

LOW-TEMPERATURE TESTING OF BENTOMAT CL

To determine whether Bentomat CL can be installed in extreme cold temperatures without undue risk of damage, CETCO contracted Precision Geosynthetic Laboratories to perform a low-temperature testing program on Bentomat CL, a needlepunch-reinforced GCL laminated to a polyethylene liner. Specifically, the following tests were performed:

- **ASTM D6768, GCL Tensile strength.** Tests performed at both room temperature and after cooling to -40 degrees C.
- **ASTM D4833, Puncture strength.** Tests performed at both room temperature and after cooling to -40 degrees C.
- **ASTM D1790, Brittleness temperature of plastic sheeting by impact.** Samples are first cooled to -40 degrees C, wrapped in a closed loop on an anvil, struck with a 6-lb swinging arm, and then checked for signs of cracking.
- **ASTM D1970, Low-temperature flexibility.** Samples are cooled to -40 degrees C, bent repeatedly around a 1-inch mandrel, and then check for signs of cracking.

The attached laboratory test results show that Bentomat CL samples cooled to subzero (-40 degrees) temperatures did not experience any reduction in tensile or puncture strength, and passed both the ASTM low-temperature brittleness and flexibility tests.

These data, together with the freeze/thaw data in TR-104, and the cold-weather installation case study in TR-245, indicate that CETCO GCLs should be considered for projects in cold climates.



Precision Geosynthetic Laboratories



September 25, 2009

Chris Athanassopoulos
CETCO
2870 Forbs Avenue
Hoffman States, IL 60192

RE: **Cold Crack Test**

Dear Mr. Athanassopoulos:

Thank you for consulting Precision Geosynthetic Laboratories for your material testing needs.

Enclosed is the **final** laboratory report for the testing of one (1) Bentomat CL GCL sample received on September 10, 2009.

It shall be noted that the samples tested are believed to be true representatives of the material produced under the designation herein stated. In addition, the attached laboratory tests results are considered indicative only of the quality of samples/specimens that were actually tested. The appropriate test methods hereby employed are based on the current and accepted industry practices. Precision Geosynthetic Laboratories neither accepts responsibility for nor makes claims to the intended final use and purpose of the material.

By accepting the data and results presented on this report, the Client agrees to limit the liability of Precision Geosynthetic Laboratories from Client and all other parties for claims arising out of the use of this data to the cost for the respective tests presented in this report; and the Client agrees to indemnify and hold harmless Precision Geosynthetic Laboratories from and against all liabilities in excess of the aforementioned limit.

The test data and all associated project information shall be held confidential and not to be reproduced and/or disclosed to other parties except in full and with prior written approval from pertinent entity duly authorized by the respective client or from the client itself.

It is a policy of the company to keep physical records of each job for two (2) years commencing from the date of receipt of the samples and keep its corresponding electronic file for seven (7) years. ***Failed seam samples are kept for two (2) years and good seam samples are disposed of after two (2) weeks. Similarly, retained conformance samples are disposed of after one (1) month.*** On the other hand, should you need us to keep them at longer time, please advise us in writing.

Should you have any questions or if we may be of further service to you, please do not hesitate to contact us at telephone number: 800-522-4599.

Sincerely,

PRECISION GEOSYNTHETIC LABORATORIES

Carmelo V. Zantua
Technical/Laboratory Director

Enclosure: (Job No. G090854)



Precision Geosynthetic Laboratories



CLIENT: **CETCO**
PROJECT: **Cold Crack Test**

VERIFICATION OF MATERIAL PROPERTIES
(PGL Job No. G090854)

MATERIAL DESCRIPTION: Bentomat CL GCL

SAMPLE SENT BY: Susie Wilkerson, CETCO

DATE RECEIVED: September 10, 2009

DATE REPORTED: September 25, 2009

SAMPLE IDENTIFICATIONS:

SAMPLE ID

PRECISION CONTROL NUMBER

R#2778 L#200931LO

61743

TESTS REQUIRED:

TEST METHOD

DESCRIPTION

ASTM D6768

Tensile Strength at Room Temp and at -40oC

ASTM D4833

Puncture Resistance at Room Temp and at -40oC

ASTM D1790

Brittleness Temperature

ASTM D1970

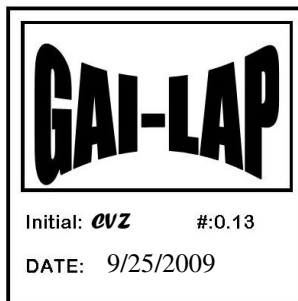
Low Temperature Flexibility

TEST CONDITIONS: The sample was conditioned for a minimum one hour in the laboratory at $22 \pm 2^{\circ}\text{C}$ ($71.6 \pm 3.6^{\circ}\text{F}$) and at $60 \pm 10\%$ relative humidity prior to test.

TEST RESULTS:

The test results are summarized in Table 1.


PRECISION GEOSYNTHETIC LABORATORIES



Carmelo V. Zantua
Technical/Laboratory Director

TABLE 1.
MATERIAL PROPERTIES
CLIENT: CETCO
PROJECT: Cold Crack Test

Date Received: **9/10/2009**
Date Reported: **9/25/2009**
Client Sample ID: **R#2778 L#200931LO**
Material Description: **Bentomat CL GCL**

QC'd By: 
PGL Job No.: **G090854**
PGL Control No.: **61743**

SPECIMENS

SPECIMENS																Proj. Specs.
	1	2	3	4	5	6	7	8	9	10	Avg.	Std. Dev.	Min	Max		
METHOD	DESCRIPTION															
ASTM D4833	Puncture Resistance (lbs) Test Temperature: <u>Room Temperature</u> Specimens were treated as directed in Test Method D4833. They were clamped without tension between circular plates of a ring clamp attachment secured in a tensile machine. Test specimens extended to or beyond the outer edges of the clamping plates.															
	129	130	128	121	128	131	134	134	128	111	124	8	111	134		
	112	112	113	120	131											
ASTM D4833	Puncture Resistance (lbs) Test Temperature: <u>-40° C</u> Specimens were treated as directed in Test Method D4833. They were clamped without tension between circular plates of a ring clamp attachment secured in a tensile machine. Test specimens extended to or beyond the outer edges of the clamping plates.															
	145	150	141	148	150	140	142	143	150	142	144	4	140	150		
	143	142	150	142	138											
ASTM D6768	Tensile Strength (lbs/in) Test Temperature: <u>Room Temperature</u> Instron Tensile Machine was used with a maximum load of <u>1500 lbs.</u>															
MD	113	90	115	110	113						108	10	90	115		
ASTM D6768	Tensile Strength (lbs/in) Test Temperature: <u>-40° C</u> Instron Tensile Machine was used with a maximum load of <u>1500 lbs.</u>															
MD	125	127	128	125	122						126	2	122	128		
ASTM D1790	Brittleness Temperature by Impact Specimens were conditioned for 1 hr in the laboratory at 22° C+/-2° C(71.6° F+/-3.6° F) and at 60% +/- 10 Relative Humidity prior to test. Thickness of Test specimen: <u>270 mils</u> Direction of fold: <u>TD</u> Test temperature: <u>-40° C</u>															
	PASSED	PASSED	PASSED	PASSED	PASSED	PASSED	PASSED	PASSED	PASSED	PASSED	PASSED	N/A				
ASTM D1970	Low Temperature Flexibility Specimens were conditioned for 1 hr in the laboratory at 22° C+/-2° C(71.6° F+/-3.6° F) and at 60% +/- 10 Relative Humidity prior to test. Thickness of Test specimen: <u>275.1 mils</u> Test temperature: <u>-40° C</u>															
MD	PASSED	PASSED	PASSED	PASSED	PASSED						PASSED	N/A				
TD	PASSED	PASSED	PASSED	PASSED	PASSED						PASSED	N/A				

MD-Machine Direction
TD-Transverse Direction
DC#1982 Record#263



Precision Geosynthetic Laboratories

