



Version 1.10, 2026

# Utility Poles Technical Guide

Wagners Composite Fibre Technologies (CFT)

**WAGNERS**



# Table of Contents

|                                                                |           |                                           |           |
|----------------------------------------------------------------|-----------|-------------------------------------------|-----------|
| <b>1.0 Scope</b>                                               | <b>4</b>  | 14.1 Field Inspections                    | 28        |
| <b>2.0 Introduction</b>                                        | <b>4</b>  | 14.1.1 Visual Inspections                 | 28        |
| <b>3.0 Performance Advantages of Wagners CFT Utility Poles</b> | <b>5</b>  | 14.1.2 Tap Test                           | 28        |
| 3.1 Resilience                                                 | 5         | 14.2 Repair Methods                       | 29        |
| 3.2 Superior Strength and Stiffness                            | 5         | 14.2.1 Level 1 - Minor repair             | 29        |
| 3.3 High Durability                                            | 6         | 14.2.2 Level 2 - Moderate repair          | 29        |
| 3.4 Environmental Benefits                                     | 6         | 14.2.3 Level 3 - Major repair/replacement | 29        |
| 3.4.1 Leaching Performance                                     | 6         | <b>15.0 Pole Library</b>                  | <b>30</b> |
| 3.4.2 Inert                                                    | 6         | <b>16.0 Safety Information</b>            | <b>30</b> |
| 3.4.3 Environmental Product Declaration                        | 6         | <b>17.0 Quality Control</b>               | <b>31</b> |
| 3.5 Lightweight                                                | 7         | <b>18.0 End-of-Life Recycling Options</b> | <b>32</b> |
| 3.6 Fire Resistant                                             | 7         | <b>19.0 Additional/Custom Testing</b>     | <b>33</b> |
| 3.7 Total Cost of Ownership                                    | 7         | 19.1 Torsional Test                       | 33        |
| <b>4.0 Manufacturing Process</b>                               | <b>8</b>  | 19.2 Combined Test                        | 34        |
| 4.1 Pull-Winding Pultrusion Technology                         | 8         |                                           |           |
| 4.1.1 Glass Fibres                                             | 9         |                                           |           |
| 4.1.2 Polymer Resin                                            | 9         |                                           |           |
| 4.2 Identification                                             | 9         |                                           |           |
| <b>5.0 Pole Structural Tests &amp; Capacities</b>              | <b>10</b> |                                           |           |
| 5.1 Full-scale Cantilever Pole Flexural Test                   | 11        |                                           |           |
| 5.2 Four-point Bending Test                                    | 11        |                                           |           |
| 5.3 Crush Strength Test                                        | 12        |                                           |           |
| <b>6.0 Connections</b>                                         | <b>13</b> |                                           |           |
| 6.1 Bolted Connection Test                                     | 13        |                                           |           |
| 6.2 Bolt Torque Test                                           | 14        |                                           |           |
| 6.3 Bolt Pull-Through Test                                     | 15        |                                           |           |
| 6.4 Pole Step Test                                             | 16        |                                           |           |
| <b>7.0 Durability Performance</b>                              | <b>17</b> |                                           |           |
| 7.1 Water Absorption                                           | 17        |                                           |           |
| 7.2 Weathering and UV Protection                               | 17        |                                           |           |
| <b>8.0 Environmental Performance</b>                           | <b>18</b> |                                           |           |
| <b>9.0 Electrical Performance</b>                              | <b>18</b> |                                           |           |
| <b>10.0 Fire Performance</b>                                   | <b>19</b> |                                           |           |
| <b>11.0 Serviceability Considerations</b>                      | <b>22</b> |                                           |           |
| <b>12.0 Poles Hardware &amp; Accessories</b>                   | <b>22</b> |                                           |           |
| 12.1 Crossarms Mounting Brackets                               | 23        |                                           |           |
| 12.2 Top and Bottom Caps                                       | 23        |                                           |           |
| 12.3 Poles Steps                                               | 24        |                                           |           |
| 12.4 Small Fixings                                             | 24        |                                           |           |
| 12.5 Hole Plugs                                                | 24        |                                           |           |
| 12.6 Surface Logs                                              | 24        |                                           |           |
| <b>13.0 Transport and Installation</b>                         | <b>25</b> |                                           |           |
| 13.1 Packaging and Shipping                                    | 25        |                                           |           |
| 13.2 Storage                                                   | 26        |                                           |           |
| 13.3 Handling                                                  | 26        |                                           |           |
| 13.4 Holes Drilling in the Field                               | 26        |                                           |           |
| 13.5 Lifting and Installation                                  | 27        |                                           |           |
| 13.6 Direct Embedment                                          | 27        |                                           |           |
| <b>14.0 Inspections and Maintenance</b>                        | <b>28</b> |                                           |           |

## LIST OF FIGURES

|           |                                                                  |    |
|-----------|------------------------------------------------------------------|----|
| Figure 1  | Timber pole vs Wagners CFT pole                                  | 5  |
| Figure 2  | Aerial transport in challenging terrains with lightweight pole   | 7  |
| Figure 3  | Pultrusion process of Wagners FRP composite products             | 8  |
| Figure 4  | ID plate information                                             | 9  |
| Figure 5  | Testing of the cantilever full-scale flexural test               | 11 |
| Figure 6  | Four-point bend test setup                                       | 11 |
| Figure 7  | Crush strength test                                              | 12 |
| Figure 8  | Bolted connection test setup                                     | 13 |
| Figure 9  | Bolt torque test setup                                           | 14 |
| Figure 10 | Bolt pull-through test setup                                     | 15 |
| Figure 11 | Pole step test setup                                             | 16 |
| Figure 12 | Bushfire test                                                    | 19 |
| Figure 13 | Full-scale fire bush/wildfire test                               | 19 |
| Figure 14 | Recorded temperature versus time diagrams                        | 20 |
| Figure 15 | Pole Shield™ fire and structural testing                         | 21 |
| Figure 16 | Crossarm - to - Wagners CFT pole connections                     | 23 |
| Figure 17 | Wagners CFT utility pole caps                                    | 23 |
| Figure 18 | FRP surface logs attached to utility poles in the foundation     | 24 |
| Figure 19 | Wagners CFT utility poles ready for transport                    | 25 |
| Figure 20 | Wagners CFT pole and crossarms are being installed into position | 27 |
| Figure 21 | Tap test - inspection of composites, aircraftsystemstech.com     | 28 |
| Figure 22 | Torsional test on the Wagners CFT utility pole                   | 33 |
| Figure 23 | Combined load test on the Wagners CFT utility pole               | 34 |

## LIST OF TABLES

|         |                                                         |    |
|---------|---------------------------------------------------------|----|
| Table 1 | Physical properties                                     | 10 |
| Table 2 | Mechanical properties                                   | 10 |
| Table 3 | Connection capacities without using a sleeve            | 14 |
| Table 4 | Washer pull-through capacities                          | 15 |
| Table 5 | Defect/activity matrix for Level 1 repair on WCFT poles | 29 |

## 1.0

# Scope

This document serves as the technical guide for utility poles manufactured by Wagners Composite Fibre Technologies (CFT). It covers key aspects such as material composition, manufacturing processes, mechanical performance, testing protocols, UV protection, and durability. Wagners Fibre Reinforced Polymer (FRP) utility poles are manufactured following American and international standards (ASTM, ANSI, ACMA, BS EN, ISO) to meet anticipated pole operating and loading requirements. As FRP properties can differ based on resin selection, fibre architecture, and manufacturing techniques, the technical data in this document is specific to Wagners CFT utility poles.

## 2.0

# Introduction

Fibre Reinforced Polymer (FRP) poles represent a superior material in utility infrastructure. FRP poles are engineered using composite materials, primarily glass fibres bound with resin, resulting in poles that are exceptionally strong, lightweight, and resistant to environmental factors such as corrosion, chemical exposure, pests and UV radiation.

Wagners CFT utility poles are manufactured using the pultrusion process as detailed in Section 4 and are designed to be durable, safe, and environmentally friendly. Wagners FRP utility poles are non-conductive, which significantly reduces the risk of electrical shock or electrocution, making them safer than traditional poles. They are also resistant to rust, rot, corrosion, termites, and acid sulphate soils, ensuring a longer lifespan even in harsh environments that are not offered in conventional poles.

