POLYFELT ROCK PEC COMPOSITE GEOTEXTILES

RECOMMENDED MATERIAL PARTIAL SAFETY FACTORS FOR LONG TERM DESIGN STRENGTH ACCORDING TO BS8006 : 1995

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Item	**Particular**	**Remarks/Reference (attachment)**
Product Description	Manufactured from high tenacity polyester yarns, knitted to form a structured grid and coated with PVC protection	
Polymer Type and Grade	**No. average molecular weight: > 26000 (Rec: > 25000)** **Carboxyl End Group (CEG): 22 (Rec: < 30)**	Statement of Quality High Tenacity Polyester Yarn
Tensile Strength PEC35 PEC50 PEC75 PEC100 PEC150 PEC200	**Characteristic short-term tensile strength** **35 kN/m** **50 kN/m** **75 kN/m** **100 kN/m** **150 kN/m** **200 kN/m**	Characteristic being 95th percentile value (mean – 1.64σ) Production Quality Report
Quality Control System	Mass/area, Tensile strength & elongation } Minimum once a day or every 10000m2 Yarn quality control Certificate of Analysis (CoA) from supplier Internal QC testing on tensile strength and elongation on all yarns prior to manufacturing Manufacture in accordance with ISO 9001:2000 protocol QC testing at GAI-LAP laboratory	Standard Operating Procedure – High Strength Production (ISO 9001:2000) document Laboratory QC Report ISO 9001:2000 Certificate and Scope GAI-LAP certificate
Creep Reduction Factor (CRF) (acc. BS8006: 1995)	Evaluation of CRF based on: SIM test on high tenacity polyester yarn used to manufactured Polyfelt Rock PEC geotextiles	ERA Report 2001-0635 (Project 100030004)

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Item	**Particular**	**Remarks/Reference (attachment)**
Creep Reduction Factor (CRF) (contd.) (acc. BS8006: 1995)	Based on the above, CRFs are derived for the followings: 5, 10, 20, 60 and 120 years for operating temperature at 20°C. CRF equation: $\sigma = 77.40 - 1.8 \log t$ Thus, CRF for 10^6 hrs (114yr) = 1.50 Applying a correction of load predicted by SIM minus 6.0% (ERA recommends 4.5%), CRF for 10^6 hrs (114yr) = **1.65**	ERA Report 2003-0437 (Project 7M0099701) Comparison between SIM and long-term creep tests on geosynthetics JH Greenwood et al
Partial material factor, f_{m11} (Consistency of manufacture) (acc. BS8006: 1995)	f_{m111} = 1.0 for characteristic base strength f_{m112} = 1.0 for ISO9001: 2000 manufacturer $\boldsymbol{f_{m11} = f_{m111} \times f_{m112} = 1.0}$	BS8006:1995 Annex A, Cl. A.3.2.2 BS8006:1995 Annex A, Cl. A 3.2.3
Partial material factor, f_{m12} Extrapolation of test data) (acc. BS8006: 1995)	f_{m121} = 1.0 for consistency of manufacturing quality procedure and consistency of polymer compound used. f_{m122} = 1.0 (creep rupture results of high tenacity polyester yarn using SIM exceeding 10^6h) $\boldsymbol{f_{m12} = f_{m121} \times f_{m122} = 1.0}$	BS8006:1995 Annex A, Cl. A.3.3.2 ERA Report 2001-0635 (Project 100030004)

