



# FRP REBAR

## Product Data Sheet

### Physical / Mechanical Properties – Tensile, Modulus & Strain

| Nominal Diameter |    | Nominal Area |                 | f*fu – Guaranteed Tensile Strength |     |     | Ultimate Tensile Load |       | Ef – Tensile Modulus of Elasticity |                     | Ultimate Strain |  |
|------------------|----|--------------|-----------------|------------------------------------|-----|-----|-----------------------|-------|------------------------------------|---------------------|-----------------|--|
| Size             | mm | in           | mm <sup>2</sup> | in <sup>2</sup>                    | MPa | ksi | kN                    | kips  | GPa                                | psi 10 <sup>6</sup> | %               |  |
| 2                | 6  | 1/4          | 31.67           | 0.049                              | 896 | 130 | 28.34                 | 6.37  | 46                                 | 6.7                 | 1.94%           |  |
| 3                | 10 | 3/8          | 71.26           | 0.110                              | 827 | 120 | 58.72                 | 13.20 | 46                                 | 6.7                 | 1.79%           |  |
| 4                | 13 | 1/2          | 126.7           | 0.196                              | 758 | 110 | 95.90                 | 21.56 | 46                                 | 6.7                 | 1.64%           |  |
| 5                | 16 | 5/8          | 197.9           | 0.307                              | 724 | 105 | 143.41                | 32.24 | 46                                 | 6.7                 | 1.57%           |  |
| 6                | 19 | 3/4          | 285.0           | 0.442                              | 690 | 100 | 196.60                | 44.20 | 46                                 | 6.7                 | 1.49%           |  |
| 7                | 22 | 7/8          | 387.9           | 0.601                              | 655 | 95  | 254.00                | 57.10 | 46                                 | 6.7                 | 1.42%           |  |
| 8                | 25 | 1            | 506.7           | 0.785                              | 620 | 90  | 314.27                | 70.65 | 46                                 | 6.7                 | 1.34%           |  |
| 9                | 29 | 1-1/8        | 641.3           | 0.994                              | 586 | 85  | 375.83                | 84.49 | 46                                 | 6.7                 | 1.27%           |  |
| 10               | 32 | 1-1/4        | 791.7           | 1.227                              | 551 | 80  | 436.60                | 98.16 | 46                                 | 6.7                 | 1.19%           |  |
| 11               | 35 | 1-3/8        | 958.1           | 1.485                              | 482 | 70  | 462.40                | 104*  | 46                                 | 6.7                 | 1.04%           |  |
| 12               | 38 | 1-1/2        | 1160            | 1.800                              | 448 | 65  | 520.40                | 117*  | 46                                 | 6.7                 | 0.97%           |  |
| 13               | 41 | 1-5/8        | 1338            | 2.074                              | 413 | 60  | 553.50                | 124*  | 46                                 | 6.7                 | 0.90%           |  |

\* Tensile properties of #11, #12 & #13 bar are NOT guaranteed due to the inability to achieve a valid bar break per ASTM D7205

#### Design Tensile & Modulus Properties...per ASTM D7205-06.

The area used in calculating the tensile strength is the nominal cross sectional area. The “Guaranteed Tensile Strength”, f\* fu is as defined by ACI 440.1R as the mean tensile strength of a given production lot, minus three times the standard deviation or  $f^*fu = f_{u,ave} - 3\sigma$ . The “Design or Guaranteed Modulus of Elasticity is as defined by ACI 440.1R as the mean modulus of a production lot or  $E_f = E_{f,ave}$ .

#### Material Certs & Traceability

Available for any production lot of Aslan 100 bar, traceable by bar marks imprinted on the bar in intervals showing the bar diameter, stock order and production date.

#### Cross Sectional Area Tolerance ..... – 0% / + 20%

Design properties are determined using “Nominal” diameters and equivalent calculated cross sectional areas. Surface undulations and sand coatings that facilitate bond are accommodated for in ASTM D7205, section 11.2.5, with a tolerance of minus zero, plus 20% as determined by the Archimedes method of volume displacement in a fluid.

#### Bond Depended Coefficient .... $k_b = 0.9$

Per ASTM draft test method. As used in ACI equation 8-9.

#### Glass Fiber Content .... > 70% by weight per ASTM D2584

#### Transverse Shear Strength .... > 22,000 psi (150MPa)

Per ASTM D7617 & ACI 440.3R method B.4

#### Void Content

No Continuous Voids after 15 minutes of capillary action, per ASTM D5117

#### Moisture Absorption

24 hour absorption at 122°F (50°C) ≤ 0.25%, per ASTM D570.

