical, CO2, water spray or regular foam.

Hazardous combustion products	None known.

6. Accidental Release Measures

Personal precautions	Wear a dust mask if dust is generated above exposure limits.
Environmental precautions	No special environmental precautions required.
Methods for containment	None necessary.
Methods for cleaning up	Avoid the generation of dusts during clean-up. Collect dust or particulates using a vacuum cleaner with a HEPA filter. Reduce airborne dust and prevent scattering by moistening with water.

7. Handling and Storage

Handling	Keep formation of airborne dusts to a minimum. Provide appropriate exhaust ventilation at places where dust is formed. In case of insufficient ventilation, wear suitable respiratory equipment.
Storage	Guard against dust accumulation of this material. No special storage conditions required. No special restrictions on storage with other products.

8. Exposure Controls / Personal Protection

Occupational exposure limits

ACGIH

Impurities	Type	Value	Form
INERT OR NUISANCE DUST (SEQ250)	TWA	10 mg/m3	Inhalable particles.
		3 mg/m3	Respirable particles.
QUARTZ (14808-60-7)	TWA	0.025 mg/m3	Respirable fraction.

U.S. - OSHA

Impurities	Type	Value	Form
INERT OR NUISANCE DUST (SEQ250)	PEL	15 mg/m3	Total dust.
		5 mg/m3	Respirable fraction.
	TWA	5 mg/m3	Respirable fraction.
		50 mppcf	Total dust.
		15 mppcf	Respirable fraction.
		15 mg/m3	Total dust.
QUARTZ (14808-60-7)	TWA	2.4 mppcf	Respirable.
		0.3 mg/m3	Total dust.
		0.1 mg/m3	Respirable.
		0.1 mg/m3	Respirable dust.

Exposure guidelines	Occupational exposure to nuisance dust (total and respirable) and respirable crystalline silica should be monitored and controlled.
Engineering controls	If material is ground, cut, or used in any operation which may generate dusts, use appropriate local exhaust ventilation to keep exposures below the recommended exposure limits. If engineering measures are not sufficient to maintain concentrations of dust particulates below the OEL, suitable respiratory protection must be worn.

Personal protective equipment

Eye / face protection	Wear dust goggles.
Skin protection	No special protective equipment required.
Respiratory protection	Use a particulate filter respirator for particulate concentrations exceeding the Occupational Exposure Limit.
General hygeine considerations	Eye wash fountain is recommended. Use good industrial hygiene practices in handling this material.

9. Physical & Chemical Properties

Appearance	The product consists of bentonite granules between geotextile layers
Color	Various.
Odor	None.
Odor threshold	Not available.
Physical state	Solid.
Form	Mat or Fabric

pH	7 - 9 estimated
Melting point	Not available.
Freezing point	Not available.
Boiling point	Not available.
Flash point	Non-flammable
Evaporation rate	Not available.
Flammability	Not available.
Flammability limits in air, upper, % by volume	Non-explosive
Flammability limits in air, lower, % by volume	Non-explosive
Vapor pressure	Not available.
Vapor density	Not available.
Specific gravity	2.1677 estimated
Relative density	Not available.
Solubility (water)	Negligible
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	Not available.
Decomposition temperature	Not available.
VOC	0 % estimated
Percent volatile	0 % estimated

10. Chemical Stability & Reactivity Information

Chemical stability	Stable at normal conditions.
Conditions to avoid	None known.
Incompatible materials	None known.
Hazardous decomposition products	None known.
Possibility of hazardous reactions	Will not occur.

11. Toxicological Information

Local effects Mild irritant to eyes (according to the modified Kay & Calandra criteria)

Chronic effects Some of the components of this product are hazardous in the respirable form. However, because of the physical nature of this product, dust generation is not expected.

In 1997, IARC (the International Agency for Research on Cancer) concluded that crystalline silica inhaled from occupational sources can cause lung cancer in humans. However in making the overall evaluation, IARC noted that "carcinogenicity was not detected in all industrial circumstances studied. Carcinogenicity may be dependent on inherent characteristics of the crystalline silica or on external factors affecting its biological activity or distribution of its polymorphs." (IARC Monographs on the evaluation of the carcinogenic risks of chemicals to humans, Silica, silicates dust and organic fibres, 1997, Vol. 68, IARC, Lyon, France.)

In June 2003, SCOEL (the EU Scientific Committee on Occupational Exposure Limits) concluded that the main effect in humans of the inhalation of respirable crystalline silica dust is silicosis. "There is sufficient information to conclude that the relative risk of lung cancer is increased in persons with silicosis (and, apparently, not in employees without silicosis exposed to silica dust in quarries and in the ceramic industry). Therefore, preventing the onset of silicosis will also reduce the cancer risk..." (SCOEL SUM Doc 94-final, June 2003)

According to the current state of the art, worker protection against silicosis can be consistently assured by respecting the existing regulatory occupational exposure limits.

Sensitization No sensitization responses were observed.

Carcinogenicity

IARC Monographs: Overall evaluation

QUARTZ (14808-60-7)	1 Carcinogenic to humans.

Carcinogenicity

US ACGIH Threshold Limit Values: A2 carcinogen

QUARTZ (14808-60-7)	Group A2 Suspected human carcinogen.

US NTP Report on Carcinogens: Known carcinogen

QUARTZ (14808-60-7)	Known carcinogen.

12. Ecological Information

Ecotoxicological data

Product	Test Results
BENTOMAT® ST (Mixture)	LC50 Fish: 22353 mg/l 96.00 Hours estimated

* Estimates for product may be based on additional component data not shown.

Ecotoxicity The product is not expected to be hazardous to the environment. This product is not expected to produce significant ecotoxicity upon exposure to aquatic organisms and aquatic systems.

Environmental effects Ecological injuries are not known or expected under normal use. Based on the physical properties of this product, significant environmental persistence and bioaccumulation would not be expected.

Persistence and degradability Not available.

13. Disposal Considerations

Disposal instructions Dispose in accordance with all applicable regulations. Material should be recycled if possible.

14. Transport Information

DOT

Not regulated as dangerous goods.

IATA

Not regulated as dangerous goods.

IMDG

Not regulated as dangerous goods.

15. Regulatory Information

US federal regulations OSHA Process Safety Standard: This material is not known to be hazardous by the OSHA Highly Hazardous Process Safety Standard, 29 CFR 1910.119.

CERCLA (Superfund) reportable quantity

None

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories Immediate Hazard - No
Delayed Hazard - Yes
Fire Hazard - No
Pressure Hazard - No
Reactivity Hazard - No

Section 302 extremely hazardous substance No

Section 311 hazardous chemical Yes

Food and Drug Administration (FDA) Total food additive
Indirect food additive
GRAS food additive

Inventory status

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	Yes
Canada	Domestic Substances List (DSL)	Yes
Canada	Non-Domestic Substances List (NDSL)	No
China	Inventory of Existing Chemical Substances in China (IECSC)	Yes
Europe	European Inventory of New and Existing Chemicals (EINECS)	Yes
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	Yes
Korea	Existing Chemicals List (ECL)	Yes

Country(s) or region	Inventory name	On inventory (yes/no)*
New Zealand	New Zealand Inventory	No
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	Yes
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

A "Yes" indicates that all components of this product comply with the inventory requirements administered by the governing country(s)

State regulations WARNING: This product contains a chemical known to the State of California to cause cancer.

US - California Proposition 65 - Carcinogens & Reproductive Toxicity (CRT): Listed substance

QUARTZ (14808-60-7) Listed.

US - California Proposition 65 - CRT: Listed date/Carcinogenic substance

QUARTZ (14808-60-7) Listed: October 1, 1988 Carcinogenic.

US - Pennsylvania RTK - Hazardous Substances: Listed substance

QUARTZ (14808-60-7) Listed.

16. Other Information

Further information This safety datasheet only contains information relating to safety and does not replace any product information or product specification.

HMIS ratings

NFPA ratings Health: 1
Flammability: 0
Instability: 0

Disclaimer The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The manufacturer expressly does not make any representations, warranties, or guarantees as to its accuracy, reliability or completeness nor assumes any liability, for its use. It is the user's responsibility to verify the suitability and completeness of such information for each particular use.

Third party materials: Insofar as materials not manufactured or supplied by this manufacturer are used in conjunction with, or instead of this product, it is the responsibility of the customer to obtain, from the manufacturer or supplier, all technical data and other properties relating to these and other materials and to obtain all necessary information relating to them. No liability can be accepted in respect of the use of this product in conjunction with materials from another supplier. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

Issue date 18-August-2009

This data sheet contains changes from the previous version in section(s):
Hazards Identification: Eyes
Hazards Identification: Chronic effects
Composition / Information on Ingredients: Potential Compounds Formed
Composition / Information on Ingredients: Composition comments
Toxicological Information: Local effects
Toxicological Information: Chronic effects
Ecological Information: Ecotoxicity
Ecological Information: Environmental effects
Other Information: Disclaimer
Other Information: Other information
Other Information: Recommended restrictions

Other information CETCO is an AMCOL International company.

Appendix B – Propex Petromat® Product Information

PETROMAT®
BY PROPEX

Product Data
PETROMAT® 4598

PETROMAT® 4598 is a nonwoven polypropylene geotextile produced by Propex, and will meet the following Minimum Average Roll Values (MARV) when tested in accordance with the methods listed below. **PETROMAT 4598** is used as a moisture barrier and stress absorbing interlayer beneath asphalt overlay or a chip seal and exceeds AASHTO M288 requirements for paving fabric.

PETROMAT 4598 conforms to the property values listed below[1]. Propex performs internal Manufacturing Quality Control (MQC) tests that have been accredited by the Geosynthetic Accreditation Institute – Laboratory Accreditation Program (GAI-LAP).

			MARV[2]
PROPERTY	TEST METHOD	ENGLISH	METRIC
ORIGIN OF MATERIALS			
% U.S. Manufactured Inputs		100%	100%
% U.S. Manufactured		100%	100%
PHYSICAL			
Mass/ Unit Area	ASTM D-5261	4.1 oz/yd^2	139 g/m^2
MECHANICAL			
Grab Tensile Strength	ASTM D-4632	101 lbs	449 N
Grab Elongation	ASTM D-4632	50%	50%
Asphalt Retention	ASTM D-6140	0.20 gal/yd^2	0.9 l/m^2
Melting Point	ASTM D-276	320 °F	160 °C
ENDURANCE			
UV Resistance % Retained at 150 hrs	ASTM D-4355	70%	70%

NOTES:
1. The property values listed above are effective 04/2011 and are subject to change without notice.
2. Values shown are in weaker principal direction. Minimum average roll values (MARV) are calculated as the typical minus two standard deviations. Statistically, it yields a 97.7% degree of confidence that any samples taken from quality assurance testing will exceed the value reported.

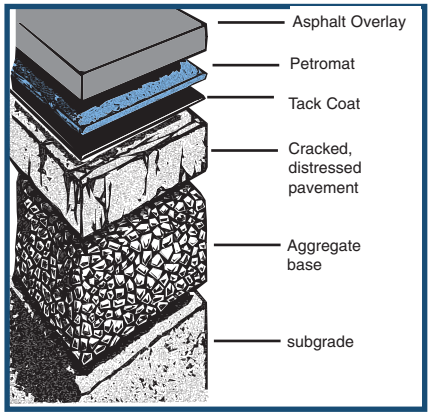
GEOTEXTILE SYSTEMS
BY PROPEX

ENGINEERING EARTH
www.geotextile.com

Propex Operating Company, LLC · 6025 Lee Highway, Suite 425 · PO Box 22788 · Chattanooga, TN 37422
ph 423 899 0444 · ph 800 621 1273 · fax 423 899 7619

Petromat®

Introduction



The Petromat® System extends the life of new asphalt concrete (AC) pavements and AC overlays. The Petromat System consists of Propex's Petromat non-woven polypropylene fabric which is field saturated with an asphalt cement tack coat. When placed between pavement layers, the Petromat system becomes an integral part of the roadway section, forming a barrier to water infiltration and absorbing stresses to reduce reflective and fatigue cracking of the new AC surface layer. Since 1965, the economical Petromat System has had an outstanding record of improving pavement performance while reducing maintenance and roadway life-cycle costs. Paving fabric systems are currently being used at a rate of over 15,000 equivalent lane miles per year in North America alone.

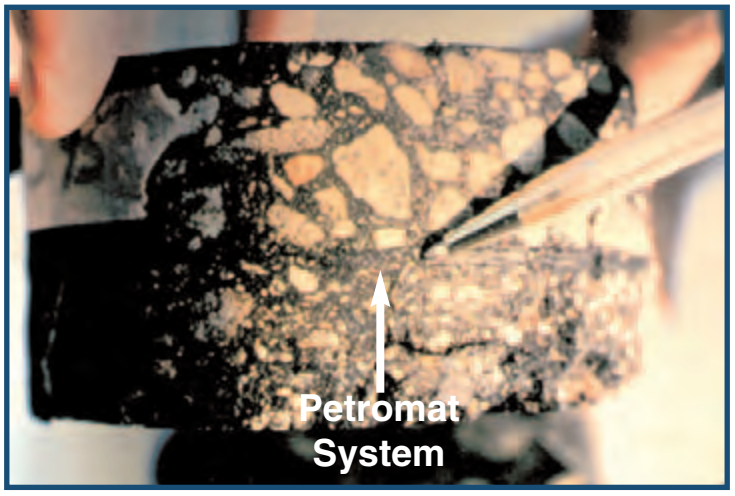
Benefits

Moisture Barrier

Function: The greatest source of damaging water in road structural sections is precipitation infiltration through pavements. Most pavements do not have adequate drainage systems to quickly remove infiltrated water. If a pavement base is saturated as little as 10% of the time, the useful life of that pavement will be reduced by 50%. The Petromat fabric, when saturated with the asphalt cement tack coat, becomes a moisture barrier in the pavement, minimizing surface water infiltration. The American Association of Highway and Transportation Officials (AASHTO) 1993 flexible pavement design methodology gives a substantial structural credit to unbound roadbase materials when they are well drained and not allowed to become saturated. By minimizing water infiltration, the Petromat System moisture barrier will keep the road base more well drained and will therefore maximize the structural strength of unbound roadbase materials.

In rehabilitation of an existing pavement, capping the surface with the Petromat System can be a much more efficient and cost effective way to control moisture problems than retrofitting edge drain systems to typically poor draining road bases.

Performance: Both laboratory and field testing have shown pavements to be 10 to 1000 times less permeable when the Petromat System is incorporated as an interlayer. A complete treatise on the need for pavement moisture control and the effectiveness of paving fabric systems as moisture barriers may be found as a Transportation Research Board (TRB) Circular and is summarized as Tech Note 4, by Propex Fabrics Inc.. The electronic circular, EC006, may be found on the TRB web site as an online publication at **"http://gulliver.trb.org/publications/circulars/ec006.html"**. Also shown in the referenced paper is the need for a uniform application of the proper amount of asphalt cement tack coat for the Petromat System to achieve the desired very low permeabilities.



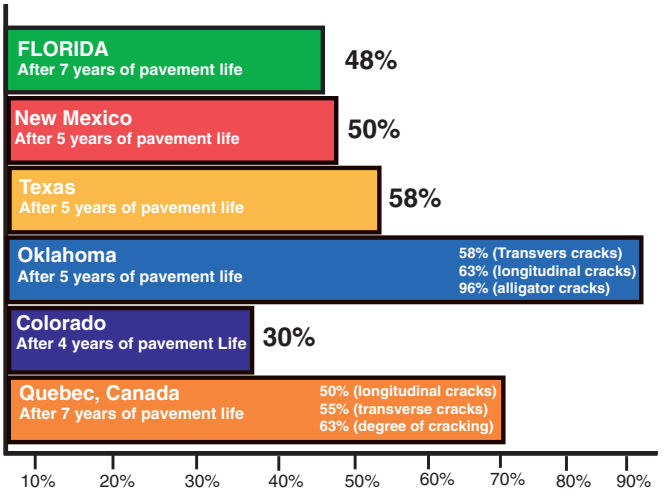
Stress Absorbing Interlayer

Function: Petromat paving fabric, saturated with asphalt cement, forms a substantial interlayer media within which stresses can be absorbed. Stresses associated with limited movement along cracks and joints in existing AC or Portland cement concrete (PCC) pavements are absorbed within the paving fabric system and therefore, are not translated, or reflected, up into the asphalt concrete layer over the system. If there is excessive movement of existing cracks or joints, there are more robust membrane interlayer products available, such as, Petrotac®, Pro-Guard®, or PetroGrid®, for pavement treatment. Also, asphalt concrete flexible pavement will eventually develop fatigue cracking due to tensile stresses while flexing. The inclusion of the Petromat System interlayer results in a layered pavement with greatly reduced tensile stresses compared to monolithic pavements with no interlayer. The result is a dramatic increase in the fatigue life of new pavements or overlays.

Performance: Laboratory simulation of comparable pavements both with and without the Petromat System indicated a 100 to 1000% increase in the number of pavement loadings before fatigue or reflective cracking appeared over the Petromat System. Field performance indicates a 50 to 150% increase in overlay life before fatigue or reflective cracking occurs in overlays over the Petromat System versus the same thickness control sections with no fabric. A comprehensive study, Maxim Technologies (1997), examined available paving fabric research and empirical evidence to find that properly applied paving fabric systems, such as the Petromat System, equate to an additional 0.1 to 0.15 foot (3 to 4.4 cm) thickness of AC overlay for the retardation of reflective

cracking. The study, which may be viewed at **"http://www.gmanow.com"**, cited both the moisture barrier environmental benefits and the stress absorbing interlayer functions as the reasons for success of paving fabric systems. The study is also summarized in Case Histories 10 and 11 as found on our website at **"www.geotextile.com"**. Widespread field evaluations have verified the effectiveness of the Petromat System as shown below:

Reduction In Overlay Reflective Cracking With The Petromat System Compared To Control Sections With No Fabric



Petromat, Number One In The Business

Petromat, the original paving fabric, is the most widely used paving fabric in the world for the following reasons:

Petromat is Designed Specifically For Pavement Application:

- a heat set side on top to minimize asphalt cement tack coat bleed-through and to protect against damage from construction traffic,
- a special blend of fiber sizes to promote rapid, uniform tack coat saturation and to give the interlayer stability while holding the asphalt cement in place indefinitely, and
- an engineered amount of stretch to ease installation while maintaining stability.

Choice of Styles: Petromat styles 4598 and 4599 are the most widely recommended and used paving fabrics. Style 4598 meets the requirements of AASHTO guideline specification M 288.