# Performance Advantages of Wagners CFT Utility Poles

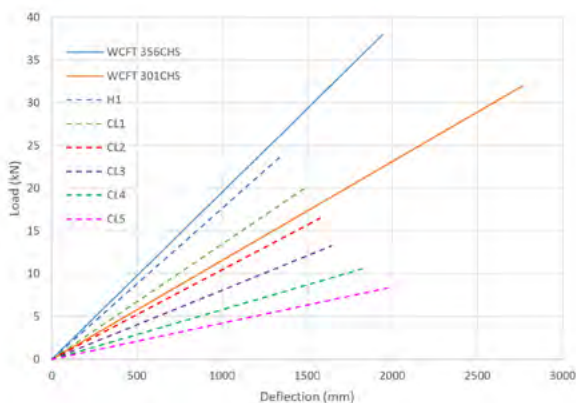
## 3.1 Resilience

With the advanced pull-winding pultrusion process used in Wagners CFT pole manufacturing, the poles are manufactured/ designed with a high Glass Transition Temperature (T<sub>g</sub>) of 130°C (266°F) to perform reliably in a range of temperatures, varying from freezing winter conditions of -15°C (5°F) to a condition of up to 50°C (122°F). This wide temperature tolerance ensures the poles remain structurally sound and functional in extreme temperature fluctuations. Owing to the inherent corrosion-resistance properties of vinyl ester resin in both acidic and alkaline environments, the Wagners CFT utility poles have demonstrated the capability to withstand harsh and extended environmental conditions such as hot weather, snow, humidity, rainfall, etc. Wagners CFT utility poles also remain impervious to termites, pests, woodpeckers and wildlife, resulting in a greater service life with minimal maintenance.

## 3.2 Superior Strength and Stiffness

Despite being lightweight, 25% of steel, Wagners CFT profiles have an elastic modulus of plus 40GPa (5800 ksi), ensuring a high strength-to-weight ratio, stiffness, and minimal deflection under lateral load. Hence, Wagners CFT poles meet and exceed the strength limit of equivalent wood poles and exhibit higher ultimate tip horizontal load capacity compared to wood poles as per ANSI 05-2022 (Figure 1). Due to the elastic nature of the material until failure, the Wagners CFT utility pole exhibits a zero residual permanent deflection recorded upon releasing the load. It is worth noting that in Figure 1, the average modulus of elasticity used for FRP represents a characteristic value, whereas the value used for timber represents an average value. Consequently, the actual in-service stiffness of timber is likely to be lower than shown.

(a) 12-meter pole



(b) 13.5-meter pole

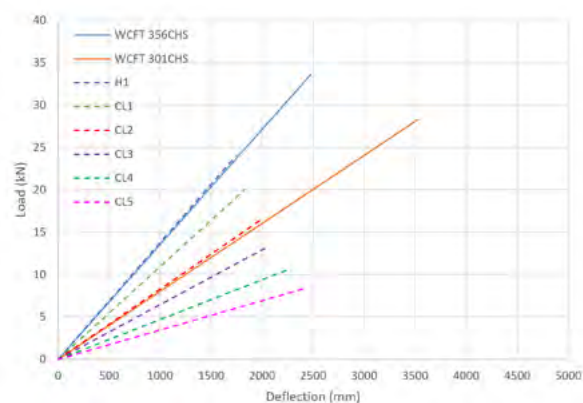


Figure 1 – Timber pole vs Wagners CFT pole

### 3.3 High Durability

FRP products are well known for their excellent durability and performance. Wagners CFT utility poles are coated with a highly durable fluoropolymer coating system that provides supreme UV resistance, ensuring the long-lasting performance of the pole for its intended design life. The coated pultruded samples, based on ASTM G154, were exposed to a QUV-B weathering machine for more than 25000 hours. Additionally, Wagners CFT poles are complemented by a polyester surface veil, which serves as a shield and outer layer during the manufacturing stage, acting as a secondary UV protection layer. Furthermore, all Wagners CFT poles exhibit an exceptionally low water absorption rate of only 0.2%, a benchmark considered remarkably minimal even among composite materials, which further enhances the durability of the Wagners CFT pole.

### 3.4 Environmental Benefits

#### 3.4.1 LEACHING PERFORMANCE

Wagners CFT utility poles offer significant environmental benefits over traditional chemically treated timber poles. These benefits are particularly pronounced in their non-leaching performance, where, unlike treated wood, Wagners CFT utility poles do not release chemicals at hazardous levels. Wagners CFT poles/samples in TCLP leaching test, in an extremely high acidic environment, the analysis detected very low trace concentrations of some analytes, and all results are well below the applicable regulatory thresholds for hazardous waste classification. No PBDEs, phenols, or BPA were detected. This is especially critical in environmentally sensitive locations such as wetlands, coastal areas and near water bodies, preventing them from being contaminated. The use of Wagners CFT utility poles in such locations ensures that environmental integrity and ecological health are maintained.

#### 3.4.2 INERT

Unlike traditional poles, Wagners CFT utility poles are inherently resistant to corrosion and do not react chemically to most substances, including alkaline and acidic environments. This exceptional inert nature of Wagners CFT utility poles makes them an ideal choice for environments that are prone to moisture, salt water, and harsh chemical exposure. Due to their inert nature, Wagners CFT utility poles can be directly embedded in the ground without any special treatment or coating.

#### 3.4.3 ENVIRONMENTAL PRODUCT DECLARATION

Wagners' Environmental Product Declaration (EPD) provides a transparent overview of the environmental impact of Wagners CFT structural products throughout their cradle-to-grave life cycle. Wagners CFT utility poles have 39% less total global warming potential than galvanised steel poles across the full life cycle and over a 100-year service life. That means choosing FRP utility poles over galvanised steel will help reduce carbon emissions and cool the planet. *\*\*These are the results of a Life Cycle Analysis comparing Wagners FRP to a galvanised steel utility pole, which has been third-party reviewed and verified. Results could vary depending on the specific design of the poles being compared. As an indicative comparison, using the same material but calculated for the crossarm application rather than the utility pole itself, results suggest a potential carbon emissions reduction of approximately 79% for FRP compared to equivalent hardwood timber. While this analysis is based on the crossarm product rather than the utility pole, it is presented here as an indicative reference point given the shared material composition, and should not be read as a certified or product-specific EPD claim for the utility pole.*

---

### 3.5 Lightweight

Wagners CFT poles are substantially lighter in weight compared to steel, concrete and wood poles. One of the most immediate benefits of this reduced weight is the ease of transportation. Lighter poles mean that lighter equipment is needed for their transport, leading to a decrease in logistical costs. This is particularly beneficial in areas with challenging terrains, where the transportation of heavy poles can be both difficult and expensive. Also, when it comes to installation, the reduced weight of Wagners CFT poles allows for quicker and more efficient installation, saving both time and resources.



*Figure 2 – Aerial transport in challenging terrains with lightweight pole*

---

### 3.6 Fire Resistant

The Wagners CFT pole is classified as self-extinguishing as it will not fuel the fire once the source is removed. An internal test simulating bush/wildfire test was undertaken where a full-scale pole was subjected to fire from a hay bale at the ground line. The flame lasted for 25 minutes with a maximum recorded surface temperature on the pole of 1652°F (900°C). Post-fire flexural tests were undertaken, and the results showed that the pole maintained its stiffness, compared to unexposed samples.

The engineering team at Wagners CFT developed a new-generation fire coating system, Pole Shield™, which demonstrated excellent fire resistance. In post-fire (simulating five bushfire events, with exposure to temperatures of up to 1100°C) cantilever testing, the utility pole showed no reduction in structural performance following repeated bushfire exposure.

---

### 3.7 Total Cost of Ownership

With a design life of up to 80 years, Wagners CFT poles bring significant cost savings over the lifespan due to the reduced replacement cycles and minimal maintenance costs compared to traditional materials. Additionally, of the lightweight nature of Wagners CFT poles results in much easier and more cost-effective transportation and installation.

# Manufacturing Process

To ensure consistent quality, Wagners CFT utility poles are manufactured by pultrusion. Pultrusion is an automated continuous manufacturing process, allowing for the efficient production of large quantities, at high and consistent quality composite profiles with a uniform cross-section, within tight tolerances, throughout the desired length.

## 4.1 Pull-Winding Pultrusion Technology

Wagners FRP composite poles are manufactured using methods that combine pultrusion with pull-wind technology, where only individual roving are used (no fibre matts) to provide strength/stiffness in both longitudinal and transverse directions. The continuous/individual glass fibres are wound and pulled over a central mandrel, with the resin being injected at the resin injection die, ensuring they are thoroughly impregnated with resin. The resin-impregnated fibres are then pulled through a heated die, shaping them in the desired cross-section. As the profile passes through the heating die, the heat initiates a chemical reaction (polymerisation), solidifying the structure. The solid profile eventually exits the die and is cooled before the cut-off saw cuts the profile into desired lengths.

