Electrical Performance of Fiberglass Crossarm in Distribution and Transmission Lines

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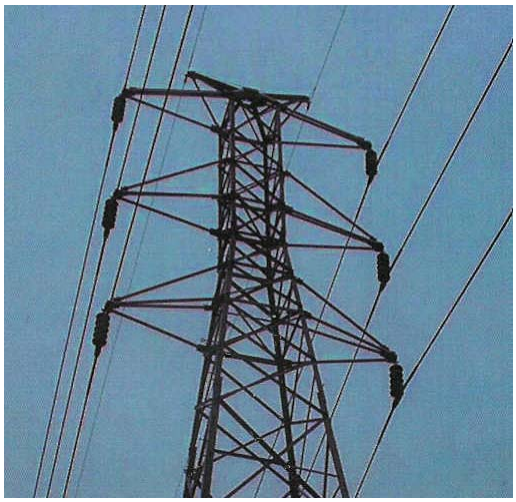
Introduction

- The materials used for crossarms in distribution and transmission lines are steel, wood, and fiberglass.
- Steel is always a conductor in any condition, so it does not have an insulation resistance.
- Wood has low electrical strength at AC especially under wet condition, and also low mechanical strength per unit weight.
- Fiberglass has superior properties under dry condition compared to other materials.
- Its properties in non-conductivity and high mechanical strength-to-weight ratio make fiberglass crossarm supersede steel crossarm and wood crossarm.

Fiberglass Crossarms Installed on the Transmission Steel Tower



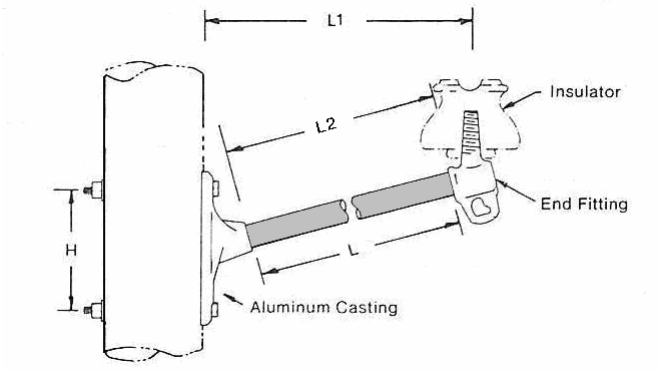
Electrical Strength of Three Different Types of Crossarms

Crossarm	Electrical Strength			
	AC Voltage		CFO Voltage	
	Dry	Wet	Dry	Wet
Steel	Conduction	Conduction	Conduction	Conduction
Wood	Insulation	Conduction	Insulation	Insulation
Fiberglass	Insulation	Conduction	Insulation	Insulation

Design of Fiberglass Crossarm

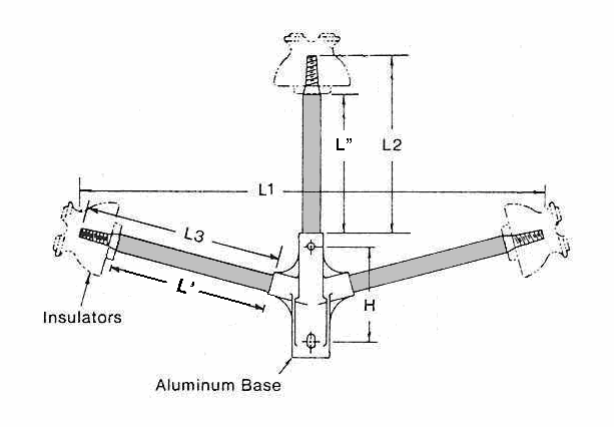
- Fiberglass crossarms are manufactured from Fiberglass Reinforced Plastics with ductile iron galvanized fittings.
- The plastic material is composed of a polyester, epoxy, or cycloaliphatic. The choice of these materials has effects in mechanical and electrical properties as well as costs.
- The ultraviolet protective inhibitors are mixed in the plastic resin to prevent ultraviolet deterioration from sunlight. The fiberglass crossarm is also coated with polyurethane on the outer surface.
- All bonded joints are sealed to prevent moisture penetration. The end fittings are either aluminum alloy or iron hot dip galvanized and are free of burrs and sharp edges.