Cost-effective: The installed cost of the Petromat System (fabric and asphalt cement tack coat) is typically less than half the cost of 0.1 foot of AC. For extending pavement life, the Petromat System is therefore much less expensive than placing additional asphalt concrete to get the same performance or increasing roadway maintenance. Use of paving fabrics generally yields a savings in pavement rehabilitation system costs of more than $7,000 per lane mile.

Versatile: The Petromat System is effective within new AC pavements, below AC overlays over rigid and flexible pavements, and below surface treatment(chip-seal) pavements. It can improve the performance of highways, city streets, parking areas, airport pavements, bridge decks and other pavement surfaces.

Installation

Detailed information on the installation of Petromat paving fabrics may be found in the Petromat Installation Guide, also located on our website at “www.geotextile.com”.

Project Planning Help

We have software available called “**Roadways And Civil Engineering (R.A.C.E.)** with Geotextiles”. The software presents easy-to-use- unpaved road and flexible pavement design methologies. The third module of the software, Pavement Rehabilitation, allows the user to identify the type of pavement distress and then using a decision tree format, helps the user identify whether or not a geosynthetic interlayer will provide a longer lasting rehabilitation project. The recommendations help the user decide which geosynthetic interlayer would be most applicable and is based on many years of experience with the products such as Petromat. A copy of the **R.A.C.E**. software may be obtained from any of our distributors. You may locate your local distributor of our products on our website at **www.geotextile.com** or by calling (800) 445-7732.

Published Reports

Majidzadeh, K., *A Laboratory Investigation of Use of Petromat for Optimization of Pavement Performance*, Ohio State University, Nov 1976.

State of California, *Evaluation of Paving Fabric Test Installations in California*, Report No. FHWA/CA-90/02, CALTRANS, Deptartment of Transportation, Feb. 1990.

State of Florida, *Reduction of Reflective Cracking in Bituminous Overlays, Payne's Prairie Experimental Project*, Florida Department of Transportation, Office of Materials & Research, Research Report 176-A, State Project No. 26260-8426, June 1977.

State of New Mexico, *New Mexico Study of Interlayers Used in Reflective Crack Control*, New Mexico State Highway Department, Research Report MB-RR-84/1, Sept. 1984.

State of Oklahoma, The Evolution of Non-Woven Fabrics, Oklahoma Department of Transportation, Research & Development Divison, Report No. FHWA/OK 82(6), May 1982.

State of South Carolina, *Evaluation of Petromat When Used With Bituminous Surface Treatment*, South Carolina Department of Highways & Public Transportation, Research & Materials laboratory, In-House Study 82-5, Dec. 1990.

State of Texas, *Overlay Construction and Performance Using Geotextiles*, Texas Transportation Institute, Texas A&M University System, Paper No. 880424, Jan. 1989.

State of Virginia, *Control of Reflection Cracking in a Fabric-Reinforced Overlay on Jointed Portland Cement Concrete Pavement,* Virginia Highway & Transportation Research Council, VHTRC 83-R8, Aug. 1982.

City of Verdun, Quebec Canada, *Paving Fabric Repairs Road in Severe Canadian Climate*, Oct. 1995.

Maxim Technologies, Inc., *“Nonwoven Paving Fabrics Study”* for Industrial Fabrics Association International, Oct. 1997.
http://www.gmanow.com
Marienfeld, M.L. and Baker, T.L., *Paving Fabric Interlayer System as a Pavement Moisture Barrier*, Transportation Research Board Paper # 9881112, 1998,
http://www.nas.edu/trb/publications/ec006.html

Marienfeld, M.L. and Baker, T.L., *Field Installation Guidelines for Paving Fabrics,* Geosynthetic Institute Conference 15, December 2001

Propex Fabrics Inc.
260 The Bluffs
Austell, GA 30168
770-941-1711 800-445-7732
770-944-4584 - fax
email address:
geotextiles@propexfabrics.com
http://www.geotextile.com

PAVING FABRIC GUIDE SPECIFICATION

DESCRIPTION This work shall consist of furnishing and placing an asphalt overlay geotextile (paving fabric) beneath a pavement overlay or between pavement layers to provide a moisture barrier membrane and a stress absorbing interlayer.

MATERIAL REQUIREMENTS

Paving Fabric: will be a staple fiber, needle-punched, nonwoven material consisting of at least 85 percent by weight polyolefins, polyesters or polyamides. The paving fabric shall be resistant to chemical attack, rot and mildew and shall have no tears or defects that will adversely alter its physical properties. The fabric shall be specifically designed for pavement applications and be heat-set on one side to reduce tack coat bleed-through and to minimize fabric pick-up by construction equipment during installation. The fabric shall meet the physical requirements specified in Table 1.

Tack Coat: The tack coat used to impregnate the fabric and bond the fabric to the pavement is typically the same grade asphalt cement as used in the hot mix asphalt concrete. A cationic or anionic emulsion may be used as approved by the Engineer. The Contractor shall follow the special recommendations of the paving fabric manufacturer when an asphalt emulsion is used. The use of cutbacks or emulsions that contain solvents shall not be permitted.

CONSTRUCTION AND INSTALLATION REQUIREMENTS*

Shipping and Storage: The paving fabric shall be kept dry and wrapped such that it is protected from the elements during shipping and storage. If stored outdoors, the fabric shall be elevated and protected with a waterproof cover. The paving fabric shall be labeled in accordance with ASTM D 4873-88, “Standard Guide for Identification, Storage, and Handling of Geotextiles.”

Weather Limitations: The air and pavement temperatures shall be at least 50°F(10 °C) and rising for placement of asphalt cement and shall be at least 60°F(16 °C) and rising for placement of asphalt emulsion. Neither asphalt tack coat nor paving fabric shall be placed when weather conditions are not suitable, in the opinion of the Engineer.

Surface Preparation: The pavement surface shall be dry and thoroughly cleaned of all dirt and oil to the satisfaction of the Engineer. Cracks 1/8inch (3mm) wide or greater shall be cleaned and filled with suitable bituminous material or by a method approved by the Engineer. Crack-filling material shall be allowed to cure prior to placement of the paving fabric. Potholes and other pavement distress shall be repaired. Repairs shall be performed as directed by the Engineer. The paving fabric must be placed on a drainable grade with no depressions which may hold water in the overlying asphalt concrete.

Tack Coat Application: The tack coat shall be applied using a calibrated distributor truck spray bar. Hand spraying, squeegee and brush application may be used in locations where the distributor truck cannot reach. Every effort shall be made to keep hand application to a minimum. The tack coat shall be applied uniformly to the prepared, clean, dry pavement surface. The tack coat application rate must be sufficient to saturate the fabric and to bond the fabric to the existing pavement surface. The tack coat application rate shall be 0.22 to 0.28 (1.0 to 1.3 liters per square meter) gallons per square yard as required by the roadway surface and environmental conditions. When using emulsions, the application rate must be increased as directed by the Engineer to offset the water content of the emulsion. Within street intersections, on steep grades or in other zones where vehicle braking is common, the normal application rate shall be reduced by about 20 percent as directed by the Engineer, but to not less than 0.20 gallons per square yard (0.9 liters per square meter).

The temperature of the tack coat shall be sufficiently high to permit a uniform spray pattern. For asphalt cements, the minimum temperature shall be 290°F(143 °C). To avoid damage to fabric, distributor tank temperatures shall not exceed 325 °F(163 °C). For asphalt emulsions, the distributor tank temperatures shall be maintained between 130°F(55°C) and 160°F(71°C).

The target width of the tack coat application shall be equal to the paving fabric width plus 6 inches(152mm). Tack coat application shall be wide enough to cover the entire width of fabric overlaps. The tack coat shall be applied only as far in advance of paving fabric installation as is appropriate to ensure a tacky surface at the time of paving fabric placement. Traffic shall not be allowed on the tack coat. Excess tack coat shall be cleaned from the pavement.

Paving Fabric Placement: The paving fabric shall be placed onto the tack coat using mechanical or manual laydown equipment capable of providing a smooth installation with a minimum amount of wrinkling or folding. The paving fabric shall be placed before the asphalt cement tack coat cools and loses its tackiness. Paving fabric shall not be installed in areas where the overlay asphalt tapers to a minimum compacted thickness of less than 1.5 inches(38mm).

When asphalt emulsions are used, the emulsion shall be allowed to cure properly such that essentially no

*Note:
Additional instructions on paving fabric installation are available from Propex Fabrics Inc. in their Petromat® Installation Manual, which may be found at **http://www.geotextile.com.**

water moisture remains prior to placing the paving fabric. Wrinkles severe enough to cause folds shall be slit and laid flat. Brooming and/or rubber-tire rolling will be required to maximize paving fabric contact with the pavement surface. Additional hand-placed tack coat may be required at overlaps and repairs as required by the Engineer.

Turning of the paver and other vehicles shall be done gradually and kept to a minimum to avoid movement and damage to the paving fabric. Abrupt starts and stops shall also be avoided. Damaged fabric shall be removed and replaced with same type of fabric and a tack coat.

Joints and Overlaps: At joints, fabric rolls shall overlap by 1 to 6 inches(25 to 152mm). End joints and joints from repair of wrinkles should be made to overlap or "shingle" in the direction that the pavement overlay will be placed. Overlaps of adjacent rolls may be as great as 6 inches to accommodate variations between the width of the roadway and paving fabric. Excess fabric shall be cut and removed to ensure that overlaps of adjacent rolls do not exceed 6 inches(152mm). Additional tack coat shall be applied between all fabric overlaps. Any locations that do not have additional tack for the overlaps shall be corrected by manual placement of tack coat prior to overlay construction. **Unless otherwise approved by the Engineer, no traffic except necessary construction traffic will be allowed to drive on the paving fabric.**

Overlay Placement: Asphalt overlay construction shall closely follow fabric placement. All areas in which paving fabric has been placed should be paved during the same day. Excess tack coat that bleeds through the paving fabric shall be removed by broadcasting sand on the paving fabric . Excess sand should be removed before beginning the paving operation. In the event of rainfall on the paving fabric prior to the placement of the asphalt overlay, the paving fabric must be allowed to dry before asphalt concrete is placed. Overlay asphalt thickness shall meet the requirements for the contract drawings and documents. The minimum compacted thickness of the first lift of overlay asphalt shall not be less than 1.5 inches(38mm) in areas of paving fabric installation.

METHOD OF MEASUREMENT

Paving Fabric: The paving fabric will be measured by the square yard (square meters).

Tack Coat: Tack coat will be measured by the gallon (liter).

BASIS OF PAYMENT

Paving Fabric: The accepted quantities of paving fabric will be paid for at the contract unit price per square yard (square meter) in place.

Tack Coat: The accepted quantities of tack coat for the paving fabric will be paid for at the contract unit price per gallon (liter) complete in place.

Table 1 Physical Requirements of Paving Fabrics[1,2,3]

(Note to Specifier: Choose one fabric specification, delete the other)

		(Petromat Style 4599)		or	(Petromat Style 4598)	
Properties	**Test Method**	**American Standard**	**Metric Units**		**American Standard**	**Metric Units**
Mass per unit Area	ASTM D 3776	na	na		4.1 oz/yd^2	140 g/m^2
Tensile Strength	ASTM D-4632	90 lbs	0.400 kN		101 lb	0.450 kN
Tensile Elongation	ASTM D-4632	50%	50%		50%	50%
Asphalt Retention	ASTM D 6140	0.20 gal/yd^2	0.90 l/m^2		0.20 gal/yd^2	0.90 l/m^2
Melting Point	ASTM D 276-87	300 °F	149 °C		300 °F	149 °C
Surface Texture	VISUAL INSPECTION	Heat-Set On One Side			Heat-Set On One Side	

NOTES

1

2 Certification of conformance from paving fabric manufacturer may be required
All numerical values represent minimum average roll values (average of test results from any sampled roll in a lot shall meet or exceed the minimum values) in the weaker principal direction. Lot shall be sampled according to ASTM D 4354-89, "Practice for Sampling of Geosynthetics for Testing."

3 Comformance of paving fabrics to specification property requirements shall be determined in accordance with ASTM D 4759-88, "Practice for Determining the Specification Conformance of Geosynthetics."

INSTALLATION GUIDELINES

PETROMAT® PAVING FABRIC

PROPEX | THE ADVANTAGE CREATORS.™

GEOSYNTHETICS

CONTENTS

PART 1 – WHAT PETROMAT IS AND WHAT IT DOES

Petromat® is a nonwoven polypropylene fabric. When used in combination with an asphalt tack coat, the Petromat System forms an asphalt membrane interlayer within the pavement section. This layer acts as a barrier to surface water infiltration and limits softening of the subgrade and freeze-thaw damage, which could otherwise occur. The Petromat membrane interlayer also absorbs stresses, improving resistance to pavement fatigue and reflective cracking. These combined Petromat functions have been widely shown to extend the life of asphalt cement concrete overlays and chip seal surface treatments. Petromat also promotes longer pavement life in new asphalt cement concrete pavements.

The Petromat System was first introduced in 1966. Since that time, hundreds of millions of square yards of Petromat have been installed around the world. Over 100 million square yards of paving fabric are installed annually on thousands of jobs in the United States.

The key to the performance of the Petromat System is proper installation. This installation guide provides important information to help you install the Petromat System properly and safely. Because no guide can cover every installation challenge, an experienced representative is available through your Propex distributor to help with your special conditions.

INSTALLATION CHECKLIST FOR HOT MIX ASPHALT CONCRETE OVERLAYS

SURFACE PREPARATION

- Clean surface free of dirt, water and debris (page 8).
- Fill cracks greater than 1/8" (page 9).
- Correct areas of subgrade failure (pages 8, 9, 11).
- Portland cement concrete pavements require special care (page 10).

TACK COAT APPLICATION

- Uncut paving grade asphalt is preferred (page 5).
- Verify application rate between 0.20 gallons/square yard and 0.30 gallons/square yard (page 11).
- Check function of distributor truck (pages 6, 7, 12).
- Apply tack coat 2" to 3" beyond area of Petromat® placement (page 11).
- Do not allow traffic on tack coat (page 12).
- Special care is needed for emulsified asphalt tack coat (pages 5, 20).

PETROMAT® PLACEMENT

- Protect paving fabric from elements until ready to use (page 4).
- Install smooth side up, fuzzy side down (pages 13, 14).
- Verify even roll brake tension (page 14).
- Avoid sharp turns (pages 14, 17).
- Overlap joints 1" to 3" (page 14).
- Verify tack coat or emulsion is placed between all overlaps (page 14).
- Do not place more than can be paved in the same day (page 15).
- Allow only construction traffic on paving fabric (page 5).

OVERLAY PLACEMENT

- Apply a minimum of 1.5" of compacted asphalt concrete (page 15).
- Maximum asphalt temperature 325°F (page 15).

INSTALLATION CHECKLIST FOR CHIP SEAL/PAVING FABRIC SYSTEMS

SURFACE PREPARATION

- Clean surface free of dirt, water and debris (pages 8, 16).
- Fill cracks greater than 1/8" (pages 9, 16).
- Correct areas of subgrade failure (pages 8, 16).

TACK COAT APPLICATION

- Check function of distributor truck (pages 6, 7, 12).
- Verify residual asphalt tack coat application rate between 0.20 gallons/square yard and 0.30 gallons/square yard (page 16).
- Apply tack coat 2" to 3" wider than Petromat® (page 11).

PETROMAT® PLACEMENT

- Protect paving fabric from elements until ready to use (page 4).
- Install smooth side up, fuzzy side down (page 17).
- Verify even roll brake tension (page 17).
- Avoid sharp turns (pages 14, 15, 17).
- Overlap joints 1" to 3" (page 17).
- Verify tack coat or emulsion is placed between all overlaps (page 17).
- Do not place more than can be paved in the same day (page 15).
- Allow only construction traffic on paving fabric (page 5).

SANDING AND ROLLING

- Broadcast dry sand, 4 to 6 pounds per square yard (page 17).
- Roll with rubber-tire roller until the fabric is saturated with tack coat (page 17).

PLACEMENT OF CHIP SEAL

- Remove excess sand (page 17).
- Visually inspect fabric bond at all overlaps (page 17).
- Apply chip seal overspray. Increase application rate where paving fabric is dry (page 17).
- Place chips and roll according to local specifications (page 17).

PART II - MATERIALS AND EQUIPMENT FOR INSTALLATION

A. PETROMAT®

Material

The principal component of the Petromat System is the nonwoven paving fabric designed specifically for use in pavement rehabilitation projects. One side of the Petromat fabric is heat-set, or fused, to create a smooth surface. This heat-set side reduces bleed-through of the asphalt tack coat and also helps prevent fabric pick-up by trucks during hot weather installation. Both of these conditions cause problems with paving fabrics that are "fuzzy" on both sides. Petromat has a tight, needle-punched, nonwoven structure that absorbs and holds the asphalt tack coat to provide a durable, stable waterproofing membrane. Fabrics with looser Petromat rolls come in widths to match most roadway requirements. A sample specification for paving fabric is included in the Appendix to this installation guide.

Storage and Handling

Use care in handling and storing Petromat rolls to limit potential damage to the fabric. Petromat comes from the factory in a black plastic wrapper to protect the fabric from moisture and exposure to sunlight. The wrapper should be left intact around the roll for continued protection until the material is to be placed. Avoid getting moisture in the fabric as this can reduce bonding of the fabric to the pavement. Do not store Petromat rolls on the ground where rain or other runoff can get into the fabric.

Prolonged exposure to sunlight can cause degradation of paving fabric. We recommend protecting the fabric from sunlight and limiting exposure to less than two weeks. Petromat comes wound on a cardboard tube or core. Take care to avoid breaking this core. To protect the core during unloading, a pipe slightly smaller in diameter and length than the core can be inserted inside the roll. Do not drag or push the material off the truck onto the end of the roll. A pipe can also be inserted during installation of the paving fabric to prevent breaking the core of the roll. If the core breaks accidentally, the pipe will stiffen the core enough to place the fabric.

Temporary Traffic

Construction vehicle traffic will not damage the Petromat® fabric. However, truck and equipment drivers should maintain slow speeds while driving on the fabric. Care should be taken not to make any sudden starts, stops or turns.

Freshly installed paving fabric may have less skid resistance than dry pavement, and moisture can further reduce the skid resistance. Traffic should not be permitted on the paving fabric due to safety considerations. If it is necessary to allow traffic on the fabric before the overlay is placed, the surface should be sanded. The paving fabric surface is slippery when wet. All safety precautions, including but not limited to warning signs and speed reductions, should be taken to limit the possibility of a skidding hazard.

B. TACK COAT MATERIALS

The Petromat System consists of Petromat paving fabric combined with an asphalt cement tack coat. Each element depends on the other for optimum performance. The Petromat fabric provides durability to the tack coat, such that it performs its waterproofing function even when deformed.

