TSDOS

TRANSMISSION & SUBSTATION DESIGN & OPERATION SYMPOSIUM

THE UNIVERSITY OF TEXAS AT ARLINGTON

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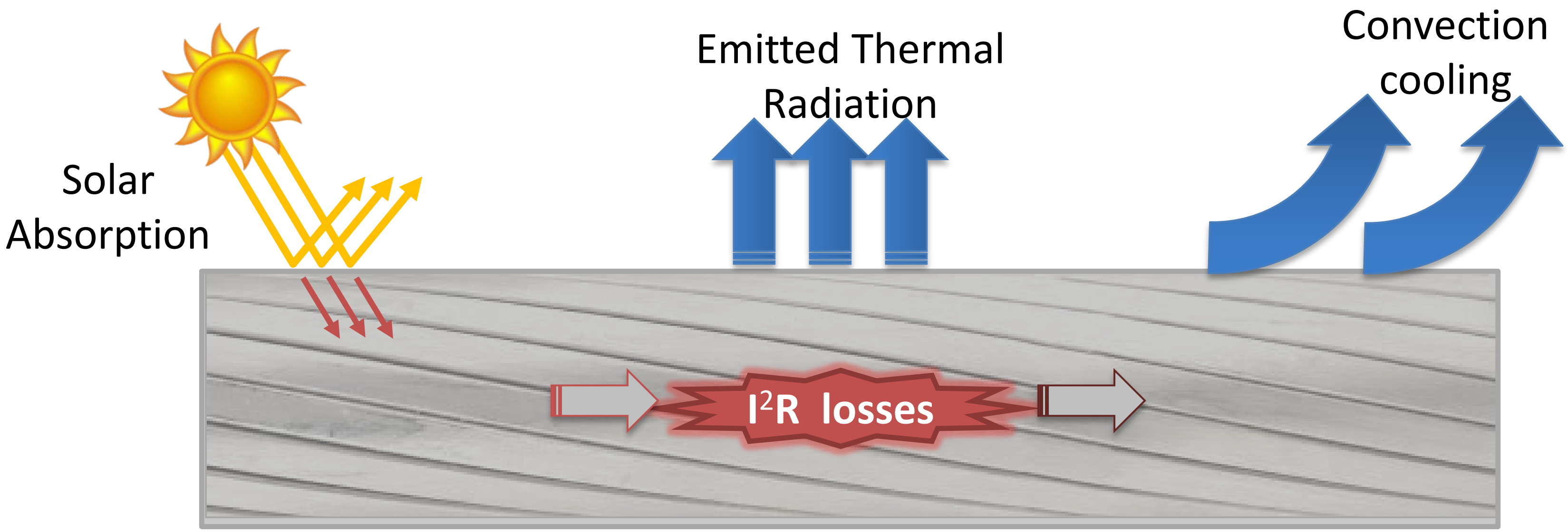
High Temperature Conductor Rating Considerations