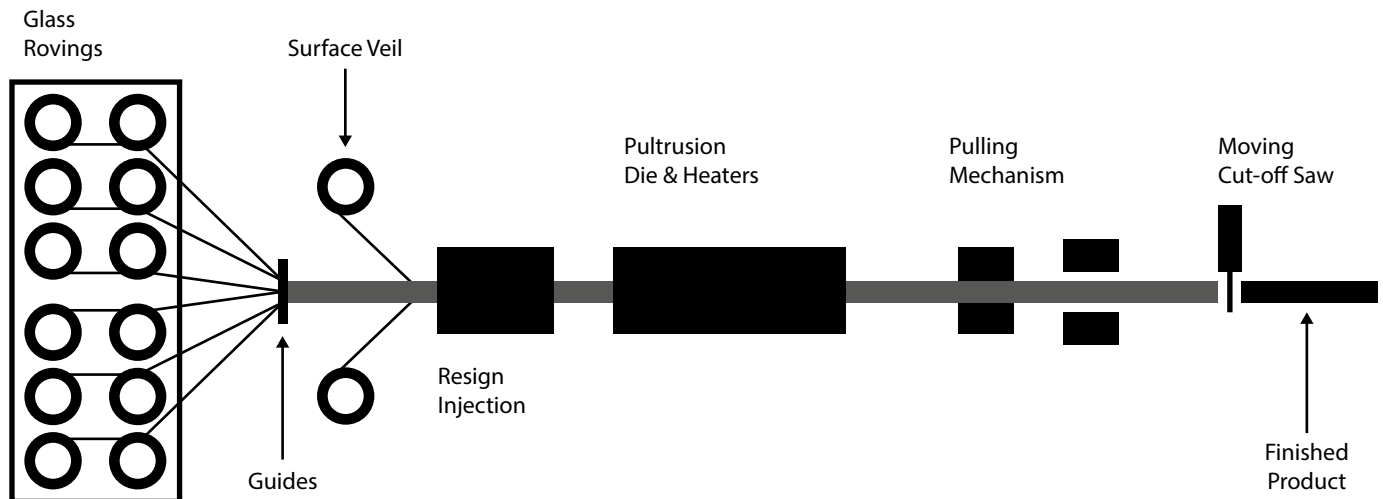


Figure 3 – Pultrusion process of Wagners FRP composite products

## 4.1 Pull-Winding Pultrusion Technology (CONTINUED)

### 4.1.1 GLASS FIBRES

Wagners CFT utility poles use boron-free, electric-grade E-CR (electrical-corrosion resistant) glass fibres as their primary reinforcement. E-CR glass fibres serve as a load-carrying component, providing impressive strength and stiffness.

### 4.1.2 POLYMER RESIN

Wagners CFT profiles utilise thermoset vinyl ester resin due to their excellent mechanical toughness and corrosion resistance. Inherent corrosion resistance allows vinyl ester resins to perform exceptionally well in both acidic and alkaline environments. In addition to their inherent properties, Wagners CFT resins have further additives injected at the time of pultrusion to improve the flame retardancy (when specified/required) of the finished profiles.

## 4.2 Identification

Wagners CFT utility poles can be equipped with a permanent branded nameplate or ID tag containing the pole identification information as per each end user. Figure 4 shows an example of what is currently been used for an Australian client.



Figure 4 – ID plate information

# Pole Structural Tests & Capacities

To guarantee that each utility pole of Wagners CFT meets the expected standards of performance, rigorous structural analysis is supported by a comprehensive testing regime following the recognised international industry standards/procedures. The testing takes place mainly at the Wagners CFT industry-standard in-house testing facility, and some universities and other approved, accredited labs. Through these rigorous tests, Wagners CFT ensures that every utility pole produced is safe and reliable to meet its intended design. The physical (Table 1) and mechanical (Table 2) properties of the typical utility poles manufactured by Wagners CFT are demonstrated.

**Table 1. Physical properties**

| Physical Properties      | Units                           | 230 CHS | 301 CHS | 356 CHS |
|--------------------------|---------------------------------|---------|---------|---------|
| Outer Diameter           | mm                              | 230     | 301     | 356     |
| Inner Diameter           | mm                              | 210     | 274     | 329     |
| Thickness                | mm                              | 9.7     | 13.5    | 13.5    |
| Cross-Sectional Area     | mm <sup>2</sup>                 | 6716    | 12193   | 14526   |
| External Surface Area    | m <sup>2</sup> /m               | 0.72    | 0.95    | 1.12    |
| Mass                     | kg/m                            | 13.8    | 25.1    | 29.9    |
| Second Moment of Inertia | 10 <sup>6</sup> mm <sup>4</sup> | 40.8    | 126.2   | 213.3   |
| Section Modulus          | 10 <sup>3</sup> mm <sup>3</sup> | 354.8   | 838.9   | 1198.5  |
| Radius of Gyration       | mm                              | 78.0    | 101.8   | 121.2   |
| Torsion Constant         | 10 <sup>6</sup> mm <sup>4</sup> | 83.7    | 252.5   | 426.6   |
| Torsion Modulus          | 10 <sup>3</sup> mm <sup>3</sup> | 728     | 1678    | 2397    |

**Table 2. Mechanical properties**

| Mechanical Properties               | Units                              | 230 CHS | 301 CHS | 356 CHS |
|-------------------------------------|------------------------------------|---------|---------|---------|
| Tensile Strength                    | MPa                                | 635     | 635     | 635     |
| Compressive Strength                | MPa                                | 395     | 395     | 395     |
| In-Plane Shear Strength             | MPa                                | 93      | 93      | 93      |
| Modulus of Elasticity (Tensile)     | GPa                                | 40      | 40      | 40      |
| Modulus of Elasticity (Compressive) | GPa                                | 41.2    | 41.2    | 41.2    |
| Bending Stiffness (EI)              | 10 <sup>12</sup> N.mm <sup>2</sup> | 1.64    | 5.1     | 8.5     |
| Ultimate Moment Capacity            | kN-m                               | 146.9   | 375.4   | 445.6   |
| Characteristic Moment Capacity      | kN-m                               | 130.0   | 332.2   | 394.3   |

## 5.1 Full-scale Cantilever Pole Flexural Test

Full-scale cantilever flexural tests were undertaken on the FRP composite poles per the modified ASTM D1036 test procedure and AS/NZS 7000 (Figure 5, full-scale flexural test conducted until failure). The full-scale flexural test demonstrates and assists in establishing the structural capacity of the utility poles under serviceability and strength limit state cases. Wagners CFT poles surpass the strength limit of poles made of various strengths of timber as classified by AS/NZS 2878:2000. The full member capacities are detailed in Table 2. The characteristic moment capacity is calculated based on the Kt factor as per AS/NZS 1170.0 (2002).



Figure 5 – Testing of the cantilever full-scale flexural test

## 5.2 Four-point Bending Test

The four-point bending test is an approved ASTM D6109-19 test that is widely adopted in the industry to gather critical data on the flexural strength and stiffness of structural members (Figure 6). By applying downward force at the midspan of utility pole specimens, the ability of Wagners CFT utility poles can be determined to resist bending and deformation. This information assists in calculating the elastic modulus and ultimate bending moment capacities of Wagners CFT utility poles. Samples predominantly failed due to compression buckling at mid-span, indicating localised instability under bending. The testing of five 356 CHS, 301 CHS, and 230 CHS poles showed ultimate bending capacities of 509.1, 359.45, and 178.78 kN.m, respectively.



Figure 6 – Four-point bend test setup

### 5.3 Crush Strength Test

To guarantee the resilience of Wagners CFT utility poles, they are subjected to a crush strength test (Figure 7). This test measures the pole's ability to withstand compressive forces.



*Figure 7 – Crush strength test*

The crush strength testing was undertaken by applying a point load using a 230 mm wide steel plate, and the design strength was established using ASCE/SEI 74-23. The ultimate crush strength of the CHS poles under a 230 mm wide load plate is 84 kN. In addition to the mechanical tests, Wagners CFT conducts a series of tests focusing on the conditions a utility pole could be exposed to during its service.

