

**MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS  
USING A FLEXIBLE WALL PERMEAMETER  
ASTM D 5084 - 03 METHOD C TEST WITH INCREASING TAILWATER LEVEL  
FLUID: DEAIRED TAP WATER WITH 0.005 N CaSO4**

PROJECT NAME: GEOPRO, INC.	PROJECT NUMBER: 02146312.0004
LOCATION:	DATE: 5/1/2014
SAMPLE ID: GeoPro's Thermal Grout w/ Max Silica sand	PANEL IDENTIFICATION: Lenexa Perm Board
BENTONITE(Thermal Grout) - 10.30% Sand (5010) - 51.60%	BURETTE AREA: 0.312 cm <sup>2</sup>
PowerTEC <sub>x</sub> - 1.00% DEIONIZED WATER - 37.00%	BURETTE INCREMENT LENGTH: 1.000 cm
	VOLUME PER INCREMENT: 0.312 cm <sup>3</sup>

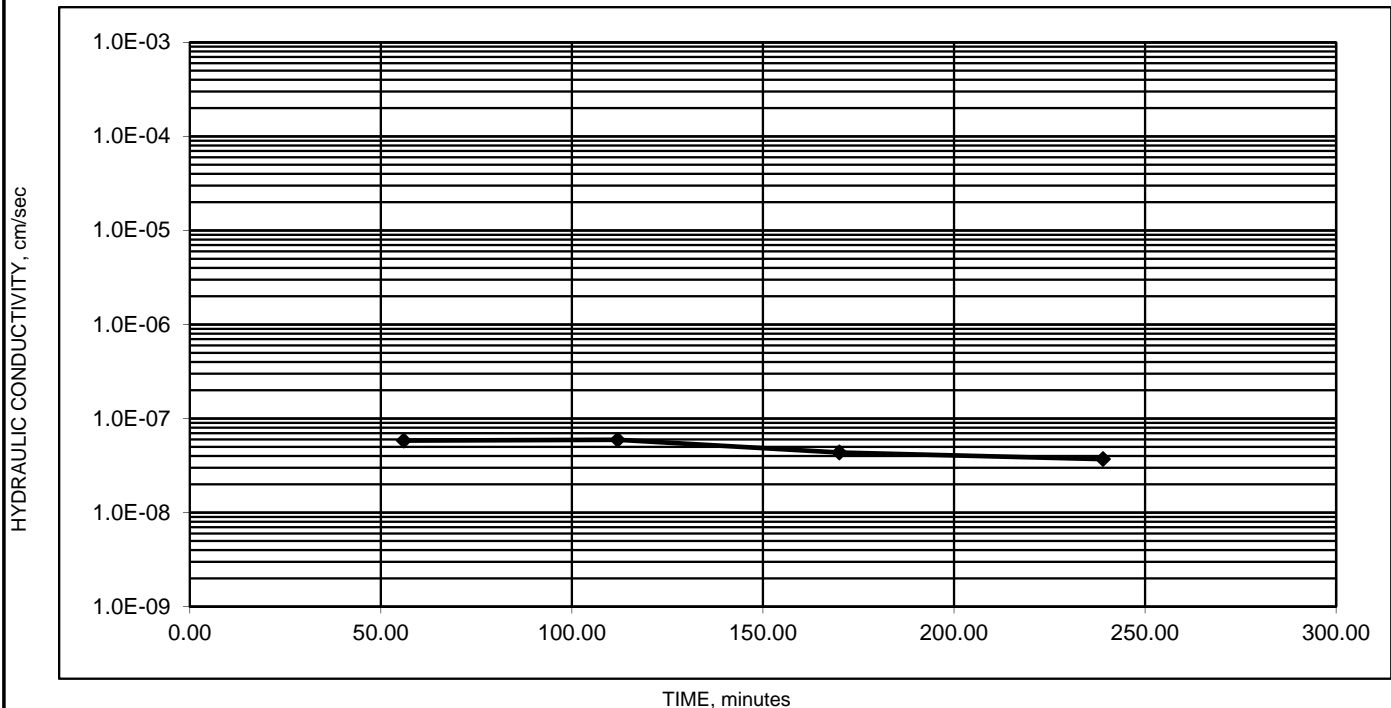
INITIAL				ADDITIONAL DATA			
MOISTURE%	DENSITY			SPECIFIC GRAVITY:	2.70	RECOMPACTED?:	YES
W & T, g	WET WT, g	125.5		SPECIFIC GRAVITY:	ASSUMED	PROCTOR, pcf:	NA
D & T, g	DIA, in	2.426	6.16	POROSITY, %:	NA	OPTIMUM, %:	NA
T, g	HT, in	0.998	2.54	SATURATION, %:	NA	COMPACTION, %:	NA
	AREA		29.82	VOID RATIO:	NA	OVER OPTIMUM, %:	NA
MOIST-URE, %	DENSITY:	103.6	PCF WET				
NA	DENSITY:	NA	PCF DRY				

<b>SATURATION:</b>	LATERAL PRESS.: 104.0 psi	BACK PRESSURE (=UPPER=LOWER): 100.0 psi	
<b>DURING TEST:</b>	LATERAL PRESS.: 104.0 psi	H2: 100.0 psi	H1: 100.0 psi
		BIAS PRESSURE (=H1-H2) 0.0 psi	