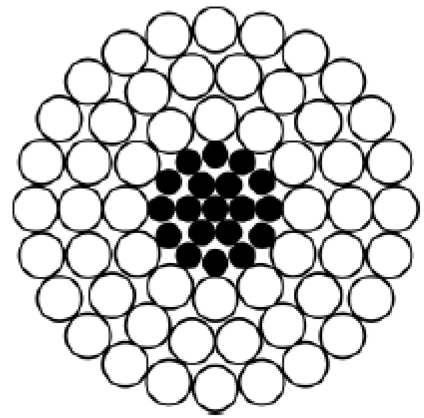
IEEE Standard 738 Heat Balance Equation

$$q_{con} + q_{rad} = q_{solar} + I^2R$$



Scenarios for current/temperature relationship

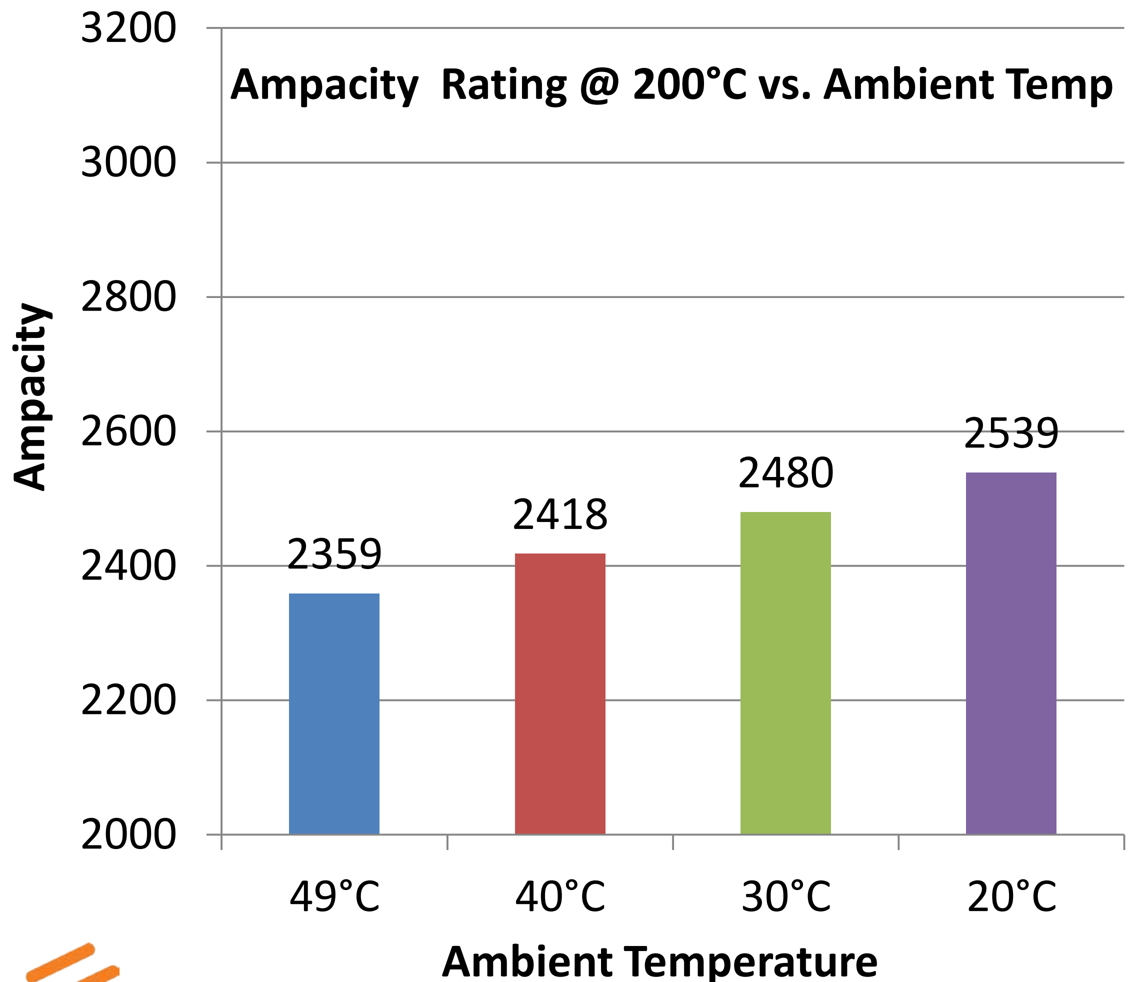
1590.0 kcmil 54/19 Falcon/ACSS



Frequency:	60 Hz	**Ambient Temperature:**	20-49 °C
Emissivity:	0.24-0.9	**Crosswind Velocity:**	0-6 ft/s
Absorptivity:	0.0-1.0	**Wind Angle:**	90 °
Total Solar Radiated Heat:	98.4 W/ft²	**Northern Latitude:**	32 °
Azimuth of Line:	90 ° (E-W)	**Elevation:**	774 ft
Atmosphere:	clear	**Month and Day of Year:**	July 1
Maximum Operating Temp	200°C (392°F)	**Time of Day:**	12 PM

IEEE 738 equations show ampacity= ??? Amps

Ambient Temperature:
vary from 49°C (120°F) to 20°C (68°F)



