TenCate Miragrid®

Quality Accredited Laboratory ISO/IEC 17025 GAI-LAP Assured

Miragrid® GX Geogrids

Properties of TenCate Miragrid® GX Geogrids

Property		Unit	GX 40/40	GX 60/30	GX 80/30	GX 100/30
Initial Mechanical Properties						
Characteristic initial strength, T_u (ISO 10319)	MD	kN/m	40	60	80	100
Characteristic initial strength (ISO 10319)	XD	kN/m	40	30	30	30
Characteristic initial strength at 5% strain (ISO 10319)	MD	kN/m	20	30	40	50
Strain at initial strength	MD	%	10	10	10	10
Material reduction factor creep-rupture, f_{cr}						
at 60 years design life			1.41	1.41	1.41	1.41
at 120 years design life			1.43	1.43	1.43	1.43
Creep limited strength based on creep-rupture, T_{CR}						
at 60 years design life		kN/m	28.4	42.6	56.7	70.9
at 120 years design life		kN/m	28.0	42.0	55.9	69.9
Material reduction factor - installation damage, f_{id}						
in clay, silt or sand			1.10	1.10	1.06	1.06
in aggregate base course (32mm maximum size)			1.15	1.15	1.15	1.10
in well graded gravel (63mm maximum size)			1.30	1.15	1.15	1.15
Material reduction factor - environmental effects ($4 < pH < 9$), f_{en}						
at 60 years design life			1.03	1.03	1.03	1.03
at 120 years design life			1.06	1.06	1.06	1.06
Long term design strengths, T_D						
at 60 years design life						
in clay, silt or sand		kN/m	25.0	37.6	51.9	64.9
in aggregate base course (32mm maximum size)		kN/m	24.0	35.9	47.9	62.6
in well graded gravel (63mm maximum size)		kN/m	21.2	35.9	47.9	59.9
at 120 years design life						
in clay, silt or sand		kN/m	24.0	36.0	49.8	62.2
in aggregate base course (32mm maximum size)		kN/m	22.9	34.4	45.9	60.0
in well graded gravel (63mm maximum size)		kN/m	20.3	34.4	45.9	57.4
Norminal roll width		m	5.2	5.2	5.2	5.2
Norminal roll length		m	100	100	100	100
Estimated roll weight		kg	132	129	160	189

Other forms of supply as well as grades, adjusted to the requirements of specific projects, are available on request.

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Miragrid® GX Geogrids

Properties of TenCate Miragrid® GX Geogrids

Property		Unit	GX 130/30	GX 160/50	GX 200/50
Initial Mechanical Properties					
Characteristic initial strength, T_u (ISO 10319)	MD	kN/m	130	160	200
Characteristic initial strength (ISO 10319)	XD	kN/m	30	50	50
Characteristic initial strength at 5% strain (ISO 10319)	MD	kN/m	65	80	100
Strain at initial strength	MD	%	10	10	10
Material reduction factor creep-rupture, f_{cr}					
at 60 years design life			1.41	1.41	1.41
at 120 years design life			1.43	1.43	1.43
Creep limited strength based on creep-rupture, T_{CR}					
at 60 years design life		kN/m	92.2	113.5	141.8
at 120 years design life		kN/m	90.9	111.9	139.9
Material reduction factor - installation damage, f_{id}					
in clay, silt or sand			1.06	1.06	1.06
in aggregate base course (32mm maximum size)			1.10	1.10	1.10
in well graded gravel (63mm maximum size)			1.15	1.15	1.10
Material reduction factor - environmental effects (4 < pH < 9), f_{en}					
at 60 years design life			1.03	1.03	1.03
at 120 years design life			1.06	1.06	1.06
Long term design strengths, T_D					
at 60 years design life					
in clay, silt or sand		kN/m	84.4	103.9	129.9
in aggregate base course (32mm maximum size)		kN/m	81.4	100.2	125.2
in well graded gravel (63mm maximum size)		kN/m	77.8	95.8	125.2
at 120 years design life					
in clay, silt or sand		kN/m	80.9	99.6	124.4
in aggregate base course (32mm maximum size)		kN/m	78.0	96.0	119.9
in well graded gravel (63mm maximum size)		kN/m	74.6	91.8	119.9
Norminal roll width		m	5.2	5.2	5.2
Norminal roll length		m	100	100	100
Estimated roll weight		kg	244	310	374

Other forms of supply as well as grades, adjusted to the requirements of specific projects, are available on request.

