About Tokyo Rope

Tokyo Rope was established in 1887 and has been the leader in Japan’s wire rope industry. Our global operations are expanding. Our main products are Steel Wire Rope, Fiber Rope, Steel Cord for tire, and CFCC.

Innovative HTLS Transmission Conductor With CFCC Core

ALUMINUM CONDUCTOR FIBER REINFORCED

Low Loss
High Capacity
Low Sag

Click here

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Today's Overhead Conductor's market

Current Status
ACSR is a conventional type of conductor which has three drawbacks as follows:
- Heavy steel core
- Large Thermal Expansion
- Corrosion

Challenge
Transmission Owners are facing the following requirements:
- Huge Electric Demand
- Environmental Concern (CO2)
- Sag Violations
- Right of Way Issue
- Construction Cost & Period
- Lower Life Cycle Cost

Solution
Next generation conductor cable ACFR
- Low Transmission Loss
- High Transmission Capacity
- Low Sag
- Longevity
- Easy Handling

ACFR Structure
ACFR stands for Aluminum Conductor Fiber Reinforced
- Core: Light Weight and Small Thermal Expansion
- Trapezoidal Aluminum Wire: Large Cross Sectional Area
- Annealed Aluminum Wire (or TAL / Hard Drawn Wire)
**Case Study**

*Performance Example compared to ACSR*

<table>
<thead>
<tr>
<th>Design Concept</th>
<th>Transmission Loss</th>
<th>Transmission Capacity</th>
<th>Sag</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Loss</td>
<td>27% Less</td>
<td>Same</td>
<td>Same</td>
</tr>
<tr>
<td>High Capacity</td>
<td>More</td>
<td>Same</td>
<td>Same</td>
</tr>
<tr>
<td>Low Sag-Low Loss</td>
<td>9% Less</td>
<td>Same</td>
<td>12% Less</td>
</tr>
<tr>
<td>Low Sag-High Capacity</td>
<td>More</td>
<td>Same</td>
<td>10% More</td>
</tr>
</tbody>
</table>

*This figure depends on design and operating conditions.*

**Standard ACFR Design Example**

The following is standard ACFR Design Example. Final design should be agreed with the conductor’s manufacturer.

**Supply Scheme**

Tokyo Rope provides CFCC to local conductor producer which will make ACFR.

**Reference**
CFCC core’s development was started in the 1980s. Initially, CFCC was used for civil engineering applications. In 2002, Tokyo Rope supplied CFCC core to conductor partners which produce ACFR, and since then, more than 10 years have passed with satisfactory operations.

### CFCC Development History

- **1980s**
  - Started development of CFCC

- **1986**
  - Supplied for PC Bridge project in Japan

- **2001**
  - Supplied for PC Bridge project in Michigan/USA.

- **2002**
  - ACFR presentation in CIGRE session 2002

- **2007**
  - Supplied for ACFR project in Korea

- **2011**
  - Established Gamagori CFCC Plant in Japan

- **2012**
  - Established Gamagori CFCC Plant in USA

- **2015**
  - Supplied for ACFR project in China

- **2016**
  - Supplied for ACFR project in Indonesia

### CFCC Advantage

- **Non-magnetic**: No Iron Loss
- **Lightweight**: 1/5 of Steel
- **High Flexibility**: Can be wound to the small Drum
- **High Corrosion resistance**: Against acid, alkali, water and UV
- **High Tensile Fatigue**: Able to withstand wind vibration
- **Small Thermal Expansion**: 1/10 of Steel (CFCC: 1.0×10⁻⁶; Steel: 11.5×10⁻⁶)
- **High Modulus**: Superior to other FRP
- **Low Creep**: Similar to Steel