Sensitivity

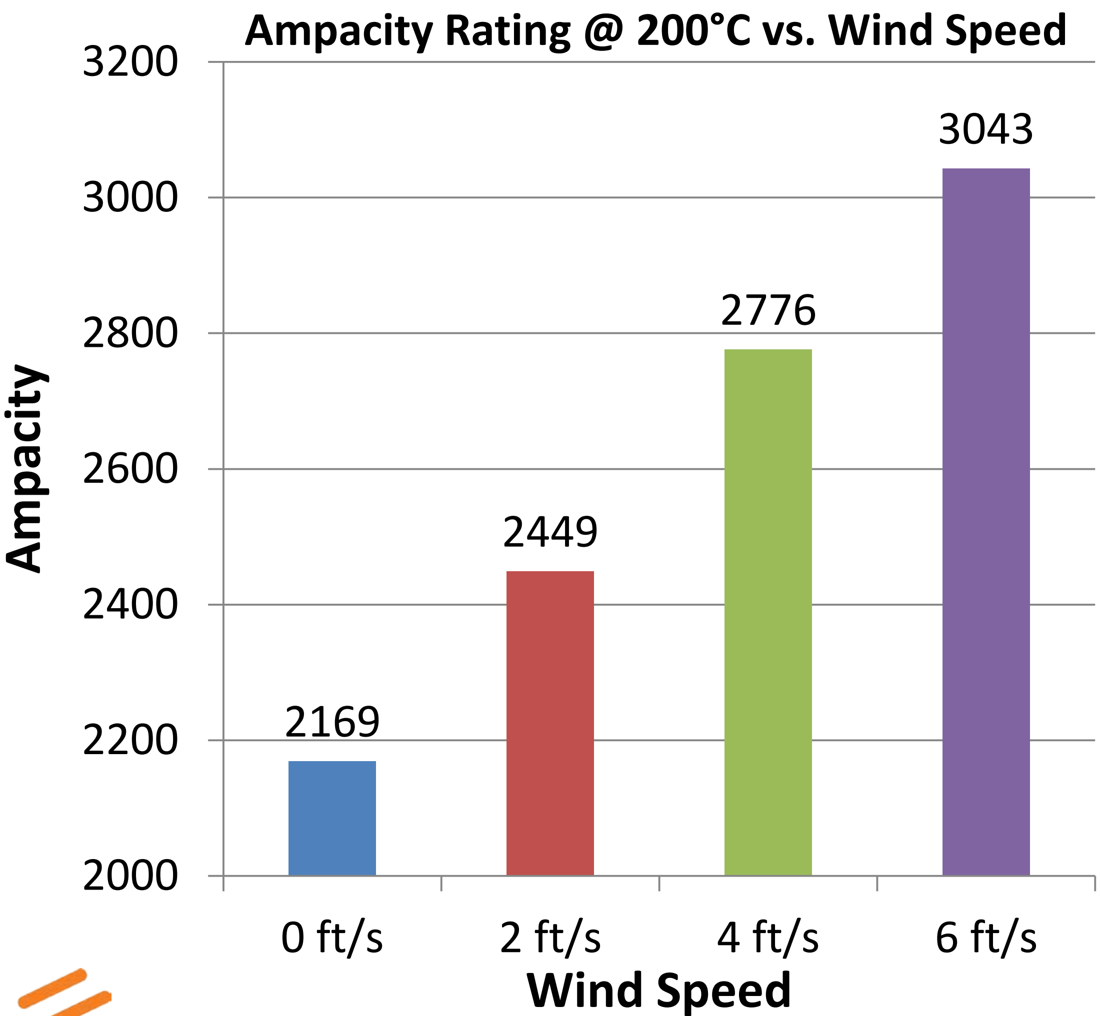
29°C (52°F) change equals 7.6% change in ampacity rating

Worst Case:

