Utility Pole - Fire Barrier Test Method & Results

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Background

As global wildfire events increase year on year, the vulnerability of wooden utility poles to fire damage is becoming a critical concern for utilities worldwide.

Wildfires can broadly be categorised into two types:

- Lower-intensity (grass, savannah, crop, and shrub) fires
- Higher-intensity (forest) fires, where poles are surrounded by dense vegetation and exposed to significantly greater heat loads and peak temperatures

In the United States, the majority of wildfire incidents are lower-level fires. In 2023, these accounted for approximately 13 million acres, compared to around 2 million acres of forest fires(1).

A key challenge for the industry is the lack of a standardised fire test method for utility poles. Existing approaches present clear limitations:

- Burning bale tests (hay or straw) are low-cost and simple but highly variable and difficult to control. They also bear little relationship to real life fire conditions.
- Large-scale laboratory tests provide consistency but are expensive and often based on building fire standards that do not accurately reflect wildfire conditions.

Critically, many current methods fail to replicate real-world wildfire exposure, which can include:

- Peak temperatures of up to approximately 1100°C (2000°F)
- Wind-driven fire behaviour, a major factor in real-life scenarios

As a result, test outcomes vary significantly and are often not comparable, making it difficult for utilities to confidently evaluate fire protection systems.

Key Considerations

When selecting wildfire protection solutions for utility poles, the following factors are critical:

- Ability to maintain pole strength following wildfire exposure (often expressed as Remaining or Residual Strength Value – RSV)
- Cost-effectiveness
- Ease of application in the field
- Long-term durability and performance

A practical, repeatable, and cost-effective test method that better reflects real-world conditions would allow utilities to independently assess and compare solutions with greater confidence.

A Practical Real-World Test Method

Overview

A new test method is proposed that is:

- Small-scale and low cost
- Repeatable and controlled
- Representative of real wildfire conditions

The method enables utilities to quickly and effectively compare the performance of different fire protection systems without the need for expensive laboratory testing.

Replicating Real Wildfire Conditions

To simulate real-world exposure, it is essential to replicate time-temperature fire behaviour.

Research into wildfire dynamics(2) provides time-temperature data across a range of fire scenarios, including high-intensity boreal forest crown fires. From this data, Wildfire Curves (WC), specifically the Butler Curve, have been developed (the graph below shows this curve).

These curves account for thermal mass, which:

- Slightly increases the initial heating phase
- Reduces peak temperatures
- Extends the cooling period

This provides a more realistic representation of the temperatures experienced by wooden utility poles during wildfire exposure.