### Standard Characteristics

<table>
<thead>
<tr>
<th>Properties</th>
<th>Item</th>
<th>1×7 7.8φ HT Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>General mechanical properties</td>
<td>Tensile strength</td>
<td>2.14 (kN/mm²)</td>
</tr>
<tr>
<td></td>
<td>Tensile modulus</td>
<td>130 (kN/mm²)</td>
</tr>
<tr>
<td></td>
<td>Elongation at break</td>
<td>1.70 (%)</td>
</tr>
<tr>
<td></td>
<td>Specific gravity</td>
<td>1.60</td>
</tr>
<tr>
<td>Static properties</td>
<td>Relaxation</td>
<td>1.3</td>
</tr>
<tr>
<td></td>
<td>Creep strain (500°C)</td>
<td>0.07×10⁻⁶/°C</td>
</tr>
<tr>
<td></td>
<td>Coefficient of linear expansion (30°C~200°C)</td>
<td>3.9×10⁻⁶/°C</td>
</tr>
<tr>
<td></td>
<td>Specific resistance (ø0.6mm)</td>
<td>60.3 (µΩcm)</td>
</tr>
<tr>
<td></td>
<td>Creep failure load ratio</td>
<td>0.80</td>
</tr>
<tr>
<td>Others</td>
<td>Fatigue capacity (Stress range)</td>
<td>780 (N/mm²)</td>
</tr>
<tr>
<td></td>
<td>Bending stiffness</td>
<td>56.5 (N/m·mm³)</td>
</tr>
<tr>
<td></td>
<td>Heat resistance</td>
<td>170°C (Operating)</td>
</tr>
<tr>
<td></td>
<td>Acid resistance</td>
<td>200°C (Emergency)</td>
</tr>
<tr>
<td></td>
<td>Alkaline resistance</td>
<td>Almost the same as steel</td>
</tr>
</tbody>
</table>

*1: Calculated by nominal cross sectional area

*2: 0.7pu, 1000hrs(20±2°C), according to JSCE-E534.

*3: 0.6pu, 1000hrs(20±2°C)

*4: 20°C~200°C, according to JSCE-8536.

*5: Tests of CFCC 1×12.5φ according to JSCE-E533 "Test Method for Creep Failure of Continuous Fiber Reinforcing Materials" gave a load ratio of 0.85 at 1 million hours.

*6: Average load is 75% of breaking load. The number of cycles is 2×10⁶, according to JSCE-E535.

### Standard Specification of CFCC

<table>
<thead>
<tr>
<th>Designation (Configuration diameter)</th>
<th>Diameter</th>
<th>Nominal cross sectional area</th>
<th>Breaking load (kN)</th>
<th>Nominal mass density* (g/m)</th>
<th>Tensile elastic modulus* (kN/mm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>U 5.0φ</td>
<td>5.0</td>
<td>19.6</td>
<td>41.9</td>
<td>30</td>
<td>135</td>
</tr>
<tr>
<td>1×7 6.8φ</td>
<td>6.8</td>
<td>28.2</td>
<td>60.3</td>
<td>45</td>
<td>122</td>
</tr>
<tr>
<td>1×7 7.8φ</td>
<td>7.8</td>
<td>37.2</td>
<td>79.5</td>
<td>61</td>
<td>130</td>
</tr>
<tr>
<td>1×7 8.3φ</td>
<td>8.3</td>
<td>42.1</td>
<td>90.0</td>
<td>69</td>
<td>131</td>
</tr>
<tr>
<td>1×7 9.6φ</td>
<td>9.6</td>
<td>56.3</td>
<td>121</td>
<td>93</td>
<td>135</td>
</tr>
<tr>
<td>1×7 10.8φ</td>
<td>10.8</td>
<td>71.3</td>
<td>153</td>
<td>111</td>
<td>126</td>
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<tr>
<td>1×7 12.5φ</td>
<td>12.5</td>
<td>99.4</td>
<td>204</td>
<td>146</td>
<td>123</td>
</tr>
<tr>
<td>1×7 15.2φ</td>
<td>15.2</td>
<td>141</td>
<td>152</td>
<td>146</td>
<td>127</td>
</tr>
<tr>
<td>1×7 20.9φ</td>
<td>20.9</td>
<td>267</td>
<td>571</td>
<td>412</td>
<td>129</td>
</tr>
</tbody>
</table>

*Reference value