

# Triflex

Delivering solutions together.

Planning documents

Waterproofing system for wind turbines

## Triflex Towersafe®



RENEWABLE ENERGY



# Waterproofing system for wind turbines Triflex Towersafe®

## Applications



Wind turbines exploit the forces of nature and give us clean, renewable energy. In the process, the tower and foundation are exposed to strong forces from wind, and the constant movement of the turbine puts stress on the structure. The strong deformation forces can encourage cracks in the tower and tower foundation and penetrating moisture can lead to long-term damage.

**Triflex Towersafe** is a waterproofing system specially developed for wind turbines. A flexible special-purpose fleece reinforcement ensures permanently elastic system properties. Its liquid form allows upstands, folds and even complex details, like bolt cage foundations, to be waterproofed seamlessly and without joints. With Triflex Towersafe a high quality technical solution is achieved.

### Versatile, customised variants

Triflex Towersafe is not only an excellent waterproofing solution for wind turbine towers and foundations, but is also the ideal choice for rotor blades, gondolas and transformer buildings. The weather resistant waterproofing solution is available in a wide range of colours and with an optional anti-slip finish. The root- and rhizome-resistant Triflex Towersafe is also suitable for use in areas covered by soil.



## Advantages at a glance

### Liquid applied waterproofing solution for details

Triflex Towersafe is a permanently elastic waterproofing with flexible special-purpose fleece reinforcement for wind turbines. Its liquid form allows even the complex details to be waterproofed, leaving no seams or joints.

### Quick and long lasting: Reducing on-site costs

Waterproofing work can be completed in less than a day, resulting in shorter downtimes. According to the ETA, the expected service life of the waterproofing system is 25 years (highest performance level). The material can also be applied in ambient temperatures down to -5 °C, allowing application to be carried out all year round. This ensures fast and cost-effective application.

### Universal application

One particular strength of Triflex Towersafe is that it can be used universally for the entire wind turbine. From tower and foundation to rotor blades and gondolas, and on to transformer buildings, Triflex Towersafe provides a long-lasting and sustainable waterproofing solution.

### Innovation and experience

Triflex Towersafe has resulted from more than 40 years of experience in the waterproofing of structures, combined with carefully tested system developments, tailored to the application. The high quality solutions meets all specifications and is applied only by specially trained Triflex contractors.

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And this is how it's done ...



1. Concrete substrates are ground off.



2. Residual moisture in the substrate and adhesive strength are determined.



3. Metals and tested special varnishes are cleaned with Triflex Cleaner.



4. The concrete foundation is primed with Triflex Towersafe Primer.



5. A permanently elastic joint is incorporated.



6. Triflex Towersafe is applied to the details; Triflex Special Fleece is embedded, removing any air bubbles ...



7. ... and another generous layer of Triflex Towersafe is applied.



8. After only 45 minutes, upstands and folds can be recoated.



9. Then Triflex Towersafe with Triflex Special Fleece ...



10. ... and a wearing layer of Triflex Towersafe are applied to the foundation surface.



11. Optionally, the still wet resin can be dressed with quartz sand.



12. Then finished with Triflex Towersafe Finish.



13. The surface is rainproof after 30 minutes and can be walked on after 45 minutes.



## Compatible system components

All the Triflex products mentioned in this system are lab-scale and application coordinated as a result of years of experience. This standard of quality ensures optimum results during both application and use.