Design Strengths and Strains for TenCate Miragrid® GX Geogrids

1. Miragrid® GX geogrids design strengths and strains

Miragrid® GX geogrids are engineered materials suitable for short and long term soil reinforcement applications. They are composed of high modulus polyester yarns, assembled to form a directionally structured and stable geogrid that enables maximum load carrying efficiency.

Miragrid® GX geogrids are manufactured in a wide range of tensile strengths to suit different soil reinforcement conditions. Several standard assessment procedures exist to determine the long term design strengths of Miragrid® GX geogrids. These rely on the application of material reduction factors to the initial tensile strength of the geosynthetic reinforcement in order to determine the appropriate long term design strength. Such procedures are standard practice in US Federal Highway Administration documentation and well-recognised Codes of Practice such as British Standard BS8006-1:2010.

The generic relationship for assessing the long term design strengths of geosynthetic reinforcements is shown below.

$$T_D = \frac{T_u}{f_{cr}\ f_{id}\ f_{en}} \qquad (1)$$

where,

- T_D is the long term design strength of the reinforcement;
- T_u is the initial tensile strength of the reinforcement;
- f_{cr} is the material reduction factor relating to creep effects over the required life of the reinforcement;
- f_{id} is the material reduction factor relating to installation damage of the reinforcement;
- f_{en} is the material reduction factor relating to environmental effects over the required life of the reinforcement.

The magnitudes of the material reduction factors f_{cr} and f_{en} are not only affected by time (the design life of the reinforcement) but also by temperature (the average in-ground temperature). In this datasheet a standard in-ground temperature of 20°C is used as this agrees with in-ground conditions in many parts of the world, and can also be considered to be conservative for colder climates.

2. Initial strengths and strains

All geosynthetic reinforcement materials should be described in terms of their characteristic initial strengths and not their mean initial strengths. This ensures the representation of initial tensile strength is statistically safe. The initial tensile strengths of Miragrid® GX geogrids shown at the front of this datasheet are expressed in terms of characteristic (95th percentile) values, which are statistically safe values.

The initial tensile loads and strains of Miragrid® GX geogrids can be represented by a single master curve covering all grades. This master curve is shown in Figure 1. Here the ordinate value is expressed as a percentage of the initial characteristic tensile strength. Because of the use of special high modulus PET yarns Miragrid® GX geogrids exhibit tensile loads of 50% of the initial tensile strength at only 5% strain which makes these materials very efficient in carrying tensile loads at relatively low strains.

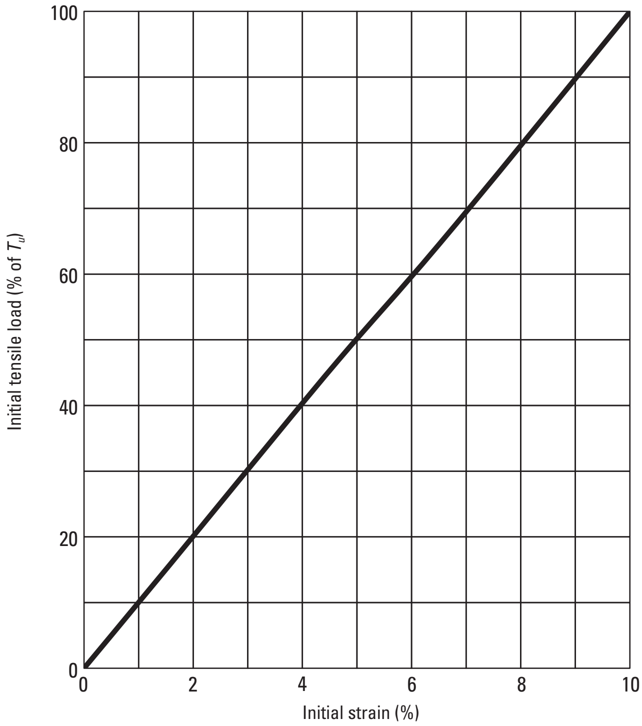

Figure 1. Initial tensile load – strain master curve for Miragrid® GX geogrids.

In prescribing suitable reinforcement strain limits to soil reinforcement applications reference is normally made to well-recognised Codes of Practice. For example, BS8006-1:2010 prescribes a maximum reinforcement short term strain limit of 5% for basal reinforced embankments constructed on soft foundations. This means that the calculated reinforcement design load must be carried at a reinforcement strain no greater than 5%. As shown in the tables at the front of this datasheet and in Figure 1, Miragrid® GX geogrids exhibit high tensile load carrying capabilities (50% of the characteristic initial strength) at tensile strains of 5%.