The tack coat is a hot liquid asphalt seal applied to the pavement surface to saturate the paving fabric and bond it to the pavement. The quality of the asphalt cement tack coat is one of the most important factors in successful installation of the Petromat System. Poor placement technique or use of an inappropriate asphalt can lead to slipping of the pavement overlay or unsatisfactory waterproofing performance. Uncut paving grade asphalt cements (AC, AR or penetration grades) are preferred for use as the tack coat material. The most commonly used are AC-20 and AR-4000. The actual grade of asphalt cement will depend on the geographic area and the season.

Asphalt emulsions (RS or CRS grades) are not recommended, but can be used if necessary. If an emulsion must be used, it is important that a sufficient amount be applied such that the residual asphalt will provide the necessary coverage. Also allow sufficient time for the emulsion to cure before laying the Petromat fabric. More information regarding use of emulsified asphalts is provided in Part V of this installation guide.

Cutback asphalts (RC, MC and SC grades) or emulsions containing oil distillates should not be used for the tack coat. These materials contain solvents that can lead to instability of the overlay and are therefore unsuitable for use with Petromat fabric.

C. DISTRIBUTOR TRUCK

Uniform application of the tack coat is vital to ensure that the Petromat® fabric is saturated with asphalt and can provide its full waterproofing benefit. A distributor truck is preferred to obtain the most uniform tack coat application rate possible. The condition of the distributor truck should not be overlooked. Prior to beginning the job, check the spray nozzles on the truck to verify that a uniform spray is delivered.

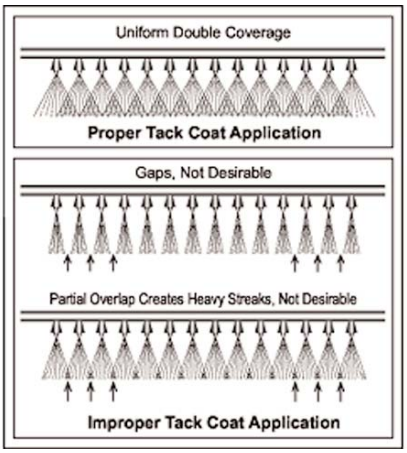


Figure 1: Distributor truck sprays.

The tack coat should not be applied with heavy spots, streaks or gaps. The height of the spray bar and spray nozzles can be adjusted to attain the correct spray width and overlap. (See Figure 1) If there is not room on the site to move a distributor truck, hand spray or use a squeegee to place the tack coat. If hand spraying or squeegee placement is used, pay careful attention to maintaining the proper amount and uniform tack coat application.

It is very important that the tack coat application rate be verified. The actual amount of tack coat on the pavement surface should be measured. This can be calculated based on the change in weight of the distributor truck, change in level gauge, on-board computer or other reliable metering system. Before relying on on-board metering systems, their sensitivity to the truck speed should be checked.

D. INSTALLATION EQUIPMENT

Experienced Petromat installers have a specially equipped tractor or distributor truck designed to place the paving fabric. This equipment has attachments to lay down and broom in the paving fabric and apply uniform tension as the laydown operation proceeds.

Like any piece of construction equipment, the laydown equipment should be in good condition. The equipment should have a roll brake at each end of the fabric boom to prevent uncontrolled unrolling of the paving fabric. The brake tension should be adjusted evenly to limit wrinkling of the fabric. The laydown equipment will often have brooms attached to smooth out the fabric as it is laid. The brooms should be in good condition. The laydown equipment may also have a tension bar to apply the paving fabric smoothly and keep wind from rolling up the edges of the fabric as it is laid. The tension bar can often be adjusted as needed to smooth out the paving fabric. Best results may be obtained if this bar is bowed out. (See Figure 2) If necessary, Petromat fabric can be installed by hand. In this case, insert a pipe through the core of the roll and use hand brakes at each end to apply tension to the fabric during the placement procedure.

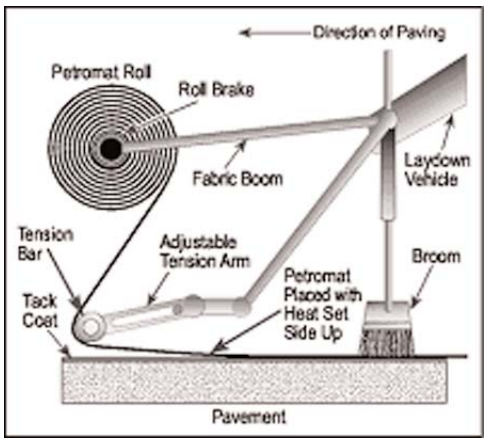


Figure 2: Components of laydown equipment.

E. MISCELLANEOUS EQUIPMENT

The following miscellaneous equipment may be useful during the Petromat fabric installation:

- Scissors, utility knife or other fabric-cutting device.
- Stiff bristle push brooms.
- Length of standard pipe, slightly shorter and smaller in diameter than the roll core, to insert inside the core when handling the fabric.
- Bucket and squeegee or small hand wand to apply asphalt on fabric joints and in areas not reached with the distributor truck.
- Rubber-tire roller to smooth fabric into the tack coat for chip seals, or to correct blisters or other loss of bond between the fabric and underlying pavement.
- Washed concrete sand (as prescribed).

PART III – INSTALLATION FOR HOT MIX ASPHALT CONCRETE OVERLAYS

A. APPLICATIONS

The most common use of the Petromat® System is as an interlayer for asphalt concrete hot mix overlays on existing asphalt pavements and on Portland cement concrete pavements. Petromat can be installed with new asphalt concrete pavements following similar procedures. This section presents detailed guidance for installation of the Petromat System in these applications.

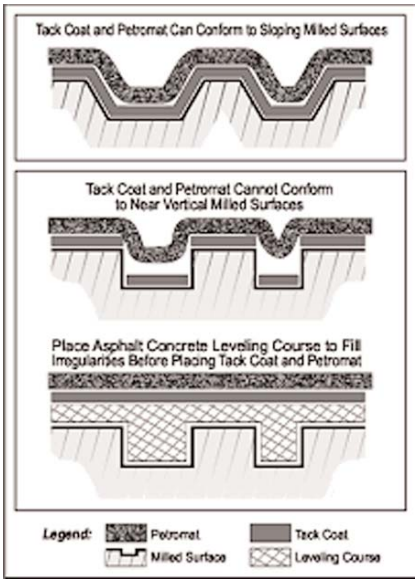


Figure 3: Preparation of milled or vertical surfaces.

B. PREPARATION OF ASPHALT CEMENT CONCRETE PAVEMENT SURFACES

Surface Preparation

The first step in the installation of the Petromat System on existing asphalt concrete pavements is the preparation of the pavement to receive the tack coat. Before beginning the project, determine what pavement surface preparation will be required. Give careful attention to areas that show signs of structural or subgrade distress, such as alligator cracking or pavement deformation. In these areas, the engineer should specify procedures for removing or stabilizing the questionable pavement area.

It is important that the surface on which the Petromat System is placed is dry and free of dirt. Sweep off accumulations of dust, debris, water, oil and other foreign matter. Power brooms may be helpful where large areas are to be resurfaced.

Sharp changes in the pavement surface should either be ground down or smoothed out with an asphalt concrete leveling course. The guiding principle is that the tack coat should be able to completely cover the pavement surface and the Petromat fabric conform to the surface.

Where grooves in milled pavements result in vertical surfaces, a leveling course will be required (Figure 3). When paving over a shoulder or other sharp edge, the surface should be ground down or a leveling course of asphalt mix used to smooth it out. Use a fine mix for the leveling course so that the tack coat can not sink into the pores.

CRACK TREATMENT

Cracks less than 1/8" wide do not require any special attention before application of the tack coat. Cracks from 1/8" to 3/8" should be filled with a liquid crack sealant so that the tack coat cannot seep down into the crack. Fill cracks larger than 3/8" with a more stable crack filler, such as hot or cold asphalt mix, emulsion slurry, or commercially available crack filler.

If the crack filler contains an emulsified asphalt or cutback asphalt, allow it to cure completely before placing the tack coat and Petromat® fabric. Otherwise, the paving fabric will form a membrane that can trap volatiles or moisture, leading to separation of the paving fabric from the pavement surface.

Fill cracks flush with or slightly below the existing pavement surface. If cracks are overfilled, such that the filler mounds up above the surface of the pavement, a noticeable bump in the pavement can result. This can lead to shoving of the overlay or bleeding of excess asphalt. (See Figure 4)

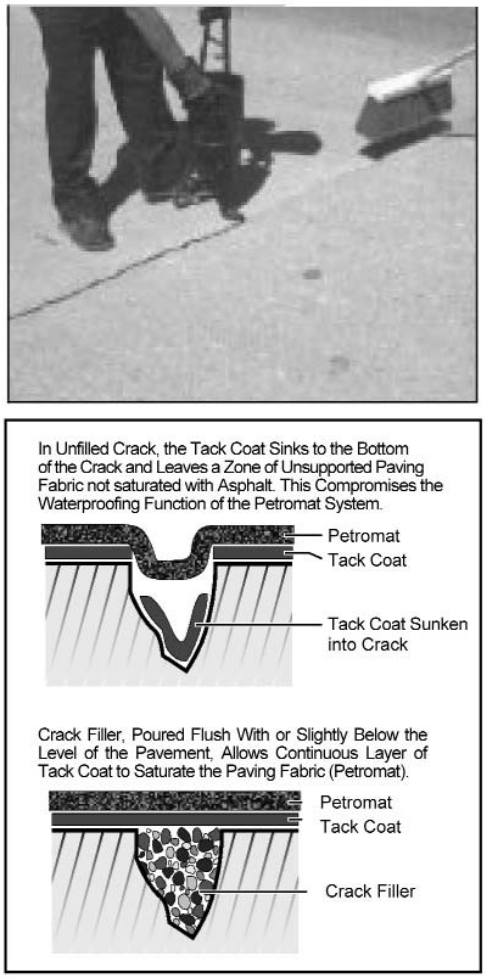


Figure 4: Crack treatment.

C. PREPARATION OF PORTLAND CEMENT CONCRETE PAVEMENT SURFACES

Inadequate pavement stability is one of the leading causes of early cracking of overlays with and without paving fabric. For the best performance of the overlay, there should be no differential movement at joints in the existing concrete pavement. Differential movement will result in early reflective cracking. It may not be possible to stabilize the joints sufficiently to obtain the full benefit from the Petromat System. In these cases, we recommend Propex's Petrotac® pavement repair composite membrane, which tolerate slightly more movement.

There are three approaches that may be used in applying the Petromat System over existing Portland cement concrete pavements. The approach depends on the condition of the existing pavement and the anticipated traffic volume. For best results, an asphalt concrete leveling course can be used over the Portland cement concrete pavement.

LIGHT TRAFFIC, STABLE PAVEMENT

In low-traffic volume areas, it may be possible to place the Petromat® System directly over the existing Portland cement concrete pavement. For this approach, the traffic volume should be less than about 5,000 vehicles per day with a low percentage of buses and other heavy vehicles. For good performance of the overlay, there should be no differential movement at cracks and joints. Clean the surface and fill cracks as described for asphalt cement concrete pavements.

Sharp changes in the pavement surface should be given special attention, as they may indicate an unstable concrete slab. Unstable areas must be stabilized before proceeding. Stable areas with sharp changes in grade should either be ground down or smoothed out with a leveling course of asphalt mix.

HEAVY TRAFFIC, STABLE PAVEMENT

Where traffic levels are relatively heavy but the concrete pavement is stable, a leveling course of asphalt concrete should be placed before the Petromat System is installed. In this approach, there should be no differential movement at joints and cracks in the Portland cement concrete.

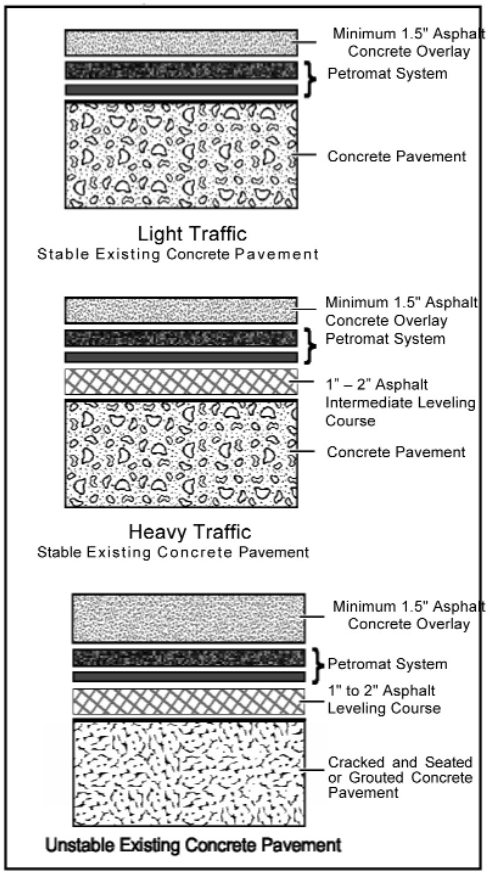


Figure 5: Portland Cement concrete pavement treatments.

This leveling course should be 1" to 2" thick. The asphalt concrete mix should leave a relatively smooth surface after compaction. Do not use an open, coarse mix, because this will allow the tack coat to seep down into the pores, leaving inadequate tack coat to saturate the paving fabric. (See Figure 5)

UNSTABLE PAVEMENT

Crack and seat or grout rehabilitation techniques should be used where the existing Portland cement concrete pavement experiences differential movement. In the crack and seat approach, the existing pavement is typically broken into sections about 3' to 6' square. The broken surface is then rolled in place with a heavy roller to provide a stable surface.

After stabilizing the concrete, an asphalt hot mix leveling course is placed. The leveling course should be 1" to 2" thick. The leveling course asphalt mix should not be so coarse and open as to allow the tack coat to seep into the pore spaces. The Petromat System and overlay may then be installed.

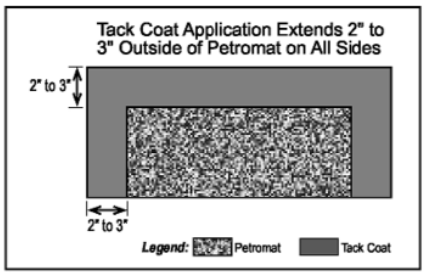
D. NEW PAVEMENTS

Petromat® fabric can be used with new asphalt concrete pavement construction to limit water infiltration and prolong pavement life. The paving fabric should be placed in the pavement section about one-third to one-half of the way up from the bottom. There should be at least 1.5" of compacted asphalt over the fabric. The asphalt concrete on which the Petromat fabric is placed should be relatively densely graded to limit loss of tack coat.

E. TACK COAT PLACEMENT

TACK COAT AMOUNT

It is critical that the tack coat be applied correctly. Excessive or insufficient tack coat can lead to shoving or delamination of the overlay. The leading cause of poor performance of overlays with paving fabric is placement of an insufficient amount of tack coat.



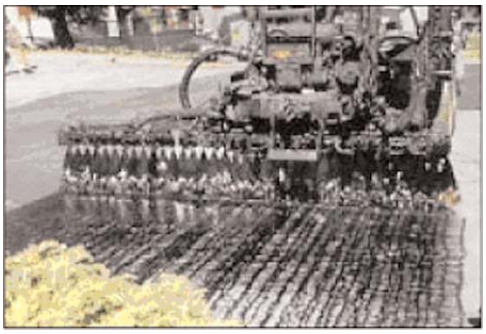
TACK COAT APPLICATION

The tack coat should extend beyond the paving fabric by 2" to 3" on all sides. Tack coat should also be applied between all fabric overlaps. A tack coat application rate of 0.25 gallons per square yard is required with Petromat fabric under most conditions when using an uncut paving grade asphalt tack coat. A minimum application rate of 0.22 gallons per square yard is required to saturate the Petromat fabric and bond it to the pavement surfaces. It is critical not to apply excess tack coat in locations where vehicles do a lot of hard starting, stopping and turning or on steep grades (greater than 8%). These areas include intersections, bus stops and sharp turns. In these locations, the maximum tack coat application rate should be limited to 0.20 to 0.25 gallons per square yard. Applying less tack coat than the above recommended amounts can result in construction problems or long-term pavement performance problems.

TABLE 1: GALLONS OF UNCUT PAVING GRADE ASPHALT TACK COAT PER MILE OF ROAD

Width of Application (Feet)	Tack Coat Application Rate		
	0.20 gallons/ Square Yard	0.25 gallons/ Square Yard	0.30 gallons/ Square Yard
8	940	1170	1410
10	1170	1470	1760
12	1410	1770	2110
14	1640	2050	2460
16	1880	2350	2820
20	2350	2930	3520
24	2820	3520	4220
30	3520	4400	5280

Also, the application rate should not exceed 0.30 gallons per square yard, as this may lead to overlay rutting and shoving. The optimum application rate depends on a number of factors including: pavement roughness, pavement porosity, and whether or not a leveling course is used. In general, more tack coat is needed for rough and porous pavements. Less tack coat is typically needed when placing Petromat over a fine mix asphalt leveling course. Experienced Petromat® fabric installers are able to adjust the tack coat application rate within the range of 0.20 to 0.30 gallons per square yard to achieve optimum pavement performance and ease of construction. Table 1 gives the tack coat volume for one mile of road of varying widths, assuming the use of uncut paving grade asphalt tack coat.



Close-up of unacceptable streaks of asphalt tack coat (refer to Part II C of this brochure).

The tack coat volume can be monitored using the mechanical or visual gauging system on the distributor equipment. The truck weight tickets can be used to verify the application rate.
Before applying the tack coat, it is important to verify proper operation of the distributor truck. The distributor truck should apply an even and uniform spray of tack. An accumulation of tack may build up where the distributor truck starts and stops. Accumulations of excessive tack coat can lead to overlay rutting and shoving. Consequently, starting and stopping should be kept to a minimum and squeegees should be used to spread any accumulated tack. Construction traffic should be kept off the tack coat before the Petromat fabric is placed. Traffic can pick up the tack coat, leaving insufficient tack coat to saturate the paving fabric and bond it to the pavement and the new overlay.

TACK COAT TEMPERATURE

The temperature of the asphalt tack coat should be high enough to allow uniform tack coat application. The allowable temperature range for uncut paving grade asphalt cement tack coat material is 290°F to 325°F. These temperatures correlate with widely accepted temperatures for asphalt placement.

AIR TEMPERATURE

Most state and local agencies have specifications for the minimum temperature for placement of asphalt tack coats and hot mixes, and the applicable specifications should be followed. In the absence of such specifications, the following guidelines are offered. For uncut paving grade asphalt cement tack coat materials, the air temperature should be sufficient to allow adequate "tack" or stickiness to hold the fabric in place. This temperature will vary for different asphalt types. As a rule-of-thumb, the temperature should be 50°F and rising.

