



| MECHANICAL PROPERTIES | | |
|--|---|---|
| Test / Standard | Property | Value |
| Specific Gravity ASTM D6111 | Specific Gravity | 0.85 – 0.90 |
| | Density | 53 – 56 lb/ft ³ (849-897 kg/m ³) |
| Compression AREMA Chapter 30 ASTM D6108 | Compressive Strength (parallel to grain) | 3,000 psi (20.6 MPa) average |
| | Compressive Strength (perpendicular to grain) | 1,200 psi (8.3 MPa) average |
| | Permanent Deformation Under Load (30,000 lb. / 13,608 kg) | 0.013 in (0.33cm) |
| Flexural AREMA Chapter 30 ASTM D6109 | Ultimate Load | 19,164 lbs (857 kN) |
| | Modulus of Elasticity (flexure) | 250,000 psi (1,724 MPa) average |
| | Modulus of Rupture (bending) | 3,000 psi (20.6 MPa) average |

| Thermal Expansion ASTM D696 | Average | Increase Length from 78° F – 160° F (25.6° C – 71.1° C) | Decrease Length from 160° F – 0° F (71.1° C – -17.8° C) | Increase Length from 0° F – 78° F (-17.8° C – 25.6° C) | Coefficient of Thermal Expansion |
|--------------------------------|---------|---|---|--|---|
| | | 0.2019 in (0.5128 cm) | -0.3503 in (-0.8897 cm) | 0.1661 in (0.4219 cm) | 0.000041 in/in/°F (0.000074cm/cm/°C) |

| Slip Resistance ASTM F609 | Average Coefficient of Friction (Dry Condition) | Average Coefficient of Friction (Wet Condition) |
|------------------------------|--|--|
| | 0.60 | 0.62 |

| ELECTRICAL PROPERTIES | | | |
|--------------------------------|----------------|--------------|---------------------------------|
| ARC Resistance ASTM D495-99 | Time (seconds) | Current (mA) | ARC Resistance (seconds) |
| | 0-240 | 10 | 124.6 (average of five samples) |

| Electrical Impedance Test AREMA Chapter 30 – TTCI | Ten volts AC 60 hertz applied between two running rails for 15 minutes before and after 6-hour soak in water | BEFORE | current | 0.002 milliampere (mA) |
|--|--|-------------|-----------|------------------------|
| | | 6-hour soak | impedance | 5 megohms |
| | | AFTER | current | 0.004 milliampere (mA) |
| | | 6-hour soak | impedance | 2.38 megohms |

| FLAMMABILITY AND COMBUSTION PROPERTIES | | | | | | |
|--|----------|-------------------------------|---|--|--------------------------------|----------------------------------|
| Flame Resistance UL 94HB | Specimen | Flame front to 25 mm mark? | Burn time after 25 mm mark (sec.) | Damaged length between 25 and 100 mm | Flame front to 100 mm mark? | Linear Burning Rate (mm/min.) |
| | Average | Yes | 246.0 | 75.0 | Yes | 20.4 |

NOTE: ECOTRAX® met the passing criterial for UL HB classification.

| Toxic Gas Generation BSS 7239 | Weight (g) | Specimen 1 | Specimen 2 | | |
|-------------------------------------|-------------------------------------|---------------|---------------|-------------|-----------------------|
| | Gas | Corrected PPM | Corrected PPM | Average PPM | Std. Deviation PPM |
| | Carbon Monoxide (CO) | 150 | 100 | 125.0 | 35.355 |
| | Hydrogen Cyanide (HCN) | 1 | 1 | 1.0 | 0.000 |
| | Sulfur Dioxide (SO ₂) | 5 | 5 | 5.0 | 0.000 |
| | Hydrogen Chloride (HCL) | 0.5 | 0.5 | 0.5 | 0.000 |
| | Hydrogen Fluoride (HF) | 0 | 0 | 0.0 | 0.000 |
| | Nitric Oxide (NO) | 60 | 60 | 60.0 | 0.000 |
| | Nitrogen Dioxide (NO ₂) | 1 | 1 | 1.0 | 0.000 |

| Specific Optical Density of Smoke ANSI/ASTM E662 | Optical Density Test Result Summary | | |
|--|-------------------------------------|-------------|---------|
| | | Non-Flaming | Flaming |
| | Ds @ 1.5 Min. (average) | 0.4 | 2.7 |
| | Ds @ 4 Min. (average) | 2.8 | 33.6 |
| Dm (corr.) (average) | 16.9 | 266.3 | |

| Surface Flammability ASTM E162 | Average Flamespread Factor (Fs) = 6.34 | Average Flamespread Index (Is) = 147.43 |
|--------------------------------------|--|---|
| | Average Heat of Evolution (Q) = 23.61 | Flamespread Index Range (Is) = 129.78 to 175.92 |



