TECHNICAL DATA SHEET
Product Data · Design Formulas · Applications

# FRP Composite Wire Rod

## COILED GFRP FIBERGLASS ROD



PRODUCT SERIES
**FRP/GRP COMPOSITE WIRE ROD**



**Diameters & Sizes**



**Specifications**



**Colors & Finish**



**Applications**

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**NABAK COMPOSITE FRP composite wire rod** (FRP / GRP Composite Wire Rod) is a thin, flexible pultruded GFRP rod supplied in long coils. With tensile strength above 1000 MPa, no rust, electrical and thermal insulation and about one quarter of the weight of steel wire, it replaces galvanized and steel wire in wall ties, vineyards, fencing, mesh and cable strength members.

| Ø 2 – 10 mm | 1000 – 1300 MPa | ≈ 0.4 W/m·K | ≤ 3000 m |
|---|---|---|---|
| Composite wire rod diameters | Tensile strength | Thermal conductivity (steel ≈ 50) | Rod length per coil |

## What is FRP composite wire rod (GFRP rod)?

**Composite wire rod**, also known as **FRP rod**, **GFRP wire rod**, **fiberglass rod**, **coiled composite rebar**, **composite wire** and **non-metallic wire**, is made by continuous pultrusion of glass-fibre rovings in vinyl ester or epoxy resin. It differs from composite rebar in its **small diameter and flexibility**: after curing, GFRP rod is wound onto large-diameter drums or coils without breaking the fibres and is cut to any length on site.

FRP is the general name for fibre-reinforced polymers, and GFRP (or GRP) is FRP made with glass fibre. In fiberglass rod, continuous parallel glass fibres make up more than 75% of the weight; composite rod is therefore very strong in tension, while its thermal and electrical conductivity is hundreds of times lower than steel wire.

## NABAK COMPOSITE wire rod types

### Smooth rod
Smooth-surface GFRP rod for vineyards, fencing, plant stakes and cable strength members

### Sand-coated rod
Rough-surface composite rod for better bond in mortar, plaster and concrete

### Thin ribbed rod
FRP rod with a helical rib for wall ties and bed-joint reinforcement of masonry

### Optical-fibre strength member
Precise, uniform fiberglass rod for the core of optical-fibre and telecom cables

### Coloured rod
Yellow, green, natural and black composite rod for identification and visible uses

### Insulating rod
GFRP rod with epoxy resin for electrical parts and thermal insulation

## Advantages of FRP rod over steel wire

- **Rust-free:** composite rod does not rust in soil, fertiliser, mortar, saltwater or humid air and leaves no rust stains on facades.
- **Near-zero thermal bridging:** GFRP rod conducts heat at about one hundredth of steel; ideal for ties in insulated cavity walls.
- **Electrically insulating and non-magnetic:** no electric-shock risk in fences and vineyards; no interference with telecom cables.
- **Lightweight:** fiberglass rod weighs about 27% of steel wire of the same diameter; far more metres per coil.
- **Resilient, no permanent set:** FRP rod springs back straight after bending and does not kink or twist like steel wire.
- **High tensile strength:** Ø4 composite rod has an ultimate tensile force of about 15 kN — more than twice ordinary steel wire.

**Composite wire rod or composite rebar?** FRP rod is 2 to 10 mm in diameter, coiled and flexible, and is used for anchoring, tying, tension and light reinforcement. Structural reinforcement of concrete beams, slabs and walls requires deformed composite rebar designed to ACI 440; its data sheet is available separately.