Waterproofing system for wind turbines

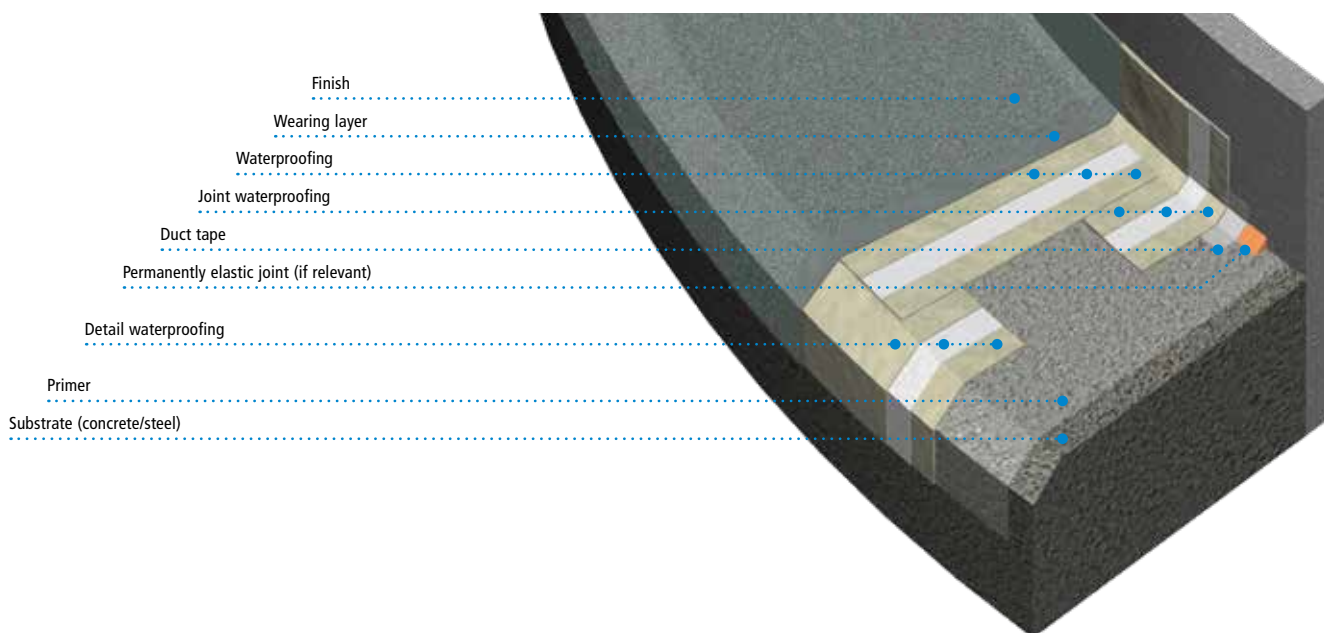
# Triflex Towersafe®

## System description

### Properties

- Fully reinforced waterproofing system with a polymethyl methacrylate (PMMA) base
- For strongly loaded tower foundation and segment flanges
- Seamless
- Cold-applied
- Fast-curing
- Flexible in low temperatures
- Excellent adhesion properties on a multitude of substrates
- Root-resistant in line with FLL
- Can be used at substrate temperatures of down to -5°C
- Tried and tested
- Joint-bridging
- Mechanically strong and wear-resistant
- Extremely weather-resistant (UV, IR, etc.)
- Permanently elastic and dynamic crack-bridging
- Vapour-permeable
- Resistant to chemicals present in air and rainwater
- Resistant to external fire exposure to DIN 4102 / DIN EN 13501
- European Technical Approval with CE mark in the highest usage categories (W3, M and S, P1 to P4, S1 to S4, TL4, TH4)
- General approval from Building Supervisory Authority

### System design



### System components

#### Primer

Triflex Towersafe Primer for sealing the substrate and ensuring substrate adhesion (if necessary, see table substrate pre-treatment).

#### Waterproofing

Triflex Towersafe waterproofing membrane is fully reinforced with a durable polyester Triflex Special Fleece.

#### Wearing layer

Triflex Towersafe, dressed with quartz sand (if necessary).

#### Finish

Triflex Towersafe Finish, wear-resistant and non-slip system finish.

### Substrate

Substrate suitability should always be checked on a case by case basis. The substrate must be clean, dry and free of cement bloom, dust, oil, grease and other adhesion-reducing dirt.

**Moisture:** When carrying out coating work, the substrate moisture must not exceed 6 % by weight. Ensure that structural measures are taken to prevent moisture penetration of the coating from underneath.

**Dew point:** During application, the surface temperature must be at least 3 °C above the dew point temperature. Below this temperature, a separating film of moisture can form on the surface.

**Hardness:** Mineral substrates must be permitted to fully harden for at least 28 days.

**Adhesion:** The following tensile strengths must be verified on pre-treated test surfaces:

Concrete: in the centre, at least 1.5 N/mm<sup>2</sup>, individual value not less than 1.0 N/mm<sup>2</sup>.