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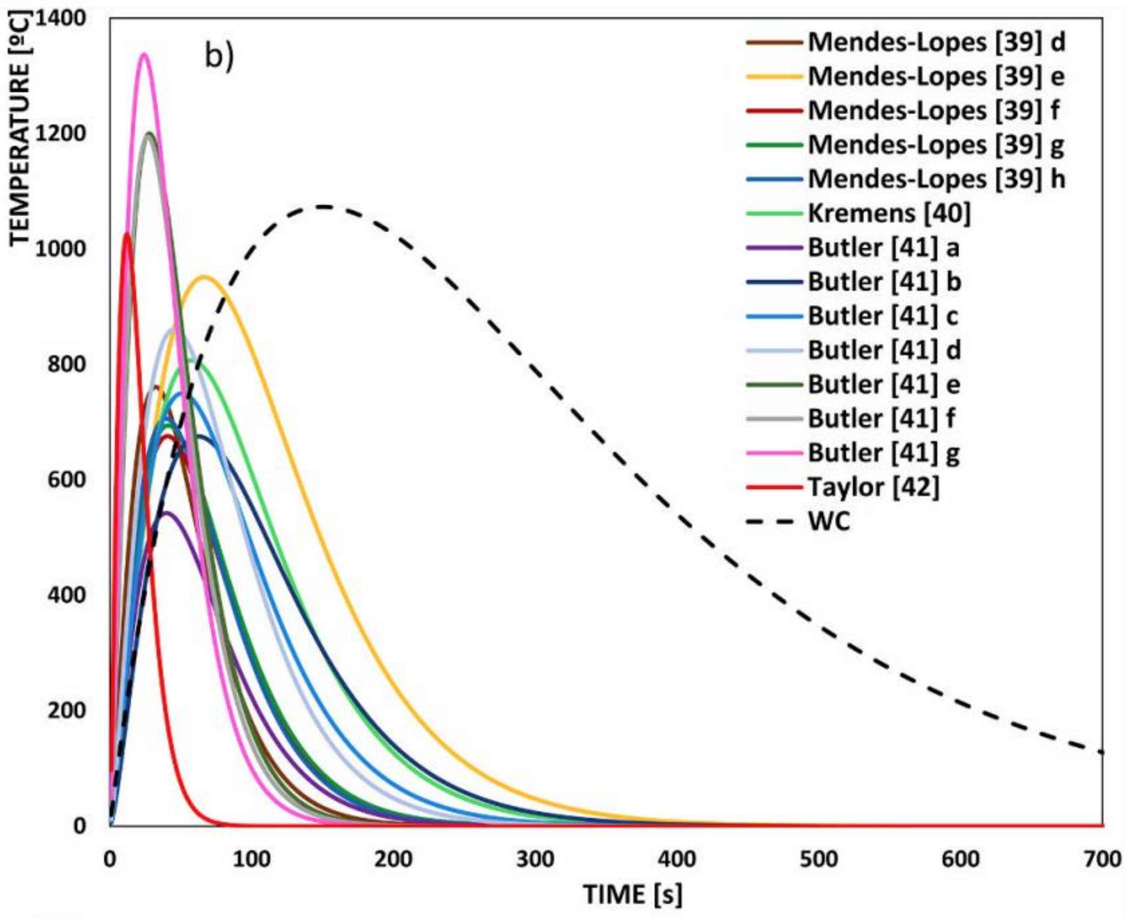

Test Method

Principle

The method replicates the Butler Wildfire Curve on a small-scale test sample using a carefully controlled heat application. All testing should be carried out in still air conditions to ensure accurate temperature control and repeatability.

A high-powered gas blow torch with a variable output is used to deliver:

- Convective heat
- Radiant (infrared) heat
- Direct flame contact

The variable output on the blow torch should be altered to replicate real life fire time and temperature conditions (shown in table 1 below). This combination closely approximates real wildfire exposure.

Key Performance Measures

Performance is assessed by:

- Measuring char depth
- Calculating remaining pole circumference
- Deriving residual strength (RSV)
- Assessing barrier condition post-test

This provides a clear, comparable indication of real-world performance across different protection systems.

Afterglow Consideration

This method focuses on initial fire exposure performance and does not fully replicate extended afterglow scenarios. However:

- If the protective barrier remains intact, afterglow risk is significantly reduced
- If the barrier fails, continued combustion and delayed failure are likely

Optional: A fan can be introduced immediately post flame test to simulate wind and assess afterglow behaviour.

Test Equipment

- Gas blow torch “strong flame” and adjustable output of up to 40kW (Sievert Promatic 3366 handle and diameter 40mm diameter power burner 335002). Power output up to 8000kw/m², equivalent with maximum flame temperature of 1100°C, 2000°F.
- Means of measuring temperature at the exposed test face of the sample - 3mm (1/8”) diameter stainless steel K type thermocouple 20” (500mm long), with electronic display, max temperature 1200°C.
- Timer.
- Electrical resistance pin type moisture meter (<15% moisture content required to meet test conditions).
- Measuring tools (Straightedge 12” or 300mm and vernier, or small ruler) to measure the char depth.
- Fire-resistant and heat proof supports and PPE (heat proof gloves, goggles and a fire extinguisher as a minimum).
- Moveable support for the torch.