Winter rating (20°C) used when actual Temp=49°C

Temp Conductor= 225°C actual vs. 200°C expected

Cross Wind Velocity: vary from 0 ft/s to 6 ft/s



Sensitivity

0 to 2ft/s = +12.9%

0 to 4ft/s = +27.9%

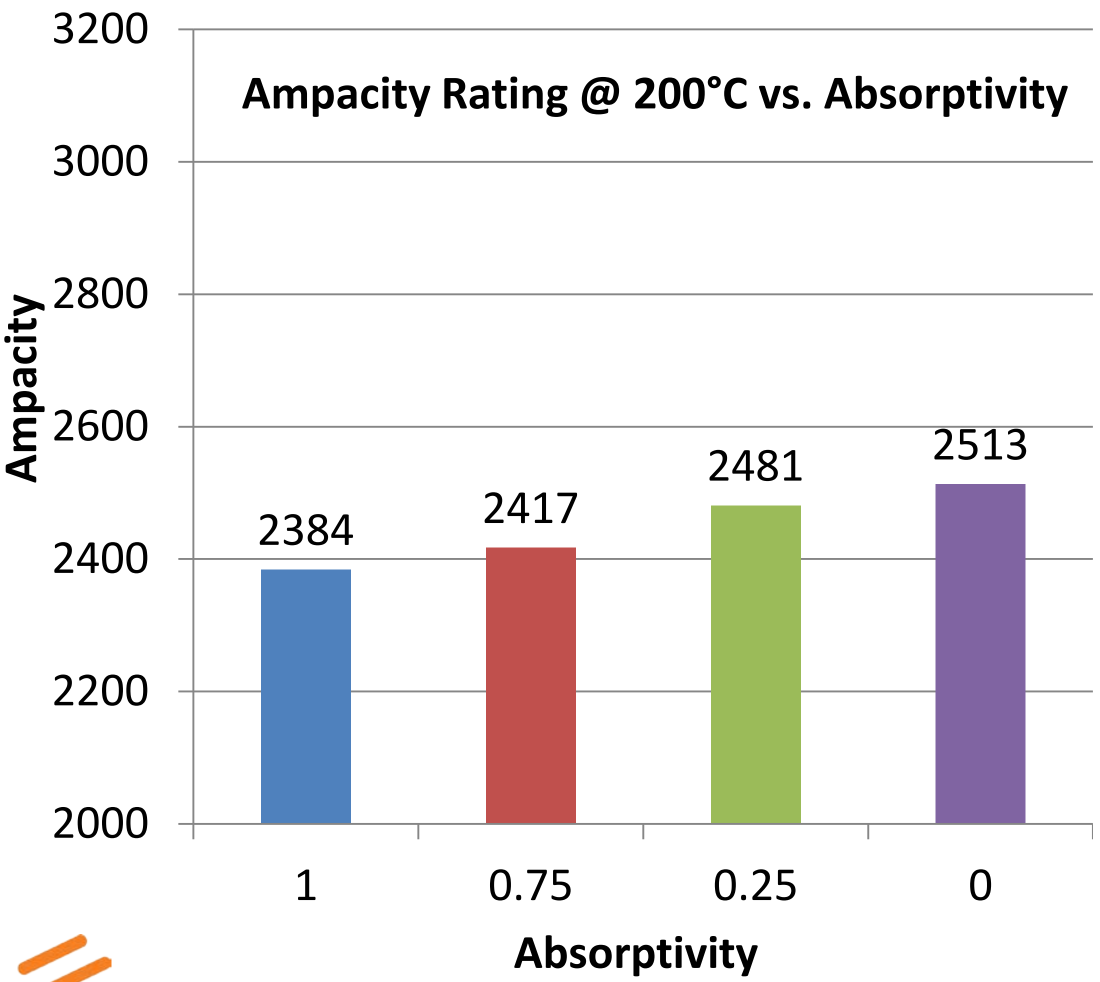
0 to 6ft/s = +40.3%

Worst Case:

Wind stops blowing for period of time on line rated @6ft/s

Temp Conductor= 340°C actual vs. 200°C expected

Absorptivity (α): vary values from 1.0 to 0.0



<u>Sensitivity</u>

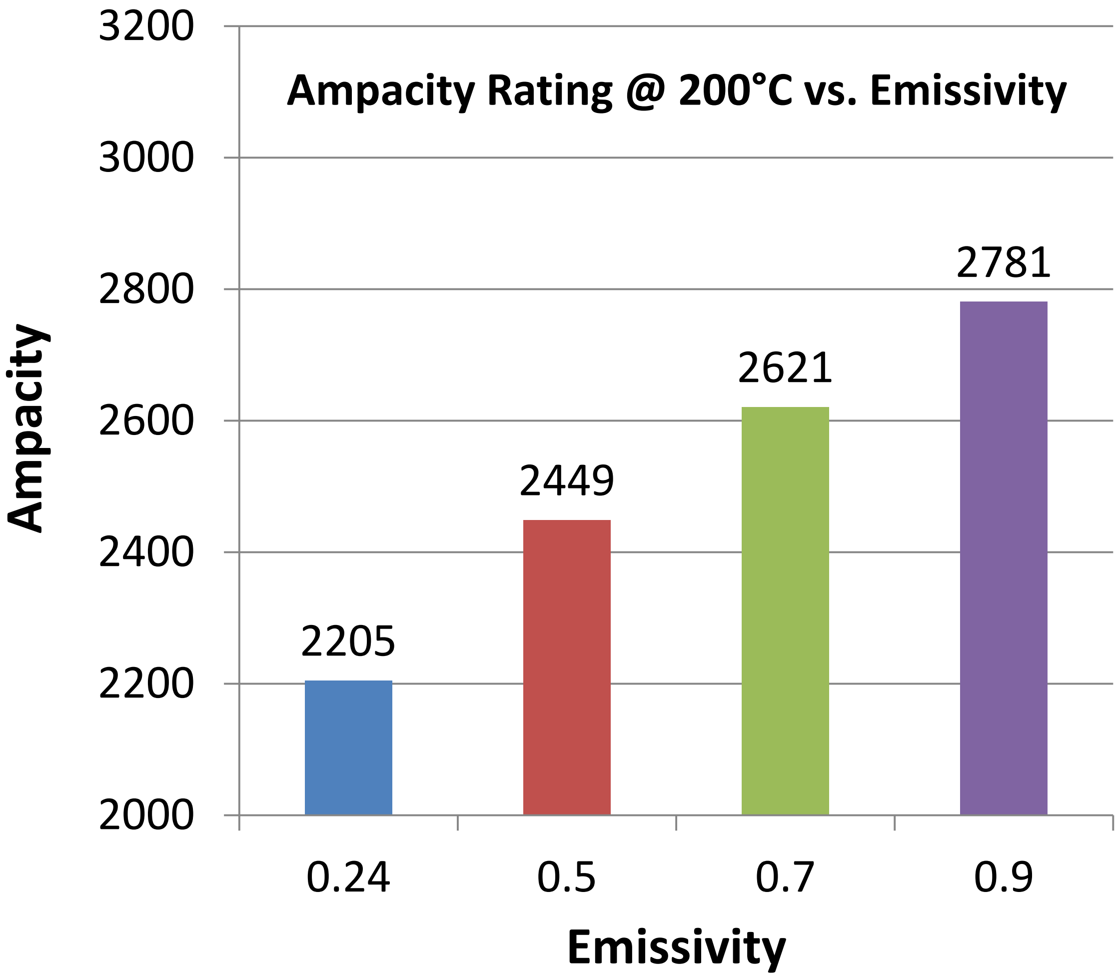
100% change in value equals 5.4% change in ampacity rating