## System description

### Substrate pre-treatment

Substrate	Pre-treatment	Primer
Concrete	Grind	Triflex Towersafe Primer
Steel with corrosion protection coating	Loose rust and blistering rust must first be removed, abrade with Triflex Cleaner	Triflex Metal Primer <sup>(1)</sup>
Steel, powder-coated	Abrade with Triflex Cleaner, roughen surface	No primer
Steel, galvanised	Loose rust and blistering rust must first be removed, abrade with Triflex Cleaner	Triflex Metal Primer <sup>(1)</sup>

<sup>(1)</sup> Alternative to priming: Abrade with Triflex Cleaner, roughen surface.  
 Information on other substrates is available on request (technik@triflex.de).

#### Important note:

Adhesion to the substrate must be checked on a case-by-case basis!

### Primer

#### Triflex Metal Primer

Apply a thin coat with a short-pile roller, or alternatively, spray on a thin coat with a spray can.  
 Volume: approx. 80 ml/m<sup>2</sup>.  
 Can be recoated after approx. 30 to 60 min.

#### Triflex Towersafe Primer

Apply evenly with a Triflex universal roller.  
 Volume: at least 0.40 kg/m<sup>2</sup>  
 Can be recoated after approx. 45 min.

### Repairs

#### Triflex Cryl RS 240

Mortar for repairing mineral substrates with roughness depths of R<sub>t</sub> > 10 mm.  
 Volume: at least 2.20 kg/m<sup>2</sup> per mm layer thickness.  
 Can be recoated after approx. 45 min.

#### Triflex Cryl Paste

Paste for filling in shrinkage cracks, smaller areas of damage and for levelling out uneven areas and fleece overlaps.  
 Volume approx. 1.40 kg/m<sup>2</sup> per mm layer thickness.  
 Can be recoated after approx. 1 hr.

### Detail waterproofing

Triflex Towersafe must be applied to all connections and other detail solutions before surface waterproofing.  
 Application is wet-on-wet.

#### 1. Triflex Towersafe

Apply evenly with a radiator roller.  
 Volume: at least 2.00 kg/m<sup>2</sup>.

#### 2. Triflex Special Fleece

Lay fleece strips, removing any air bubbles.  
 Overlap the fleece strips by at least 5 cm.

#### 3. Triflex Towersafe

Apply until the Triflex Special Fleece is fully saturated.  
 Volume: at least 1.00 kg/m<sup>2</sup>.

Total volume Triflex Towersafe: at least 3.00 kg/m<sup>2</sup>.

Can be recoated after approx. 45 min.

For dimensions, see Triflex Towersafe system drawings.

### Tower segment flange

#### 1. Triflex Special Fleece SK

Fix the self-adhesive fleece over the flange. The joints are butted together and overlapped with an additional strip of Triflex Special Fleece (Standard).

#### 2. Triflex Towersafe

Apply evenly with a radiator roller.  
 Fleece wings must be embedded and saturated in the resin on both sides.  
 Application is wet-on-wet.  
 Volume: at least 3.00 kg/m<sup>2</sup>.

Can be recoated after approx. 45 min.

### Joint waterproofing

Triflex Towersafe must be applied to all connections and other detail solutions before surface waterproofing.

Transitions between tower and foundation or any component joints are taped with Triflex duct tape to increase the free expansion.

Application is wet-on-wet.

#### 1. Triflex Towersafe

Apply evenly with a radiator roller.  
 Volume: at least 2.00 kg/m<sup>2</sup>.

#### 2. Triflex Special Fleece

Lay strips, removing any air bubbles.  
 Overlap the fleece strips by at least 5 cm.

#### 3. Triflex Towersafe

Apply until the Triflex Special Fleece is fully saturated.  
 Volume: at least 1.00 kg/m<sup>2</sup>.

Total volume Triflex Towersafe: at least 3.00 kg/m<sup>2</sup>.

Can be recoated after approx. 45 min.

For dimensions, see Triflex Towersafe system drawings.



## System description

### Surface waterproofing

If the formation of hairline cracks in the foundation cap is anticipated, surface waterproofing is necessary.

Application is wet-on-wet.

#### 1. Triflex Towersafe

Apply evenly with a Triflex universal roller.  
Volume: at least 2.00 kg/m<sup>2</sup>.

#### 2. Triflex Special Fleece

Lay fleece strips, removing any air bubbles.  
Overlap the fleece strips by at least 5 cm.

#### 3. Triflex Towersafe

Apply until the Triflex Special Fleece is fully saturated.  
Volume: at least 1.00 kg/m<sup>2</sup>.