### Density

| Size | Diameter |       | Length/Weight |          |
|------|----------|-------|---------------|----------|
|      | mm       | in    | kg / m        | lbs / ft |
| 2    | 6        | 1/4   | 0.0774        | 0.052    |
| 3    | 10       | 3/8   | 0.159         | 0.107    |
| 4    | 13       | 1/2   | 0.2813        | 0.189    |
| 5    | 16       | 5/8   | 0.4271        | 0.287    |
| 6    | 19       | 3/4   | 0.6072        | 0.408    |
| 7    | 22       | 7/8   | 0.8096        | 0.544    |
| 8    | 25       | 1     | 1.0462        | 0.730    |
| 9    | 29       | 1-1/8 | 1.4137        | 0.950    |
| 10   | 32       | 1-1/4 | 1.7114        | 1.15     |
| 11   | 35       | 1-3/8 | 1.9346        | 1.30     |
| 12   | 38       | 1-1/2 | 2.4554        | 1.65     |
| 13   | 41       | 1-5/8 | 2.8721        | 1.93     |



# FRP REBAR

## Product Data Sheet

### Bent Bars & Stirrups:

- Must be made at the factory, field bending not permitted.
- Industry standard bent shapes are available, standard shape codes are used.

Some limitations include:

- Max leg length of a stirrup is 60" (152cm)
- Redirection of bends, such as Z-shapes or gull-wings types are not very economical. Bent shapes should continue in the same circular direction.
- Closed square shapes are best furnished as pairs of U-bars or continuous spirals.
- A 90-degree bend with 12db, bar diameter, pigtail used to shorten development length is equally as effective as a J-shape as per ACI 440.1R.
- The radius on all bends is fixed as per the table shown. Some U-shaped stirrups fall in between the range of these two bend radiuses and are not possible.

\*\* We advise that you work closely with the factory to implement the most economical detailing of bent bars and stirrups.

**Field Forming of Large Radius Curves** Permitted when the radius is larger than in the following table. The table gives the minimum allowable radius for induced bending stresses without any consideration for additional sustained structural loads.

### Strength of the Bent Portion of the Bar

.... > 50% strength of the straight length of the bar, per ACI 440.3R method B.5

| Diameter |    | <u>Density</u>                                     |      |  |      | Exterior Use |    |
|----------|----|--|------|--|------|--------------|----|
|          |    | Interior Use<br>C <sub>e</sub> = 0.8<br>Min Radius |      | Exterior Use<br>C <sub>e</sub> = 0.7<br>Min Radius |      | cm           | in |
| Size     | mm | in   | cm   | in   | cm   | in           |    |
| 2        | 6  | 1/4  | 107  | 42   | 122  | 48           |    |
| 3        | 10 | 3/8  | 170  | 67   | 196  | 77           |    |
| 4        | 13 | 1/2  | 246  | 97   | 282  | 111          |    |
| 5        | 16 | 5/8  | 323  | 127  | 368  | 145          |    |
| 6        | 19 | 3/4  | 404  | 159  | 462  | 182          |    |
| 7        | 22 | 7/8  | 495  | 195  | 566  | 223          |    |
| 8        | 25 | 1  | 597  | 235  | 678  | 267          |    |
| 9        | 29 | 1-1/8  | 711  | 280  | 813  | 320          |    |
| 10       | 32 | 1-1/4  | 871  | 343  | 996  | 392          |    |
| 11       | 35 | 1-3/8  | 1052 | 414  | 1204 | 474          |    |
| 12       | 38 | 1-1/2  | 1237 | 487  | 1412 | 556          |    |
| 13       | 41 | 1-5/8  | 1448 | 570  | 1656 | 652          |    |

### Bend Radius

| Diameter |    | Inside Bend Radius |    |       |
|----------|----|--------------------|----|-------|
| Size     | mm | in                 | mm | in    |
| 2        | 6  | 1/4                | 38 | 1.5   |
| 3        | 10 | 3/8                | 54 | 2.125 |
| 4        | 13 | 1/2                | 54 | 2.125 |
| 5        | 16 | 5/8                | 57 | 2.25  |
| 6        | 19 | 3/4                | 57 | 2.25  |
| 7        | 22 | 7/8                | 76 | 3.0   |
| 8        | 25 | 1                  | 76 | 3.0   |

**Characteristic Properties** – Characteristic Properties are those that are inherent to the FRP bar and not necessarily measured or quantified from production lot to production lot.

### Durability – Alkali Resistance ~ without load

.... > 80% strength retention, when exposed to 12.8pH solution for 90 days at 140°F (60°C)

### Tensile Strength at Cold Temperature

.... < 5% strength reduction from ambient at -40°F (-40°C), per ASTM D7205.

### Transition Temperature of Resin - T<sub>g</sub>

.... > 230°F (110°C) per DSC method

### Handling and Placement

- Follow guidelines in ACI440.5-08 "Specification for Construction with FRP Bars".
- In general, field handling and placement is the same as for epoxy or galvanized steel bars.
- Do NOT shear FRP bars. When field cutting of FRP bars is necessary, use a fine blade saw, grinder, carborundum or diamond blade.
- Sealing the ends of FRP bars is not necessary.
- Support chairs are required at two-thirds the spacing of steel rebar.
- Plastic coated tie wire is the preferred option for most projects. When completely non-ferrous reinforcing, i.e., no steel is required in the concrete, nylon zip ties (available from local building materials centers) or plastic bar clips are recommended. (Don't forget to use non-metallic form ties in formwork.)
- It is possible, especially in precast applications, for GFRP bars to "float" during vibrating. Care should be exercised to adequately secure GFRP in the formwork.