<u>Worst Case:</u>

Assume no sun absorbed when actual α =1.0

Temp Conductor= 218°C actual vs. 200°C expected

Emissivity (Ɛ): vary from 0.24 to 0.9



<u>Sensitivity</u>

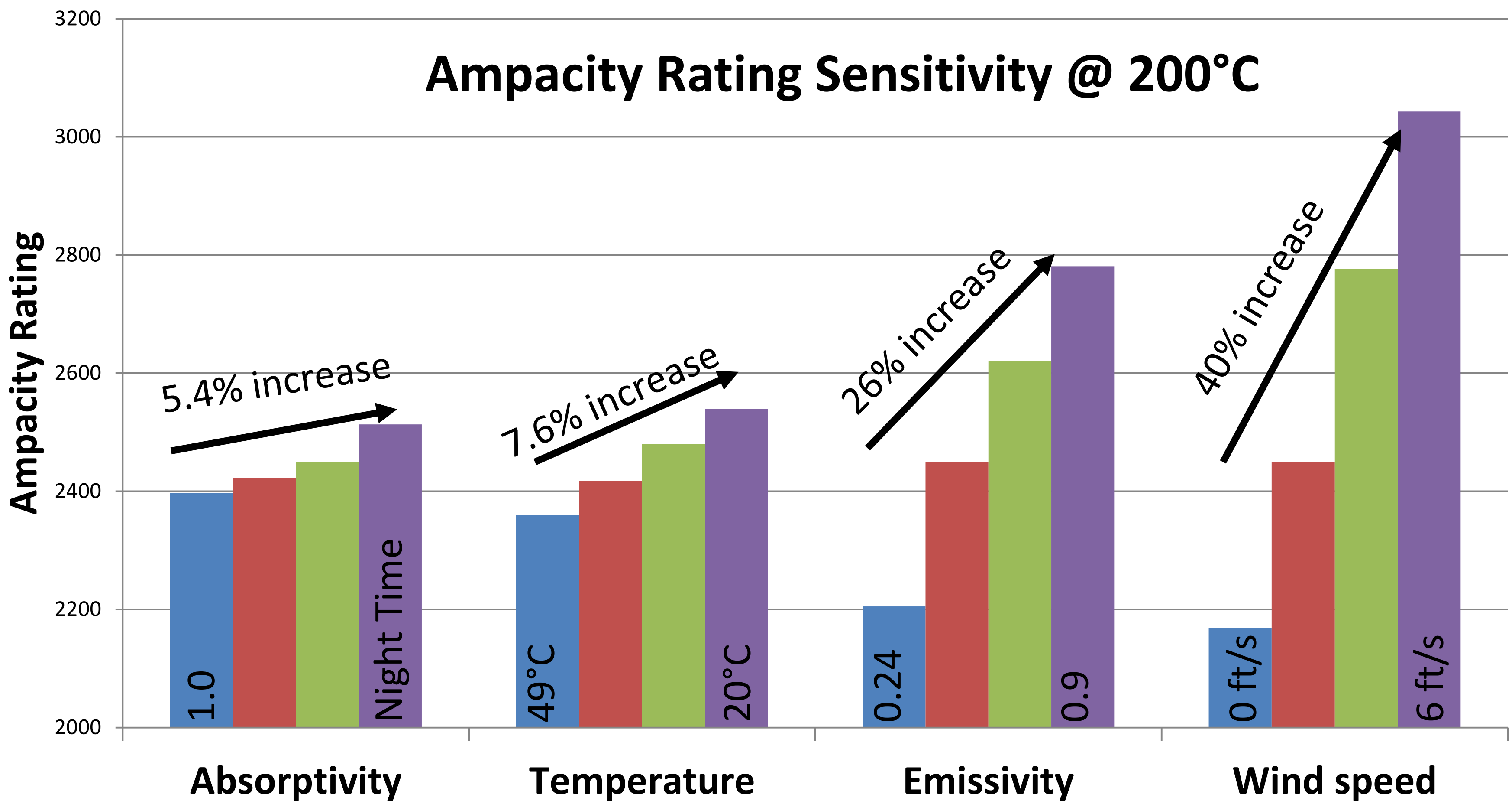
0.66 change in value equals 26.1% change in ampacity rating

