DUCTILE IRON POLE FIRE EXPOSURE

McWANE POLES

2020 WHITE PAPER

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DUCTILE IRON UTILITY POLES WITHSTAND THE HEAT OF WILDFIRE AND TENSION LOAD TESTING

Introduction

Over the past few years, the number of wildfires has increased, particularly in the western U.S. This increase has been linked to rising temperatures, drier summers, more drought periods, and earlier snowmelt.[1] California has been one of the epicenters for catastrophic wildfires. Prior to 2019, 14 of the 20 largest wildfires in California history occurred between 2000 and 2017.[2] And nationally, the World Meteorological Organization has reported that although the overall number of wildfires has decreased, the destruction and burn area has increased, over 500% since the 1970s.[4]

Many utilities and government agencies in the U.S. are taking steps to mitigate risk associated with their infrastructures as they relate to wildfires. In fact, the State of California has issued General Order (GO) 95, which requires utilities to upgrade wooden utility structures, including electrical poles.[3] Due to this Order, utilities will need to implement use of non-wood utility poles or other mitigation.

There are several types of non-wood utility poles, including steel, concrete, steel-and-concrete hybrids, composites, and ductile iron, each of which, with an intumescent wrap for composite, is more resistant to fire than wood. These wood alternatives vary in benefits, resistance to heat, failure stress, and cost.

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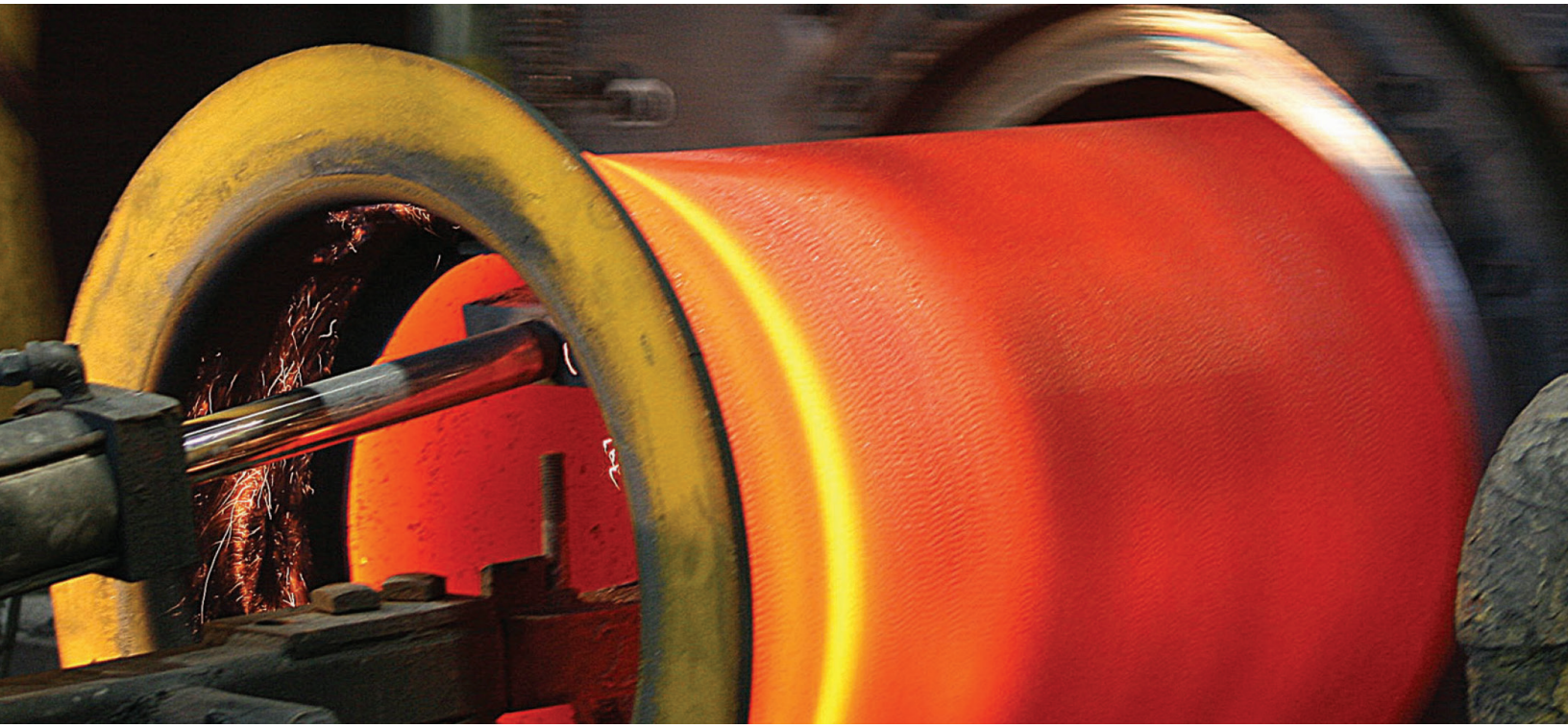
McWANE POLES

McWane Poles, A Division of McWane, Inc.

