WFCi Western Fire Center, Inc.
2204 Parrott Way | Kelso, Washington 98626
Telephone: (360) 423-1400 | Fax: (360) 423-5003 | Toll Free: 1-877-423-1401

Testing of Polymer Concrete Composite Power Poles in Accordance with the ENA Pole Fire Test Method

Weathered in Accordance with

ASTM D2898-08, Method A, Augmented with UV

Covered Product:
CMT Eco-Titan Polymer Concrete Pole

Report # 10007

WFCi Project# 10007

Rendered to:

Dulhunty Poles Pty Ltd,
Moolap, Victoria, Australia

and

CMT Worldwide, LLC
Marietta, GA

TESTING COMPLETED: MAY 11, 2010

REPORT REISSUED: JUNE 9, 2010

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INTRODUCTION

This report documents the successful testing of a polymer concrete pole specimen in accordance with the *ENA Pole Fire Test Method* for CMT Worldwide, LLC by Western Fire Center, Inc. (WFCi). WFCi performed replicate tests on pole test specimens after exposure for 12 weeks to the accelerated weathering conditions of ASTM D2898, Method A, augmented with UV exposure (in accordance with the ENA test requirements).

ENA pole fire test method

The ENA pole fire test method is described in detail in the report entitled "**Assessing the ability of a large-scale fire test to predict the performance of wood poles exposed to severe bushfires and the ability of fire retardant treatments to reduce loss of wood poles exposed to severe bushfires" (Gardner and White, Forest & Wood Products Australia, Project No. PNA014-0708, April 2009).** The test procedure was developed as a method for assessing the performance of poles subjected to severe bushfire (typically termed 'wildland fire' in North America) attack where exposure to high heat fluxes and flame contact from the fire front and adjacent burning vegetation are likely.

The method is summarized as follows:

- Specimens shall be of typical pole diameter and a minimum length of 2 m.
- All specimens shall be subjected to the ASTM D2898 accelerated weathering regime with UV exposure.
- Specimens are exposed to 60 kW/m^2 heat flux for ten minutes.
- A 40 kW output ring burner is ignited at five minutes into the ENA pole fire test and maintained for five minutes.
- Maximum surface temperature of specimens is monitored by scanning them with an infra red camera following the fire test exposure and up to a maximum of four hours after the ENA pole fire test start.
- Specimens are exposed to a 2 m/s wind within five minutes following the ENA pole fire test exposure. The 2 m/s wind exposure is maintained until four hours after the ENA pole fire test start, unless the test is terminated within that time.
- Ignitions on the specimen above the level of the top of the radiant panel shall be extinguished during the 2 m/s wind exposure.
- Unless the test has been terminated by four hours after the test start, specimens will be retained in the laboratory and examined 24 hours after the test start.
- The test shall be terminated when:
  a) There is no evidence of combustion and the maximum surface temperature is less than 200 ^{o}C, or
  b) The specimen is so severely damaged it is considered likely to collapse, or
  c) Twenty four hours after the test start, whichever occurs first.
- Specimens shall be inspected after test termination and rated for performance. Specimens shall be rated:
  a) Excellent, if damage is limited to surface charring of less than 5 mm depth for hardwoods and 10 mm for softwoods.
  b) Fair, if damage exceeds the criteria for excellent, but the damage is considered to be insufficient to cause structural failure if it were present in a pole in service.

c) Poor – if the specimen is severely damaged and the damage is considered to be sufficient to cause structural failure if it were present in a pole in service.

A minimum of two and a maximum of three specimens shall be tested. Duplicate results shall be required for a test outcome.

SAMPLE DESCRIPTION

Four (4) concrete test pole sections were received from the client at the WFCi laboratory on February 10, 2010. The test items were described in information provided by the client as "Eco-Titan Polymer Concrete Poles", consisting of reinforced high performance lightweight concrete shaft with alkali-resistant roving, manufactured by CMT Worldwide, LLC. The 7 ft. long hollow poles ranged in weight from 111 to 116 lbs, with nominal outside diameter ranging from 7 to 10 inches and a nominal wall thickness of 5/8".

Figure 1. Pole specimens prior to weathering

METHODS

ACCELERATED WEATHERING

The specimens were subjected to the twelve weeks accelerated weathering regime of ASTM D2898-08 *Standard practice for accelerated weathering of fire retardant treated wood for fire testing. Method A.* Method A was modified to permit ultraviolet (UV) exposure during the drying cycle. The specimens were exposed to a total of 12 weeks of accelerated weathering conditions. Each of the 12 weeks consists of 4 days of rain exposure and 3 days of heating/UV exposure. During the 4-day rain exposure, the total water usage is 1711 ± 41 L/m^2. During the 3-day heating/UV cycle of each week, the accelerated weathering room temperature was maintained at 60°C and the UV lamps are adjusted to provide a specimen irradiance of approximately 5 W/m^2. All specimens were reconditioned during an additional drying regime at 60^{o}C to a moisture content of approximately 4% before fire testing.