F. PETROMAT® FABRIC PLACEMENT

TEMPERATURE

The surface temperature of the tack coat at the time that the Petromat fabric is placed should not exceed 325°F. The temperature of the tack coat drops very quickly after it contacts the pavement surface, so this is generally not a consideration. When uncut paving grade asphalt cement tack coat is used, the fabric can usually be placed closely behind the distributor truck. Place the paving fabric while the tack coat is still sticky enough to hold the fabric in place. Paving fabric can be placed after the tack coat has lost its stickiness, but pneumatic rolling may be necessary to keep the material in place. The heat of the overlay will then soften and draw the asphalt tack up into the paving fabric. In very hot weather, (in excess of 100°F, 38°C) it helps to let the asphalt tack coat firm up before placing the fabric, while in cool weather, the fabric should be placed into the tack coat immediately.

PAVING FABRIC PLACEMENT - MECHANICAL

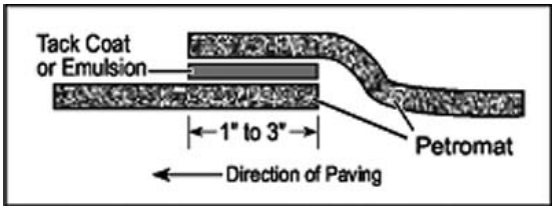
Petromat fabri has a fuzzy side and a relatively smooth, heat-set side. Install the fabric with the fuzzy side down into the tack coat. With the smooth side up, fabric pick-up by construction equipment and bleed-through of the tack coat will be minimized. For ease of installation, the fabric is rolled at the factory with the fuzzy side "in" so that it can easily be installed correctly when using lay- down equipment. A pipe slightly smaller in diameter and length than the roll core can be inserted into the roll. This adds strength and helps the core resist buckling, especially if the core was accidentally broken during handling.

Initially, hold the Petromat® fabric in place at the beginning point and unroll about 20' to 50' of fabric into the tack coat. The material should be lined up with the tack coat and installed as smoothly as possible.
During placement, turns of the laydown equipment should be made gradually to limit wrinkling of the fabric. Avoid moving equipment on the paving fabric before the overlay is placed. This can cause wrinkles in the paving fabric and in extreme instances can rip the fabric. The fabric roll brakes should be adjusted evenly. Poorly adjusted brakes result in uneven tension in the paving fabric, which can cause wrinkles during placement. Petromat fabric can be placed on slopes of up to about 8%. On steeper slopes, it may be difficult to compact the asphalt overlay without slippage. Take extra precaution when maneuvering installation equipment on slopes.

PETROMAT PAVING FABRIC PLACEMENT - MANUAL
When installing the paving fabric by hand, use hand brakes to maintain tension on the fabric and minimize wrinkling. Do not rest the Petromat roll on the pavement and roll it out. This will not provide adequate tension on the fabric and will also incorrectly place the smooth, heat-set side down into the tack coat.

The fabric should be broomed in, working from the center out, to smooth the fabric into the tack coat. When placing the paving fabric by hand, the tack coat may have cooled such that the fabric does not adhere well. Under these circumstances, it may be helpful to roll the installed paving fabric using a rubber-tire roller to promote adhesion to the pavement.

JOINTS AND OVERLAPS
Tack coat should be applied between all overlaps. At joints, overlap the fabric by 1" to 3". End joints should be made to overlap or "shingle" in the direction that the pavement overlay will be placed. Adjacent rolls should also overlap 1" to 3". Overlaps of adjacent rolls may be greater than 3" in some cases, depending on the width of the road. However, adjacent rolls should not have overlaps wider than 6". Do not overlay on joints or overlaps that do not have tack coat between the overlapping fabrics. Care should be taken to limit excessive tack or emulsion beyond the overlap.



Joints and overlaps.

DRAINS, EXPANSION JOINTS AND OTHER PENETRATIONS

At drains, expansion joints or other penetrations, Petromat® paving fabric can be placed over the opening. After the fabric is in place, cut out the excess fabric around the inside of the opening.

CURVES

Sharp curves may be encountered that will not allow mechanical paving fabric placement without wrinkles. In this condition, it may be desirable to cut and piece the paving fabric around the curve. The joints in this procedure should be treated as with other overlaps mentioned previously.

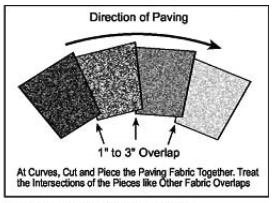


Figure 8 **PETROMAT PLACEMENT AROUND CURVES**

Placement around curves.

G. OVERLAY PLACEMENT

The asphalt concrete overlay can be placed immediately after the Petromat fabric has been installed. No cure time is necessary when using an uncut paving grade asphalt tack coat, and there is no need for additional tack coat application before paving. Installation of the Petromat System by an experienced crew will easily stay well ahead of paving operations. However, no more paving fabric should be placed than will be covered in the same day by the paving crew.

A maximum temperature for the hot mix will usually be dictated by the governing state or local agency. In the absence of such specification, the maximum temperature allowed should not exceed 325°F at the time of placement.

The overlay should be designed based on the condition of the pavement and the anticipated traffic. A minimum compacted thickness of 1.5" is required. Thinner overlays will not generate enough heat to draw the asphalt tack coat up into the paving fabric and produce a waterproof membrane. If the overlay thickness is tapered toward the edges, Petromat fabric should not be placed where the thickness tapers to less than 1.5", or the edge should be milled to allow a minimum 1.5" overlay thickness to the edge.

PART IV – INSTALLATION OF CHIP SEAL/PAVING FABRIC SYSTEMS

A. APPLICATIONS

Petromat® fabric can be used with chip seals as a cost-effective maintenance solution for low volume pavements. A chip seal/paving fabric system consists of aggregate chips embedded in an asphalt binder and placed over an asphalt-saturated paving fabric. The Petromat paving fabric provides an excellent seat for the chips and forms a continuous, long-lasting, waterproofing membrane. The primary difference between this application and use with hot mix asphalt concrete overlays is that the chip seal procedure does not generate enough heat to draw the tack coat up into the paving fabric. Additional measures, such as rolling the fabric and placing a second tack coat, are used to fully saturate the paving fabric.

B. SURFACE PREPARATION

Surface preparation for chip seal overlays follows the procedures given in Part II B for hot mix overlays. The surface on which the Petromat fabric will be placed should be free of dirt, debris, water, oil and loose stone. A power broom may be helpful in preparing the roadway surface. areas showing signs of subgrade distress should be repaired. Cracks greater than 1/8" should be sealed with a liquid crack sealant. Where cracks greater than 3/8" are present, a more stable crack filler should be used such as hot or cold asphalt mix or commercial crack filler.

C. TACK COAT PLACEMENT

The tack coat for this application can be either an uncut paving grade asphalt cement or an emulsified asphalt. Again, a pure uncut asphalt cement is recommended instead of the emulsion. The tack coat should provide enough asphalt to saturate the paving fabric and bind the Petromat fabric to both the existing pavement surface and new surface treatment.

Use of an uncut paving grade asphalt tack coat will follow the same guidelines given in Part II E. Under normal conditions the tack coat application rate for the Petromat fabric should be 0.25 gallons per square yard of uncut paving grade asphalt cement. A greater amount of tack coat is needed for rough and porous surfaces. Less tack coat is typically needed when placing the fabric over a smooth surface. An experienced Petromat installer can evaluate project requirements and adjust the application rate as necessary. The tack coat application rate should be within the range of 0.20 to 0.30 gallons per square yard of residual asphalt.

When an emulsion is used, the application rate must be increased to allow for complete evaporation of water and additives in the emulsified asphalt. The residual asphalt coverage, after curing, should be 0.25 gallons per square yard. Emulsified asphalt curing time can become critical. The length of time required for all the water and additives to evaporate is highly dependent on the type of emulsion and weather conditions.

Additional details for use of emulsified asphalts are given in Part V.

Uncut paving grade asphalt tack coats should be placed at temperatures of 290°F to 325°F. Emulsified asphalt tack coats should be applied at temperatures below 160°F.

D. PETROMAT® PAVING FABRIC PLACEMENT

The paving fabric should be placed into the tack coat smoothly and without wrinkles. Place the fuzzy side of the Petromat fabric down. With the smooth side up, fabric pick-up by construction equipment is limited. Fabric roll brakes should be adjusted to provide even tension. Poorly adjusted brakes can cause wrinkles in the fabric. Turns of the installation equipment should be made gradually to avoid wrinkling.

Overlaps of the Petromat fabric should be kept to a minimum when used with chip seal pavements. Tack coat should be applied between all overlaps. At joints, overlap the fabric by 1" to 3". Adjacent rolls should also overlap 1" to 3". Overlaps of adjacent rolls may be greater than 3" in some cases, depending on the width of the road. However, adjacent rolls should never have overlaps wider than 6". Do not apply chip seal treatment on joints or overlaps that do not have tack coat between the overlapping fabrics. Care should be taken not to spray excessive tack or emulsion beyond the overlap.

E. SANDING AND ROLLING

Chip seal pavements require sanding and rolling once the Petromat fabric has been placed. A uniform layer of sand is applied to the fabric at the rate of 4 to 6 pounds per square yard. The sanded fabric is thoroughly rolled using a rubber-tire roller. This step is important to ensure a strong bond between the paving fabric and the pavement and at overlap joints. During the rolling operation, the tack coat should be observed to come up from beneath and saturate the paving fabric, changing the fabric color from gray to a dark brown or black.

F. CHIP SEAL PLACEMENT

The next step is to sweep off any accumulations of sand or debris. Prior to chip seal application, inspect the fabric to verify that it is adhered to the pavement and that overlaps are tightly bonded. Apply additional tack to any loose overlaps and reroll as necessary to saturate overlap and achieve a good bond. The chip seal is then placed following procedures dictated by state or local agencies. This usually involves a tack of emulsified asphalt into which chip stone is immediately set and secured by rolling. In areas where the paving fabric appears to be dry or not fully saturated, the chip seal tack coat application should be increased by about 0.1 gallons per square yard. Do not use cutback asphalts for the overspray. Finally, roll the surface to stabilize the chips and embed them in the tack coat. A rubber-tire roller is often used to minimize breaking of the chips.

PART V – SPECIAL CONSIDERATIONS

A. EMULSIFIED ASPHALT TACK COATS

Emulsified Asphalts Uncut paving grade asphalt cement is the preferred tack coat for use in the Petromat® System. Emulsified asphalt tack coats can be used with the Petromat System; however, there are several construction-related concerns that make emulsions difficult to use. These include the relatively long curing time required for emulsions and the higher volume of tack coat that must be applied.

Emulsified asphalts are a blend of asphalt and water. The asphalt content may be only 50% to 70% of the total emulsion. Emulsions must be applied at a high rate to ensure the required residual asphalt coverage after the water has evaporated. For example:

1. Emulsion has 60% by volume asphalt content.
2. A tack coat with a residual asphalt coverage of 0.25 gallons per square yard is required.
3. The required emulsion application rate = 0.25 ÷ 0.6 = 0.42 gallons per square yard.

Emulsions are relatively free-flowing at these high application rates. They will tend to run off comparatively gentle slopes or uneven pavements, leaving no asphalt on the high points and an excess of asphalt in low spots.

The curing time for emulsified asphalt tack coats can become critical. Sufficient time must be allowed for all water and any additives to evaporate. The length of time necessary is dependent on the type of emulsion, whether rapid setting (RS, CRS), medium setting (MS, CMS) or slow setting (SS, CSS). Weather conditions also affect the curing time significantly. The medium- and slow-setting emulsions (MS, CMS, SS and CSS) require much longer curing times, which makes them impractical for use with paving fabrics. Table 2 provides cure time guidelines for rapid-setting emulsions.

TABLE 2: CURING TIME FOR RAPID-SETTING EMULSIFIED ASPHALTS (RS & CRS)

Air Temperature	Humidity		
	Dry	Moderate	Humid
60°F	2 hrs.	3 hrs.	4 hrs.
75°F	1 hrs.	2 hrs.	3 hrs.
90°F	0.5 hr.	1 hr.	2 hrs.

When cured, the surface will be tacky, and the color will have changed from an initial brown hue to glossy black. In windy weather, the surface of an emulsified asphalt tack coat may cure without the full thickness curing. Before installing the fabric, check carefully that the emulsion has cured thoroughly and not just skinned over.

When emulsified asphalt tack coats are used, the air temperature should be 60°F and rising. Cool temperatures lengthen the time that it takes for the tack coat to cure. The temperature of the asphalt emulsion itself should not exceed 160°F.

B. WET CONDITIONS

There is always a risk of poor bonding within the pavement system if moisture is present during construction. This is also true when paving fabrics are used. Therefore, Propex recommends the existing pavement surface, tack coat, and the Petromat® fabric be completely dry during construction. If the pavement surface is wet when the tack coat is placed, the tack coat may not properly bond to the existing pavement, leading to an unsatisfactory installation. We do not recommend placing the asphalt tack coat on a wet pavement surface.

If the surface of the tack coat becomes wet before the paving fabric is placed, squeegee standing water off the surface and allow the surface to dry before placing the fabric. Rolling the fabric with a rubber-tire roller may be required to improve adhesion. Petromat fabric should not be placed on wet tack coat.

Propex also recommends that the Petromat fabric be completely dry prior to placement of the overlay. However, if the fabric is slightly damp to the touch, an overlay can be placed. If free water can be forced from the paving fabric or is beaded on the surface, allow the fabric to dry before placing the overlay. A squeegee or broom can be used to force the water out of the paving fabric to help accelerate the drying process. Rain will sometimes cause a blistered appearance in the Petromat fabric surface. If this occurs, the fabric should be rolled down with a rubber-tire compactor before the overlay is placed.

C. RECYCLING OF PAVEMENTS CONTAINING PETROMAT PAVING FABRIC

If pavements containing Petromat fabric are to be recycled, we recommend that the milling machine does not cut deep enough to penetrate the Petromat System, so that the waterproof, stress-relieving interlayer remains intact. If a pavement containing Petromat fabric must be recycled, field studies have shown that standard cold milling techniques can be used in the recycling operation. Satisfactory performance has been obtained at proportions of up to 70% recycled pavement (containing Petromat) to 30% virgin hot mix.

PART VI – TROUBLESHOOTING GUIDE

A. WRINKLES

Wrinkles may be formed during placement of the Petromat® paving fabric. Causes include out-of adjustment roll brakes on the laydown equipment, sharp turns of the laydown equipment and maneuvering of equipment on the paving fabric. Wrinkles that result in three layers of fabric should be repaired. Generally, these wrinkles will be more than 1" high. They should be slit and laid flat in the direction of paving. Extra tack coat should be placed at the location of the overlap. Wrinkles less than 1" high are usually not a problem and can be left in place.

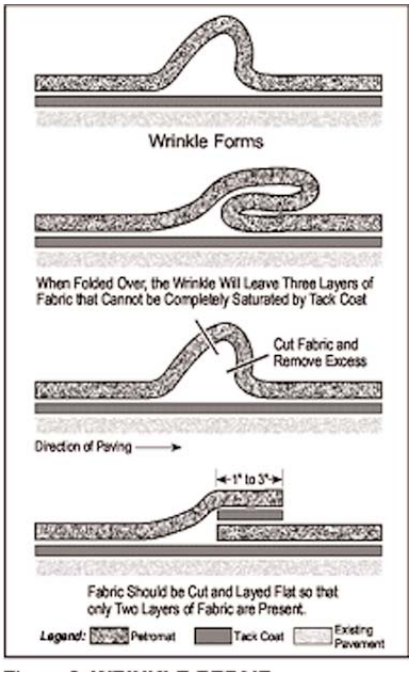


Figure 6: Wrinkle repair.

B. TRUCKS PICK UP FABRIC

In hot weather, construction traffic may pick up the paving fabric. The Petromat fabric is designed with a fuzzy (beard) side and a smooth (heat-set) side. Install the fabric with the smooth (heat-set) side up to limit the potential for trucks to pick up the fabric. If this problem does occur, broadcast sand or hot mix over the fabric. Be sure to sweep off any excess sand before placing the asphalt concrete overlay. The amount of tack coat should not be reduced to remedy this condition, unless it exceeds the previously prescribed rate of application. It is also possible to go to a stiffer grade of asphalt tack coat material, such as from an AR-4000 to an AR-8000, to reduce this problem. This minimizes asphalt seeping through the paving fabric and sticking to the tires of the equipment.

C. BLISTERS

Blisters may form under the paving fabric before overlay construction if the pavement is saturated with water. This must be corrected before the overlay is placed, or they can cause delamination of the overlay. Blisters can be treated by rolling the paving fabric with a rubber-tire roller until the fabric adheres to the pavement surface. If it is suspected that the subgrade is thoroughly saturated, it may be necessary to install drainage.

D. EXCESS TACK COAT AND BLEED-THROUGH

Bleed-through occurs when excess tack coat material seeps through the asphalt concrete overlay to the surface. This can happen even when relatively thick overlays are used. Bleed-through can soften the overlay mix and cause rutting and shoving of the overlay.

Bleeding can occur where the distributor truck stops and starts, leaving a thick spot in the tack coat. Improper adjustment of the spray bar can leave heavy streaks of tack coat, also leading to bleed-through. During tack coat application, check adjustment of the equipment and keep the distributor truck moving, limiting starting and stopping. Use a squeegee to spread any excess tack coat before it cools. Alternatively, blot up any heavy spots in the tack coat using dry sand. Broadcast the sand over the heavy spots and then sweep away excess.

E. OVERLAY DELAMINATION OR SHOVING

Historically, overlay delamination or shoving is the leading cause of the very few complaints received on the service of pavements containing Petromat® paving fabric. The main cause of overlay delamination or shoving is insufficient tack coat. If the tack coat is too light to saturate the paving fabric and adhere it to the pavement, there will be a dry layer at the fabric/pavement interface. In extreme cases, the overlay may literally peel off the old pavement. It is critical to check and verify the uniformity and quantity of the tack coat spray from the distributor at the beginning of the job and at intervals throughout the operation. Also be sure the pavement and paving fabric are dry during construction and prior to overlay placement.

F. DIFFICULTY BONDING FABRIC TO PAVEMENT

Rolling with a rubber-tire roller can improve adhesion of the Petromat paving fabric to the tack coat in a number of situations. Rolling can be particularly helpful when the tack coat has cooled and in locations where the tack coat has been reduced, such as at intersections. In these and other situations, a rubber-tire roller applies a uniform pressure across the fabric to set it into the tack coat. However, rolling should not be used as a substitute for placing the amount of tack coat prescribed in this document.