Distribution Fiberglass Crossarm System



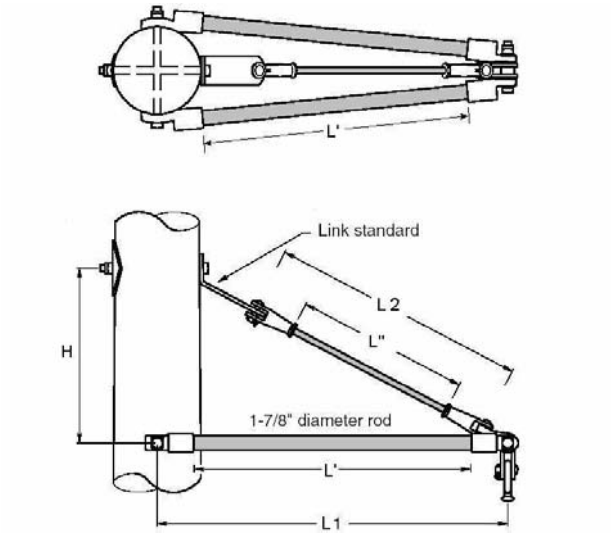
Vertical single standoff bracket

Distribution Fiberglass Crossarm System

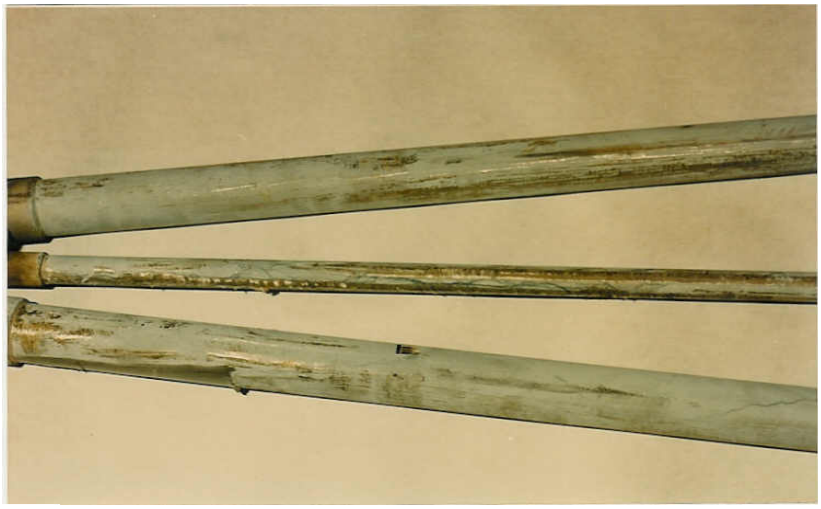


Horizontal three phase pin bracket

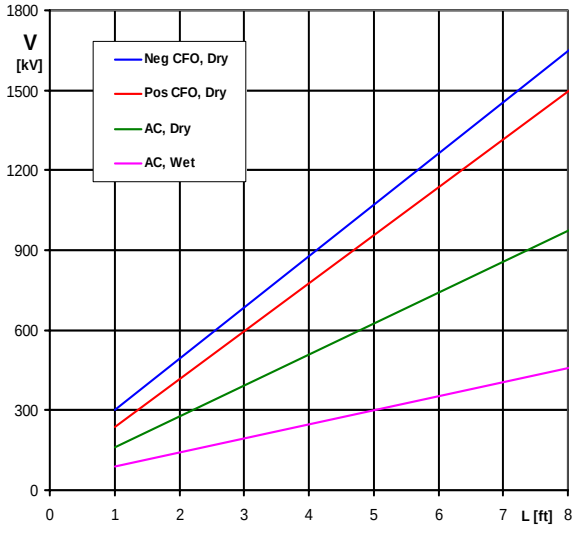
Transmission Fiberglass Crossarm System



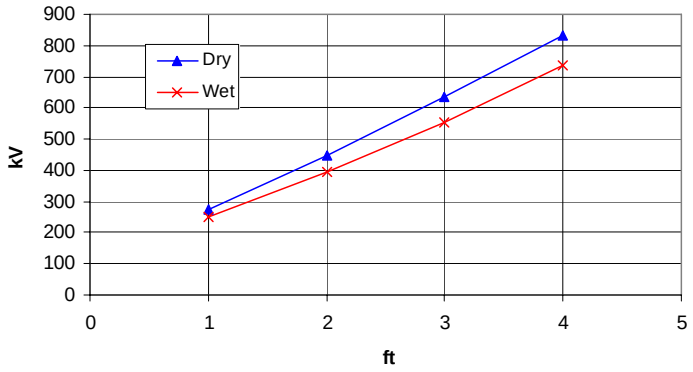
Damaged Surface of Fiberglass Crossarm after 20 Years in Service