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Design Strengths and Strains for TenCate Miragrid® GX Geogrids

3. Material reduction factor for creep effects, f_{cr}

Creep effects can influence the behaviour of geosynthetic reinforcements in two ways – by decreasing the rupture load over time and by increasing the strain over time. Creep-rupture effects are associated with ultimate limit states (i.e. collapse modes) and are considered a critical case where basal reinforced embankments constructed on soft foundations are concerned.

The material reduction factor for creep-rupture f_{cr} is derived from the creep-rupture curve of the geosynthetic reinforcement. The creep-rupture curve for Miragrid® GX geogrids is shown in Figure 2. This has been generated from a combination of long term and accelerated creep testing. For example, from Figure 2, the material reduction factor for creep-rupture at 120 yrs is f_{cr} = 100%/70% = 1.43. Table 1 lists the creep-rupture material reduction factors for Miragrid® GX geogrids at 10 yrs, 60 yrs and 120 yrs design lives. Interpretation of the creep-rupture curve in Figure 2 can yield creep-rupture reduction factors for other reinforcement design lives.

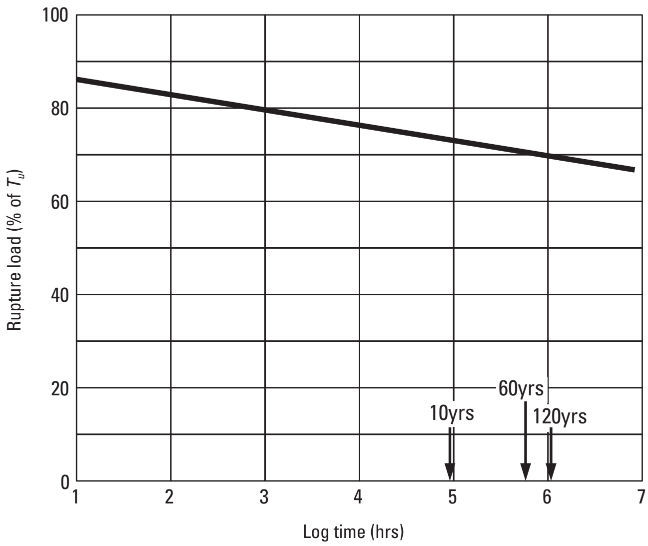

Figure 2. Creep-rupture curve at 20°C for Miragrid® GX geogrids.

Table 1. Material reduction factors based on creep-rupture at 20°C for Miragrid® GX geogrids at three different reinforcement design lives.

	at 10 yrs	at 60 yrs	at 120 yrs
f_{cr}	1.37	1.41	1.43

In some design codes, the creep limited strength of the reinforcement based on creep-rupture T_{CR} is quoted. $T_{CR} = T_u/f_{cr}$, where T_u and f_{cr} are described in Equation 1. Values of T_{CR} for the various grades of Miragrid® GX geogrids at two different reinforcement design lives are quoted at the front of this datasheet.

4. Material reduction factor for installation damage effects, f_{id}

When the reinforcement is installed and fill is compacted against it then some loss in strength can be experienced by the reinforcement. This loss in strength due to installation damage is accounted for by use of a material reduction factor, f_{id}. The magnitude of the material reduction factor for installation damage effects depends on the reinforcement bulk and the type of fill being compacted against the reinforcement. Normally, installation damage tests are carried out on sites, or by large scale laboratory testing, using different fill types.

Miragrid® GX geogrids depends on the grade of product and the type of fill used. For example, when clayey, silty or sandy fill soil is compacted against Miragrid® GX geogrids a value of f_{id} of 1.10 is a conservative upper limit to be used for design. For coarser fills the material reduction factor will be greater.

5. Material reduction factor for environmental effects, f_{en}

The chemical inertness of the high modulus PET yarns used in Miragrid® GX geogrids makes them highly durable when installed in a wide range of soil environments. For PET reinforcement to be used for long term design lives the US Federal Highway Administration recommends that the PET molecular weight ≥ 25,000 g/mol and Carboxyl End Group count ≤ 30 mmol/kg. Miragrid® GX geogrids surpass these requirements.

Long term environmental testing in pH conditions ranging from 4 < pH < 9 at 20°C yield the material reduction factors listed in Table 2 for Miragrid® GX geogrids.

Table 2. Material reduction factors based on environmental effects at 20°C for Miragrid® GX geogrids at three different reinforcement design lives.

	at 10 yrs	at 60 yrs	at 120 yrs
f_{en}	1.00	1.03	1. 06

References

BS8006-1:2010 Code of practice for strengthened/reinforced soils and other fills, British Standards Institution.

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