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Item	Particular	Remarks/Reference (attachment)
Partial material factor, f_{m21} (Construction effect) (acc. BS8006: 1995)	Installation damage test conduct on base yarn of high tenacity polyester using ≤ 6mm particles and ≤ 60mm aggregate	Extrapolation from BBA certificate on installation damage on base polyester yarn of high tenacity BBA certificate No 99/R114
Partial material factor, f_{m22} (Environmental effect) (acc. BS8006: 1995)	RTA R57 recommends pH range for reinforced fill materials for polyester reinforcement at 4<pH<9. FHWA publication recommends electrochemical properties for backfills when using geosynthetic reinforcement at 3<pH<9. (Similar recommendations given in NCMA document on properties of backfill). (No formalized limitations on the environments in which polymeric reinforcements are expected to operate given in BS 8006:1995).	Design of Reinforced Soil Walls Ed 1 R57, RTA NSW USDoT FHWA Publication No. FHWA-NHI-00-043 on 'Mechanically Stabilized Earth Walls and Reinforced Soil Slopes Design & Construction Guidelines (2001). Design Manual for Segmented Retaining Walls, NCMA

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Item	Particular	Remarks/Reference (attachment)
Partial material factor, f_{m22} (contd.) (Environmental effect) (acc. BS8006: 1995)	Extensive research has been conducted (see References) on long-term durability testing using High Tenacity Polyester yarns of min 1100 dtex (990 denier), No. avg molecular weight (Mn) > 25000 and Carboxyl End Group (CEG) < 30 **All Rock PEC geotextiles are manufactured using high tenacity poyester yarns (min 2000 denier) with Mn > 25000 and CEG < 30.** Based on the research outlined in the References and that the yarns used in the manufacturing of all Rock PEC geotextiles are within the range to those that were evaluated in the above tests, f_{m22} **= 1.10** is reasonable for all Rock PEC geotextiles in the recommended soil pH range.	The Effect of pH, Resin Properties, & Manufacturing Process on Laboratory Degradation of Polyester Geosynthetics, Elias et al (1998), Geosynthetics Int. Vol.5 No. 5, pp459-490. Hydrolysis of HT Polyester yarns in water at moderate temperatures, Risseeuw & Schmidt (1990), 4th Int .Conf. on G&G, The Hague, Netherlands, pp691-696. Durability for geosynthetics based on accelerated laboratory testing, Salmon et al (1997), Geosynthetics '97, pp217-234. The hydrolytic stability of PET yarns under medium alkaline conditions, Schmidt el at (1994), 5th Int. Conf. On G&G, Singapore, pp1153-1158.

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(SUMMARY)

Design temperature of soil = 20°C
Soil pH range 3 - 9
Polyester type: High tenacity Mn > 26000, CEG = 22, Denier ≥ 2000

Rock GX Grade			**PEC35**	**PEC50**	**PEC75**	**PEC100**	**PEC150**	**PEC200**
Characteristic tensile strength (MD) (kN/m)			100	200	300	400	600	800
Creep reduction factor (CRF)* 5 yrs 10yrs 20yrs 60yrs 120yrs					1.59 1.60 1.61 1.64 1.65			
f_{m1}	Consistency of manufacture, f_{m11}	f_{m111}	1.00	1.00	1.00	1.00	1.00	1.00
		f_{m112}	1.00	1.00	1.00	1.00	1.00	1.00
	Extrapolation of test data, f_{m12}	f_{m121}	1.00	1.00	1.00	1.00	1.00	1.00
		f_{m122}	1.00	1.00	1.00	1.00	1.00	1.00
f_{m2}	Construction effect, f_{m21} ≤ 6mm		1.05	1.02	1.00	1.00	1.00	1.00
	≤ 60mm		1.33	1.25	1.19	1.14	1.09	1.05
	Environmental effect, f_{m22}		1.10	1.10	1.10	1.10	1.10	1.10

* Based on regression line σ = 77.40 – 1.80 log t.
Difference in load predicted by SIM and conventional method for 10^6 hours on high tenacity polyester yarns based on ERA long term creep test data = 4.5% (ERA Report 2003-0437).
Load predicted by SIM for 120 years = 66.6%
Correction for load predicted = 66.6 – 4.5 = 62.1%, which yielded CRF = 1.61. Therefore used **1.65** (correction reduction 6.0%)

The above material partial factors of safety are based on latest data available.