What is Ductile Iron?

Ductile iron was introduced in the 1960s as a modified version of cast iron, which has been used for hundreds of years for products dependent on strength and corrosion resistance. Ductile iron contains the same ingredients as cast iron, but with a different configuration of carbon. In cast iron, carbon is in flake form, while in ductile iron, the carbon is in nodular form. The result is that ductile iron has the ability to bend without breaking under intense load pressure and is resistant to extreme heat, even over extended periods of time.

Ductile iron utility poles have been available from McWane Poles, a division of McWane, Inc., since 2007. The poles were developed as an alternative that is more durable and resilient than wood.



DUCTILE IRON POLES OFFER SEVERAL KEY BENEFITS TO UTILITY COMPANIES, BASED ON LOCATION AND NEED.

1. **Low maintenance** — Ductile iron poles are completely resistant to rot, insects, and woodpeckers, resulting in less maintenance.

2. **Lower lifecycle cost** — With an expected service life of more than 75 years and a low-maintenance requirement, ductile poles have a low lifecycle cost.

3. **Engineered consistency** — Ductile iron poles are engineered and manufactured for consistent strength and appearance. They do not warp or shrink over time with wear and weathering.

4. **Simple installation** — Ductile iron poles are lightweight and easy to drill.

5. **Low environmental impact** — Ductile poles are made of more than 96 percent recycled material and are 100 percent recyclable, and they do not leach harmful chemicals.

6. **Weather and fire resistant** — because of its strength and composition, ductile iron is highly resistant to wind, storms and heat from wildfires.

MULTIPLE, INDEPENDENT EVALUATIONS PUT DUCTILE IRON TO THE TEST

Based on the results of three separate fire resistance tests from three different testing institutions, data reveals that ductile iron poles are among the strongest and most fire-resistant utility poles available in the United States. Summaries of the three tests are outlined in the following segments.

01 WESTERN FIRE CENTER TEST

SUMMARY OF TEST METHOD

The Western Fire Center test followed the principles contained within the proposed American Society of Testing Materials (ASTM) standard test method for fire resistance of wood utility poles. This standard was developed to evaluate the effectiveness of a pole by measuring exposure to radiative heating, convective flames and wind effects.

The test on ductile iron poles was intended to evaluate ductile iron poles in order to compare them to other poles. The test was conducted using a combination of heat sources, including radiant heaters and a convection ring burner. Heat intensity was gradually added over a burn period of 10 minutes until reaching 980 degrees Celsius.

In addition, a wind test was performed after the fire application, exposing the pole to a 2.0 m/s wind speed for four hours.

RESULTS

The final results and observations reported no significant damage to the ductile iron pole after fire and wind tests.

SUMMARY OF CONCLUSIONS

Ductile iron poles are resistant to the heat and wind parameters set by the Western Fire Center testing, making them a viable option for all utilities, especially those in areas of high risk for wildfires and excessive winds.