APPENDIX

PAVING FABRIC GUIDE SPECIFICATION*

DESCRIPTION
This work shall consist of furnishing and placing an asphalt overlay geotextile (paving fabric) beneath a pavement overlay or between pavement layers to provide a water-resistant membrane and crack-retarding layer.

MATERIAL REQUIREMENTS
Paving Fabric: The paving fabric will be a staple fiber, needle-punched, nonwoven material consisting of at least 85 percent by weight polyolefins, polyesters or polyamides. The paving fabric shall be resistant to chemical attack, rot and mildew and shall have no tears or defects that will adversely alter its physical properties. The fabric shall be specifically designed for pavement applications and be heat-set on one side to reduce bleed-through of tack coat and to minimize fabric pick-up by construction equipment during installation. The fabric shall meet the physical requirements specified in Table 1.

Tack Coat: The tack coat used to impregnate the fabric and bond the fabric to the pavement shall be the same grade asphalt cement as used in the hot mix asphalt. A cationic or anionic emulsion may be used as approved by the engineer. The contractor shall follow the recommendations of the paving fabric manufacturer when an asphalt emulsion is used. The use of cutbacks or emulsions that contain solvents shall not be permitted.

CONSTRUCTION AND INSTALLATION REQUIREMENTS
Shipping and Storage: The paving fabric shall be kept dry and wrapped such that it is protected from the elements during shipping and storage. If stored outdoors, the fabric shall be elevated and protected with a waterproof cover. The paving fabric shall be labeled in accordance with ASTM D 4873-88, "Standard Guide for Identification, Storage, and Handling of Geotextiles."

Weather Limitations: The air and pavement temperatures shall be at least 50°F and rising for placement of asphalt cement and shall be at least 60°F and rising for placement of asphalt emulsion. Neither asphalt tack coat nor paving fabric shall be placed when weather conditions are not suitable, in the opinion of the Engineer.

Surface Preparation: The pavement surface shall be dry and be thoroughly cleaned of all dirt and oil to the satisfaction of the engineer. Cracks 1/8" wide or greater shall be cleaned and filled with suitable bituminous material or by a method approved by the Engineer. Crack-filling material shall be allowed to cure prior to placement of paving fabric. Potholes and other pavement distress shall be repaired. Repairs shall be performed as directed by the Engineer.

Tack Coat Application: The tack coat shall be applied using a calibrated distributor spray bar. Hand spraying, squeegee and brush application may be used in locations where the distributor truck cannot reach. Every effort shall be made to keep hand spraying to a minimum.

* Note: This specification is for an overlay application, not for a chip seal treatment. For a chip seal specification, please contact Propex Inc.

The tack coat shall be applied uniformly to the prepared, dry pavement surface. The tack coat application rate must be sufficient to saturate the fabric and to bond the fabric to the existing pavement surface. The tack coat application rate shall be 0.22 to 0.30 gallons per square yard as required by the roadway surface and environmental conditions. When using emulsions, the application rate must be increased as directed by the engineer to offset the water content of the emulsion. Within street intersections, on steep grades or in other zones where vehicle speed changes are common, the normal application rate shall be reduced by about 20 percent as directed by the engineer, but to not less than 0.20 gallons per square yard.

The temperature of the tack coat shall be sufficiently high to permit a uniform spray pattern. For asphalt cements, the minimum temperature shall be 290°F. To avoid damage to the fabric, distributor tank temperatures shall not exceed 325°F. For asphalt emulsions, the distributor tank temperatures shall be maintained between 130°F and 160°F.
The target width of the tack coat application shall be equal to the paving fabric width plus 6". Tack coat application shall be wide enough to cover the entire width of fabric overlaps. The tack coat shall be applied only as far in advance of paving fabric installation as is appropriate to ensure a tacky surface at the time of paving fabric placement. Traffic shall not be allowed on the tack coat. Excess tack coat shall be cleaned from the pavement.

Paving Fabric Placement: The paving fabric shall be placed onto the tack coat using mechanical or manual laydown equipment capable of providing a smooth installation with a minimum amount of wrinkling or folding. The paving fabric shall be placed before the asphalt cement tack coat cools and loses its tackiness. Paving fabric shall not be installed in areas where the overlay asphalt tapers to a minimum compacted thickness of less than 1.5".
When asphalt emulsions are used, the emulsion shall be allowed to cure properly such that essentially no water moisture remains prior to placing the paving fabric. Fabric wrinkles severe enough to cause folds shall be slit and laid flat. Brooming and/or rubber-tire rolling will be required to maximize paving fabric contact with the pavement surface. Additional hand-placed tack coat may be required at overlaps and repairs as required by the engineer.
Turning of the paver and other vehicles shall be done gradually and kept to a minimum to avoid movement and damage to the paving fabric. Abrupt starts and stops shall also be avoided. Damaged fabric shall be removed and replaced with the same type of fabric and a tack coat.

Joints and Overlaps: At joints, fabric rolls shall overlap by 1"to 3". End joints and joints from repair of wrinkles should be made to overlap or "shingle" in the direction that the pavement overlay will be placed. Overlaps of adjacent rolls may be as great as 6" to accommodate variations between the width of the roadway and the paving fabric. Excess fabric shall be cut and removed to ensure that overlaps of adjacent rolls do not exceed 6". A uniform application of tack coat shall be applied between all fabric overlaps. Any locations that do not have tack between the overlaps shall be corrected by manual placement of tack coat prior to overlay construction.

All areas with paving fabric placed will be paved the same day. No traffic except necessary construction traffic will be allowed to drive on the paving fabric.

Overlay Placement: Asphalt overlay construction shall closely follow fabric placement. All areas in which paving fabric has been placed will be paved during the same day. Excess tack coat that bleeds through the paving fabric shall be removed. Excess tack coat can be removed by broadcasting hot mix or sand on the paving fabric. Excess sand or hot mix should be removed before beginning the paving operation. In the event of rainfall on the paving fabric prior to the placement of the asphalt overlay, the paving fabric must be allowed to dry completely before asphalt is placed. Overlay asphalt thickness shall meet the requirements of the contract drawings and documents. The minimum compacted thickness of overlay asphalt shall not be less than 1.5" in areas of paving fabric installation.

METHOD OF MEASUREMENT

Paving Fabric: The paving fabric will be measured by the square yard. Tack Coat: Tack coat will be measured by the gallon.

BASIS OF PAYMENT

Paving Fabric: The accepted quantities of paving fabric will be paid for at the contract unit price per square yard in place.

Tack Coat: The accepted quantities of tack coat for the paving fabric will be paid for at the contract unit price per gallon complete in place.

TABLE 1 PHYSICAL REQUIREMENTS OF PAVING FABRICS[1,2,3]
(Note to Specifier: Choose one fabric specification, delete the other)

		Petromat 4599		or Petromat 4598	
Properties	**Test Method**	**American Standard**	**Metric Units**	**American Standard**	**Metric Units**
Mass Per Unit Area	ASTM D 3776	na	na	4.1 oz/yd2	104 g/m2
Tensile Strength	ASTM D 4632	90 lbs.	0.400 kN	101 lb.	0.450 kN
Tensile Elongation	ASTM D 4632	50%	50%	50%	50%
Asphalt Retention	ASTM D 6140	0.20 gal/yd^2	0.90 l/m^2	0.20 gal/yd^2	0.90 l/m^2
Melting Point	ASTM D 276-87	300° F	149° C	300° F	149° C
Surface Texture	VISUAL INSPECTION	Heat-Set on One Side		Heat-Set on One Side	

NOTES

1 Certification of conformance from paving fabric manufacturer may be required.

2 All numerical values represent minimum average roll values (average of test results from any sampled roll in a lot shall meet or exceed the minimum values) in weaker principal direction. Lot shall be sampled according to ASTM D 4354-89, "Practice for Sampling of Geosynthetics for Testing."

3 Conformance of paving fabrics to specification property requirements shall be determined in accordance with ASTM D 4759-88, "Practice for Determining the Specification Conformance of Geosynthetics."

PROPEX | THE ADVANTAGE CREATORS.™
GEOSYNTHETICS

6025 Lee Highway, Suite 425
PO Box 22788
Chattanooga, TN 37422

PH: 423 899 0444
PH: 800 621 1273
FAX: 423 899 7619

www.geotextile.com

Appendix C – 3M™ Scotchweld™ DP-600 Self Leveling Sealant Product Information

Scotch-Weld™
Concrete Repair
DP-600, Self-Leveling, Gray

Technical Data **July, 2006**

Product Description

3M™ Scotch-Weld™ Concrete Repair DP-600 is a self-leveling, gray, rapid setting, two-component polyurethane. It is packaged as 1:1 ratio liquids in a duo-pak cartridge. With the squeeze of the trigger, the components are automatically mixed and easily dispensed as a bubble-free self-leveling liquid.

Suggested Applications:

Building & Construction Maintenance & Repair

Pool Maintenance & Repair

- Rapid repair of spalled or cracked concrete floors or pool decks in high traffic areas
- Re-installing posts and rails
- Custom tapping of bolts and screws into wood, concrete and masonry
- Tough, non-brittle bonding of wood, metal, glass and plastic
- Fixturing of hand/grabrails into pool decks
- Rapid repair of pool decks prior to being coated

Typical Properties

Note: The following technical information and data should be considered representative or typical only and should not be used for specification purposes.

Test	Conditions	Test Method	Properties
Appearance	Cured	PEC	Gray mass
Viscosity Part A	77°F (25°C)	HBDVI+CP	4050 cps
Viscosity Part B	77°F (25°C)	HBDVI+CP	2500 cps
Work Life	10 g, 1/4" thick @ 77°F (25°C)	PEC	70 seconds
Tack-free Time	10 g, 1/4" thick @ 77°F (25°C)	PEC	4 minutes
Full Cure Time	10 g, 1/4" thick @ 77°F (25°C)	PEC	1 hour
Hardness After Full Cure	1 hour at 77°F (25°C)	ASTM D2240-91	70 Shore D
Lap Shear Strength	7 days at 77°F (25°C)	ASTM D1002-72	2,300 psi
Temperature Range	Continuous	PEC	-60°F (-51°C) to 250°F (121°C)

3M
Scotch-Weld™
Concrete Repair
DP-600, Self-Leveling, Gray

Prepare the Cartridge for Dispensing:

1. Select the desired dispenser (manual or pneumatic) and mix tip.
2. Cut the blind-end off of the cartridge orifice or remove the plugs and place the cartridge in the dispenser.
3. Dispense just enough material so that both components dispense equally.
4. Assemble the mix tip onto the cartridge with a half-twist.

CONCRETE REPAIR, SELF-LEVELING:

Section 1: Preparation

General Preparation for Concrete Repairs

1. Prepare a cavity, depression, groove, saw-cut, or crack by removing all loose aggregate, dust, old caulks, grease or other compounds from the repair surface.
2. For maximum relief of stresses in large concrete sections, it is best to create a 1/4-inch saw cut entirely through the concrete. However, first determine that there are no other structural limitations including rebar, plumbing and electrical installations. The use of a foam backer embedded to within 1/4-inch of the surface is recommended for maximum stress relief.
3. For tracing cracks for stress relief, it is best to use a tapered grinder to create a taper starting at 1/4-inch at the top and tapering deeply into the concrete.
4. Use a bristle brush to remove the debris. Then use moisture-free and oil-free compressed air to blow out the fine dust.
5. Mask off the areas surrounding the repair allowing approximately a 1-inch overlap of 3M™ Scotch-Weld™ Concrete Repair DP-600 around the periphery of the prepared cavity.

Preparing for Damage from Corrosion:

1. Apply a pre-coat of concrete corrosion inhibitor or protectant exclusively to corroded areas.
2. Allow the pre-coat to dry thoroughly.

Section 2: Procedures

General Procedure for Doing Concrete Repairs

1. Keeping the mixer tip at the deepest portion of the repair area, dispense into the prepared cavity, depression, void, groove or crack.
2. Slightly over-fill the prepared cavity.
3. 3M™ Scotch-Weld™ Concrete Repair DP-600 will self-level and set approximately within one minute and leave a slight meniscus. If desired, one can create a repair flush and level to the concrete floor on smaller areas up to 6 inches square by overlaying a slightly stiff polyethylene sheet (approximately the modulus of a plastic spreader) just prior to the set of Scotch-Weld concrete repair DP-600.
4. Overfilling Scotch-Weld concrete repair DP-600 and allowing it to overlap approximately one inch along the edges of the repair tapering to just a few mils thickness provides a substantial tie into the concrete and increases the lifetime of the repair.
5. At 75°F (24°C), a 1/4"-thick section sets and becomes tack-free within 4 minutes and will cure within one hour. **Note:** Thicker masses or substrates at higher temperature take less time to cure. Thinner masses or substrates at lower temperature take more time to cure.

Section 3: Clean-up and Finishing

1. Remove the masking tape surrounding the repair areas.
2. If desired, grind the cured product with 36 to 50 grit sanding disks or sandpaper to take off any rough edges and achieve the desired shape. Sand with finer grit sandpaper to the desired finish.

CUSTOM TAPPING AND FASTENING

The flanges of posts and rails, auditorium and stadium seats, pallet racks, and other load-bearing structures are usually secured into concrete floors by shooting nails or screwing lag bolts into shields embedded within cored holes. Custom tapping provides the advantage that these structures can be easily removed and relocated to other locations without having to grind down the protruding nails or fill the remaining cored holes.

Custom Tapping is done by molding the threads of bolts and screws into 3M™ Scotch-Weld™ Concrete Repair DP-600. The tough molding properties of Scotch-Weld concrete repair DP-600 allows it to form and maintain a high-strength, non-brittle interlock between holes cored into concrete (or wood, ceramic or masonry) and the threads of the inserted bolt or screw. The release characteristics, upon removal, are achieved by simply spraying the bolt or screw with 3M™ 5-Way Penetrant (or other release agent) before the bolt or screw is inserted into the liquid Scotch-Weld concrete repair DP-600 prior to its setting. To achieve a more permanent fixture, the bolts and screws simply are not lubricated before imbedding into the liquid Scotch-Weld concrete repair DP-600 prior to setting.

Section 1: Preparation For Custom-Tapping:

1. Drill holes into the concrete, wood or masonry to the specified depth using the chart below.

Bolt Width (in.)	Minimum Hole Diameter (in.)	Minimum Hole Depth (in.)
1/4	3/8	2
3/8	1/2	3-1/2
1/2	5/8	4-1/4
5/8	3/4	5
3/4	7/8	6-3/8
7/8	1	7-1/2
1	1-1/8	8-1/4
1-1/8	1-1/4	9
1-1/4	1-3/8	9-3/4
1-3/8	1-1/2	10-1/2
1-1/2	1-5/8	11-1/4

2. Use a round bristle brush to clean the cored holes if they have not been freshly drilled. Use moisture-free and oil-free compressed air to blow out the debris.
3. Lightly coat the bolts or screws with 3M 5-Way Penetrant.

Section 2: Procedures

Procedure for Custom Tapping Concrete:

1. Dispense 3M™ Scotch-Weld™ Concrete Repair DP-600 into the hole nearly halfway full. To obtain a consistent fill, judge for under-fill or overfill by counting the number of squeezes of the trigger.
2. Insert the bolt or screw within the first 20 seconds after dispensing. The paste characteristic of Scotch-Weld concrete repair DP-600 will hold the bolt or screw in place until it cures. Once the work life has been exceeded, do not disturb the bolt.
3. Move to the next hole to keep Scotch-Weld concrete repair DP-600 flowing in the mixer tip. If material sets in the mixer tip, replace the tip and start dispensing again.
4. Scotch-Weld concrete repair DP-600 will become tack-free within 4 minutes and cure within one hour. **Note:** It is best to wait one full hour before extracting the bolt or screw for securing the cupboards, wall hangers or other cabinetry in place.
5. Allow Scotch-Weld concrete repair DP-600 to fully cure before applying a load. The maximum torque recommended is 9.0 pounds.

Note: Not for use in repairing or anchoring diving boards.

RE-ANCHORING HANDRAILS AND GRABRAILS

Section 1A: Preparation of Hand/Grabrails

1. Bore a hole through the base of the hand/grabrail just above grade level to allow introduction of the product.
2. Using 80 grit sandpaper, roughen the footing surface of the hand/grabrail which is to be imbedded below the concrete grade.
3. Refer to instructions on cartridge for dispensing.

Section 1B: Preparation of Concrete for Re-anchoring

1. Chip away the cracked or broken concrete to allow removal of the hand/grabrail.
2. Leave the concrete as close as possible around the hand/grabrail. It is best to allow the concrete to remain intact as close as possible (within 1/2 to 1 inch all around) to the base of the hand/grabrail.
3. Dig down to the base of the concrete, typically 4- to 6-inches deep.
4. Expose any rebar, if possible, in order to create a ground connection to the rebar.
5. Create as much as a 1-inch undercut under the concrete in a smooth taper from the concrete surface.
6. Remove all of the loose concrete particles and dust prior to encasing the replacement hand/grabrail.
7. Attach the replacement hand/grabrail to surrounding rebar using a copper wire. Cinch the connection down tightly, allowing a slight amount of slack in the wire connection.
8. Create a shield to corrosion at the base of the hand/grabrail by laying a piece of polyethylene plastic at the base of the hole.
9. Insert the hand/grabrail in the hole. Align the hand/grabrail for its elevation and vertical plumb.

Section 2 Encasement Procedure

1. Dispense 3M™ Scotch-Weld™ Concrete Repair DP-600 into the concrete hole. Product will remain liquid for approximately 50 seconds, and fully cure in 1 hour. Dispense more cartridges as necessary to bring the fill level up to the concrete surface level.
2. Dispense Scotch-Weld concrete repair DP-600 into the inside of the hand/grabrail. Fill with product up to and slightly above the grade level. (Filling the inside of the post provides extra strength and protection against corrosion.)
3. Apply cement dust or sand, if desired, to blend the surface appearance into the surrounding concrete.
4. If Scotch-Weld concrete repair DP-600 is applied in a traffic area, apply sand or some type of grit to repaired surface area.

Section 3: Repair Clean-up and Finishing

1. Shave or grind cured product with 36 grit sandpaper to achieve desired shape.

3M
Scotch-Weld™
Concrete Repair
DP-600, Self-Leveling, Gray

Storage

This product has a shelf life of 6 months when properly stored in unopened packages at temperatures of 65°F to 85°F (18°C to 30°C). Do not expose to excessive cold or moisture.