Total volume Triflex Towersafe: at least 3.00 kg/m<sup>2</sup>.  
Can be recoated after approx. 45 min.

### Wearing layer

If the surface is subject to mechanical loads (e.g., due to being walked on), a wearing layer must be applied.

#### Standard:

##### 1. Triflex Towersafe

Apply evenly with a Triflex universal roller.  
Volume: at least 1.00 kg/m<sup>2</sup>

##### 2. Quartz sand, size 0.7–1.2 mm

Dress the wet wearing layer in excess.  
Once the wearing layer is cured, remove any surplus.  
Volume: at least 7.00 kg/m<sup>2</sup>

Can be recoated after approx. 2 hrs.

#### Important note:

No quartz sand is applied in the wearing layer around the joints.

#### “Smooth surface” version:

##### Triflex Towersafe

Apply evenly with a Triflex universal roller.  
Volume: at least 1.00 kg/m<sup>2</sup>  
Can be recoated after approx. 2 hrs.

### Finishing

#### Standard:

##### Triflex Towersafe Finish

Cross-coat evenly using a Triflex finish roller.  
Volume: at least 0.70 kg/m<sup>2</sup>.  
Can be walked on after 2 hrs.

#### “Smooth surface” version:

##### Triflex Towersafe Finish

Cross-coat evenly using a Triflex finish roller.  
Volume: at least 0.50 kg/m<sup>2</sup>.  
Can be walked on after 2 hrs.

### Resistance to chemicals

Ammonia up to 10 %	++	Nitric acid up to 10 %	++
Ammonium chloride	++	Oxalic acid 10 %	++
Ammonium sulphate	++	Paraffin oil	++
Animal fats	++	Petroleum	++
Calcium chloride	++	Phosphoric acid up to 30 %	++
Caustic potash solution up to 50 %	++	Potassium chloride	++
Chlorinated lime	++	Sea water	++
Crude oil	++	Sodium carbonate	++
Diesel oil	++	Sodium chloride	++
Hydraulic oils	++	Sodium hydroxide solution up to 50 %	++
Hydrochloric acid up to 30 %	++	Sodium sulphate	++
Lubricant	++	Sulphuric acid up to 30 %	++
Mineral oil	++	Vegetable fats	++

++ = résistant

### Work interruptions

If work is interrupted for more than 12 hrs, or if soiled by rain etc., the intersection must be activated with Triflex Cleaner.

Airing time: at least 20 min.

Transitions to subsequent waterproofing must overlap (incl. Triflex Special Fleece) by a minimum of 10 cm. This also applies to junctions, transitions and detail solutions with Triflex Towersafe.

The finish must be applied within 24 hrs. If this application is delayed for any reason, the surface to be finished must be pre-treated with Triflex Cleaner.





## System description

### System components

For information on applications, conditions for use and instructions for mixing, see product information (request if necessary):

**Triflex Cleaner**  
**Triflex Cryl Paste**  
**Triflex Cryl RS 240**  
**Triflex Duct Tape**  
**Triflex Metal Primer**  
**Triflex Special Fleece**  
**Triflex Special Fleece SK**  
**Triflex Towersafe**  
**Triflex Towersafe Finish**  
**Triflex Towersafe Primer**

### Quality standard

All Triflex products are manufactured in accordance with the standards defined in ISO 9001. To ensure that quality is not compromised, Triflex products are only installed by specialist, fully trained and qualified contractors.

### Gradient / Evenness

Before commencing any work and during the work itself, it is essential to ensure the correct gradient and evenness of the substrate. Any corrections required must be taken into account during this work.

### Dimensional tolerances

When carrying out the work, always ensure compliance with the permissible tolerances for building construction (DIN 18202, Table 3, line 4).

### Safety tips / Accident prevention

Read the safety data sheets before using the products.

### Volumes required / Waiting times

The specified volumes apply only to smooth, even surfaces. Special allowances must be made for unevenness, roughness and porosity. Information regarding airing and waiting times applies to a substrate at an ambient temperature of +20 °C.

### General notes

The basis for the use of Triflex products can be found in the system descriptions, system drawings and product information sheets. It is essential to heed these when planning and carrying out the building project. Departures from the technical documentation of Triflex GmbH & Co. KG applicable at the time of work can compromise the guarantee. Any project-related departures are subject to the written authorisation of Triflex.

All data is based on general regulations, directives and other technical rules. The general regulations applicable in the particular country of use must be respected.