02

EDM FULL-SCALE BURN AND BEND TEST ON CLASS 1 UTILITY POLES

SUMMARY OF TEST METHOD

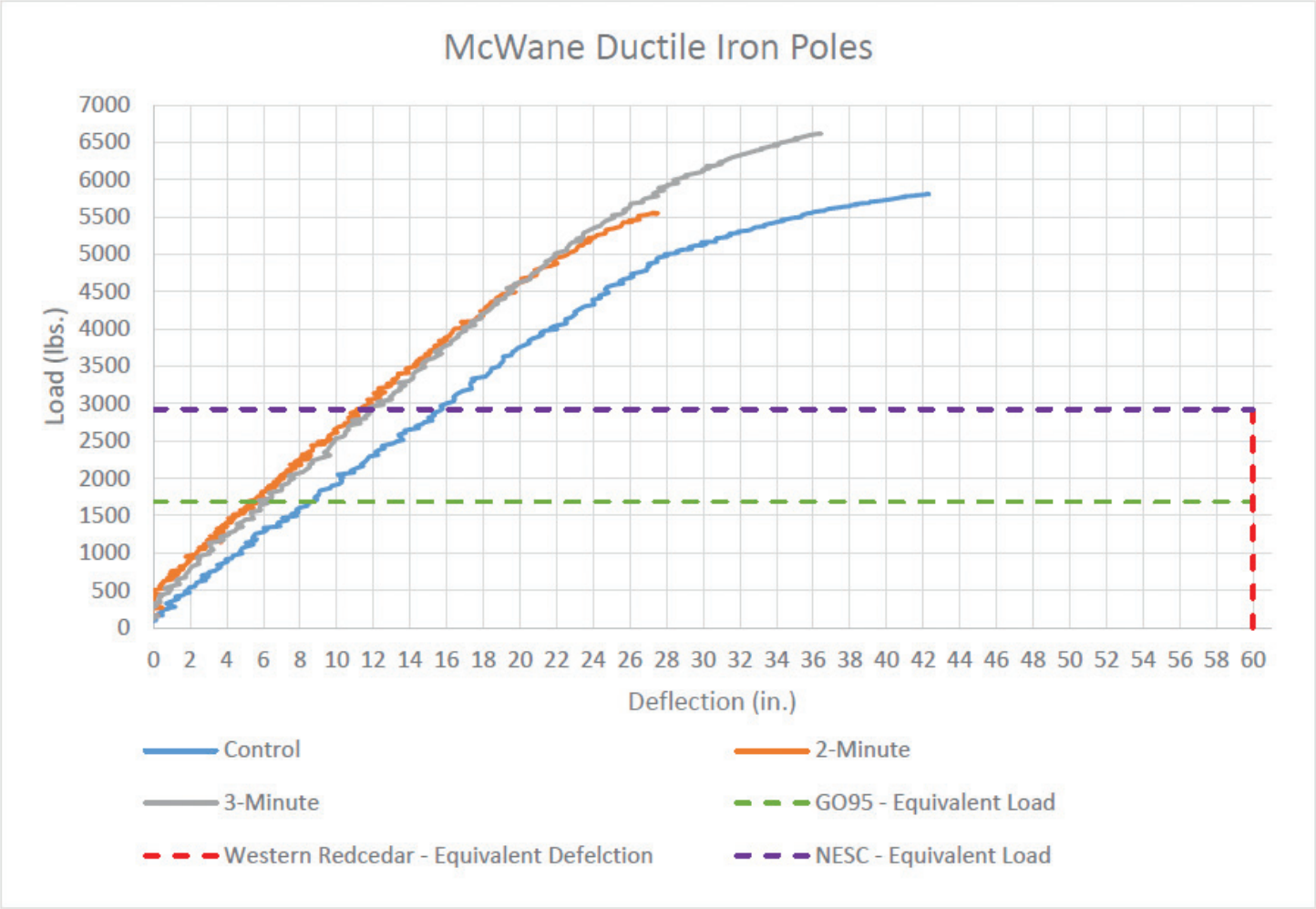
EDM International, Inc. conducted tests on behalf of Pacific Gas & Electric (PG&E) to evaluate the fire resilience and strength of ductile iron utility poles. In this two-phase test, the poles were first subject to two and three minute periods of high-intensity fire exposure under a tension load. The flame test temperature goal was in the range of 1,472 to 2,100 degrees Fahrenheit.

Tested poles were weighed and labeled and were then set 7.5 feet into the ground. A 75-foot long tension cable was connected 2 feet below the top of each pole in order to apply the tension load during the fire exposure.

The fire exposure systems consisted of metal shrouds used to provide high heat to each pole using propane gas burners. To simulate the bending moment that the pole would see in use, a tension load of 1,325 pounds was applied with a wench cable prior to burning, resulting in a horizontal load of 1,125 pounds and a vertical load of 700 pounds.

Phase two of this study was a full-scale bend test of the burned poles that determine what impact, if any, the fire may have created on the pole during the heating and cooling periods.

The load test was developed based on ASTM D 1036, Standard Test Methods of Static Tests of Wood Poles A steel frame was used to fix the base of the pole while a wench and cable applied a tension load two feet from the tip of the pole. The poles were loaded until catastrophic failure.



RESULTS

Results from the burn segment of the test indicated ductile iron poles showed no signs of damage and fully supported the tension load throughout the burn period.

Results from the full-scale bending test showed the ductile iron poles were able to sustain a 6,500-pound load before shearing after burn, which is greater than twice the NESC requirement of 2,950 pounds.

SUMMARY OF CONCLUSIONS

This two-phase test concluded that not only were ductile iron utility poles undamaged after a burn test, but the burned poles were then able to sustain well above-average load tests. This indicates that ductile iron poles would be able to withstand the heat and maintain structural integrity during a wildfire.

03

CERAMIC EPOXY EMBED COATING BURN TEST

SUMMARY OF TEST METHOD

Many types of poles, including ductile iron, use a coating at the base of the pole as an additional barrier against corrosion and wear. Many times, the embedment coating is extended several feet above the ground level. Induron Protective Coatings conducted a fire test of the ceramic epoxy (Permasafe) coating used on ductile iron poles.

