

**Safety factors to be applied to calculate the Long Term Design Strength (LTDS) properties of MACTEX W2®**

The **MACTEX W2®** are made from synthetic polymers, therefore, the creep behavior, ultraviolet, microbes, temperature and chemical aggressions can significantly affect the long term strength of materials and it is critical issue for the reinforced structure design. Reduction factors for reinforcement fabrics are obtained from tests, which are described in ISO TR 20432. The Long Term Design Strength is derived as the follows:

$$T_{LTDS} = T_{UTS} / RF$$

$$RF = RF_{CR} \times RF_{ID} \times RF_W \times RF_{CH} \times F_s$$

- T<sub>LTDS</sub>** = Long Term Design Strength
- T<sub>UTS</sub>** = Ultimate Tensile Strength
- RF** = Overall reduction factor
- RF<sub>CR</sub>** = Reduction factor for creep
- RF<sub>ID</sub>** = Reduction factor for the effect of installation damage
- RF<sub>W</sub>** = Reduction factor for weathering
- RF<sub>CH</sub>** = Reduction factor for the environmental degradation (chemical biological) at the service temperature
- F<sub>s</sub>** = Reduction factor related to the mass of info available and to the production quality management

**Ultimate Tensile Strength (UTS, T<sub>UTS</sub>)** : the UTS of **MACTEX W2®** uses a constant rate of extension testing machine to pull a specific width fabric to failure, ad described in ASTM D4595 and EN ISO 10319. Make reference to the product data sheet to determine the UTS for the different grades of **MACTEX W2®**.

**Reduction Factor for Durability (RF<sub>W</sub> and RF<sub>CH</sub>)** : durability of reinforcement material is an issue in the design. The material has been fully tested according the European marking requirements to verify its chemical and environmental resistance according to EN 14030, 12225, 12447 (Acid/Alkali/microbiological/hydrolysis). The data obtained are consistent with an adequate FS with the value suggested by FHWA-NHI-10-024 for reinforcement material characterized by a CEG below 30 and a Molecular Weight higher than 25.000;

For seismic analyses, the computation of the polymeric reinforcements strength is evaluated considering a RF<sub>CR</sub> equal to 1.00, as indicated in several main international guidelines (BS 8006:2016, NF P94-270, FHWA-NHI-10-024, Japanese Railway Code).

**Reduction Factor for Installation Damage (RF<sub>ID</sub>)** : during installation of the fabric, backfill placement may cause it's damage according to the different type of fills and to the compacting energy. To have the degree of damage it's advisable to run full scale installation test with the **MACTEX W2®** woven fabrics and specific fill material (silty sand, concrete sand and coarse gravels). Test run by accredited laboratories as TRI and SGI provided detailed data for grades over the 200kN/m while safe values based on our experience has been assumed for lower strength fabrics;

**Reduction Factor for Creep (RF<sub>CR</sub>)** : as the material under a constant load, the strength will gradually decay due to the changes of the molecular structure. The relevant tests should be conducted to understand the creep behavior of geogrids and extrapolate the reduction factors for the required service life. The following values - based on accelerated (SIM) and conventional tests according to ASTM D6992 and ISO13431 - can be assumed at a standard 20°C temperature

Design life of	10y	25y	50y	75y	120y
RF <sub>creep</sub> - % of UTS	1.35 - 74%	1.37 - 73%	1.38 - 72.4%	1.39 - 72%	1.40 - 71.4% .

**Reduction Factor for statistical data and uncertainties (F<sub>s</sub>)** : this safety factor takes into account those cause whose effects cannot be quantified, the quality of the data provided, together with the statistical variation in the reduction factors calculated; for **MacTex W2®** range such value is safely assumed higher than 1.1. Some normative impose a constant value independently from any certificate evidence; in such cases the values reported in the data sheet should be factorized of the value imposed by the normative.

**For the overall reduction factor table for the MacTex W2® range for a design life of 50 & 120 years please refer hereafter; to evaluate the safety factor value to be applied to intermediate grades please refer to the one of the closest lower grade showed in the table while for global reduction factors related to a 75years design life please refer to intermediate values reported for 50 and 120 design life for the corresponding grade.**

**For values related to other design life please contact the competent Maccaferri Office.**

Overall safety factor (RF) for temperature ≤ 20 ° C; 4 < ph < 9 for soil reinforcement long term application					
MacTex W2 WG GRADE	<20.05	≥20.05; <50.05	≥50.05; <60.05	≥60.05; <100.05	≥100.05
<b>Design life 50 years</b>					
D <sub>90</sub> ≤ 1.0 mm - silty sand	2.55	1.89	1.83	1.74	1.74
D <sub>90</sub> ≤ 3.0 mm - concrete sand	2.55	1.89	1.83	1.74	1.74
D <sub>90</sub> ≤ 28.0 mm - coarse gravel	2.55	2.32	2.21	2.01	1.75
<b>Design life 100 &amp; 120 years</b>					
D <sub>90</sub> ≤ 1.0 mm - silty sand	2.58	1.92	1.86	1.76	1.76
D <sub>90</sub> ≤ 3.0 mm - concrete sand	2.58	1.92	1.86	1.78	1.76
D <sub>90</sub> ≤ 28.0 mm - coarse gravel	2.58	2.36	2.24	2.03	1.78

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