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Classic Connectors, Inc.

ClampStar CSF-1302-048-COR230

Effect on Conductor Sag

Installed on 954 kcmil 54/7 (Cardinal) ACSR conductor under the following conditions:

- 700 ft Ruling Span.
- Final tension: 19% RTS @ 60°F = 6,422 lbf..
- NESC Medium Loading with Heavy Ice Loading (temperature: 15°F, ½" radial ice, 4 lb/ft² horizontal wind pressure, 0.20 lb/ft safety factor added to the resultant).
- Level spans with no significant change in elevation.
- Conductor properties:
- Area = 0.8464 in², Diameter = 1.196", Weight = 1.229 lbs/ft, RTS = 33,800 lbf.

The curved shape of a completely flexible cable suspended between two rigid supports is defined as a catenary. A stranded conductor suspended between two rigid supports assumes very nearly that shape even though it is not completely flexible. The exact formula for determining the sag of a catenary is expressed as:

$S = Th/Wc\ [(\cosh WcL/2Th) - 1]$

Where:
S = sag at mid-span in feet
L = span length in feet
Th = horizontal tension in lbf
Wc = weight of the conductor in lbs/ft

For span lengths less than 1,000 ft, or where sag is less than 5% of the span length, the parabola equation can be used with sufficient accuracy for level spans.

$S = WcL^2/8Th$

This equation is the first term of MacLaurin's infinite series for hyperbolic functions with each successive term resulting in greater accuracy.

Using this equation, the conductor final sag (S) = 11.72 ft at 60°F and the length of the conductor in the span = 700.52 ft.

Applying ClampStar unit CSF-1302-048-COR230 at the center, or elsewhere in the span results in sag at mid-span (S) = 12.25 ft, or an increase of 0.53 ft.

Combined Wind and Ice Loading

The combined wind and ice loading noted above (including the 0.20 lb/ft safety factor added to the resultant vector sum of weight and transverse loading at +15°F) results in conductor tension of 10,530 lbf (31% RTS), combined loading of 2.598 lbs/ft and mid-span sag = 15.1 ft. With a CSF-1302-048-230COR installed on the iced conductor, the mid-span sag increases to 15.42 ft.

Discussion: A good example of what happens when conductor weight changes can be illustrated by considering this iced conductor in which the weight of the bare conductor is 1.229 lbs/ft and the combined loading on the iced conductor results in a conductor weight of 2.598 lbs/ft. Thus, 2.598/1.229 = 2.1, which means the conductor tension must increase by a factor of 2.1 unless there is a change in conductor length. In this case, the length of the conductor does change due to the 45° difference in ambient temperature, based on the stress-strain properties of the Cardinal conductor.

Another interesting comparison is this relatively light weight ClampStar unit (at approximately 39 lbs) to in-line, hook stick operated disconnect switches that are frequently used in overhead transmission and distribution lines. A 161 kV 1200 amp in-line switch with a single polymer insulator typically weighs approximately 81 lbs and similar switches for 230 kV weigh in the neighborhood of 130 lbs, depending on the BIL. Similar 1200 amp switches for 69 – 138 kV range from around 54 – 70 lbs.

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