A flame test was performed on Permasafe Pole coating to gauge resistance to heat and direct flame, using a torch to apply heat at various temperatures and burn lengths.

RESULTS

After a two-minute flame application with temperatures in excess of 2,000 degrees F, the coating charred and turned to ash, but there was no flame or burning once the torch was removed.

SUMMARY OF CONCLUSIONS

The cured films of Permasafe Pole Coating on ductile iron poles did not support self-sustaining combustion at any time during testing with various burn durations and temperatures.

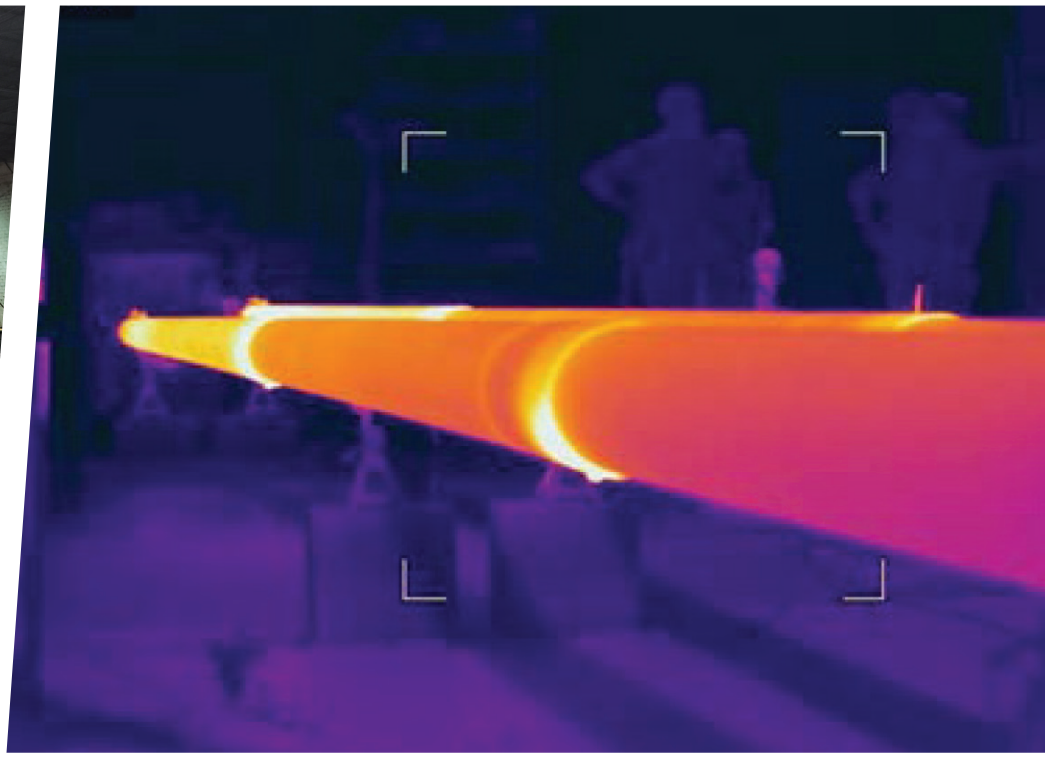
OVERALL CONCLUSION

The growing wildfire risk in many areas of the U.S. is forcing utilities and other companies to develop solutions that decrease use of flammable materials. Wood-alternative products are being considered and, in some cases, mandated by law. Ductile iron utility poles provide a non-wood solution to utilities who need to replace existing distribution and transmission pole lines or expand service.

The evidence provided by three independent tests on ductile iron poles concluded the following:

- Ductile iron utility poles proved to be fire-proof*, heat resistant and able to sustain loads well beyond the requirement before failure, even after being subject to excessive heat over a sustained amount of time.
- In areas with an increased risk of wildfires, ductile iron utility poles would withstand extreme and prolonged fire/heat applications and heavy loading and emerge undamaged and completely intact.
- Ductile iron poles should be considered by utility companies with distribution and transmission lines in wildfire risk areas - for replacement or expansion.

*As demonstrated by the Western Center Fire Center Test and EDM Full-Scale Burn and Bend Test.



[1]https://oehha.ca.gov/epic/impacts-biological-systems/wildfires

[2]https://oehha.ca.gov/epic/impacts-biological-systems/wildfires)

[3]https://www.cpuc.ca.gov/gos/GO95/go_95_rule_61_3.html

[4]https://www.cnn.com/2019/10/29/us/wildfires-california-by-the-numbers-wxc-trnd/index.html