

2019 PLS-CADD Advanced Training and User Group

IEEE P1283

Elevated Temperature Creep

by

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# Introduction

- ETC calculator applies sequential stages of elevated temperatures for given lengths of time
- Calculate a total temperature change
- Resulting temperature change can then be added to the previous temperatures to get sag that includes ETC
- Initial implementation is minimal to avoid revising cable files or DON files

# Prerequisites

- Cable types of AAC, AAAC, ACAR, ACSR & AACSR only (per IEEE P1283)
- Cable stranding quantity and diameter (must equal traditional cable cross section area)
- Cable ultimate tension
- Cable thermal expansion coefficient
- Type of construction - cast rod or rolled rod (per IEEE P1283 & not currently stored in cable files)

# Required Cable Inputs

**Cable Data**

File: c:\temp\etc\arbutus\_aac.wir  
 Description: 795 kmil 37/0 Strands ARBUTUS AAC - Adapted from 1970's Publicly Available Data  
 Manufacturer: \_\_\_\_\_ Stock Number: arbutus\_aac  
 Cable Type: AAC Size Label: \_\_\_\_\_ Display Color: ■

**Physical** | Electrical | Notes

Bimetallic Conductor

Strands: Number 37 Diameter (in) 0.146577

The parameters below are used to model sag and tension for this cable.

**Cable Model**

Nonlinear cable model (separate polynomials for initial and creep behavior for inner and outer materials)  
 Linear elastic with permanent stretch due to creep proportional to creep weather case tension  
 Linear elastic with permanent stretch due to creep specified as a user input temperature increase

Cross section area (in<sup>2</sup>) 0.624341 Outside diameter (in) 1.026 Unit weight (lbs/ft) 0.746401 Ultimate tension (lbs) 13900  
 Number of independent wires (1 unless messenger supporting other wires with a spacer) 1  
 Temperature at which strand data below obtained (deg F) 70  Conductor is a J-Power Systems GAP type conductor strung with core supporting all tension.

Final modulus of elasticity (psi/100) 84000.1  
 Thermal expansion coeff. (/100 deg) 0.0012777

Polynomial coefficients (all strains in %, stresses in psi)

	a0	a1	a2	a3	a4
Stress-strain	-410.001	78390.9	-104568	88104.9	-32482
Creep	c0	c1	c2	c3	c4
	-254.299	41670.1	-55606.1	42471	-1517

**Section Elevated Temperature Creep**

Cable Description: 795 kmil 37/0 Strands ARBUTUS AAC - Adapted from 1970's Publicly Available Data  
 Cable File: c:\temp\etc\arbutus\_aac.wir

Initial ambient conditions

Temperature (deg F) 60.8 Time (d) 3650 Condition: Creep RS  Cable strands are cast rod  
 Sag (ft) 19.1929 Max. Tension (lbs) 3127 Creep (in/ft) 0.0057034

**Elevated Temperature History**

	Temperature (deg F)	Time (d)	Cable Condition	Sag (ft)	Max. Tens. (lbs)	Stress (ksi)	Equiv. Time (d)	Total Time (d)	Elev. Creep (in/ft)	Delta T (deg F)	Elev. Sag (ft)	Elev. Max. Tens. (lbs)
1	212.00	41.667	Creep RS	28.12	2147	3.44		41.667	0.012	71.60	30.36	1993
2	257.00	4.167	Creep RS	30.38	1991	3.19	10.917	15.084	0.012	75.67	32.49	1866
3	302.00	0.417	Creep RS	32.51	1864	2.99	5.223	5.640	0.013	76.67	34.51	1760
4												
5												
6												
7												

Generate Report OK Cancel

# Steps to Use

- Select **Sections** | **Thermal Calculations** | **Elevated Temperature Creep**
- Graphically select the cable to analyze
- Enter initial ambient conditions (note “Cable strands are cast rod” option in dialog)
- Enter sequential stages of elevated temperatures, times and cable conditions
- Click **Generate Report** to see results

# Notables

- Maximum input time for each stage is 50 years
- Only ACSR with steel area ratios ( $A_s/A_t$ )  $\leq 7.5\%$  are analyzed (per IEEE P1283)
- Only outer strand counts of 7, 19, 37 & 61 are supported for non-steel type conductors (per IEEE P1283)

# Example B.3 from IEEE P1283 Annex B

## IEEE 1283-2013 Elevated Temperature Creep Calculations

### Span and Cable Input

Line No. = 1  
 Section No. = 1  
 Ruling Span Length = 799.87 (ft)  
 Cast Rod Cable = Yes  
 Cable File = c:\temp\etc\arbutus\_aac.wir  
 Cable Description = 795 kcmil 37/0 Strands ARBUTUS AAC - Adapted from 1970's Publicly Available Data

### Initial Ambient Conditions

Temperature = 60.0 (deg F)  
 Time = 3650.0 (d)  
 Cable Condition = Creep RS  
 Sag = 19.14 (ft)  
 Max. Tension = 3135.21 (lbs)  
 Horiz. Tension = 3120.93 (lbs)  
 Creep (elevated) = 0.006 (in/ft)  
 Sag (elevated) = 22.03 (ft)  
 Max. Tension (elevated) = 2729.24 (lbs)  
 Horiz. Tension (elevated) = 2712.80 (lbs)

### Elevated Temperature Results

Temp. (deg F)	Time (d)	Cable Condition	Sag (ft)	Max. Stress Tens. (lbs)	Stress (ksi)	Equiv. Time (d)	Total Delta T Time (d)	Delta T (deg F)	-----Elevated-----			
									Creep (in/ft)	Sag (ft)	Hori. Tens. (lbs)	Max. Tens. (lbs)
212.00	41.67	Creep RS	28.12	2147	3.44		41.67	71.47	0.0118	30.35	1970	1993
257.00	4.17	Creep RS	30.38	1991	3.19	10.92	15.08	75.54	0.0124	32.49	1841	1866
302.00	0.42	Creep RS	32.51	1864	2.99	5.22	5.64	76.54	0.0126	34.50	1735	1760

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