## Diameter and specification table of composite wire rod

**Table 1 — GFRP rod specifications by diameter (ρ = 2.1 g/cm³, E = 50 GPa)**

| Diameter (mm) | Cross-section area (mm²) | Weight (g/m) | Length per 100 kg coil (m) | Tensile strength (MPa) | Ultimate tensile force (kN) | Axial stiffness EA (kN) | Minimum coil diameter (mm) |
|---|---|---|---|---|---|---|---|
| **2** | 3.14 | 6.6 | 15 160 | 1300 | 4.1 | 157 | 270 |
| **3** | 7.07 | 14.8 | 6 740 | 1250 | 8.8 | 353 | 400 |
| **4** | 12.57 | 26.4 | 3 790 | 1200 | 15.1 | 628 | 535 |
| **5** | 19.63 | 41.2 | 2 425 | 1150 | 22.6 | 982 | 670 |
| **6** | 28.27 | 59.4 | 1 685 | 1100 | 31.1 | 1414 | 800 |
| **7** | 38.48 | 80.8 | 1 240 | 1080 | 41.6 | 1924 | 935 |
| **8** | 50.27 | 105.6 | 945 | 1050 | 52.8 | 2513 | 1070 |
| **10** | 78.54 | 164.9 | 605 | 1000 | 78.5 | 3927 | 1335 |

Values are calculated with the formulas on page 4; minimum coil diameter is based on an allowable storage strain of 0.75%. The tensile strength of composite rod is higher in small diameters because the fibres share the load more uniformly. Values are typical market ranges; the guaranteed value of each order is determined by tensile testing.

## Packing and supply forms of GFRP rod

**Table 2 — Supply forms of composite wire rod**

| Supply form | Diameter (mm) | Weight or length | Coil inside diameter (mm) | Remarks |
|---|---|---|---|---|
| **Drum** | 2 – 3 | 2000 – 10000 m | ≥ 400 | Optical-fibre cable strength member; even pay-off on the production line |
| **Small coil** | 3 – 6 | 50 / 100 / 200 m | ≥ 800 | Wall ties, gardens and vineyards, retail use |
| **Industrial coil** | 4 – 10 | 50 – 100 kg | 1200 – 1500 | Strapped and palletised for projects |
| **Cut lengths** | 2 – 10 | 0.2 to 6 m | — | Ready-made wall ties, plant stakes and fence posts |

## Colours and surfaces of fiberglass rod

**Table 3 — Colour, surface and resin options**

| Option | Specification | Recommended use |
|---|---|---|
| **Natural cream and light green** | Vinyl ester resin, unpigmented | Wall ties, mesh, industrial use |
| **Yellow and green** | Pigment through the section + UV stabiliser | Vineyards, gardens, fencing and outdoor uses |
| **Black** | Carbon pigment with high UV stability | Electric fencing, long-term use in sunlight |
| **Smooth gloss** | Pultruded, uncoated | Cable strength member, vineyards, stakes |
| **Sand-coated or helical rib** | Roughness and mechanical interlock | Mortar, plaster, lightweight concrete and masonry |

## Diameter selection guide for composite rod

**Table 4 — Recommended GFRP rod diameter by application**

| Application | Recommended diameter (mm) | Surface | Note |
|---|---|---|---|
| **Optical-fibre cable strength member** | 2 – 3 (smaller to order) | Precision smooth | Diameter tolerance ±0.05 mm and full uniformity |
| **Wall ties and brick facades** | 4 – 6 | Sand-coated or ribbed | Embedment ≥ 50 mm in each leaf |
| **Plaster, mortar and lightweight-concrete mesh** | 3 – 5 | Sand-coated | Mesh spacing 50 to 200 mm |
| **Vineyard and orchard trellis** | 3 – 5 | Smooth, coloured, UV-resistant | Replaces galvanized wire gauge 12 to 14 |
| **Fencing and electric fencing** | 4 – 8 | Smooth black or yellow | Inherently insulating; no insulators needed |
| **Small greenhouse hoops and stakes** | 6 – 10 | Smooth | Hoop radius ≥ 100 d |

## Mechanical, physical and electrical properties of composite rod

**Table 5 — Reference properties of pultruded GFRP rod**

| Property | Test method | Unit | Typical value |
|---|---|---|---|
| Glass fibre content (by weight) | ASTM D2584 | % | 75 – 83 |
| Density | ASTM D792 | g/cm³ | 2.05 – 2.15 |
| Tensile strength | ASTM D3916 | MPa | 1000 – 1300 |
| Tensile modulus of elasticity | ASTM D3916 | GPa | 48 – 55 |
| Ultimate strain | ASTM D3916 | % | 2.2 – 2.6 |
| Flexural strength | ASTM D4476 | MPa | 1100 – 1400 |
| Water absorption (24 h) | ASTM D570 | % | ≤ 0.1 |
| Longitudinal coefficient of thermal expansion | ASTM E831 | $10^{-6}$ /°C | 5 – 7 |
| Thermal conductivity | — | W/m·K | 0.3 – 0.5 |
| Volume resistivity | ASTM D257 | Ω·cm | ≥ $10^{14}$ |
| Continuous service temperature | — | °C | -40 to +80 (epoxy up to +120) |

ASTM D3916 and D4476 are the common tensile and flexural test methods for pultruded rods. Values are reference ranges of the FRP and GFRP composites industry and are not NABAK COMPOSITE's own laboratory results.