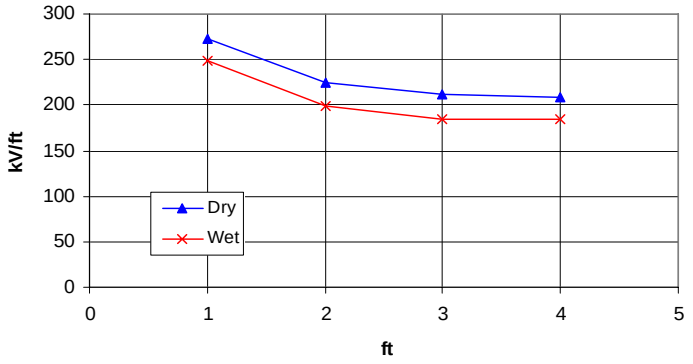
Expected Lightning Impulse CFO and AC Flashover Voltages versus Lengths for Fiberglass Crossarm



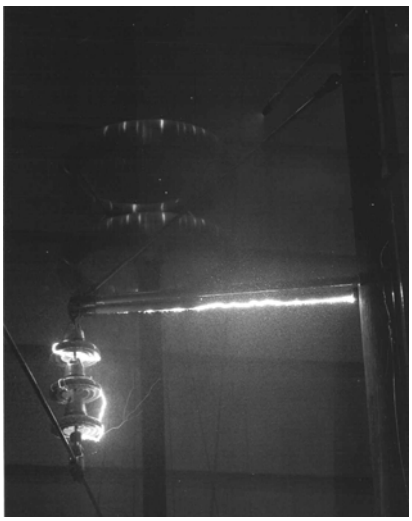
The CFO Voltage of Fiberglass Crossarm versus Length for Dry and Wet Condition



The CFO Voltage Per Unit Length of Fiberglass Crossarm versus Length



Flashover Arc on a Fiberglass Crossarm with Three Insulators Lightning Impulse under Wet Condition



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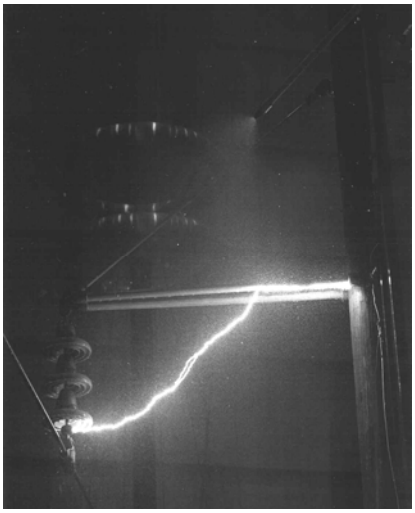

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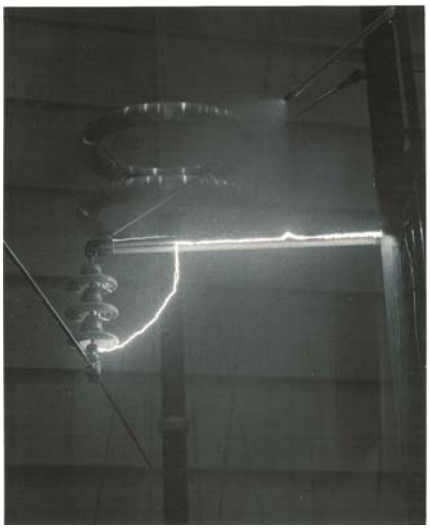
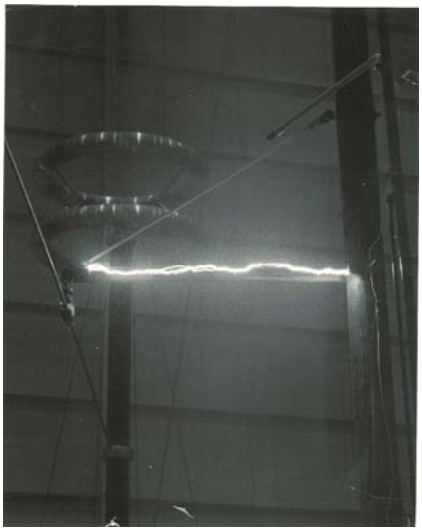
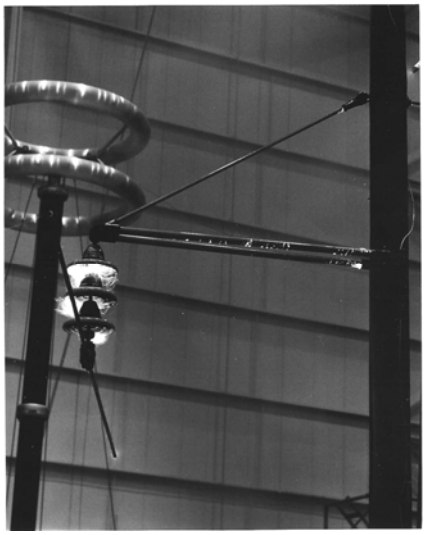