FIRE TEST

The fire test method is based on a modified version of the ASTM E1623 *Standard test method for determination of fire and thermal parameters of materials products, and systems using an Intermediate Scale Calorimeter (ICAL)* shown below in Figure 2. The main modification consisted of using a bracket to hold the pole specimen instead of the 1m^2 sample holder on a load cell as shown and the inclusion of a ring burner at the base of the pole specimen that is ignited at 5 minutes into the test.

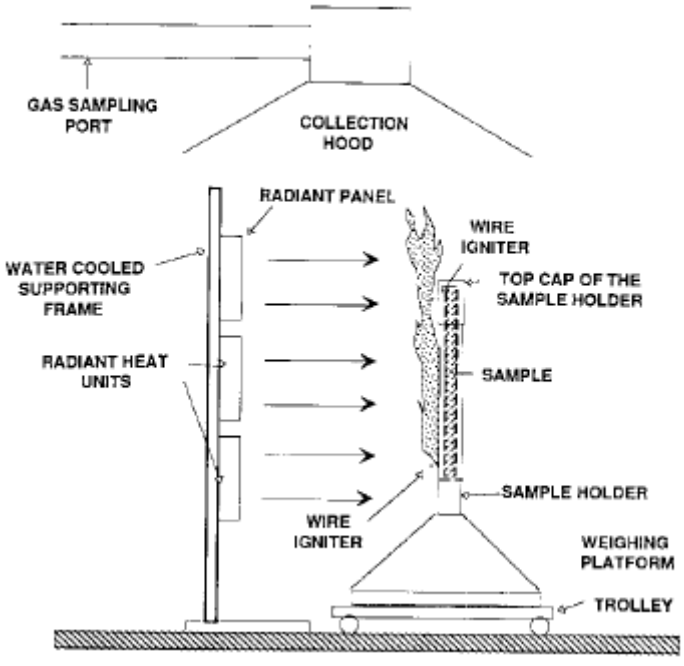


Figure 2. Illustration of ASTM E1623 test apparatus

The fire exposure system is comprised of a 1500x1500 mm radiant panel and the gas-fired ring burner. The ring burner is located around the pole specimen level with the lower edge of the radiant panel. The radiant panel is calibrated for the irradiation of the test specimens at a heat flux of 60 kW/m^2. Prior to the test, a pole specimen is moved to the predetermined distance from the radiant panel where the heat flux value had been established.

The pole specimens are exposed to the fixed 60 kW/m^2 heat flux for ten minutes and flame contact from a ring burner for the second five minutes of the test. The ring burner output is 40 kW. After the ten minute fire exposure, the test sample is relocated for post-fire exposure observations and temperature measurements. and to

The test equipment is shown in Figure 3 with a wood pole specimen during a representative test.

Figure 3. Wood pole specimen six minutes after ENA pole fire test start

Following the ten minute fire test exposure the pole specimens are relocated from the test stand and exposed to a 2 m/s (5 mph) wind. During this time the maximum surface temperature of the specimens is measured by scanning with a Flir ThermaCAM EX 320 infrared camera, which can measure up to 1200°C with an accuracy of ± 2°C. The maximum surface temperature is monitored until four hours after the test start or until it is less than 200^{o}C, whichever occurs first. The test is terminated in less than four hours if the maximum surface temperature recorded was less than 200^{o}C.

If there was evidence of continuing combustion – temperatures above 200^{o}C and/or visible smoke or glowing or flaming combustion, the specimens are retained overnight and inspected the next day, 24 hours after the test start.

At the end of the test period, the specimens are examined for damage due to the fire test exposure.

RESULTS

Three test pole sections (pole sample nos. 1, 2 and 3) were subjected to the 12-week accelerated weathering exposure, which was initiated on February 11, 2010 and concluded on May 6, 2010. Pole sample no. 4 was not weathered. The final heat cycle (without UV) was extended until 24 hours prior to testing in order to assure a low moisture content sample condition; the moisture content of a representative pole sample was determined by the oven dry method to be less than 4% at the time of the test. Prior to weathering, the weights of Pole Samples 1 and 3 were 110.8 lbs and 116.4 lbs, respectively. After weathering, the respective weights were 107.2 and 112.6 lbs, representing a decrease of 3.4% in each case. The appearance of the weathered specimens was comparable to the unweathered pole sample which had been set aside at the onset of the program. The samples were held at ambient laboratory conditions of 60-65°F and 40-50% relative humidity during the period extending from time of removal from the weathering chamber until time of testing.

The ENA fire testing was commenced and completed on May 11, 2010. Observations from the individual tests are presented in the following. The ambient laboratory conditions were 65°F/58%RH. Photographs from a representative test are provided in Appendix A.