Since the parameters can vary from case to case, the user is required to test the suitability, e.g., of the substrate.

Non-system substances must not be added to Triflex products. Subject to change in the interests of technical advancement or enhancement of Triflex products.

### Tender texts

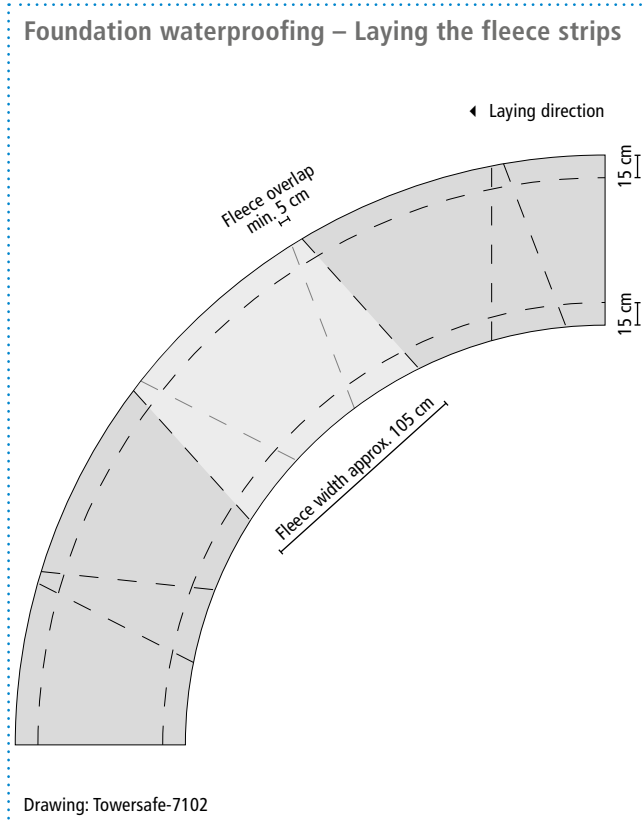
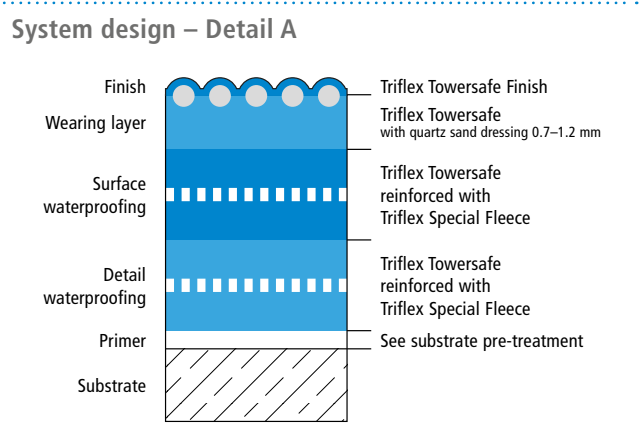
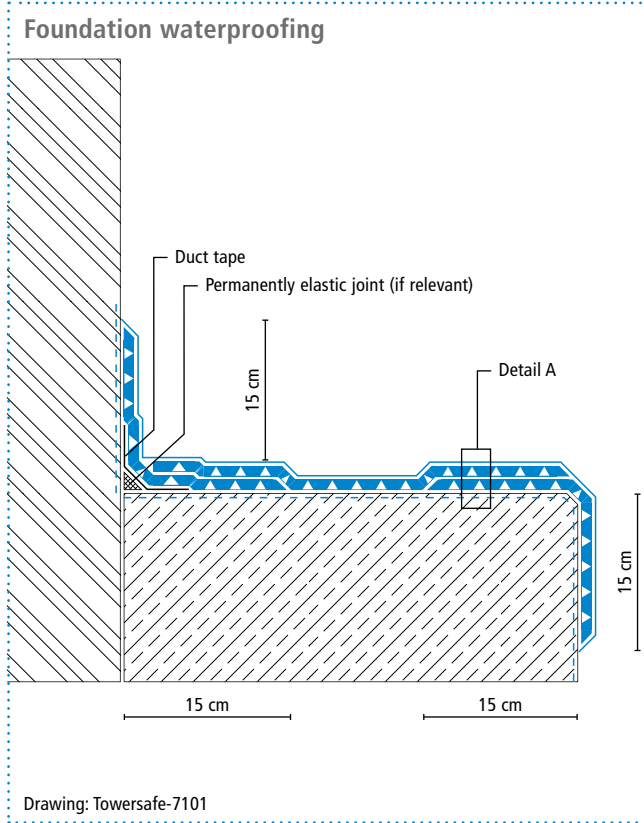
Please visit the download section of the Triflex website at [www.triflex.com](http://www.triflex.com) to obtain the current standard specifications for tender, which are available in a range of different file formats.