Flashover Arc on a Fiberglass Crossarm Lightning Impulse under Wet Condition



Flashover Arc on a Fiberglass Crossarm with Three Insulators AC Voltage under Wet Condition



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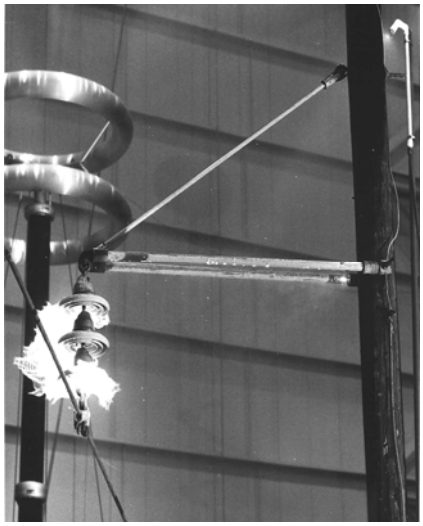

The AC Flashover Test
Fiberglass Crossarm, Wet Condition

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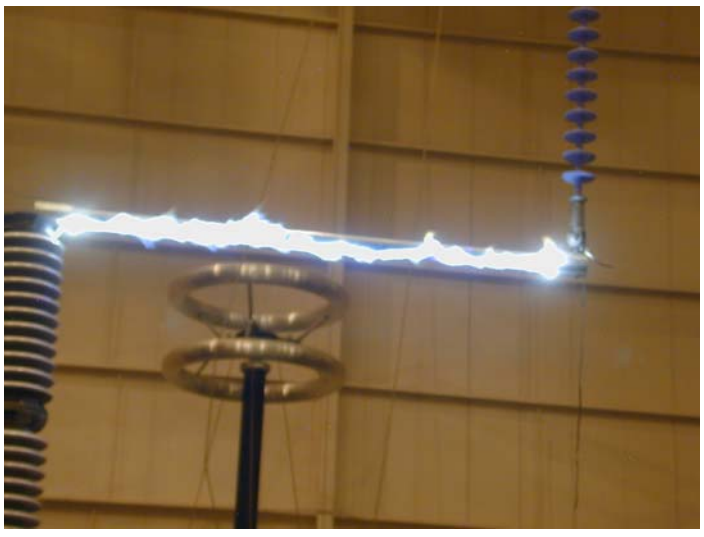

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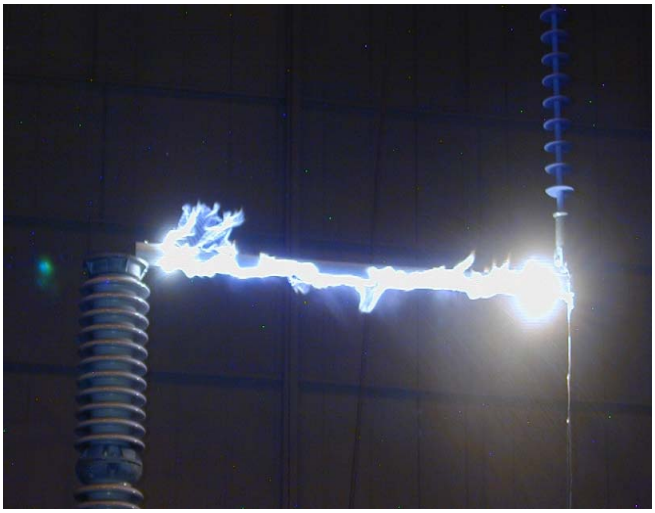