## Composite rod compared with metal wires

**Table 6 — GFRP rod vs galvanized wire, stainless wire and aramid rod**

| Feature | FRP rod | Galvanized wire | Stainless wire | Aramid rod |
|---|---|---|---|---|
| Density (g/cm³) | 2.1 | 7.85 | 8.0 | 1.35 |
| Tensile strength (MPa) | 1000 – 1300 | 400 – 550 | 600 – 900 | 1800 – 2400 |
| Modulus (GPa) | 50 | 200 | 190 | 60 – 120 |
| Thermal conductivity (W/m·K) | 0.4 | 50 | 16 | 0.04 |
| Corrosion in mortar and soil | None | Once the zinc is gone | Low | None |
| Electrical conductivity | Insulating | Conductive | Conductive | Insulating |
| Price | Moderate | Low | High | Very high |

## Applications of FRP composite rod

### Wall ties
Connect the two leaves of cavity walls and brick facades without thermal bridging or rust

### Vineyards and orchards
Trellis wire for grapes, kiwi and fruit trees; no rust in soil or fertiliser

### Fencing and electric fencing
Insulating fence wire and posts for livestock and sites

### Optical-fibre cable
Non-metallic, lightweight central FRP strength member

### Plaster, mortar and lightweight-concrete mesh
GFRP rod mesh to control cracking with no risk of rust

### Greenhouses and plant stakes
Hoops for low tunnels and plant stakes made of fiberglass rod

## Section, weight and strength formulas for composite rod

### 1. Cross-section area and weight per metre

$$A = \frac{\pi\, d^2}{4}\,, \quad w = \rho \cdot A \quad [\mathrm{g/m}]$$

Ø6: A ≈ 28.3 mm²; w = 2.1 × 28.3 ≈ 59.4 g/m (steel wire ≈ 222 g/m)

### 2. Ultimate and allowable tensile force

$$T_u = f_u \cdot A\,, \quad T_a = C_E \cdot 0.2 \cdot T_u$$

Ø4: $T_u$ = 1200 × 12.57 ≈ 15.1 kN. For sustained outdoor load ($C_E$ = 0.7, creep limit 0.2): $T_a$ ≈ 2.1 kN

### 3. Axial stiffness and elongation

$$K = E \cdot A\,, \quad \Delta L = \frac{T \cdot L}{E \cdot A}$$

Ø4 with T = 1 kN over 100 m: ΔL = 1000 × 100 000 / 628 300 ≈ 159 mm

### 4. Specific strength (strength-to-weight ratio)

$$L_{br} = \frac{f_u}{\rho \cdot g}$$

Breaking length: GFRP rod ≈ 1200×10⁶ / (2100 × 9.81) ≈ 58 km; galvanized wire ≈ 6.5 km

## Coil and bending formulas for FRP rod

### 5. Minimum coil and drum diameter (allowable bending strain)

$$D_{min} = \frac{d}{\varepsilon_a}\,, \quad \sigma_b = E \cdot \frac{d}{D}$$

$\varepsilon_a$ ≈ 0.75% for long-term coil storage (about one third of ultimate strain). Ø6: $D_{min}$ = 6 / 0.0075 = 800 mm; on a 1200 mm coil: $\sigma_b$ = 50 000 × 6 / 1200 = 250 MPa (≈ 23% of tensile strength)

