

## Key Specifications of Mateenbar

### 1. Reference Standards and Reports

The references below should be referred to by the engineer regarding the application of Mateenbar for concrete reinforcement. Additional information is also available from Pultron for use with these documents and for design assistance for specific applications.

References	Titles
ACI 318-95	<ul style="list-style-type: none"> <li>“Building Code Requirements for Concrete” (1995) American Concrete Institute, Farmington Hills, MI</li> </ul>
ACI 440.1 R-06	<ul style="list-style-type: none"> <li>“Guide for the Design and Construction of Concrete Reinforced with FRP Bars” American Concrete Institute, Farmington Hills, Mich.</li> </ul>
AASHTO GFRP - 1	<ul style="list-style-type: none"> <li>“American Association of State Highway and Transport Officials” ISBN 978 – 1 – 56051-458-9</li> </ul>

### 2. Mechanical Properties

Property	Value			Test Method
Guaranteed UTS  Note:- Guaranteed UTS = Average – 3 STDV	Nominal Diameter	Root Diameter	Guaranteed UTS	ASTM D 7205 / 7205 M – 06 ASTM D 3916; ACI 440.3R-4 B.2
	6 mm	5.2 mm	750 MPa	
	8 mm	7.2 mm	750 MPa	
	10 mm	9.2 mm	750 MPa	
	11.8 mm	11.0 mm	750 MPa	
	12.5 mm	11.7 mm	750 MPa	
	12.7 mm	11.9 mm	750 MPa	
	14 mm	13.2 mm	750 MPa	
	16 mm	15.2 mm	690 MPa	
	18 mm	17.2 mm	690 MPa	
	20 mm	19.2 mm	690 MPa	
	21.75 mm	21.0 mm	690 MPa	
	25 mm	24.2 mm	650 MPa	
	31.4 mm	30.6 mm	600 MPa	
37.4 mm	36.6 mm	550 MPa		
Elastic Modulus  (Average)	6mm to 14mm		53 GPa	ASTM D 7205 / 7205 M – 06 ASTM D 3916; ACI 440.3R-4 B.2
	16mm to 25mm		51 GPa	
	31.4mm to 37.4mm		49 GPa	

Flexural strength (Average)	> 900 MPa for all sizes	ASTM D 790
Compressive Strength (Average)	> 400 MPa for all sizes	ASTM D 695
Transverse Shear Strength (Guaranteed)	> 150 MPa for all sizes	ACI 440.3R-4 B.4
Short Beam Shear Strength (Average)	> 50 MPa for all sizes	ASTM D 4475
Ultimate Strain	> 1.226% for all sizes	
Bond Strength at Failure (Average)	16 MPa	ACI 440.3R-4 B.3
Barcol Hardness (Average)	> 60	ASTM D 2583

### 3. Thermal Properties

Property	Value	Test Method
Glass Transition Temperature (Average)	> 110 °C (at storage modulus curve)	ASTM E1640-04 (DMTA Method)
Thermal expansion coefficient (Average)	Transverse: $22 \times 10^{-6} / ^\circ\text{C}$ Longitudinal: $7.2 \times 10^{-6} / ^\circ\text{C}$	ASTM D 696

### 4. Durability

Property	Value	Test Method
Moisture uptake	< 0.1%	ISO 62-1980/ASTM D570
Resistance to alkaline environment (pH:12.6-13 at 60 °C)	After 6 months (typical): i) Tensile strength retention by 87% ii) Elastic modulus retained by 100% iii) Transverse shear strength retention by 92% iv) Short beam shear strength retention by 100% v) Moisture absorption $\leq 0.4\%$ vi) Glass transition temperature retention by 100%	ACI 440.3R-4 B.6

## 5. QC Requirements for Raw Materials

Property	Test Method	Comment
Resin Type	Epoxy vinyl ester resin <i>Polyester resin not allowed.</i>	Required for long term corrosion resistance and mechanical strength
Glass Type	ECR- glass (tested to ASTM D578) <i>E-glass not allowed</i>	ECR Glass is essential due to long-term corrosion resistance and immunity to alkaline attack.
Glass Content	75% by weight (tested to ASTM D 3171)	

## 6. Manufacturing QC Testing Standards

Test Certificate with every shipment shall contain:

Test with every shipment	Requirement
Incoming resin	<ul style="list-style-type: none"> <li>Enthalpy of reaction and Glass transition temperature analysis by DSC prior processing</li> <li>Minimum of 1 per resin batch (may apply to more than one batch of dowel production)</li> </ul>
Diameter	<ul style="list-style-type: none"> <li>As measured from tolerance sheets at 2 hourly checks.</li> </ul>
Glass content	<ul style="list-style-type: none"> <li>Glass content check every 2 hours</li> </ul>
Short Beam Shear Strength (ASTM D 4475)	<ul style="list-style-type: none"> <li>Average and standard deviation</li> <li>Derived from production tolerance sheets</li> <li>Short beam shear tests performed from each product stream every 2 hours</li> </ul>
Glass transition temperature (ASTM E1640-04, DMTA test method)	<ul style="list-style-type: none"> <li>Minimum of 1 test every 10,000 meters.</li> <li>For production runs of less than 10,000 meters, one test per batch is considered</li> </ul>
Surface	<ul style="list-style-type: none"> <li>That the surface is crack free, as per the two hourly tolerance sheet information</li> </ul>

## 7. Design Requirements

Requirements
<ul style="list-style-type: none"> <li>Do not substitute FRP reinforcing bars on an equal area basis, due to differences in material properties.</li> </ul>
<ul style="list-style-type: none"> <li>Design requirements on crack width, moment capacity and deflection with respect to material properties such as tensile strength, elastic modulus, etc must be accounted for. Please consult with Pultron for structural design considerations.</li> </ul>
<ul style="list-style-type: none"> <li>In most cases, deflection will control design of concrete structures reinforced with FRP bars based on value of modulus of elasticity of FRP bars.</li> </ul>
<ul style="list-style-type: none"> <li>Stress under sustained load should not be greater than 20% of the design strength.</li> </ul>
<ul style="list-style-type: none"> <li>A minimum overlap length of 40 diameters is required.</li> </ul>

## 8. Handling Instruction for Mateenbar

Instructions	Notes
Placement and Fastening	<ul style="list-style-type: none"> <li>Place Mateenbar in accordance to CRSI Placing Reinforcing Bars, unless otherwise specified. Place Mateenbar accurately in accordance with approved placing drawings, schedules, typical details and notes. Secure Mateenbar in formwork to prevent displacement by concrete placement or workers. Fasten Mateenbar with nylon ties (preferable), coated or stainless steel tie wire.</li> </ul>
Form Ties	<ul style="list-style-type: none"> <li>Use plastic or nylon form ties</li> </ul>
Splicing	<ul style="list-style-type: none"> <li>Use lap splices</li> </ul>
Tolerances	<ul style="list-style-type: none"> <li>Do not exceed placing tolerances as per ACI117</li> </ul>
Cutting Mateenbar	<ul style="list-style-type: none"> <li>Mateenbar can be cut in the field with a standard handsaw or grinder.</li> </ul>
Storage	<ul style="list-style-type: none"> <li>Mateenbar not used immediately should be kept on a pallet and covered with a tarp. Mateenbar can be kept for an indefinite period of time without losing its performance.</li> </ul>
Scrapes and cuts	<ul style="list-style-type: none"> <li>Nicks, scrapes, and cuts that do not exceed 5% of the depth of the bar are acceptable. Beyond 5% we recommend replacement of the bar.</li> </ul>
Handling	<ul style="list-style-type: none"> <li>It is recommended that gloves are worn</li> </ul>
Comparison	<ul style="list-style-type: none"> <li>Mateenbar can be handled in the same way as steel equivalents in the field.</li> </ul>

Chemical reaction	<ul style="list-style-type: none"> <li>With Mateenbar there is no concern regarding contact with salt, alkaline, diesel, gas, or other typical chemicals.</li> </ul>
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**9. Bends**

Requirements	Comments
Bent bars must be manufactured at Pultron	<ul style="list-style-type: none"> <li>Standard inside bend radius = 4x diameter of bar.</li> </ul>
Tensile Strength of a 90 degree bend	<ul style="list-style-type: none"> <li>40% of guaranteed design strength of a straight bar.</li> </ul>

**10. Mateenbar is sold subject to Pultron’s standard warranty and nothing herein shall expand or extend such warranty.**

The data contained herein is considered representative of present production and believe to be reliable. Pultron Composites Limited reserves the right to make improvements in the product and process which may result in benefits and/or changes to some physical and mechanical properties.