# Connections

The connection capacities of Wagners CFT poles at different configurations were characterised per ASCE/SEI 74-23 'Load and Resistance Factor Design (LRFD) for Pultruded Fibre Reinforced Polymer (FRP) Structures' as AS/NZS1170:0:2002 'Structural Design Actions – Part 0: General Principles'.

## 6.1 Bolted Connection Test

The bolted connection test evaluates the shear strength of bolted connections in Wagners CFT poles using industry-standard-sized bolts (Figure 8). The test is conducted in the longitudinal and transverse orientations to evaluate the bolted shear strength in both directions. Tests were conducted on the 356 CHS to evaluate its bolted connection capacities in both longitudinal and transverse orientations using M20 and M24 bolts. Characteristic values for the bolted connection capacities were established using ASCE/SEI 7-23 'LRFD for Pultruded FRP Structures' for longitudinal direction using M24 bolts (139.9 kN), transverse direction using M24 (139.0 kN) and M20 bolts (113.4 kN). The transverse bolted connection testing of Wagners CFT 301 CHS was also undertaken by applying a compressive load onto M24 and M20 threaded bolts through a stainless-steel sleeve, and the average failure loads were 124.91 kN and 120.4 kN, respectively. Similarly, the characteristic longitudinal connection capacity of 230 CHS for M24, M20, M16 bolts were 73.86, 64.5, and 55.36 kN, respectively. In transverse direction the characteristic capacities were 48.34, 48.22, and 30.88 kN.

(a) Longitudinal



(b) Transverse



Figure 8 – Bolted connection test setup

6.1 Bolted Connection Test (CONTINUED)

In a case where the stainless-steel sleeve is not implemented in the connection, the following values, Table 3, can be used for the design as a characteristic capacity:

Table 3. Connection capacities without using a sleeve

| Bolt Size | Orientation | Characteristic Capacity (kN) |         |
|-----------|-------------|------------------------------|---------|
|           |             | 301 CHS                      | 356 CHS |
| M16       | Long.       | 110.1                        | 83.5    |
|           | Trans.      | 82.15                        | 73.2    |
| M20       | Long.       | 132.1                        | 110.9   |
|           | Trans.      | 85.3                         | 75.4    |
| M24       | Long.       | 157.4                        | 117.4   |
|           | Trans.      | 88.5                         | 77.5    |

6.2 Bolt Torque Test

A proper bolt torque test is essential for the hollow FRP poles to determine their capacity. The bolt torque test involves applying torque to bolts to establish the relevant design values, ensuring that safety standards are met (Figure 9). The washer size and thickness play a critical role in the bolt torque capacity. In the testing conducted, the M24 bolt and a square 152x9.5 mm stainless steel washer were used. All bolts in both 356 CHS and 301 CHS specimens exhibited no signs of cracks or any noise up to 800 N-m of torque.



Figure 9 – Bolt torque test setup

In a case of not using any washer, and according to ASCE No. 104, an applied torque of 55 ft-lbs (75 N-m) is designated as the required threshold at which no significant deformation of the cross-section should occur. In contrast, the Wagners CFT pole sustained an applied torque of 147.5 lb-ft (200 N-m) without any crack initiation, indicating superior mechanical resilience and durability under extreme loading conditions. Accordingly, the use of rattle gun for bolt tightening during assembly and other stages is considered acceptable, given the section's torque resistance.

### 6.3 Bolt Pull-Through Test

The bolt pull-through test assesses and determines the design capacity of Wagners CFT utility poles under forces exerted by fasteners, where the force is going through the pole rather than along its length, i.e. push-pull on bolts (Figure 10). Washer pull-through capacity value depends on the bolt size and the washer. For instance, the characteristic pull-through capacity of the 230 CHS with a 75 mm square washer is 27.18 kN. Table 4 demonstrates the characteristic value strength of the washer pull-through for 301 and 356 CHS profiles with different bolts and washers.



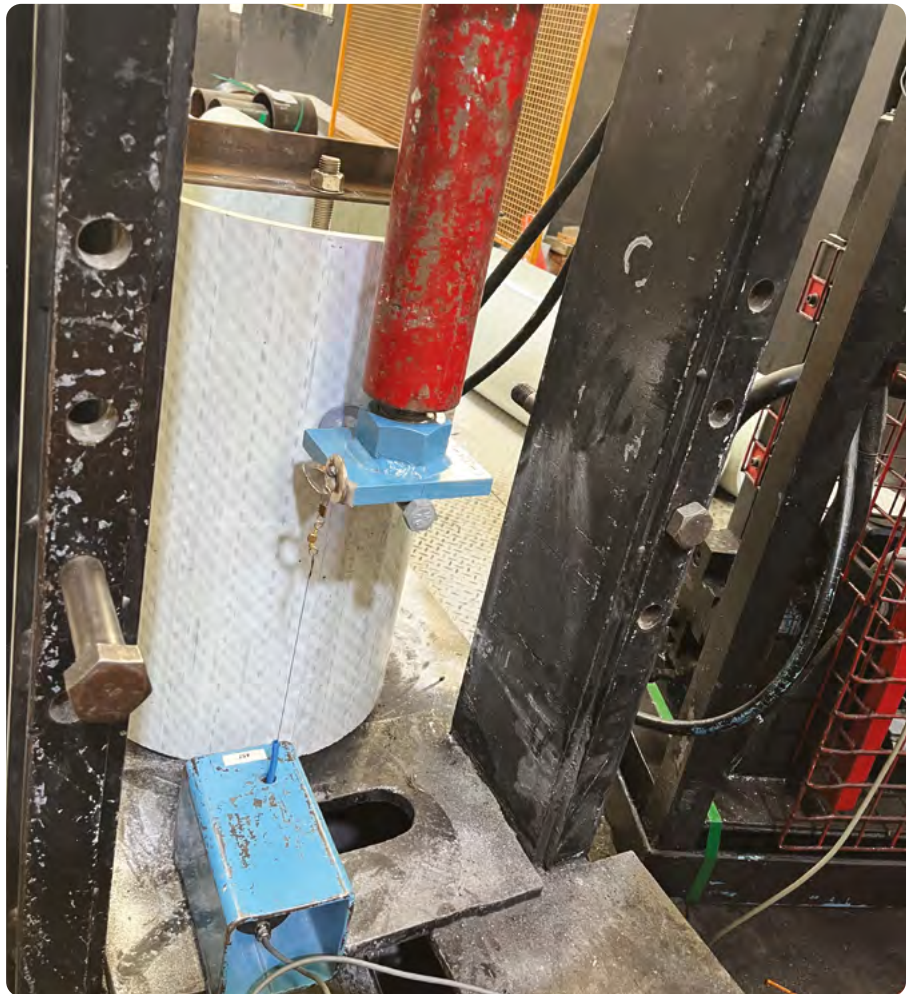
Figure 10 – Bolt pull-through test setup

Table 4. Washer pull-through capacities

| Bolt | Washer           | Characteristic pull-through capacity (kN) |         |
|------|------------------|-------------------------------------------|---------|
|      |                  | 356 CHS                                   | 301 CHS |
| M16  | Std flat washer  | 34.2                                      | 37.4    |
| M16  | Sq. 50 x 4.5 mm  | 37.1                                      | 41.2    |
| M16  | Sq. 150 x 9.5 mm | 65.7                                      | 63.6    |
| M20  | Std flat washer  | 39.1                                      | 44.3    |
| M20  | Sq. 50 x 4.5 mm  | 42.4                                      | 48.8    |
| M20  | Sq. 150 x 9.5 mm | 75.1                                      | 75.4    |
| M24  | Std flat washer  | 42.6                                      | 47.3    |
| M24  | Sq. 50 x 4.5 mm  | 46.2                                      | 52.1    |
| M24  | Sq. 150 x 9.5 mm | 81.8                                      | 80.5    |

### 6.4 Pole Step Test

The pole steps are experimentally tested to determine their capacity and confirm their compliance with AS 1657-2013. This test verifies that the poles can support the steps used by workers to climb and perform maintenance tasks, ensuring the safety of utility workers and the structural integrity of the poles (Figure 11). It needs to be mentioned, the ultimate load was governed by the yielding of the step while the FRP pole was intact.



*Figure 11 – Pole step test setup*

# Durability Performance

Wagners CFT utility poles exhibit high durability and excellent resistance to aggressive environments. Wagners FRP sections have been thoroughly tested/evaluated for durability in accelerated weathering conditions and actual case studies and have demonstrated great corrosion resistance in both acidic and alkaline environments. The durability report can be made available per request.