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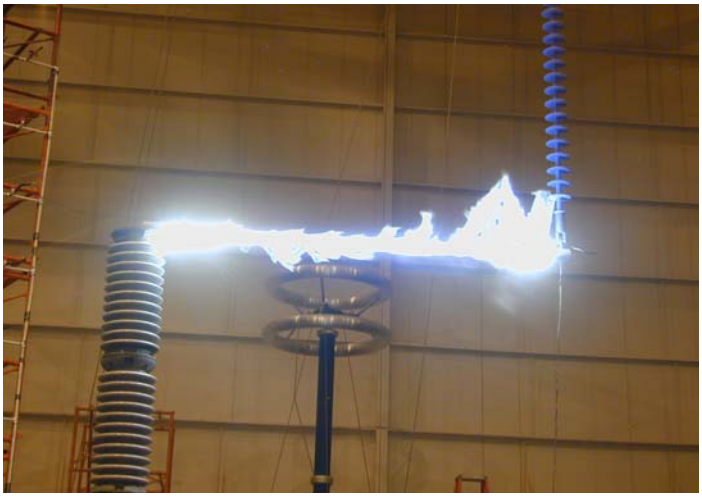
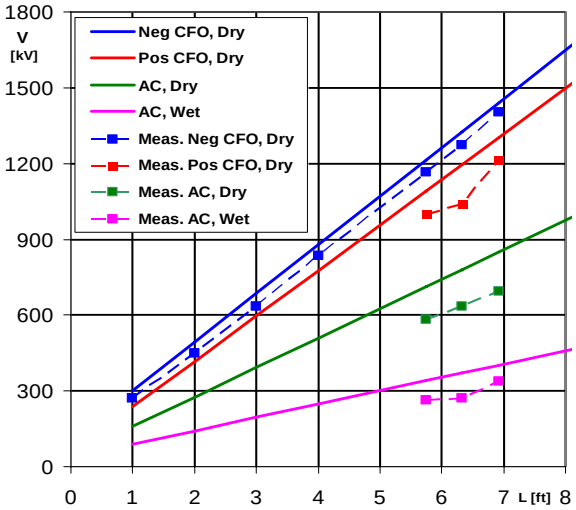


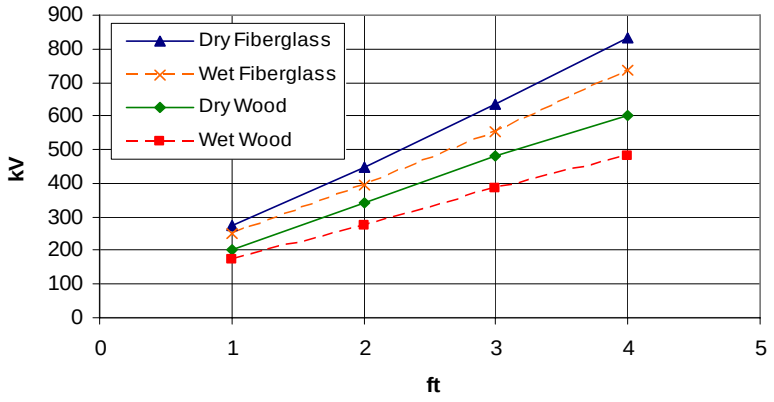
Fiberglass Crossarm Ends Damaged after AC Wet Test

If the leakage current level is high
and time duration of applied voltage is long,
it could create extensive heat that would cause
damage to the fiberglass crossarm surface.

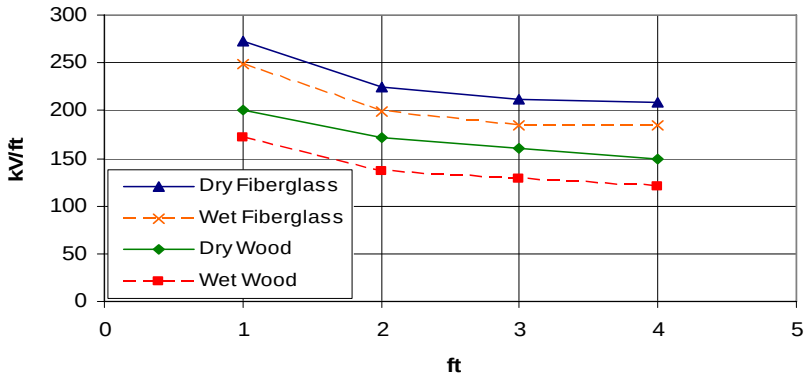
Measured Lightning Impulse CFO AC Flashover Voltages versus Lengths of Fiberglass Crossarm



CFO Voltage of Fiberglass and Wood Crossarm versus Length



CFO Voltage Per Unit of Fiberglass and Wood Crossarm versus Length



Conclusions

- Taking all parameters into the account, especially the electrical performance, fiberglass crossarm can be used in place of other conventional crossarms.
- The fiberglass crossarm cannot be used as the only insulation component. It must be used as a secondary insulation component of the multiple-insulation with insulator as a primary insulation component.

Conclusions

- For fiberglass crossarm with porcelain insulators, CFO voltage is not much different under dry and wet condition.
- The AC flashover voltage under wet condition is approximately 50-60% lower than under dry condition.
- The CFO voltages of fiberglass crossarms are 30-40% higher than wood crossarms under dry condition and 40-50% higher under wet condition.
- As the length increases, the CFO voltage per unit length of the fiberglass crossarm and the wood crossarm tend to decrease.