MECHANICAL PROPERTIES

| Cyclic Load Test (TTCI) 21,000 lb (9,525 kg) load rotated between gage side and field side | Lateral Railhead Displacement | | | |
|--|---|----------------------------|-----------------------|-----------------------------------|
| | | Railhead Displacement (in) | Tie Displacement (in) | Total Railhead Displacement* (in) |
| | Cycles | Static Gage Load | Static Gage Load | Static Gage Load |
| | 500,000 | 0.2 in (5.08 mm) | 0.158 in (4.01 mm) | 0.042 in (1.07 mm) |
| | 1,000,000 | 0.176 in (4.47 mm) | 0.101 in (2.57 mm) | 0.075 in (1.91 mm) |
| | 1,500,000 | 0.136 in (3.45 mm) | 0.102 in (2.59 mm) | 0.034 in (0.86 mm) |
| | 2,000,000 | 0.139 in (3.53 mm) | 0.096 in (2.44 mm) | 0.043 in (1.09 mm) |
| | 2,500,000 | 0.179 in (4.55 mm) | 0.086 in (2.18 mm) | 0.093 in (2.36 mm) |
| | 3,000,000 | 0.18 in (4.57 mm) | 0.085 in (2.16 mm) | 0.095 in (2.41 mm) |
| | NOTES: There was no abnormal workout of the cut spikes. *Total Railhead Displacement = Railhead Displacement - Tie Displacement | | | |
| Tie Plate Cutting | | | | |
| | Field | Center | Gage | |
| Top | 0.022 in (0.56 mm) | 0.021 in (0.53 mm) | 0.025 in (0.64 mm) | |
| Center | 0.014 in (0.35 mm) | 0.018 in (0.46 mm) | 0.042 in (1.07 mm) | |
| Bottom | 0.025 in (0.64 mm) | 0.027 in (0.69 mm) | 0.023 in (0.58 mm) | |
| NOTE: No cracking developed in the rail-seat area. | | | | |

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| Rail/Plate Area Compression Test AREMA Chapter 30 – TTCI | Railhead loaded to 100,000 lbs. (45,359 kg) in 20,000 lb. (9,072 kg) increments. 30-60 seconds between increments | Elastic deformation at 100,000 lbs. (45,359 kg) | 0.153 in (3.89 mm) |
| | | Permanent deformation at recovery after release of 100,000 lb. (45,359 kg) load within 1 minute | 0.043 in (1.09 mm) |

| | | | |
|--|---|--|----------------------|
| Spike Pullout and Spike Lateral Restraint Tests AREMA Chapter 30 – TTCI | Cut Spike Insertion and Extraction | Insertion Force *4.5 inches (11.4 cm) depth (average of 8 spikes) | 5,906 lbs. (26.3 kN) |
| | inserted/extracted at 2 inches/minute (51 mm/min) | Extraction Force *4.5 inches (11.4 cm) depth (average of 8 spikes) | 2,541 lbs. (11.3 kN) |
| | Lateral Restraint | Force to deflect spike 0.2 in (5 mm) laterally *cut spike inserted to depth of 4.5 in (11.4 cm) | 1,849 lbs. (8.2 kN) |

| | | |
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| Screw Spike Pullout ASTM D6117 | Mechanical Fastener Screw Spike Pullout 11/16" (17.5 mm) screw, 14 mm nominal diameter hole, 97 mm clip | 7,103 lbs. (31.6 kN) |
| Single Tie Lateral Push Test AREMA Chapter 30 – TTCI | Single Tie Lateral Push (newly installed) | 2,750 lbs. (12.2 kN) |

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|---|---|---|
| All testing was conducted at third-party test facilities: | | |
| <ul style="list-style-type: none"> • Chicago Transit Authority (CTA) • Construction Technology Laboratories, Inc. (CTL Group) • NGC Testing Services • Rutgers University | <ul style="list-style-type: none"> • Société Nationale des Chemins de fer Français (SNCF) • STARK Pty, Ltd. • Transportation Technology Center Inc. (TTCI) • TRACE Laboratories, Inc. | <ul style="list-style-type: none"> • U.S. Army Corps of Engineers (USACE) • Villanova University • VTEC Laboratories, Inc. |

NOTE: The information provided herein contains typical or average values intended for reference and comparison purposes only. They should NOT be used as a basis for part design and are not intended for use in establishing maximum, minimum, or ranges of values for specification purposes.