---

## 7.1 Water Absorption

The Wagners CFT pole demonstrates excellent performance in high-humidity and moisture environments. It exhibits significant resistance to moisture absorption. Tests conducted at 23°C for 24 hours according to ISO 62 have yielded a remarkably low moisture absorption rate of less than 0.2%. These strong results are attributed to the unique pultrusion process used in manufacturing Wagners CFT poles, which assures high glass content and effective stacking to minimise air voids, thereby reducing the likelihood of water ingress. The low moisture absorption contributes to the durability of Wagners CFT poles, as the deterioration of FRP materials typically occurs when moisture enters through air voids in exposed composites. Low temperatures can lead to freeze-thaw cycles, as water expands by 9% when frozen, exerting internal stresses. However, due to the notably low water absorption of Wagners CFT poles, they are highly effective in withstanding the impacts of freeze-thaw cycles.

---

## 7.2 Weathering and UV Protection

In FRP pole applications, surface finishes play a crucial role in providing UV protection, ensuring long-term appearance, enhancing performance, and extending service life. Wagners CFT utility poles are manufactured using vinyl ester resin, which is superior to polyester resin, and coated with a specifically formulated fluoropolymer paint system offering excellent UV resistance. It prevents UV degradation such as fibre blooming, flaking, blistering, and cracking, and provides an aesthetically pleasing finish uniform along the entire pole length. The paint system is thoroughly tested in a QUV machine for up to 25,000 plus hours under accelerated weathering conditions and has been proven in many case studies around the world. UV and weathering tests were undertaken on Wagners CFT composite materials as per ASTM G154. The samples were tested using Type 1 lamps (UVB-313) with a cycle time of eight hours UV at 60°C (140°F), followed by four hours of condensation at 50°C (122°F), with no indication of fibre blooming nor any structural damage. In addition to the simulated exposure, Wagners CFT has conducted mechanical coupon testing on a decade-old pultrusion in service. The testing validated the long-term protection provided by the Wagner coating system under harsh UV conditions and conformed to the simulated testing.

# Environmental Performance

Wagners CFT utility poles are sustainable and environmentally conscious and have achieved a cradle-to-grave Environmental Product Declaration (EPD) from EPD Australasia as per ISO 14025:2006 and EN 15804:2019. Environmental Product Declarations are based on Life Cycle Assessments (LCA) and communicate independently verified data about the environmental performance of products and services. Having an EPD shows that Wagners CFT is an early mover in the market and demonstrates the businesses genuine commitment to environmental responsibility and transparency. The full EPD can be accessed via the Wagners CFT website.

---

# Electrical Performance

Wagners CFT poles are widely used for low-voltage and high-voltage grid lines. Wagners CFT has completed extensive electrical testing on its FRP composite material as per AS 4435.1-1996 and AS/NZS 2947.1: 1999. Wagners CFT coated members were subjected to a power frequency voltage test at 120 kV for 60 seconds at 50 Hz, over a test distance of 305 mm, without failure. The members also withstood 15 positive and 15 negative polarity lightning impulse voltage tests at 210 kV, over a distance of 312 mm. In addition, a conductivity test was conducted on the pole, comprising a high-voltage AC test at 50 Hz, stepped from 2 kV to 20 kV in 2 kV increments, with wire mesh electrodes wrapped around the pole at 300 mm spacing. Under the test condition, the Wagners CFT poles did not exhibit conductive behaviour, indicating non-conductive performance.

# Fire Performance

The Wagners CFT pole is classified as self-extinguishing as it will not fuel the fire once the source is removed, unlike timber. The Wagners CFT pole is also able to achieve a V0 rating/classification as per UL94, clause 8. Wagners CFT poles have a Flame Spread Index of 25, which qualifies them for a Class A rating as per ASTM E84. Regarding the Bushfire Attack Level (BAL-40), a fire test was undertaken under AS1530.8.1:2018 to validate the performance/compliance of Wagners CFT poles in such extreme conditions (Figure 12).

Moreover, an internal test simulating a bush/wildfire test was undertaken where a full-scale pole was subjected to fire from a hay bale at ground line. The flame lasted for 25 minutes with a maximum recorded surface temperature on the pole of 900°C (1652°F). Post-fire flexural tests were undertaken, and the results showed that the pole maintained its stiffness (Figure 13). Furthermore, in a fire test, Wagners CFT poles and CCA-treated timber were tested against intense direct flame, radiant heat and wind exposure to stimulate Australian bushfires. While CCA-treated timber poles continued to burn and smoulder over several hours and were deemed structurally destroyed, Wagners CFT poles exhibited sufficient residual strength to allow for powerline assessment and repair or planned replacement.

Pole Shield™ with FireFix™ technology has been developed to provide an added layer of bushfire protection for Wagners' fire resilient FRP utility poles, supporting improved asset resilience in high-risk bushfire environments. The system has been tested to CSIRO bushfire conditions for flame zone bushfire exposure, supporting specification in high-risk areas for bushfire, or hard to access areas where regular vegetation management is problematic.

(a) Test setup as per AS1530.8.1



(b) Test setup as per AS1530.8.1

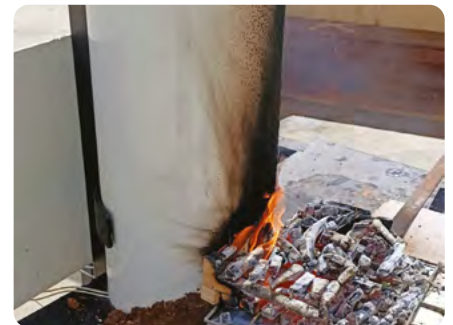


Figure 12 – Bushfire test

(a) Bush/wildfire test



Figure 13 – Full-scale fire bush/wildfire test

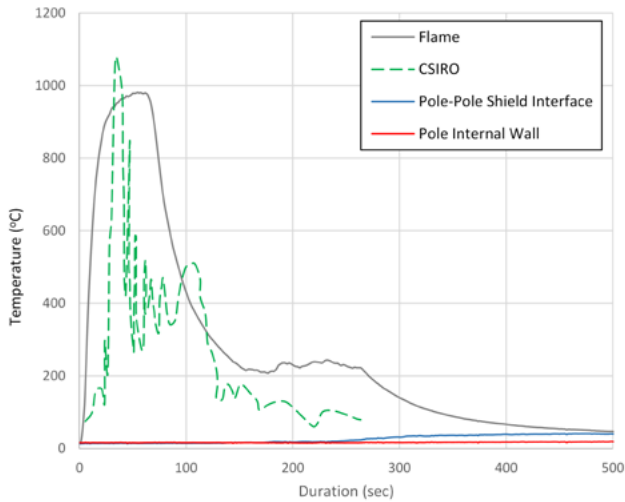
(b) Post-fire flexural test



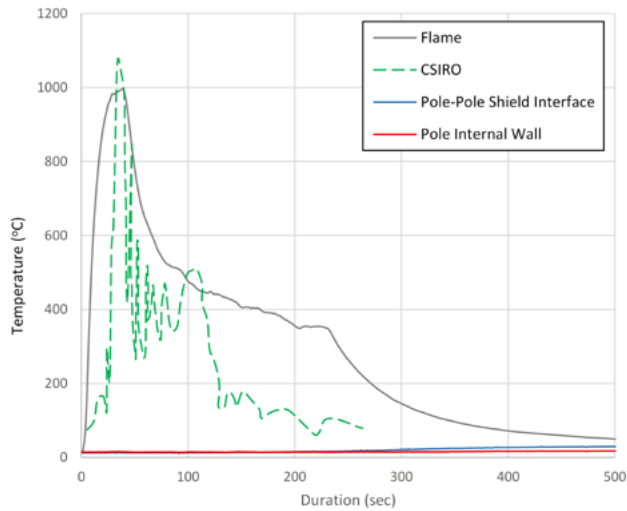
10.0 FIRE PERFORMANCE

The Pole Shield™ underwent five simulated bushfire events (Figure 14), with flame temperatures reaching approximately 1000°C in each test (peaking around 1080-1100°C based on the CSIRO reference curve). Despite this extreme external heat, the temperature at the FRP pole-to-Pole Shield™ interface reached a maximum of only 35°C across all five tests, and the pole's internal wall stayed even cooler. This roughly 965-1000°C differential between the flame and the protected pole surface demonstrates that the shield is highly effective at insulating the underlying composite pole from direct fire exposure, preventing thermal degradation of the FRP substrate even under repeated, intense heat loading.