Maintenance

No maintenance is required. However, if repairs become damaged, simply reapply 3M™ Scotch-Weld™ Concrete Repair DP-600.

Precautionary Information

Refer to Product Label and Material Safety Data Sheet (MSDS) for health and safety information before using this product. For environmental information, refer to MSDS. Always wear gloves, eye protection, appropriate respiratory protection, and work in a well-ventilated area. For additional health and safety information, call 1-800-364-3577 or (651) 737-6501.

Product Use

All statements, technical information and recommendations contained in this document are based upon tests or experience that 3M believes are reliable. However, many factors beyond 3M's control can affect the use and performance of a 3M product in a particular application, including the conditions under which the product is used and the time and environmental conditions in which the product is expected to perform. Since these factors are uniquely within the user's knowledge and control, it is essential that the user evaluate the 3M product to determine whether it is fit for a particular purpose and suitable for the user's method of application.

Warranty and Limited Remedy

Unless stated otherwise in 3M's product literature, packaging inserts or product packaging for individual products, 3M warrants that each 3M product meets the applicable specifications at the time 3M ships the product. Individual products may have additional or different warranties as stated on product literature, package inserts or product packages. 3M MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR ANY IMPLIED WARRANTY ARISING OUT OF A COURSE OF DEALING, CUSTOM OR USAGE OF TRADE. User is responsible for determining whether the 3M product is fit for a particular purpose and suitable for user's application. If the 3M product is defective within the warranty period, your exclusive remedy and 3M's and seller's sole obligation will be, at 3M's option, to replace the product or refund the purchase price.

Limitation of Liability

Except where prohibited by law, 3M and seller will not be liable for any loss or damage arising from the 3M product, whether direct, indirect, special, incidental or consequential, regardless of the legal theory asserted, including warranty, contract, negligence or strict liability.

ISO 9001:2000

This Industrial Adhesives and Tapes Division product was manufactured under a 3M quality system registered to ISO 9001:2000 standards.

3M

Industrial Business
Industrial Adhesives and Tapes Division

3M Center, Building 21-1W-10, 900 Bush Avenue
St. Paul, MN 55144-1000
800-362-3550 • 877-369-2923 (fax)
www.3M.com/industrial

Recycled Paper
40% pre-consumer
10% post-consumer

Material Safety Data Sheet

PRODUCT NAME: Concrete Repair DP-600, Non-Sag, Gray
MANUFACTURER: 3M
DIVISION: Industrial Adhesives and Tapes

ADDRESS: 3M Center
St. Paul, MN 55144-1000

EMERGENCY PHONE: 1-800-364-3577 or (651) 737-6501 (24 hours)

Issue Date: 07/21/2003
Supercedes Date: 10/18/2002

Document Group: 18-1146-2

Formerly known as DYNAMix(TM) Non-Sag Rapid Set 6142-1, Gray.

ID Number(s):
62-2652-1230-8, 62-2652-1235-7, 62-2652-5030-8, 62-2652-5037-3

This product is a kit or a multipart product which consists of multiple, independently packaged components. An MSDS for each of these components is included. Please do not separate the component MSDSs from this cover page. The document numbers of the MSDSs for components of this product are:

18-1134-8, 18-1141-3

Revision Changes:
Copyright was modified.
Kit: Component document group number(s) was modified.
Section 1: Product name was modified.
Kit: Product name was modified.
Kit: Division name was modified.
Kit: ID number(s) was modified.

DISCLAIMER: The information in this Material Safety Data Sheet (MSDS) is believed to be correct as of the date issued. 3M MAKES NO WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR COURSE OF PERFORMANCE OR USAGE OF TRADE. User is responsible for determining whether the 3M product is fit for a particular purpose and suitable for user's method of use or application. Given the variety of factors that can affect the use and application of a 3M product, some of which are uniquely within the user's knowledge and control, it is essential that the user evaluate the 3M product to determine whether it is fit for a particular purpose and suitable for user's method of use or application.

3M provides information in electronic form as a service to its customers. Due to the remote possibility that electronic transfer may have resulted in errors, omissions or alterations in this information, 3M makes no representations as to its completeness or accuracy. In addition, information obtained from a database may not be as current as the information in the MSDS available directly from 3M.

Material Safety Data Sheet

SECTION 1: PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: 3M(TM) Concrete Repair DP-600, Non-Sag, Gray (Part B)
MANUFACTURER: 3M
DIVISION: Industrial Adhesives and Tapes

ADDRESS: 3M Center
St. Paul, MN 55144-1000

EMERGENCY PHONE: 1-800-364-3577 or (651) 737-6501 (24 hours)

Issue Date: 01/29/2004
Supercedes Date: 07/21/2003

Document Group: 18-1134-8

Product Use:
Specific Use: Two-part urethane adhesive/sealant.

Formerly known as DYNAMix(TM) Non-Sag Rapid Set 6142-1, Gray.

SECTION 2: INGREDIENTS

Ingredient	C.A.S. No.	% by Wt
polyether polyol	9082-00-2	40 - 70
propoxylated trimethylolpropane	25723-16-4	10 - 30
tetrakis(2-hydroxypropyl)ethylenediamine	102-60-3	10 - 30
m-xylene-alpha,alpha'-diamine	1477-55-0	1 - 5
amorphous silica	68611-44-9	1 - 5
bis(1,2,2,6,6-pentamethyl-4-piperidinyl) sebacate	41556-26-7	0.1 - 1

SECTION 3: HAZARDS IDENTIFICATION

3.1 EMERGENCY OVERVIEW

Specific Physical Form: Viscous
Odor, Color, Grade: Slight ammonia like odor, gray.
General Physical Form: Liquid
Immediate health, physical, and environmental hazards: May cause allergic skin reaction.

3.2 POTENTIAL HEALTH EFFECTS

Eye Contact:
Dust created by cutting, grinding, sanding, or machining may cause eye irritation. Signs/symptoms may include redness, swelling, pain, tearing, and blurred or hazy vision.

Vapors released during curing may cause eye irritation. Signs/symptoms may include redness, swelling, pain, tearing, and blurred or hazy vision.

Moderate Eye Irritation: Signs/symptoms may include redness, swelling, pain, tearing, and blurred or hazy vision.

Skin Contact:
Mild Skin Irritation: Signs/symptoms may include localized redness, swelling, and itching.

Prolonged or repeated exposure may cause:
Allergic Skin Reaction (non-photo induced): Signs/symptoms may include redness, swelling, blistering, and itching.

Inhalation:
Dust from cutting, grinding, sanding or machining may cause irritation of the respiratory system. Signs/symptoms may include cough, sneezing, nasal discharge, headache, hoarseness, and nose and throat pain.

Vapors released during curing may cause irritation of the respiratory system. Signs/symptoms may include cough, sneezing, nasal discharge, headache, hoarseness, and nose and throat pain.

Upper Respiratory Tract Irritation: Signs/symptoms may include cough, sneezing, nasal discharge, headache, hoarseness, and nose and throat pain.

Ingestion:
Gastrointestinal Irritation: Signs/symptoms may include abdominal pain, nausea, diarrhea and vomiting.

SECTION 4: FIRST AID MEASURES

4.1 FIRST AID PROCEDURES

The following first aid recommendations are based on an assumption that appropriate personal and industrial hygiene practices are followed.

Eye Contact: Flush eyes with large amounts of water. If signs/symptoms persist, get medical attention.

Skin Contact: Remove contaminated clothing and shoes. Immediately flush skin with large amounts of water. Get medical attention. Wash contaminated clothing and clean shoes before reuse.

Inhalation: Remove person to fresh air. If signs/symptoms develop, get medical attention.

If Swallowed: Do not induce vomiting. Give victim two glasses of water. Never give anything by mouth to an unconscious person. Get immediate medical attention.

SECTION 5: FIRE FIGHTING MEASURES

5.1 FLAMMABLE PROPERTIES

Autoignition temperature	*Not Applicable*
Flash Point	>=290 ºF [*Test Method:* Tagliabue Closed Cup]
Flammable Limits - LEL	*Not Applicable*
Flammable Limits - UEL	*Not Applicable*

5.2 EXTINGUISHING MEDIA
Use fire extinguishers with class B extinguishing agents (e.g., dry chemical, carbon dioxide).

5.3 PROTECTION OF FIRE FIGHTERS

Special Fire Fighting Procedures: Wear full protective equipment (Bunker Gear) and a self-contained breathing apparatus (SCBA).

Unusual Fire and Explosion Hazards: Non-flammable: ordinary combustible material. Not applicable.

Note: See STABILITY AND REACTIVITY (SECTION 10) for hazardous combustion and thermal decomposition information.

SECTION 6: ACCIDENTAL RELEASE MEASURES

Accidental Release Measures: Observe precautions from other sections. Call 3M- HELPS line (1-800-364-3577) for more information on handling and managing the spill. Ventilate the area with fresh air. Contain spill. For larger spills, cover drains and build dikes to prevent entry into sewer systems or bodies of water. Collect as much of the spilled material as possible. Clean up residue with an appropriate organic solvent. Read and follow safety precautions on the solvent label and MSDS. Collect the resulting residue containing solution. Place in a closed container approved for transportation by appropriate authorities. Dispose of collected material as soon as possible.

In the event of a release of this material, the user should determine if the release qualifies as reportable according to local, state, and federal regulations.

SECTION 7: HANDLING AND STORAGE

7.1 HANDLING
Avoid eye contact with vapors, mists, or spray. Avoid breathing of dust created by cutting, sanding, grinding or machining. Avoid prolonged or repeated skin contact. Do not eat, drink or smoke when using this product. Wash exposed areas thoroughly with soap and water. Avoid contact with oxidizing agents.

7.2 STORAGE
Store away from acids. Store away from oxidizing agents.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 ENGINEERING CONTROLS
Provide appropriate local exhaust for cutting, grinding, sanding or machining.

8.2 PERSONAL PROTECTIVE EQUIPMENT (PPE)

8.2.1 Eye/Face Protection
Avoid eye contact with vapors, mists, or spray. Avoid eye contact.

8.2.2 Skin Protection
Avoid prolonged or repeated skin contact. Avoid skin contact.

Select and use gloves and/or protective clothing to prevent skin contact based on the results of an exposure assessment. Consult with your glove and/or protective clothing manufacturer for selection of appropriate compatible materials.
Gloves made from the following material(s) are recommended: Butyl Rubber.

8.2.3 Respiratory Protection
Avoid breathing of dust created by cutting, sanding, grinding or machining. Avoid breathing of vapors, mists or spray.
Select one of the following NIOSH approved respirators based on airborne concentration of contaminants and in accordance with OSHA regulations: Half facepiece or fullface air-purifying respirator with organic vapor cartridges. Consult the current 3M Respiratory Selection Guide for additional information or call 1-800-243-4630 for 3M technical assistance.

8.2.4 Prevention of Swallowing
Do not eat, drink or smoke when using this product. Wash exposed areas thoroughly with soap and water.

8.3 EXPOSURE GUIDELINES

Ingredient	Authority	Type	Limit	Additional Information
bis(1,2,2,6,6-pentamethyl-4-piperidinyl) sebacate	CMRG	TWA	1 mg/m3	
m-xylene-alpha,alpha'-diamine	ACGIH	CEIL	0.1 mg/m3	Skin Notation*
m-xylene-alpha,alpha'-diamine	OSHA	CEIL	0.1 mg/m3	Table Z-1A

* Substance(s) refer to the potential contribution to the overall exposure by the cutaneous route including mucous membrane and eye, either by airborne or, more particularly, by direct contact with the substance. Vehicles can alter skin absorption.

SOURCE OF EXPOSURE LIMIT DATA:
ACGIH: American Conference of Governmental Industrial Hygienists
CMRG: Chemical Manufacturer Recommended Guideline
OSHA: Occupational Safety and Health Administration
AIHA: American Industrial Hygiene Association Workplace Environmental Exposure Level (WEEL)

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

Specific Physical Form:	Viscous
Odor, Color, Grade:	Slight ammonia like odor, gray.
General Physical Form:	Liquid
Autoignition temperature	*Not Applicable*
Flash Point	>=290 ºF [*Test Method:* Tagliabue Closed Cup]
Flammable Limits - LEL	*Not Applicable*
Flammable Limits - UEL	*Not Applicable*
Boiling point	>=400 ºF
Vapor Density	>=1 [*Ref Std:* AIR=1]

Vapor Pressure	*Not Applicable*
Specific Gravity	1.03
pH	*Not Applicable*
Melting point	*No Data Available*
Solubility in Water	Negligible
Evaporation rate	<=1 [*Ref Std:* WATER=1]
Hazardous Air Pollutants	00 % weight [*Test Method:* Calculated]
Volatile Organic Compounds	<=10 g/l [*Test Method:* calculated per EPA method 24]
Volatile Organic Compounds	<=5 g/l [*Test Method:* calculated per EPA method 24] [*Details:* when mixed 1:1 with Part A]
Percent volatile	<=1 % [*Test Method:* Estimated]
Percent volatile	<=0.5 % [*Test Method:* Estimated] [*Details:* when mixed 1:1 with Part A]
VOC Less H2O & Exempt Solvents	**<=10 g/l [*Test Method:* calculated per EPA method 24]**
VOC Less H2O & Exempt Solvents	**<=5 g/l [*Test Method:* calculated per EPA method 24] [*Details:* when mixed 1:1 with Part A]**
Viscosity	**2,000 - 2,700 centipoise**

SECTION 10: STABILITY AND REACTIVITY

Stability: Stable.

Materials and Conditions to Avoid: Strong acids; Strong oxidizing agents

Hazardous Polymerization: Hazardous polymerization will not occur.

Hazardous Decomposition or By-Products

Substance	Condition
Carbon monoxide	**During Combustion**
Carbon dioxide	**During Combustion**
Hydrogen Chloride	**During Combustion**
Oxides of Nitrogen	**During Combustion**

SECTION 11: TOXICOLOGICAL INFORMATION

Please contact the address listed on the first page of the MSDS for Toxicological Information on this material and/or its components.

SECTION 12: ECOLOGICAL INFORMATION

ECOTOXICOLOGICAL INFORMATION

Not determined.

CHEMICAL FATE INFORMATION

Not determined.

SECTION 13: DISPOSAL CONSIDERATIONS

Waste Disposal Method: Dispose of completely cured (or polymerized) wastes in a sanitary landfill. As a disposal alternative, incinerate uncured product in an industrial or commercial incinerator in the presence of a combustible material.

EPA Hazardous Waste Number (RCRA): Not regulated

Since regulations vary, consult applicable regulations or authorities before disposal.

SECTION 14:TRANSPORT INFORMATION

ID Number(s):
62-2652-8535-3, 62-2652-9535-2

Not regulated per U.S. DOT, IATA or IMO.

These transportation classifications are provided as a customer service. As the shipper YOU remain responsible for complying with all applicable laws and regulations, including proper transportation classification and packaging. 3M's transportation classifications are based on product formulation, packaging, 3M policies and 3M's understanding of applicable current regulations. 3M does not guarantee the accuracy of this classification information. This information applies only to transportation classification and not the packaging, labeling, or marking requirements. The original 3M package is certified for U.S. ground shipment only. If you are shipping by air or ocean, the package may not meet applicable regulatory requirements.

SECTION 15: REGULATORY INFORMATION

US FEDERAL REGULATIONS

Contact 3M for more information.

311/312 Hazard Categories:
Fire Hazard - No Pressure Hazard - No Reactivity Hazard - No Immediate Hazard - Yes Delayed Hazard - Yes

STATE REGULATIONS

Contact 3M for more information.

CHEMICAL INVENTORIES

The components of this product are in compliance with the chemical notification requirements of TSCA.

Contact 3M for more information.

INTERNATIONAL REGULATIONS

Contact 3M for more information.

This MSDS has been prepared to meet the U.S. OSHA Hazard Communication Standard, 29 CFR 1910.1200.

SECTION 16: OTHER INFORMATION

HMIS Hazard Classification

Health: 2 Flammability: 1 Reactivity: 1 Protection: X - See PPE section.

Hazardous Material Identification System (HMIS(r)) hazard ratings are designed to inform employees of chemical hazards in the workplace. These ratings are based on the inherent properties of the material under expected conditions of normal use and are not intended for use in emergency situations. HMIS(r) ratings are to be used with a fully implemented HMIS(r) program. HMIS(r) is a registered mark of the National Paint and Coatings Association (NPCA).

Revision Changes:
Section 1: Product name was modified.
Copyright was modified.
Section 5: Fire fighting procedures information was modified.
Section 6: Release measures information was modified.
Section 10: Hazardous decomposition or by-products table was modified.
Section 2: Ingredient table was modified.
Page Heading: Product name was modified.
Section 8: Exposure guidelines ingredient information was modified.
Section 9: Property description for optional properties was modified.
Section 13: EPA hazardous waste number (RCRA) heading was added.
Section 13: EPA hazardous waste number (RCRA) information was added.
Section 14: ID Number heading was added.
Section 14: ID Number(s) was added.
Section 12: Ecotoxicological phrase was added.
Section 12: Chemical Fate phrase was added.

DISCLAIMER: The information in this Material Safety Data Sheet (MSDS) is believed to be correct as of the date issued. 3M MAKES NO WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR COURSE OF PERFORMANCE OR USAGE OF TRADE. User is responsible for determining whether the 3M product is fit for a particular purpose and suitable for user's method of use or application. Given the variety of factors that can affect the use and application of a 3M product, some of which are uniquely within the user's knowledge and control, it is essential that the user evaluate the 3M product to determine whether it is fit for a particular purpose and suitable for user's method of use or application.

3M provides information in electronic form as a service to its customers. Due to the remote possibility that electronic transfer may have resulted in errors, omissions or alterations in this information, 3M makes no representations as to its completeness or accuracy. In addition, information obtained from a database may not be as current as the information in the MSDS available directly from 3M.

Material Safety Data Sheet

SECTION 1: PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: 3M(TM) Concrete Repair 600, Non-Sag, Gray (Part A)
MANUFACTURER: 3M
DIVISION: Industrial Adhesives and Tapes

ADDRESS: 3M Center
St. Paul, MN 55144-1000

EMERGENCY PHONE: 1-800-364-3577 or (651) 737-6501 (24 hours)

Issue Date: 01/29/2004
Supercedes Date: 07/21/2003

Document Group: 18-1141-3

Product Use:
Specific Use: Two-part urethane adhesive/sealant.

Formerly known as DYNAMix(TM) Non-Sag Rapid Set 6142-1, Gray.