H1 VALUE	H2 VALUE	ELAPSED TIME, min	DELTA H, cm	Ln H1/H2	HYD CON k, cm/sec	OUT FLOW cm <sup>3</sup>	IN FLOW cm <sup>3</sup>	OUT/IN RATIO	HYD GRAD	% FROM MEAN k	TEMP.: C	TEMP. CORR.:
8.4	57.2	0.00	48.8									
8.8	56.8	56.00	48.0	0.016529	5.84E-08	0.12	0.12	1.00	18.9	18	24.8	0.893
9.2	56.4	112.00	47.2	0.016807	5.95E-08	0.12	0.12	1.00	18.6	20	24.7	0.895
9.5	56.1	170.00	46.6	0.012793	4.36E-08	0.09	0.09	1.00	18.4	12	24.8	0.893
9.8	55.8	239.00	46.0	0.012959	3.70E-08	0.09	0.09	1.00	18.1	25	24.9	0.891

HYDRAULIC CONDUCTIVITY (k<sub>20</sub>) = **AVERAGE 5.0E-08 cm/sec**

MAXIMUM	1.0E-03 TO 1.0E-04	2	0.75<	30	% < 25 AT
HYDRAULIC GRADIENT	1.0E-04 TO 1.0E-05	5	RATIO	MAX	> 1.0E-8
	1.0E-05 TO 1.0E-06	10	<1.25	HYDRAULIC GRADIENT	OR
	1.0E-06 TO 1.0E-07	20		% < 50 AT	
	less than 1.0E-07	30		ALLOWED	< 1.0E-8



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ASTM D 5084 - 03 METHOD C TEST WITH INCREASING TAILWATER LEVEL  
FLUID: DEAIRED TAP WATER WITH 0.005 N CaSO4**

PROJECT NAME: GEOPRO, INC.	PROJECT NUMBER: 02146312.0003
LOCATION:	DATE: 4/30/2014
SAMPLE ID: GeoPro's Thermal Grout w/ PowerTECx BENTONITE(Thermal Grout) - 23.20% PowerTECx - 9.30% DEIONIZED WATER - 67.60%	PANEL IDENTIFICATION: Lenexa Perm Board BURETTE AREA: 0.312 cm <sup>2</sup> BURETTE INCREMENT LENGTH: 1.000 cm VOLUME PER INCREMENT: 0.312 cm <sup>3</sup>

INITIAL				ADDITIONAL DATA			
MOISTURE%	DENSITY			SPECIFIC GRAVITY:	2.70	RECOMPACTED?:	YES
W & T, g	WET WT, g	91.0		SPECIFIC GRAVITY:	ASSUMED	PROCTOR, pcf:	NA
D & T, g	DIA, in	2.426	6.16	POROSITY, %:	NA	OPTIMUM, %:	NA
T, g	HT, in	1.000	2.54	SATURATION, %:	NA	COMPACTION, %:	NA
	AREA		29.82	VOID RATIO:	NA	OVER OPTIMUM, %:	NA
MOIST-URE, %	DENSITY:	75.0	PCF WET				
NA	DENSITY:	NA	PCF DRY				

<b>SATURATION:</b>	LATERAL PRESS.: 104.0 psi	BACK PRESSURE (=UPPER=LOWER): 100.0 psi	
<b>DURING TEST:</b>	LATERAL PRESS.: 104.0 psi	H2: 100.0 psi	H1: 100.0 psi
	BIAS PRESSURE (=H1-H2) 0.0 psi		

H1 VALUE	H2 VALUE	ELAPSED TIME, min	DELTA H, cm	Ln H1/H2	HYD CON k, cm/sec	OUT FLOW cm <sup>3</sup>	IN FLOW cm <sup>3</sup>	OUT/IN RATIO	HYD GRAD	% FROM MEAN k	TEMP.: C	TEMP. CORR.:
7.7	68.0	0.00	60.3									
8.0	67.7	71.00	59.7	0.010000	2.78E-08	0.09	0.09	1.00	23.5	16	24.9	0.891
8.4	67.3	133.00	58.9	0.013491	4.32E-08	0.12	0.12	1.00	23.2	31	24.7	0.895
8.6	67.1	188.00	58.5	0.006814	2.45E-08	0.06	0.06	1.00	23.0	26	24.8	0.893
9.0	66.7	263.00	57.7	0.013770	3.64E-08	0.12	0.12	1.00	22.7	10	24.8	0.893

HYDRAULIC CONDUCTIVITY (k<sub>20</sub>) = **AVERAGE 3.3E-08 cm/sec**

MAXIMUM	1.0E-03 TO 1.0E-04	2	0.75<	30	% < 25 AT
HYDRAULIC GRADIENT	1.0E-04 TO 1.0E-05	5	RATIO	MAX	> 1.0E-8
	1.0E-05 TO 1.0E-06	10	<1.25	HYDRAULIC GRADIENT	OR
	1.0E-06 TO 1.0E-07	20		% < 50 AT	
	less than 1.0E-07	30		ALLOWED	< 1.0E-8