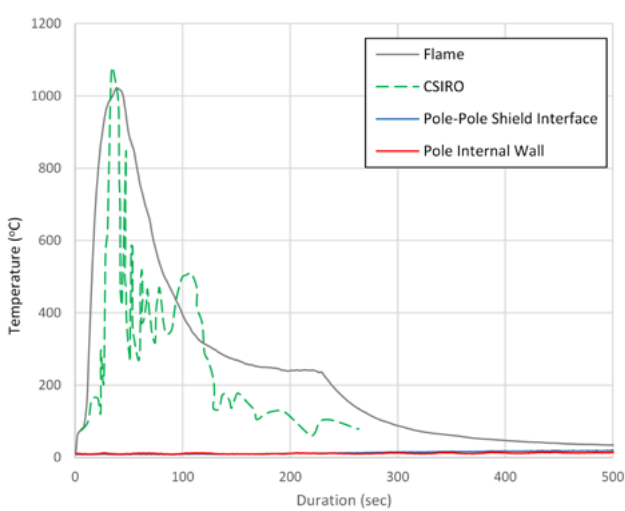
(a) Bush fire #1



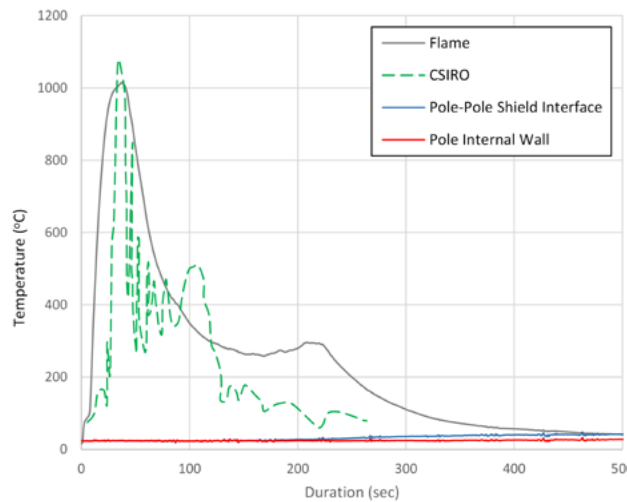
(b) Bush fire #2



(c) Bush fire #3



(d) Bush fire #4



(e) Bush fire #5

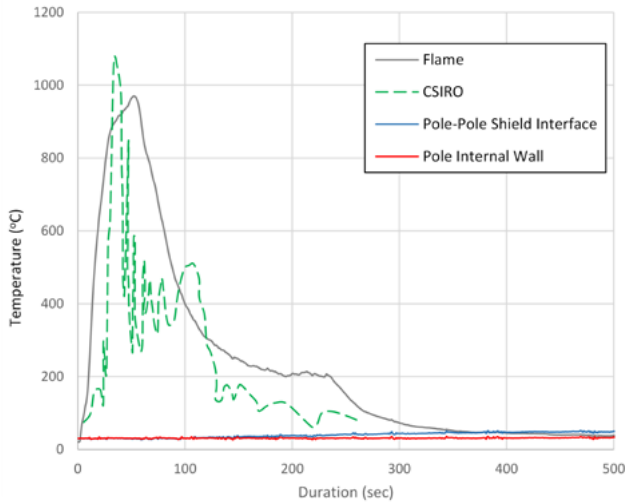
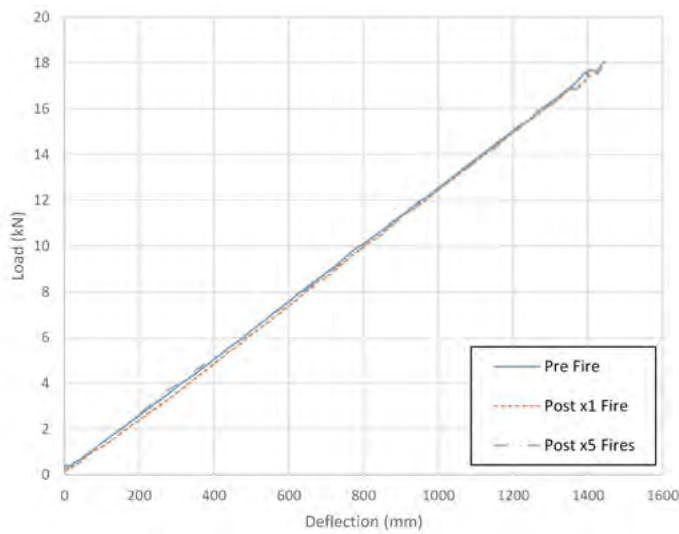


Figure 14 – Recorded temperature versus time diagrams

To confirm the pole retained its load-carrying capacity, cantilever bending tests (Figure 15) were performed at three stages; before any fire exposure, after one simulated bushfire, and after all five bushfire events, with load applied up to 18 kN (the ultimate limit state design load). The results were remarkably consistent across all three stages, measured ultimate load stayed at approximately 18 kN, deflection was the same as unexposed pole, modulus of elasticity varied minimally between 42,400-43,300 MPa, and stiffness remained constant. This consistency shows that repeated bushfire exposure had no measurable degrading effect on the pole's mechanical properties, confirming the Pole Shield™ successfully protects the pole's structural performance even after cumulative fire damage over its simulated service life.

(a) Load - deflection diagram



(b) Fire test



(c) Post fire inspection



(d) Post fire cantilever test



Figure 15 – Pole Shield™ fire and structural testing

# Serviceability Considerations

Wagners CFT composite poles, while exceptionally strong, have a lower stiffness compared to materials like steel due to their lower modulus of elasticity. The lower stiffness translates into comparatively higher deflections and, as such, the design of composite profiles is generally deflection-controlled (e.g., 5% of the pole height above the ground under service loads, per Appendix J of AS/NZS 7000). The FRP poles are carefully designed, tested, and analysed at the Wagners CFT facility to meet the client's serviceability criteria and do not exceed specified deflection limits under service loads.

---

# Poles Hardware & Accessories

Wagners CFT poles are compatible with most of the commercially available hardware for FRP poles, and other hardware connections can still be accommodated if needed. However, it is recommended to engage/communicate with the Wagners CFT engineering team for sanity checks to ensure the structural integrity of the system/components working together properly and efficiently.

## 12.1 Crossarms Mounting Brackets

Crossarms can be mounted onto Wagners CFT utility poles using a gain block/kingbolt connection to provide the transition between the circular pole to the square/rectangular crossarms. Standard two fixing points mounting brackets can also be adopted if that is the preferred connection method.

(a) Bearing capacity of the crossarm at the gain block



(b) Mounting bracket



Figure 16 – Crossarm – to – Wagners CFT pole connections

## 12.2 Top and Bottom Caps

Wagners CFT poles are supplied with a flat top and bottom plastic cap mechanically fixed to the side of the pole with rivets or screws to prevent easy removal. A hole in the bottom cap can be/is generally provided for water drainage as shown in Figure 17.

(a) Top Cap



(b) Bottom Cap

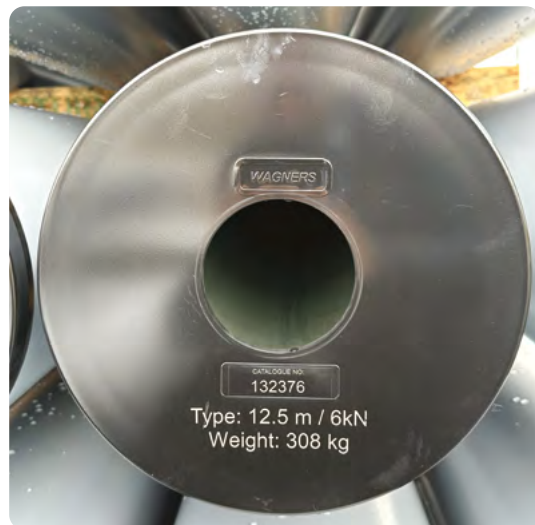


Figure 17 – Wagners CFT utility pole caps

### 12.3 Poles Steps

Wagners CFT poles are pre-drilled to accommodate pole steps and other utility hardware as required by the asset owner. Hole size and location will be as per client specifications (e.g., AS 1657-2013 for pole steps), which could vary from one utility to another.

### 12.4 Small Fixings

Small brackets, clips, saddles, or identification markers can be fixed to the pole before or post installation through screwing, strapping, or gluing. This type of fixing might leave marks on the poles. Also, it is suggested to check with a professional if this type of fixing becomes outside the norm.