SECTION 2: INGREDIENTS

Ingredient	C.A.S. No.	% by Wt
4,4'-diphenylmethane diisocyanate	101-68-8	30 - 60
diphenylmethanediisocyanate prepolymer	68424-09-9	15 - 40
poly(diphenylmethane-4,4'-diisocyanate)	25686-28-6	15 - 40

SECTION 3: HAZARDS IDENTIFICATION

3.1 EMERGENCY OVERVIEW

Specific Physical Form: Viscous
Odor, Color, Grade: Low or no detectable odor, clear.
General Physical Form: Liquid
Immediate health, physical, and environmental hazards: May cause allergic skin reaction. May cause allergic respiratory reaction.

3.2 POTENTIAL HEALTH EFFECTS

Eye Contact:
Dust created by cutting, grinding, sanding, or machining may cause eye irritation. Signs/symptoms may include redness, swelling, pain, tearing, and blurred or hazy vision.

Vapors released during curing may cause eye irritation. Signs/symptoms may include redness, swelling, pain, tearing, and blurred or hazy vision.

Moderate Eye Irritation: Signs/symptoms may include redness, swelling, pain, tearing, and blurred or hazy vision.

Skin Contact:
Mild Skin Irritation: Signs/symptoms may include localized redness, swelling, and itching.

Prolonged or repeated exposure may cause:
Allergic Skin Reaction (non-photo induced): Signs/symptoms may include redness, swelling, blistering, and itching.

Inhalation:
Dust from cutting, grinding, sanding or machining may cause irritation of the respiratory system. Signs/symptoms may include cough, sneezing, nasal discharge, headache, hoarseness, and nose and throat pain.

Vapors released during curing may cause irritation of the respiratory system. Signs/symptoms may include cough, sneezing, nasal discharge, headache, hoarseness, and nose and throat pain.

Upper Respiratory Tract Irritation: Signs/symptoms may include cough, sneezing, nasal discharge, headache, hoarseness, and nose and throat pain.

Prolonged or repeated exposure may cause:
Allergic Respiratory Reaction: Signs/symptoms may include difficulty breathing, wheezing, cough, and tightness of chest.

Ingestion:
Gastrointestinal Irritation: Signs/symptoms may include abdominal pain, nausea, diarrhea and vomiting.

Target Organ Effects:
Persons previously sensitized to isocyanates may develop a cross-sensitization reaction to other isocyanates.

SECTION 4: FIRST AID MEASURES

4.1 FIRST AID PROCEDURES

The following first aid recommendations are based on an assumption that appropriate personal and industrial hygiene practices are followed.

Eye Contact: Flush eyes with large amounts of water. If signs/symptoms persist, get medical attention.

Skin Contact: Remove contaminated clothing and shoes. Immediately flush skin with large amounts of water. Get medical attention. Wash contaminated clothing and clean shoes before reuse.

Inhalation: Remove person to fresh air. If signs/symptoms develop, get medical attention.

If Swallowed: Do not induce vomiting. Give victim two glasses of water. Never give anything by mouth to an unconscious person. Get immediate medical attention.

SECTION 5: FIRE FIGHTING MEASURES

5.1 FLAMMABLE PROPERTIES

Autoignition temperature	*Not Applicable*
Flash Point	>=290 ºF [*Test Method:* Tagliabue Closed Cup]
Flammable Limits - LEL	*Not Applicable*
Flammable Limits - UEL	*Not Applicable*

5.2 EXTINGUISHING MEDIA

Use fire extinguishers with class B extinguishing agents (e.g., dry chemical, carbon dioxide).

5.3 PROTECTION OF FIRE FIGHTERS

Special Fire Fighting Procedures: Wear full protective equipment (Bunker Gear) and a self-contained breathing apparatus (SCBA). Water may be used to blanket the fire.

Unusual Fire and Explosion Hazards: Non-flammable: ordinary combustible material. Not applicable.

Note: See STABILITY AND REACTIVITY (SECTION 10) for hazardous combustion and thermal decomposition information.

SECTION 6: ACCIDENTAL RELEASE MEASURES

Accidental Release Measures: Refer to other sections of this MSDS for information regarding physical and health hazards, respiratory protection, ventilation, and personal protective equipment. Call 3M-HELPS line (1-800-364-3577) for more information on handling and managing the spill. Evacuate unprotected and untrained personnel from hazard area. The spill should be cleaned up by qualified personnel. Ventilate the area with fresh air. Contain spill. For larger spills, cover drains and build dikes to prevent entry into sewer systems or bodies of water. Pour isocyanate decontaminant solution (90% water, 8% concentrated ammonia, 2% detergent) on spill and allow to react for 10 minutes. Or pour water on spill and allow to react for more than 30 minutes. Cover with absorbent material. Place in a container approved for transportation by appropriate authorities, but do not seal the container for 48 hours to avoid pressure build-up. Dispose of collected material as soon as possible.

In the event of a release of this material, the user should determine if the release qualifies as reportable according to

local, state, and federal regulations.

SECTION 7: HANDLING AND STORAGE

7.1 HANDLING

Avoid eye contact with vapors, mists, or spray. Avoid breathing of dust created by cutting, sanding, grinding or machining. Do not breathe vapors. Avoid prolonged or repeated skin contact. Do not eat, drink or smoke when using this product. Wash exposed areas thoroughly with soap and water. Avoid contact with water to prevent potentially violent reaction or fire.

7.2 STORAGE

Store away from acids. Keep container in well-ventilated area.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 ENGINEERING CONTROLS

Use with appropriate local exhaust ventilation. Do not use in a confined area or areas with little or no air movement. Provide appropriate local exhaust ventilation on open containers. Provide appropriate local exhaust for cutting, grinding, sanding or machining.

8.2 PERSONAL PROTECTIVE EQUIPMENT (PPE)

8.2.1 Eye/Face Protection

Avoid eye contact. Avoid eye contact with vapors, mists, or spray.

8.2.2 Skin Protection

Avoid skin contact. Avoid prolonged or repeated skin contact.

Select and use gloves and/or protective clothing to prevent skin contact based on the results of an exposure assessment. Consult with your glove and/or protective clothing manufacturer for selection of appropriate compatible materials.
Gloves made from the following material(s) are recommended: Butyl Rubber, Nitrile Rubber.

8.2.3 Respiratory Protection

Avoid breathing of dust created by cutting, sanding, grinding or machining. Do not breathe vapors.
Select one of the following NIOSH approved respirators based on airborne concentration of contaminants and in accordance with OSHA regulations: Half facepiece or fullface air-purifying respirator with organic vapor cartridges. Consult the current 3M Respiratory Selection Guide for additional information or call 1-800-243-4630 for 3M technical assistance.

8.2.4 Prevention of Swallowing

Do not eat, drink or smoke when using this product. Wash exposed areas thoroughly with soap and water.

8.3 EXPOSURE GUIDELINES

Ingredient	Authority	Type	Limit	Additional Information
FREE ISOCYANATES	3M	TWA	0.005 ppm	
FREE ISOCYANATES	3M	STEL	0.02 ppm	
4,4'-diphenylmethane diisocyanate	ACGIH	TWA	0.005 ppm	
4,4'-diphenylmethane diisocyanate	OSHA	CEIL	0.02 ppm	Table Z-1

SOURCE OF EXPOSURE LIMIT DATA:
ACGIH: American Conference of Governmental Industrial Hygienists
CMRG: Chemical Manufacturer Recommended Guideline
OSHA: Occupational Safety and Health Administration
AIHA: American Industrial Hygiene Association Workplace Environmental Exposure Level (WEEL)

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

Specific Physical Form:	Viscous
Odor, Color, Grade:	Low or no detectable odor, clear.
General Physical Form:	Liquid
Autoignition temperature	*Not Applicable*
Flash Point	>=290 ºF [*Test Method:* Tagliabue Closed Cup]
Flammable Limits - LEL	*Not Applicable*
Flammable Limits - UEL	*Not Applicable*
Boiling point	>=400 ºF
Vapor Density	>=1 [*Ref Std:* AIR=1]
Vapor Pressure	<=0.000004 mmHg [@ 68 ºF]
Specific Gravity	1.11
pH	*Not Applicable*
Melting point	*No Data Available*
Solubility in Water	Negligible
Evaporation rate	<=1 [*Details:* Gels with exposure to humidity.]
Volatile Organic Compounds	<=10 g/l [*Test Method:* calculated per EPA method 24]
Volatile Organic Compounds	<=5 g/l [*Test Method:* calculated per EPA method 24] [*Details:* when mixed 1:1 with Part B]
Percent volatile	<=1 % [*Test Method:* Estimated]
Percent volatile	<=0.5 % [*Test Method:* Estimated] [*Details:* when mixed 1:1 with Part B]
VOC Less H2O & Exempt Solvents	**<=10 g/l [*Test Method:* calculated per CARB title 2]**
VOC Less H2O & Exempt Solvents	**<=5 g/l [*Test Method:* calculated per EPA method 24] [*Details:* when mixed 1:1 with Part B]**
Viscosity	**1,200 - 2,600 centipoise**

SECTION 10: STABILITY AND REACTIVITY

Stability: Stable.

Materials and Conditions to Avoid: Water; Strong acids; Strong bases

Hazardous Polymerization: Hazardous polymerization will not occur.

Hazardous Decomposition or By-Products

Substance	Condition

Carbon monoxide	**During Combustion**
Carbon dioxide	**During Combustion**
Oxides of Nitrogen	**During Combustion**
Toxic Vapor, Gas, Particulate	**During Combustion**

SECTION 11: TOXICOLOGICAL INFORMATION

Please contact the address listed on the first page of the MSDS for Toxicological Information on this material and/or its components.

SECTION 12: ECOLOGICAL INFORMATION

ECOTOXICOLOGICAL INFORMATION

Not determined.

CHEMICAL FATE INFORMATION

Not determined.

SECTION 13: DISPOSAL CONSIDERATIONS

Waste Disposal Method: Cure (harden, set, or react) the product according to product instructions. Dispose of completely cured (or polymerized) wastes in a sanitary landfill. As a disposal alternative, incinerate uncured product in an industrial or commercial incinerator in the presence of a combustible material.

EPA Hazardous Waste Number (RCRA): Not regulated

Since regulations vary, consult applicable regulations or authorities before disposal.

SECTION 14:TRANSPORT INFORMATION

ID Number(s):
62-2752-8535-1, 62-2752-9535-0

Not regulated per U.S. DOT, IATA or IMO.

These transportation classifications are provided as a customer service. As the shipper YOU remain responsible for complying with all applicable laws and regulations, including proper transportation classification and packaging. 3M's transportation classifications are based on product formulation, packaging, 3M policies and 3M's understanding of applicable current regulations. 3M does not guarantee the accuracy of this classification information. This information applies only to transportation classification and <u>not</u> the packaging, labeling, or marking requirements. The original 3M package is certified for U.S. ground shipment only. If you are shipping by air or ocean, the package may not meet

applicable regulatory requirements.

SECTION 15: REGULATORY INFORMATION

US FEDERAL REGULATIONS

Contact 3M for more information.

311/312 Hazard Categories:
Fire Hazard - No Pressure Hazard - No Reactivity Hazard - No Immediate Hazard - Yes Delayed Hazard - Yes

Section 313 Toxic Chemicals subject to the reporting requirements of that section and 40 CFR part 372 (EPCRA):

Ingredient	C.A.S. No	% by Wt
4,4'-diphenylmethane diisocyanate (Diisocyanates (EPCRA 313))	101-68-8	30 - 60

STATE REGULATIONS

Contact 3M for more information.

CHEMICAL INVENTORIES

Contact 3M for more information.

The components of this product are in compliance with the chemical notification requirements of TSCA.

INTERNATIONAL REGULATIONS

Contact 3M for more information.

This MSDS has been prepared to meet the U.S. OSHA Hazard Communication Standard, 29 CFR 1910.1200.

SECTION 16: OTHER INFORMATION

HMIS Hazard Classification
Health: 2 Flammability: 1 Reactivity: 1 Protection: X - See PPE section.

Hazardous Material Identification System (HMIS(r)) hazard ratings are designed to inform employees of chemical hazards in the workplace. These ratings are based on the inherent properties of the material under expected conditions of normal use and are not intended for use in emergency situations. HMIS(r) ratings are to be used with a fully implemented HMIS(r) program. HMIS(r) is a registered mark of the National Paint and Coatings Association (NPCA).

Revision Changes:
Section 1: Product name was modified.
Copyright was modified.
Section 5: Fire fighting procedures information was modified.
Section 6: Release measures information was modified.
Section 8: Eye/face protection phrase was modified.
Section 8: Skin protection phrase was modified.
Section 2: Ingredient table was modified.
Page Heading: Product name was modified.
Section 15: Inventories information was modified.
Section 15: EPCRA 313 information was modified.
Section 8: Exposure guidelines ingredient information was modified.
Section 9: Property description for optional properties was modified.
Section 14: ID Number heading was added.
Section 14: ID Number(s) was added.

Appendix D – Sikagard® 62 Product Information

Construction

Sikagard®-62

Solvent free epoxy coating

Description	Sikagard-62 is a two component high build thixotropic protective coating based on epoxy resin. When cured Sikagard-62 provides a hard, glossy film with high resistance to abrasion and chemical attack.
Uses	Sikagard-62 is successfully used for concrete and steel protection in the following applications: waterproof internal reservoir coatings, interior or exterior (when not subject to UV irradiation) protective coating for silos, pipes, tunnels and galleries. Also in laundries, factories, chemical process areas, sewage treatment works, dairies etc as an impervious chemical resistant coating for floors and walls. Sikagard-62 is vapour proof. When Sikadur Silica Aggregate is applied to the final coat of Sikagard-62 an extremely hard wearing anti-skid, waterproof, chemical resistant finish is obtained.
Advantages	▪ Protective and decorative. ▪ Excellent chemical resistance. ▪ Easy for cleaning and graffiti removal. ▪ High abrasion resistance. ▪ Excellent adhesion to most building materials. ▪ Approved for use with potable water.
Storage and Shelf Life	Stored in the original sealed containers within the temperature range of +5°C to +35°C, this product will keep for a minimum of three (3) years.

Instructions for Use

Surface Preparation	The substrate must be sound, dry, free from dust and any surface contaminants (e.g. oil, grease, fats, chemicals, rust, paint, form release and curing membrane residues, etc.) Blow holes or irregularities should be filled and the substrate levelled with appropriate Sikafloor or Sikadur mortars prior to application of Sikagard-62. This is essential in all areas of contained liquids or water. On steel structures light abrasion of the substrate is recommended. Pre-seal the surface of porous and/or damp substrates with Sikagard-720 EpoCem. This is a very fine fairing mortar formulated on a hybrid epoxy resin/cementitious base. Sikagard-720 should be applied in conditions of falling substrate temperature to avoid the formation of pin holes, blow holes or drumminess caused by expanding air in the porous substrate. Cementitious materials other than EpoCem should be at least 3 or 4 weeks old and should be prepared by mechanically wire-brushing, acid etching, scarifying, abrasive blasting or high pressure water blasting.
Mixing	Sikagard-62 is supplied in preweighed containers. Mix all of Part B with all of Part A and the pigment pack in the large container using a low speed drill and windmill stirrer (max. 600 rpm). Mix until no streaks of colour are visible (about 3 to 5 minutes). Mix so as not to entrap too much air in the product. Use immediately. Application is made easier if materials are stored at between 15°C to 23°C for 24 hours prior to mixing.
Application	Sikagard-62 is may be applied by brush, roller or airless spray. Apply at least the first coat to porous substrates when the substrate temperature is falling. Ideally, start the coating application at sunset. The air in the substrate pores will be contracting then and will physically suck the coating into the pores and cracks enhancing the penetration and sealing function of the coating. Apply a minimum of two coats (three coats for chemical and high mechanical resistance). Ideally, use differing colours on each coat to enable easier application and site control. Recoating should occur when the previous coat can still be clearly pressed in with a fingernail. If recoating cannot be carried out within 48 hours, roughen surface with glass paper, wipe with Sika Colma Cleaner and recoat without delay.

Construction

Cleaning	Uncured material may be cleaned from application tools, etc. by using Sika Colma Cleaner (flammable solvent). Cured material can only be removed mechanically.

Technical and Physical Data

Form	Liquid thixotropic epoxy resin
Mixing Ratio	Ratio by volume A : B = 2.1 : 1 Ratio by weight A : B = 3 : 1
Density	1.35 kg / litre
Consumption/Coverage	0.25 - 0.4 kg / m^2 per coat depending on method of application, temperature, and surface texture, at the recommended film thickness per coat. Normally 2 - 3 coats.
Potlife (12 kg mix)	30 minutes approx. @ 20°C - at higher temperatures potlife is reduced. - at lower temperatures potlife is extended. Refer 'Important Notes'
Maximum relative humidity during cure	85%
Application temperature	Minimum 5°C, Maximum 30°C
Maximum intercoat period	48 hours @ 20°C
Maximum thickness per coat	150 - 200 microns
Coefficient of thermal expansion (-10°C to +40°C)	7.5 x 10^{-5} mm/m/°C approx.
Temperature resistance (without chemical or mechanical action)	Permanent Maximum: dry 70°C wet 60°C

Approximate cure times	30°C	20°C	10°C
Repaintable after	5 hours	10 hours	18 hours
Walkable after	8 hours	17 hours	24 hours
Full chemical resistant cure	9 days	12 days	15 days

Note: Sikagard-62 reaches 90% of its full cure at 20°C in 4 days.

Mechanical strengths (At 7 days)		
Tensile strength	25MPa approx.	
Elongation at break	10% approx.	
Compressive strength	50MPa approx.	
Flexural tensile strength	50MPa approx.	
E-Modulus (dynamic)	30-40.10^2 MPa approx.	

Adhesive strength (DIN 53232)		
To dry concrete approx.	3.5 MPa *	
To sandblasted steel approx.	25 MPa	
To aluminium approx.	16 MPa	
** failure in concrete*		

Colour	Standard colours as per Sikafloor colour chart		
Packaging	Pre-proportioned 2 part kit:	Part A:	8.4 kg
		Part B:	3.0 kg
		Pigment Pack	600 g

Construction

Suitability for use in drinking water	Complies with the requirements of AS 4020: 2005 (Int) – 1994 at a maximum allowable surface area to volume ration of 3365 mm^2 /litre of water
Chemical resistance	(3 coats on sheet steel - 500 microns approximately).