### 6. Rod length in one coil

$$L = \frac{M}{w}$$

100 kg coil of Ø6 rod: L = 100 000 / 59.4 ≈ 1684 m

### 7. Number of turns in the coil

$$n = \frac{L}{\pi \cdot D_m}\,, \quad D_m = \frac{D_{in} + D_{out}}{2}$$

$D_{in}$ = 1.2 m, $D_{out}$ ≈ 1.3 m: n ≈ 1684 / (π × 1.25) ≈ 429 turns

### 8. Outside coil diameter

$$D_{out} = \sqrt{\left( D_{in}^2 + \frac{L \cdot d^2}{H \cdot \varphi} \right)}$$

H coil height, φ ≈ 0.85 packing factor. Ø6, L = 1684 m, $D_{in}$ = 1.2 m, H = 0.3 m: $D_{out}$ = √(1.44 + 1684 × 3.6×10⁻⁵ / 0.255) ≈ 1.30 m

**Why does coil diameter matter?** Composite rod is fully elastic; if it is wound or folded tighter than $D_{min}$, the glass fibres on the outer surface break in bending. Always store and uncoil GFRP rod at the inside diameters given in Tables 1 and 2.

## Application formulas for FRP rod

### 9. Thermal bridging of wall ties (point thermal transmittance)

$$\chi = \frac{\lambda \cdot A}{L_{ins}} \quad , \quad \Delta U = n_t \cdot \chi$$

**Example — 4 ties Ø4 per square metre of wall with 100 mm insulation:**

Galvanized steel ($\lambda = 50$): $\Delta U = 4 \times 50 \times 12.57\times10^{-6} / 0.1 \approx 0.025$ W/m²K

Stainless ($\lambda = 17$): $\Delta U \approx 0.0085$ W/m²K ; GFRP ($\lambda = 0.4$): $\Delta U \approx 0.0002$ W/m²K

Wall ties made of composite rod cut the heat loss through ties about 125 times compared with galvanized steel and create practically no thermal bridge.

### 10. Tension in vineyard wire (sag relation)

$$T = \frac{q \cdot L^2}{8 \cdot f}$$

q distributed load (canes, leaves and fruit), L post spacing, f allowable sag. q = 10 N/m, L = 6 m, f = 0.15 m: T = 300 N; Ø4 rod with $T_u \approx 15$ kN

### 11. Thermal length change of rod outdoors

$$\Delta L = \alpha \cdot L \cdot \Delta T$$

100 m row, $\alpha = 6\times10^{-6}$, $\Delta T = 40$ °C → $\Delta L \approx 24$ mm; about half of steel wire, with little need for seasonal re-tensioning

### 12. Number of wall ties

$$N = A_w \cdot n_t + \frac{P_o}{s_o}$$

$n_t \approx 2.5 – 5$ ties per m² plus extra ties around openings at $s_o \approx$ 300 mm. 100 m² wall with 20 m of opening perimeter: N ≈ 250 + 67 = 317

### 13. Embedment length in mortar

$$l_e = \frac{T_d}{\tau_b \cdot \pi \cdot d}$$

Sand-coated Ø4 rod, $\tau_b \approx 3$ MPa in mortar, $T_d = 0.5$ kN: $l_e \approx 13$ mm → practical minimum 50 mm in each leaf

## User guide for composite rod

**1** **Uncoiling:** unwind the coil on a turntable or by rolling the coil; never pull the rod out from the centre of the coil.

**2** **Bend control:** do not bend GFRP rod tighter than the minimum diameter in Table 1; sharp bends and knots break the fibres.

**3** **Cutting:** cut with a thin grinding disc, fibre shears or a saw; smooth the cut end with sandpaper.

**4** **Fixing and anchoring:** use clips and clamps made for FRP rod in vineyards and fences; knotting the rod is not allowed.

**5** **Tensioning:** tension the rod with a tensioner to the design force and avoid impact and severe twisting while tensioning.

**6** **Safety:** wear goggles, gloves and a mask when cutting and always restrain the free end of the coil.

**Request a quote for FRP composite rod:** send diameter, metres or weight, coil or cut lengths, surface type (smooth, sand-coated, ribbed), colour and application.

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Disclaimer: The information in this data sheet is based on general, typical data of the FRP and GFRP composites industry and is intended as guidance only. NABAK COMPOSITE reserves the right to change the technical specifications of composite rod without notice.