### 12.5 Hole Plugs

Predrilled and unused holes on the body of the pole can be closed with hole plugs that meet the specifications and requirements of the end-user.

### 12.6 Surface Logs

Wagners CFT offers FRP surface logs, which can be utilised in the foundation of the utility poles to increase the bearing area of the soil when required (Figure 18). The Wagners CFT surface logs are similar in dimensions to the timber logs and provide exceptionally higher strength. Additionally, due to the inert nature of FRP, Wagners CFT surface logs are immune to rotting, insect damage, and moisture absorption, making them more durable and long-lasting than traditional timber logs.

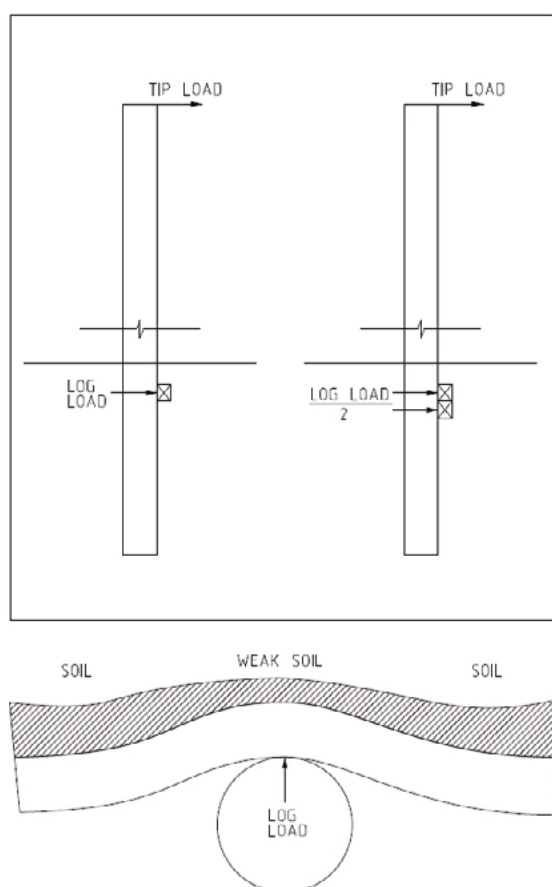


Figure 18 – FRP surface logs attached to utility poles in the foundation

# Transport and Installation

## 13.1 Packaging and Shipping

The general specifications/guidelines for the transportation, loading, unloading, storage, and lifting of Wagners FRP poles are presented below. Ensuring the correct packaging of dispatched items with a recommended cribbing material (e.g., rubber-lined wooden supports) is crucial for Wagners CFT to fulfil their Chain of Responsibility (COR) obligations. The packaging must adhere to the following criteria:

- a) Withstand road transport over long distances and rough terrain.
- b) Be safely lifted on and off relevant transport vehicles.
- c) Minimise the risk of injury to those involved in freight loading and unloading.
- d) Minimise the risk of damage to the item.
- e) Minimise the risk to the environment.
- f) Minimise the risk to other freight, road users, and the public.



*Figure 19 – Wagners CFT utility poles ready for transport*

---

### 13.2 Storage

Considering the high durability of Wagners FRP poles, they can practically be stored indoors or in open-air yards, depending on the site logistics/requirements. Cribbing/dunnage is used for storage and transport, which elevates the poles off the ground and facilitates the easy strapping of nylon lifting straps underneath. Also, ASCE 104 recommends placing support every 10 ft (~ 3 m) to prevent sagging or bowing under self-weight, which could vary upon further structural checks, i.e. pole size, weight, stiffness and actual deflection/sagging.

---

### 13.3 Handling

Wagners CFT poles should be lifted rather than dragged on rough ground to prevent surface scratching and damage to the UV protective layer. If there was any excessive damage to the poles due to inappropriate handling, it should be discussed with the structural team of Wagners CFT to ensure the structural integrity of the poles is not compromised.

---

### 13.4 Holes Drilling in the Field

Wagners CFT poles will be pre-drilled to accommodate pole steps and other hardware as requested. Wagners CFT poles are compatible with most of the commercially available hardware for FRP poles. However, it is recommended to engage/communicate with the Wagners CFT engineering team for sanity checks to ensure the structural integrity of the system/components is working together properly and efficiently.

## 13.5 Lifting and Installation

Wagners CFT poles weigh approximately a third of traditional timber poles, making them significantly safer and easier to handle, transport, and install. Wagners CFT utility poles should be lifted using cranes or forklifts with rubber slings. For longer poles, spreader bars can be used to distribute the weight evenly. FRP poles can be installed similarly to poles made from other materials, but their lighter weight makes the process generally easier. Smaller and lighter equipment can be used, potentially lowering installation costs compared to poles of other types. Their high strength-to-weight ratio also makes FRP poles ideal for areas with restricted access, such as locations that require helicopter transport. Regarding Wagners CFT utility pole installation, the standard equipment and methods of traditional utility poles can be used based on the terrain and site conditions. FRP poles can be installed using a single pickup point. Nylon slings are typically used to secure and lift the pole without damaging the surface. Before lifting, ensure that all top caps, bearing plates, and joints are properly checked and secured. It is important to confirm that the lifting strap is tightly fastened and will not slip during the lift by using specially made straps or placing it below a temporary through-bolt or permanent hardware on the pole.



*Figure 20 – Wagners CFT pole and crossarms are being installed into position*

## 13.6 Direct Embedment

Wagners CFT utility poles are capable of being embedded directly into soil, concrete or structural foam without any detrimental effects on the pole due to the high durability of the FRP material. Well-designed and correctly installed foundations are crucial for the long-term stability of any pole material, including FRP poles. The foundation design must be adequate to resist the loads transferred by the pole to the ground. However, a general industry practice of the pole embedment depth is 10% of the pole length plus 800 mm, similar to other types of poles. However, in cases of poor soil conditions or higher load requirements, the embedment depth may vary. A geotechnical soil investigation is required to determine the soil holding capability and appropriate embedding burial depth.

# Inspections and Maintenance

## 14.1 Field Inspections

Considering the high durability and long design life of Wagners FRP poles, regular inspections are not necessarily required, however, it is recommended after major loading events such as direct accidents and natural disasters.

### 14.1.1 VISUAL INSPECTIONS

Visual inspection is a very common and reliable technique for damage assessment at the surface level of FRP structures, however, it does not reveal much about underlying issues that might be within the wall of the hollow FRP pole. As per ASCE 104, the maintenance technician should visually inspect the FRP pole to identify the following:

- Tearing or other FRP damage at hardware/connections
- Vandalism damage
- Mechanical impact damage (typically near the ground line)
- Delamination
- Tracking on FRP surface
- Lightning damage
- Any surface damage or change in the surface conditions, including fibre blooming, cracking, crazing, charring, and discolouration

### 14.1.2 TAP TEST

The tap test can be used as a routine test to further check for any suspected localised damage. The test requires an inspector to use a small hammer to tap all around the area of suspected damage. This is a fast, inexpensive, and easy way to roughly evaluate the condition of the FRP material and locate delamination, large voids, and cracks. A Tap Hammer or a coin can be used for this test. Inspection conducted with tools like a shifter/wrench should be avoided, as it can induce further damage to the composite.