Test Medium	Test Temp °C	Exposure Period and Performance Rating					
		1 day	7 days	30 days	2 mths	6 mths	12 mths
Acetic acid 20%	20	A	A	A	A	AD	C
	40	A	A	A	AD	C	-
Ethyl Acetate	20	A	B	C	-	-	-
Acetone	20	A	C	-	-	-	-
Ammonia 10%	20	A	A	A	A	A	A
Ammonia 10%	40	A	A	A	A	A	AD
Caustic Soda 30%	20	A	A	A	A	A	A
Cement water	20	A	A	A	A	A	AD
	40	A	A	A	A	A	BD
Citric Acid 20%	20	A	A	A	A	AD	AD
	40	A	A	AD	AD	AD	AD
Detergents (eg. liquid	20	A	A	A	A	A	A
"Ajax")	40	A	A	A	A	AD	AD
Distilled water	20	A	A	A	A	A	A
	40	A	A	A	A	A	AD
	60	A	A	A	BD	BD	BD
Ethanol	20	A	A	A	B	C	-
	40	A	B	C	-	-	-
Ethanol/Water 60:40	20	A	A	A	A	A	A
Formic acid 10%	20	A	A	A	A	A	B
Fuel oil (EMPA)	20	A	A	A	A	A	A
	40	A	A	A	A	A	A
	60	A	A	A	A	A	A
Hydraulic fluids	20	A	A	A	A	A	A
(eg. "Arcosafe", "Skydrol")	40	A	A	A	A	B	C
Hydrochloric acid, 10%	20	A	A	A	A	A	A
Hydrochloric acid,	20	A	AD	AD	AD	AD	AD
concentrated	40	AD	AD	AD	BD	C	-
Hydrogen peroxide 5%	20	A	A	A	A	B	B
Iron (III) chloride sol. 35%	20	A	A	AD	AD	AD	AD
	40	A	A	AD	AD	AD	AD
Iron (II) sulphate sol. 35%	20	A	AD	AD	AD	AD	AD
	40	A	AD	AD	AD	AD	AD
Sodium Hypochlorite 14% Cl	20	A	A	AD	BD	BD	C
Kerosene	20	A	A	A	A	A	A
	40	A	A	A	A	A	A
Lactic acid 20%	20	A	A	A	AD	BD	C
	40	A	A	AD	C	-	-

Construction

Chemical resistance (3 coats on sheet steel - 500 microns approximately).

Test Medium	Test Temp °C	Exposure Period and Performance Rating					
		1 day	7 days	30 days	2 mths	6 mths	12 mths
Liquid manure	20	A	A	A	A	A	AD
	40	A	A	A	AD	AD	AD
Liquid silage	20	A	A	A	AD	AD	AD
	40	A	A	AD	BD	BD	BD
Methyl ethyl ketone MEK	20	A	C	-	-	-	-
Nitric acid 20%	20	AD	AD	AD	C	-	-
	40	AD	AD	C	-	-	-
Oxalic acid 10%	20	A	A	AD	AD	BD	C
	40	A	AD	AD	C	-	-
Phosphoric acid 40%	20	A	AD	AD	BD	BD	C
	40	AD	AD	BD	C	-	-
Potassium permanganate 10%	20	A	A	B	C	-	-
Red wine	20	A	A	A	A	A	A
Sodium Carbonate Solution	20	A	A	A	A	A	A
(saturated)	40	A	A	A	A	A	A
Sodium Chloride solution	20	A	A	A	A	A	A
(saturated)	40	A	A	A	A	A	A
Sodium sulphite solution	20	A	A	A	A	A	A
(saturated)	40	A	A	A	A	A	A
Styrene	20	A	A	A	A	A	B
Sulphuric acid 50%	20	AD	AD	AD	AD	AD	AD
	40	AD	AD	AD	AD	AD	AD
Sulphurous acid 5%	20	A	A	AD	AD	AD	BD
	40	A	AD	AD	AD	AD	BD
Tartaric acid 20%	20	A	A	A	A	A	A
Toluene	20	A	A	B	B	B	B
	40	A	A	B	B	B	C
Trichloroethylene	20	A	B	C	-	-	-
Water	20	A	A	A	A	A	A
	40	A	A	A	A	A	A
	60	A	A	A	B	B	B
White wine	20	A	A	A	A	A	A

For information about resistance to other media, please consult our Technical Department.
A = resistant to prolonged contact
B = temporarily resistant
C = breakdown of coating
D = discolouration of coating

Construction

Important Notes

- Do not dilute the product as this will affect in-service performance. Thinners or solvents must not be used.
- For application in damp conditions please consult our Technical Department for further information.
- Do not part mix containers.
- Do not mix and apply product that has a temperature of greater than 30°C. If applying at higher than 30°C, as soon as the Sikagard-62 is mixed transfer the container into an esky containing ice to just below the rim of the container, and then apply the Sikagard-62 from the open container in the esky.
- The temperature at which the Sikagard-62 is stored during the 24 hours before it is mixed will govern its potlife when mixed.
- If the temperature of a porous substrate (which includes the vast majority of concrete) is rising i.e. is in direct sunlight prior to late afternoon, the air in the pores and cracks is expanding and if a wet coating is placed over such a substrate the expanding air will blow bubbles in the coating and prevent the liquid coating penetrating the substrate pores and cracks etc. Prior to the coating reaching the gel phase the bubbles will burst and leave "pin holes" in the coating, whereas when in the gel phase bubbles will be “frozen” into the cured coating. These bubbles will be a weak point in the coating as their wall thickness will be less than the applied film thickness on the substrate.
- To avoid unsightly water spotting do not apply Sikagard-62 when ambient temperature will reach "dew point" before the coating has cured.
- Similarly do not allow water to contact Sikagard-62 that is not seven (7) days old @ 20°C or older at lower temperatures since it will mark the coating.
- Do not apply Sikagard-62 to cementitious mortars that are modified with acrylic, acrylic co-polymer, EVA or PVA polymers (eg. SikaTops or Sika MonoTops) because under certain environmental conditions hardened mortar or render may swell slightly and crack the rigid epoxy coating.
- Light colours will yellow with exposure to sunlight or UV radiation
- Please consult our Technical Department for further information.

Handling Precautions

- Avoid contact with the skin, eyes and avoid breathing its vapour.
- Wear protective gloves when mixing or using.
- If poisoning occurs, contact a doctor or Poisons Information Centre.
- If swallowed, do NOT induce vomiting. Give a glass of water.
- If skin contact occurs, remove contaminated clothing and wash skin thoroughly.
- If in eyes, hold eyes open, flood with water for at least 15 minutes and see a doctor.

Important Notification

The information, and, in particular, the recommendations relating to the application and end-use of Sika’s products, are given in good faith based on Sika’s current knowledge and experience of the products when properly stored, handled and applied under normal conditions. In practice, the differences in materials, substrates and actual site conditions are such that no warranty in respect of merchantability or of fitness for a particular purpose, nor any liability arising out of any legal relationship whatsoever, can be inferred either from this information, or from any written recommendations, or from any other advice offered. The proprietary rights of third parties must be observed. All orders are accepted subject of our terms and conditions of sale. Users should always refer to the most recent issue of the Technical Data Sheet for the product concerned, copies of which will be supplied on request.

PLEASE CONSULT OUR TECHNICAL DEPARTMENT FOR FURTHER INFORMATION.

Material Safety Data Sheet

Sikagard-62 Component A

HAZARDOUS ACCORDING TO CRITERIA OF WORKSAFE AUSTRALIA

COMPANY DETAILS

COMPANY:	Sika (NZ) Ltd
ADDRESS:	85-91 Patiki Road, Avondale, Auckland
TELEPHONE:	(09) 828 7002
EMERGENCY AFTER HOURS:	0800 734 607
FAX NUMBER:	(09) 828 4091

IDENTIFICATION

PRODUCT NAME:	Sikagard-62 Component A
OTHER NAMES:	None
MANUFACTURER'S PRODUCT CODE:	None
U.N. NUMBER:	Free
DANGEROUS GOODS CLASS AND SUBSIDIARY RISK:	Not applicable
HAZCHEM CODE:	Not applicable
POISONS SCHEDULE NUMBER:	5
USE:	Components of 2 part epoxy resin protective coatings for concrete and steel etc.

PHYSICAL DESCRIPTION/PROPERTIES:

APPEARANCE:	Sikagard-62 A buff coloured thixotropic pastes in 8.4Kg can.
BOILING POINT/MELTING POINT:	Not measured
VAPOUR PRESSURE:	< 7 (Pascals @ 20 deg. C)
SPECIFIC GRAVITY:	~ 1.4
FLASHPOINT:	> 70ºC (deg. C Closed cup method)
FLAMMABILITY LIMITS:	Upper None measured Lower None (% in air)
SOLUBILITY IN WATER:	Insoluble (g/L @ 20 deg. C)

ADVICE NOTE:
The information contained in this Safety Data Sheet corresponds to our level of knowledge at the time of publication. All warranties are excluded. Our most current General Sales Conditions shall apply. Please consult the Technical Data Sheet prior to any use and processing.

OTHER PROPERTIES:

Decomposition temperature : >200°C

INGREDIENTS:

Chemical Name:	*CAS Number:*	*Proportion:*
Epoxy resin	-	35-60%
Non hazardous diluents	-	5-10%
Non-hazardous ingredients	-	<1%
Non hazardous inorganic fillers	-	to 100%

Trace amount (typically <10ppm) of Epichlorohydrin remain in the epoxy resins as a result of the chemical reactions in which they are made.

HEALTH HAZARD INFORMATION

HEALTH EFFECTS:

Acute:

Swallowed: Harmful if swallowed.

Eye: May cause very mild irritation to the eyes.

Skin: Mild irritation may result from prolonged contact.

Inhaled: May cause slight irritation if inhaled.

Chronic: *Susceptible individuals may develop allergic reactions such as dermatitis or asthma-like symptoms on a single significant skin exposure or may become sensitised to the material on repeated contact.*

If cured material made using this product is to be cut or sanded, ensure an appropriate dust mask (Class P3, disposable) is worn. In addition industrial safety glasses or goggles should also be worn.

Epoxy resins are made in reactions involving Epichlorohydrin. Therefore it must be assumed that a very small amount of the material will remain in the final product. Epichlorohydrin has been classified as a category 2 carcinogen (worksafe). Hence it is essential that all forms of exposure be kept to an absolute minimum.

FIRST AID:

Swallowed: Affected person should drink 500-800ml water, if possible with suspended activated carbon for medical use. In case of spontaneous vomiting be sure that vomitus can freely drain. Give nothing by mouth to an unconscious person.

Eye: Hold eyes open. Flood with water for at least 15 minutes. See a doctor.

Skin: Remove contaminated clothing. Wash affected skin areas with soap and water. Do not use solvents.

Inhaled: Remove to fresh air. Give oxygen if required.

First Aid Facilities: Eye wash station. Showering facility.

ADVICE TO DOCTOR: **No specific antidote. Treat symptomatically.**

PRECAUTIONS FOR USE

EXPOSURE STANDARDS: Epichlorohydrin 2ppm, 7.6 mg/m³ TWA STEL None established

Avoid exceeding exposure limits by use of ventilation an / or personal protection.

Follow good working practice : handle with care, avoid ingestion, inhalation, eye or skin contact. Do not smoke while using this product. Wash hands with soap and water before eating, drinking, smoking or using toilet facilities.

ENGINEERING CONTROLS: Local ventilation not normally necessary but should be considered if used in poorly ventilated or very confined spaces alternatively a respiratory protection mask fitted with a type A1 filter and complying with AS/NZS 1716 Respiratory Devices and used in accordance with AS/NZS 1715 which describes use and maintenance.

PERSONAL PROTECTION: Avoid contact with skin and eyes by wearing long impervious gloves, (Rubber, Neoprene, PVC complying to AS/NZS 2161) and industrial safety glasses. Respiratory protection using an A1 filter complying with AS/NZS 1715, 1716 should be worn if ventilation at the workplace is inadequate. Apply barrier creams to exposed skin areas.

Do not store or consume food, drink or tobacco in an area where they may become contaminated with this material. Wash thoroughly before eating, smoking, applying cosmetics etc. Thoroughly launder work clothes before reuse.

FLAMMABILITY: Product is not flammable, therefore does not need to be handled, used or stored in a flameproofed area.

SAFE HANDLING INFORMATION

STORAGE & TRANSPORT:

General	:	Product can be handled and stored safely
Storage	:	With only minimal hazard to operators
UN Number	:	Free
Dangerous Goods Class and Subsidiary Risk	:	Not applicable
Packaging Group	:	Not applicable
HAZCHEM Code	:	Not applicable
IATA Class	:	Free
IMDG Reference	:	Free
Minimum temperature	:	5°C
Maximum temperature	:	35°C
Incompatible DG Classes	:	Classes 5.1, 5.2

Incompatible Receptacle :	Unapproved plastic containers
Incompatible Substances:	Strong oxidising agents, acids or bases

Product should be stored in properly resealed containers if not all used in the first application. Product should be stored in a cool, dry place.

SPILLS & DISPOSAL:

In case of spill, wear personal protection as indicated above. Spilt material should be absorbed into dry, inert material (eg sand), which then can be put into appropriately labelled drums. The wasted material can be disposed of by incineration (preferably high temperature), by an approved agent according to local regulations.

FIRE/EXPLOSION HAZARD:

Extinguishing Media:	Water mist, foam, Carbon Dioxide, dry powder.
Hazardous combustion products:	Carbon Monoxide, Carbon Dioxide and other possibly toxic gases and vapours on burning.

Product will not decompose explosively.

Product as received will not present a dust explosion hazard. However, should cured material made using this product be machined or sanded, a dust explosion hazard may be created. Therefore all dust generated should be removed as quickly as possible, preferably by using a vacuum cleaner.

OTHER INFORMATION:

Environmental Data

Prevent spillage from entering waterways or drains.

CONTACT POINT:

Operations Manager (09) 828 7002 or (09) 820 1432.

Material Safety Data Sheet

Sikagard-62 Component B

HAZARDOUS ACCORDING TO CRITERIA OF WORKSAFE AUSTRALIA

COMPANY DETAILS

COMPANY:	Sika (NZ) Ltd
ADDRESS:	85-91 Patiki Road, Avondale, Auckland
TELEPHONE:	(09) 828 7002
EMERGENCY AFTER HOURS:	0800 734 607
FAX NUMBER:	(09) 828 4091

IDENTIFICATION

PRODUCT NAME:	Sikagard-62 Component B
OTHER NAMES:	Corrosive liquid N.O.S (contains aliphatic amine)
MANUFACTURER'S PRODUCT CODE:	None
U.N. NUMBER:	1760
DANGEROUS GOODS CLASS AND SUBSIDIARY RISK:	Class 8 None
HAZCHEM CODE:	3X
POISONS SCHEDULE NUMBER:	5
USE:	Sikagard-62 is a 2 component epoxy resin chemical resistant coating.

PHYSICAL DESCRIPTION/PROPERTIES:

APPEARANCE:	Mid brown colour low viscosity liquid with an amine odour
BOILING POINT/MELTING POINT:	> 200ºC / < 0ºC
VAPOUR PRESSURE:	< 0.2hPa @ 20ºC
SPECIFIC GRAVITY:	~ 1.01
FLASHPOINT:	~ 100°C
FLAMMABILITY LIMITS:	Not available
SOLUBILITY IN WATER:	@ 20ºC solubility ~ 25% v/v.

ADVICE NOTE:
The information contained in this Safety Data Sheet corresponds to our level of knowledge at the time of publication. All warranties are excluded. Our most current General Sales Conditions shall apply. Please consult the Technical Data Sheet prior to any use and processing.

OTHER PROPERTIES:

Auto Ignition Temperature	>350°C
Reactivity	Reacts with strong acids and strong oxidising agents exothermically.
	Thermal decomposition @>250ºC produces ammonia, other nitrogen compounds, carbon monoxide and carbon dioxide.

INGREDIENTS:

Chemical Name:	*CAS Number:*	*Proportion:*
IPD	*2855-13-2*	*<40%*
aliphatic polyamine adduct	*none allocated*	*<40%*
benzyl alcohol	*100-51-6*	*to 100%*

HEALTH HAZARD INFORMATION

HEALTH EFFECTS

Acute

Swallowed:	Harmful if swallowed.
Eye:	Irritating to eyes - risk of serious eye damage.
Skin:	Harmful in contact with skin - causes burns.
Inhaled:	Harmful by inhalation.
Chronic	*May cause sensitisation by skin contact & inhalation.*

FIRST AID

Swallowed:	If poisoning occurs, contact a doctor or 0800 734 607. If swallowed, do NOT induce vomiting. Give a glass of water.
Eye:	In case of contact with eyes, rinse immediately with plenty of water and contact a doctor or 0800 734 607.
Skin:	If skin contact occurs, remove contaminated clothing and wash skin thoroughly with plenty of soap and water.
Inhaled:	Remove from exposure.
First Aid Facilities:	Clean running water.

ADVICE TO DOCTOR: Treat as for corrosive alkali with low water solubility.

PRECAUTIONS FOR USE

EXPOSURE STANDARDS:	IPD	TLV:	WorkSafe None determined
		STEL:	WorkSafe None determined

ENGINEERING CONTROLS:	Use only in well ventilated areas, use local exhaust ventilation if necessary. If ventilation is poor use respirator specified below.
PERSONAL PROTECTION:	Wear suitable protective clothing. Wear PVC gloves. Wear safety goggles. In poorly ventilated areas wear a half face filter respirator suitable for organic vapours. (Filter A1). Gloves and safety glasses recommended should comply with Australian Standards or an equivalent approved by a Commonwealth, State or Territory authority. Respirators should comply with Australian Standard AS/NZS 1716 Respiratory Protective Devices or an equivalent approved by a State or Territory authority and should be used in accordance with Australian Standard AS/NZS 1715 Selection, Use and Maintenance of Respiratory Protective Devices. Do not store or consume food, drink or tobacco in an area where they may become contaminated with this material. Wash thoroughly before eating, smoking, applying cosmetics etc. Thoroughly launder work clothes before reuse.
FLAMMABILITY:	Not flammable under conditions of use but will support combustion.

SAFE HANDLING INFORMATION

STORAGE & TRANSPORT:	Corrosive Dangerous Goods Class 8 No subsidiary risk. Packing Group: III UN Number: 1760 Correct Shipping Name: Corrosive liquid N.O.S. (contains aliphatic amine)
SPILLS & DISPOSAL:	Prevent entering sewers or stormwater drains or waterways. In poorly ventilated or confined spaces wear a half face respirator suitable for organic vapours wear safety glasses or goggles and rubber or PVC gloves. Absorb with dry sand, vermiculite or special spill absorbent for organic materials. Collect absorbent and absorbed spill in a steel container that can be sealed. Dispose of using a licences incinerator.
FIRE/EXPLOSION HAZARD:	Hazchem Code: 3X Combustible liquid. Produces oxides of nitrogen and carbon on combustion. Fire fighting media-foam, carbon dioxide or dry powder.
OTHER INFORMATION:	
CONTACT POINT:	Operations Manager (09) 828 7002 or (09) 820 1432.