Test Observations

Test #1 (Pole Sample No.3)

Time	Observation
0:00:00	Initiate 60kW/m2 exposure
0:00:30	Audible reports (‘popping’ noises)
0:00:50	Surface delamination and cracks forming on surface of pole facing radiant panel
0:01:10	Audible reports, light smoke from sample surface, discoloration
0:05:00	Ring burner ignited
0:07:00	Some audible reports, sample has not ignited
0:10:00	No change; test terminated, sample relocated to wind/post-exposure area

Post-Exposure Observations: Upon relocation of the test pole to the post exposure examination area and prior to the 5 mph wind exposure, the maximum surface temperature was determined to be 186°C. The surface temperature diminished to 48°C after 35 minutes. The wind exposure was terminated at 70 minutes, with the surface temperature between 20-30°C. No signs of combustion were noted upon termination of the fire exposure. The exposed surface of the test pole section exhibited surface cracking and delamination of the top 2-3 layers of the pole surface. Surface disruption extended no further than approximately the first 3-4mm of the specimen thickness.

Post-exposure photographs:

Test #2 (Pole Sample No. 1)

Time	Observation
0:00:00	Initiate 60kW/m2 exposure
0:00:50	Audible reports ('popping' noises), surface delamination and cracks forming on surface of pole facing radiant panel
0:02:00	Surface discoloring, light smoke
0:04:00	Light smoke, discoloration
0:05:00	Ring burner ignited
0:07:00	Some audible reports, sample has not ignited
0:10:00	No change; test terminated, sample relocated to wind/post-exposure area

Post-Exposure Observations: Upon relocation of the test pole and prior to the 5 mph wind exposure, the maximum surface temperature was determined to be 130°C. The surface temperature diminished to 42°C after 38 minutes, whereupon the wind exposure was terminated. No signs of combustion were noted on the pole sample after termination of the fire test. The exposed surface of the test pole section exhibited surface cracking and delamination of top 2-3 layers of the pole surface. Surface disruption extended no further than approximately the first 3-4 mm of the specimen thickness.

Post-exposure photographs:

CONCLUSIONS

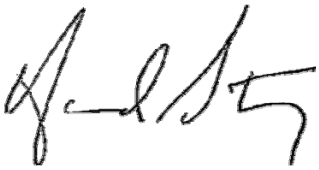
Upon inspection after termination of the replicate ENA pole fire tests, the Eco-Titan polymer concrete pole sections as identified in this report demonstrated fire test performance which can be deemed 'Excellent' in terms of the ENA rating system described in the referenced test method. The ENA pole fire test criteria ('excellent', 'fair', 'poor') were originally established on the basis of char depth (surface disruption) and the overall structural damage and effect on serviceability of the fire exposure conditions on wood poles. In this test program wherein a concrete composite pole construction was evaluated, the post test observation of the pole surface showed the minimal disruption of only the first 2-3 layers of the composite surface to a depth of less than 5 mm. This minimal degree of surface damage together with the apparent structural soundness of the test pole sections support the 'Excellent' rating. It should be noted that the laboratory determination of structural soundness is subjective, and is not based on physical mechanical properties testing.

SIGNATURES

Testing Performed by,

Mike White
Laboratory Director

Report Prepared and Approved by,



Howard Stacy

Director, Testing Services

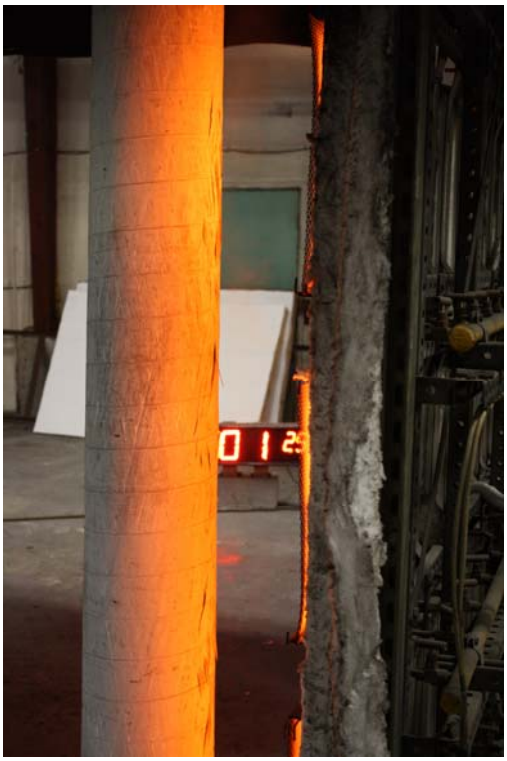
The test specimen identification is as provided by the client and WFCi accepts no responsibilities for any inaccuracies therein. WFCi did not select the specimen from inventory, and has not verified the composition, manufacturing techniques or quality assurance procedures.

REVISION SUMMARY

DATE	PAGE(S)	SUMMARY
June 8, 2010	None	Original issue
June 9, 2010	Cover	Add additional client name – Dulhunty Pole Ltd

Appendix A- Photographs from a representative test

Prior to test



Test time = 01:25

Ring burner ignited

T = 7 min

Immediately post-test