Test Material

- Section of preservative-treated pole, as specified by the utility
- Measured moisture content should be below 15% for consistent results
- Fire protection system applied as per manufacturer guidance to cover the full circumference of the pole and 20” (500mm) along the pole length

Test Set-Up

- Ensure no combustible materials are present within **3 m** of the test area
- Have appropriate fire safety equipment available (e.g. fire extinguisher)
- Wear suitable personal protective equipment (PPE)
- Position a ‘set-up’ test sample horizontally on a fire- and heat-resistant support
- Mount the blow torch on a fixed stand, aligned with the centre line of the pole, circumferentially and length ways
- Install the temperature probe so that it is aligned with the flame centreline and positioned adjacent to, but not touching, the wood/protection system surface (large staples can be driven in and used to support the probe
- Ignite the blow torch (low flame) and secure the handle in position
- Adjust the distance between the torch and sample so the full temperature profile (see Table 1) can be achieved by varying the heat output of the blow torch with the gas control valve.

Test Procedure

1. Replace the set-up sample with the fire protected sample
2. Ensure the blow torch is correctly aligned with the centre of the pole both circumferentially and length ways
3. Ignite the torch at a low setting
4. Using the defined time–temperature profile (Table 1), adjust the heat output to reach the required surface temperature, and start the timer
5. Continue adjusting the heat output at each time interval to follow the specified temperature curve (as shown in Table 1)
6. At the end of the test, turn off the torch and allow the sample to cool naturally
    - For copper-treated poles, a fan may be introduced immediately after fire exposure to simulate wind and assess afterglow behaviour over time until burning/smoke stops or the pole is destroyed.
7. Record the condition of the fire protection system (photographs recommended)
8. Remove any remaining protective layer and char material before measuring char depth.

Recording Data

Char Depth Measurement

Char depth should be measured at the centre of the test zone as follows:

1. Remove the fire protection system to expose wood/char
2. Remove all char in a central area (~50 mm / 2” diameter) of the test zone until solid wood is exposed
3. Place a straightedge across uncharred wood on to solid undamaged wood either side of the test area
4. Measure the depth from the straightedge to the solid wood using a vernier gauge or ruler. Take multiple measurements along the centreline and calculate the average

Residual Strength Calculation

Char depth can be used to determine the remaining pole circumference and estimate structural performance.

The indicative remaining or residual Strength Value (RSV) is calculated as:

$$\left(\frac{\text{Post-exposure circumference}}{\text{Original circumference}}\right)^3 \times 100$$

This provides an indicative measure of retained structural capacity following fire exposure.

The test should be repeated to ensure that consistent results are achieved.

Table 1. Time temperature/results table (extrapolated from graph 1)

Time	Flame temperature at surface of sample under test °C
O	20°C
30 seconds	500°C
1 min	800°C
2 mins	1050°C
2 mins 30 secs	1080°C (peak)
3 mins	1060°C
4 mins	930°C
5 mins	800°C
6 mins	650°C
8 mins	520°C
9 mins	380°C
10 mins	300°C

Results for Polesaver Blaze-Guard

Original pole circumference	**Char depth**	**Calculated pole circumference with char removed**	**Calculated indicative remaining strength value (RSV)**
300mm (11.81”) = 943mm	5mm (0.196”)	290mm (11.41”) = 911mm	90.33%
Comments: Forced airflow was continued, smoke stopped after 2 minutes. The barrier was intact after exposure.			

Conclusion

Current fire testing methods for utility poles are either:

- Too variable to be reliable, or
- Too complex and costly to be practical for utilities to implement
- Do not always relate well to real life wildfire exposure

This proposed method offers a balanced alternative, delivering:

- Realistic wildfire simulation
- Simple, low-cost test method using standard off the shelf equipment.
- Quantifiable assessment of fire protection system’s ability to maintain pole strength after fire exposure.
- Repeatable, comparable results

By enabling better, evidence-based comparisons, this approach supports more informed decision-making and ultimately contributes to more resilient utility infrastructure in wildfire-prone environments.

Note

The above is for guidance purposes only, utilities should always take necessary steps to ensure any fire protection product used meets their specific requirements.

References

1. Samborska, V. & Ritchie, H. *Wildfires: Global and Country-Level Data* https://ourworldindata.org/wildfires
2. Fiorini, C. et al. *Assessment of the Proposed Wildfire Curves for Housing Design Protection* Fire Safety Journal, 155