### CAD drawings

All CAD system drawings can be downloaded free of charge from the download section of the Triflex website at [www.triflex.com](http://www.triflex.com).



## System drawings



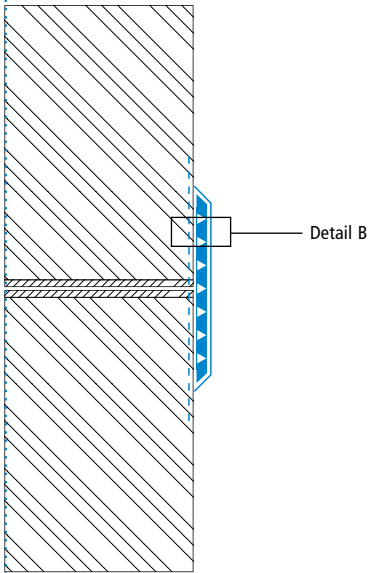
Height differences between fleece overlaps are exaggerated.





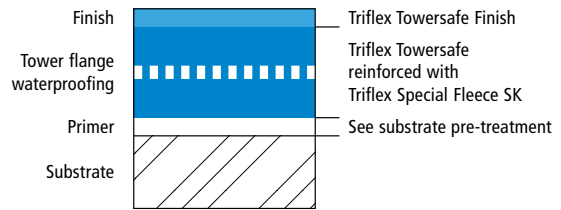
## System drawings

### Tower flange waterproofing

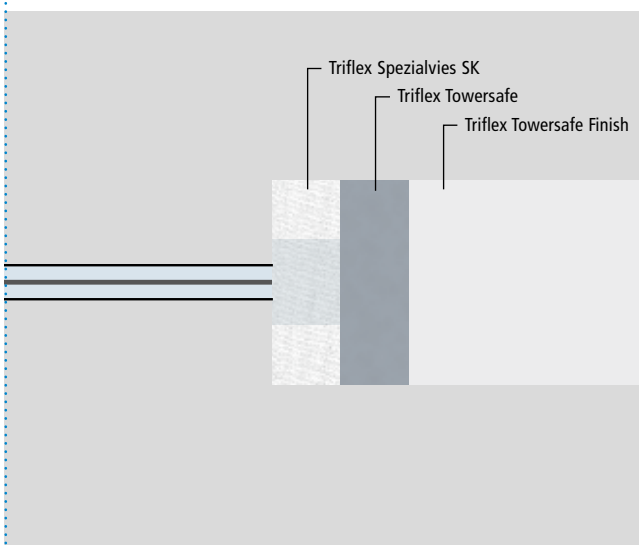


Drawing: Towersafe-7103

### System design – Detail B



### Tower flange waterproofing – Laying the Special Fleece SK



Drawing: Towersafe-7104



Height differences between fleece overlaps are exaggerated.

Triflex Special Fleece SK for reinforcement of the tower flange waterproofing.



Waterproofing system for wind turbines

# Triflex Towersafe®

## Surfaces

### Triflex Towersafe Finish Colours



7030 Stone grey with quartz sand dressing



7031 Blue grey with quartz sand dressing



7032 Pebble grey with quartz sand dressing



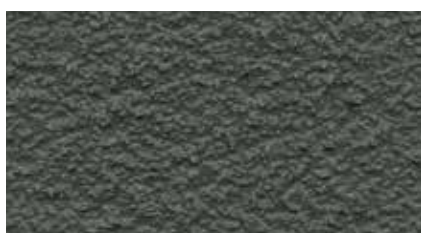
7035 Light grey with quartz sand dressing



7037 Dusty grey with quartz sand dressing



7038 Agate grey with quartz sand dressing



7043 Traffic grey B with quartz sand dressing

**Please note:**

Minor variations between the colour shown here and the actual colour are due to printing technology and the materials used.

Waterproofing system for wind turbines

# Triflex Towersafe®



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