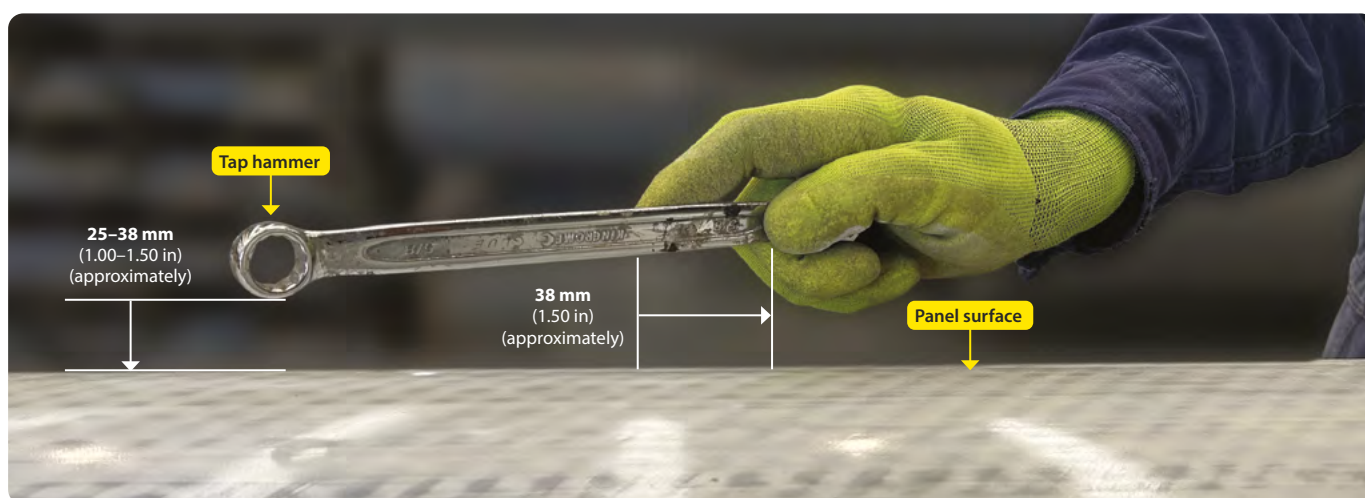


Figure 21 – Tap test (inspection of composites, aircraftsystemstech.com)

## 14.2 Repair Methods

The appropriate repair method for Wagners FRP poles depends on the type of damage. ASCE 104 classify the FRP damage into three levels as listed below. Also, it is highly recommended that all repairs be assessed by Wagners CFT to ensure compliance with structural integrity standards.

- **Level 1** – Minor repair, aesthetic, where no repair/minor touch-ups are required
- **Level 2** – Moderate repair, outer and mid-thickness layers, where in-field repair is required
- **Level 3** – Major repair of all layers of composites, where pole replacement is required

### 14.2.1 LEVEL 1 – MINOR REPAIR

This repair level is intended for minimal surface damage only that could be caused due to the handling/installation or light environmental parameters such as small kinetic debris. Such surface/aesthetic damage can be repaired with a paint touch-up after preparing/cleaning the FRP surface. Table 5 below is the defect/activity matrix for Level 1 repair.

**Table 5. Defect/activity matrix for Level 1 repair on WCFT poles**

| Defect/damage                                                                                                                                                  | Action                                            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|
| Chipping of the surface with exposed laminate, but no visible damage to the laminate                                                                           | Touch up the surface with matching paint/coating. |
| Delamination of composites to a depth of up to 0.5 mm and area not exceeding 50 mm x 50 mm or equivalent                                                       | Touch up the surface with matching paint/coating. |
| Minor impact damage, depth not exceeding 0.5 mm and area not exceeding 50 mm x 50 mm square or equivalent, with damage restricted to the first layer of glass. | Touch up the surface with matching paint/coating. |

### 14.2.2 LEVEL 2 – MODERATE REPAIR

Level 2 repair is required for damage extended beyond the surface and going into the substrate fibre layers, such as deeper scratches and gouges, for example. This kind of damage is generally assessed on a case-by-case basis, where detailed information needs to be provided to assess:

- Extent of damage
- Structural utilisation of the pole
- Cost of the repair versus cost of replacement

This kind of repair generally involves sanding, cleaning, epoxy filling, sanding, and possibly hand layup laminating, then finishing/painting. Also, these repairs must be implemented by certified composite repair professionals to ensure the quality of the repair and the integrity of the repaired pole.

### 14.2.3 LEVEL 3 – MAJOR REPAIR/REPLACEMENT

Certain types of damage are irreparable, such as full flexural/shear failure through the whole wall, which requires the replacement of the damaged FRP pole.

15.0

# Pole Library

The Wagners CFT utility poles are/will be available in the overhead line design program available at the market.

---

16.0

# Safety Information

Wagners CFT is committed to ensuring and complying with ISO 14001. Wagners FRP is classified as a non-hazardous material according to the Safe Work Australia criteria. A Safety Data Sheet (SDS) for Composite Fibre, Pultrusion can be downloaded from the resources page on the company website.

# Quality Control

Wagners CFT incorporated a strict quality control procedure, including quality inspection requirements for the raw materials that have a direct impact on product quality for manufactured items, and stringent quality control measures on the manufactured product as per ISO9001. The following QA/QC testing info is fully detailed in the Wagners CFT quality control plan, and the Inspection Test Procedures (ITP) are available upon request.

- Testing frequency
- Determination of low and high confidence levels
- Pass/fail criteria
- Corrective action
- Test methods (work instructions)
- Test result records (forms)
- QC check responsibility



# End-of-Life Recycling Options

Today, the end-of-life strategy for Wagners CFT utility poles is land fill. Whilst this is not the preferred end-of-life strategy, it does not harm the environment as the product, once cured, is inert. However, the utility poles can be repurposed in various low-strength applications, fence posts, for example, or they can even be recycled. Fibre Reinforced Polymer waste management differs from conventional waste disposal. The recycling of thermoset composites remains an evolving research area, with emerging technologies such as pyrolysis and mechanical crushing showing promise. However, current limitations include high energy consumption and fibre degradation, which require further technological advancements. The recycling of FRP products is feasible where the glass can be retrieved and reused as reinforcements in several applications, while the resin parts can be crushed into fine sand and used as filler material in different proportions.

One of the emerging and commercially available technologies for recycling thermoset FRP is pyrolysis, which is defined as the thermal decomposition of the material at elevated/higher temperatures. Various research in the past has indicated that pyrolysis is a very effective and viable recycling technology for thermoset composites. Pyrolysis not only decomposes composite materials but also extracts valuable fibres and organic fuels for further application. Another recycling method is mechanical crushing, where the glass can be retrieved and reused as reinforcements in injection moulding applications, and the resin part can be crushed into fine sand and used as filler materials in cement production.

# Additional/Custom Testing

To support line designers and provide added confidence, Wagners CFT's engineering team is equipped and ready to design and conduct non-conventional testing that simulates the real-world conditions and loading experienced by utility poles and their hardware. Following are two examples of the testings have been conducted.

## 19.1 Torsional Test

A 12.5 m Wagners CFT 301 CHS utility pole was subjected to a torsion test in accordance with Section 10.2.1 of ENA Technical Specification 43-18 (2022), the industry guideline for engineered poles and associated products for overhead lines. Using a 1.4 m lever arm and a winch-applied load, the pole was tested to a target torsional moment of 25.9 kN-m, equivalent to an applied load of 18.5 kN, with the load gradually increased and then held at the target for 10 minutes to confirm sustained performance under peak torsional demand. The pole successfully reached and sustained the full target torsional moment of 25.9 kN-m without any sign of failure, deformation, or local damage at the connection. Upon unloading, the pole returned to its original position, confirming it remained structurally intact and behaved elastically throughout the test. This result demonstrates that the Wagners CFT pole meets the torsional capacity requirements set out in ENA 43-18 (2022), confirming its suitability and reliability for use in overhead line applications subject to torsional loading.



Figure 22 – Torsional test on the Wagners CFT utility pole

### 19.2 Combined Test

A 12.5 m Wagners CFT 301 CHS utility pole was subjected to a combined load test in accordance with Section 10.3 of ENA Technical Specification 43-18 (2022), which requires utility pole to simultaneously withstand vertical, transverse, and torsional forces. Using a 1.4 m lever arm positioned 0.5 m from the pole tip and a winch set at a 45° angle to the sample, the test applied all three load types concurrently, replicating real-world in-service conditions where bending and torsional forces act together rather than in isolation. The target loads of 13 kN (vertical), 4.1 kN (transverse), and 32.4 kN-m (torsional) were applied and then held for 10 minutes to confirm sustained performance under combined loading. The pole successfully achieved and maintained all three target loads for the full 10-minute hold period without any sign of failure. The achieved transverse and vertical loads of 16.4 kN each substantially exceeded their respective ENA requirements of 4.1 kN and 13.0 kN, while the torsional moment reached the full target of 32.4 kN-m.



*Figure 23 – Combined load test on the Wagners CFT utility pole*



Wagners Composite Fibre Technologies (CFT)

# Utility Poles Technical Guide



Published by Wagners CFT Manufacturing Pty Ltd

© Wagners CFT Manufacturing Pty Ltd  
ABN 91 099 936 446

**Head Office**

11 Ballera Court, Wellcamp  
Queensland, Australia 4350

**Postal Address**

PO Box 151, Drayton North,  
Toowoomba Qld 4350, Australia

**T** +61 7 4637 7777

**F** +61 7 4637 7778

**E** [cftsales@wagnerscft.com.au](mailto:cftsales@wagnerscft.com.au)

[wagnerscft.com.au](http://wagnerscft.com.au)