<u>Worst Case:</u>

"shiny" new line rated with Ɛ=0.9

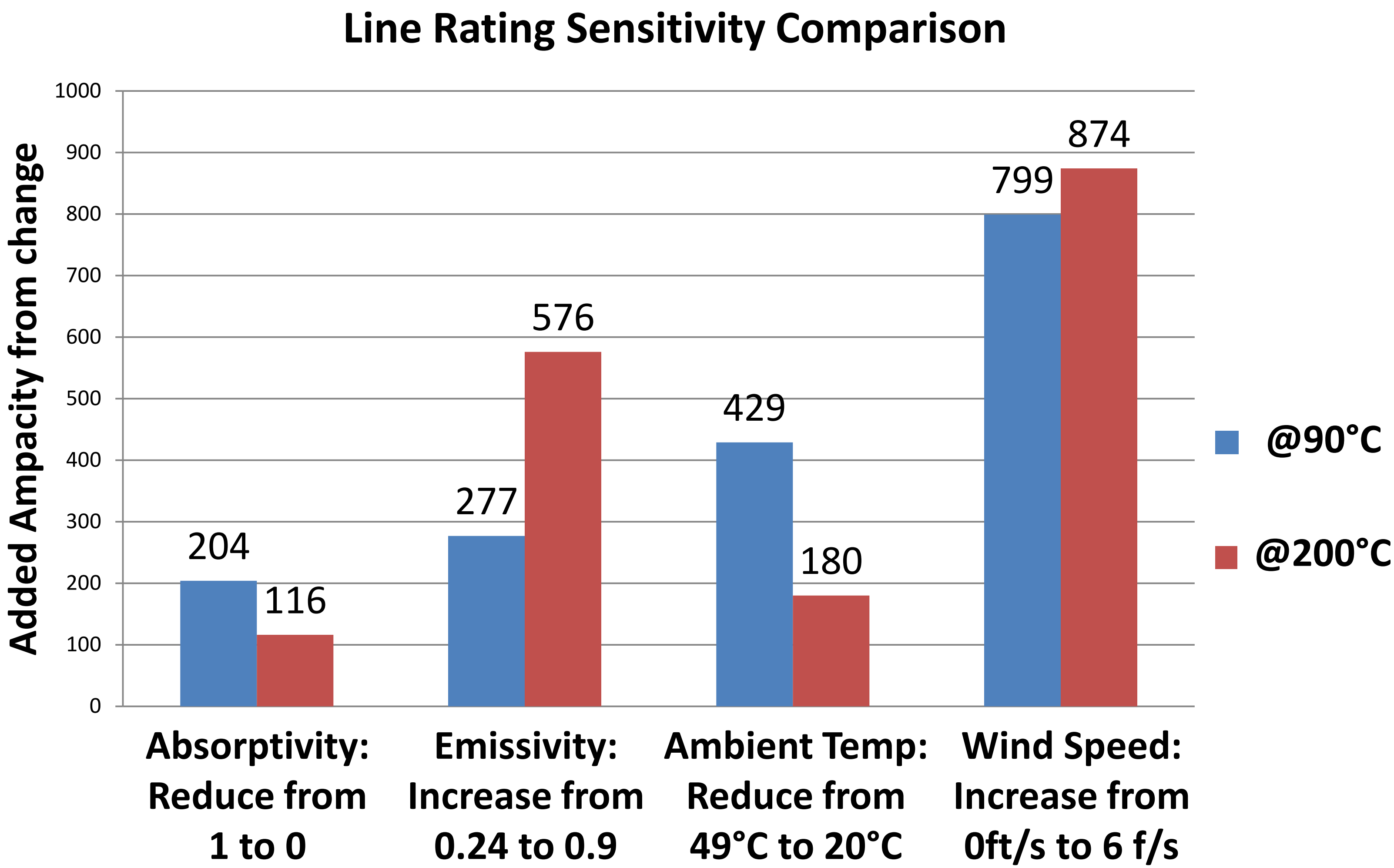
Temp Conductor= 326°C actual vs. 200°C expected

Summary of impact of variables



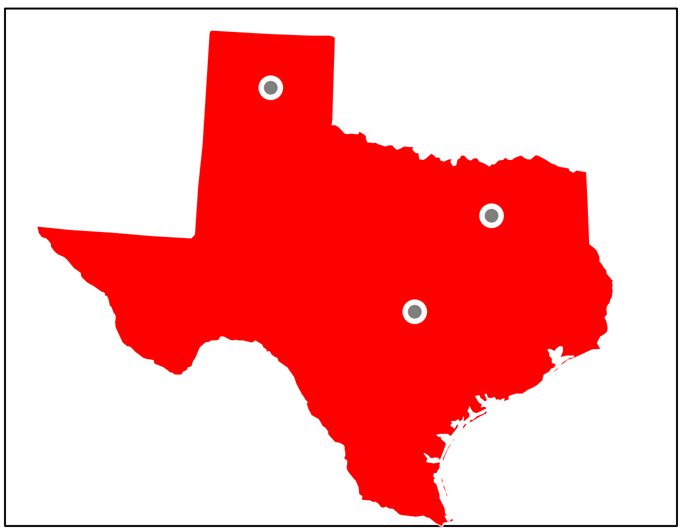
Impact from wind speed and emissivity much greater than ambient temp and absorptivity

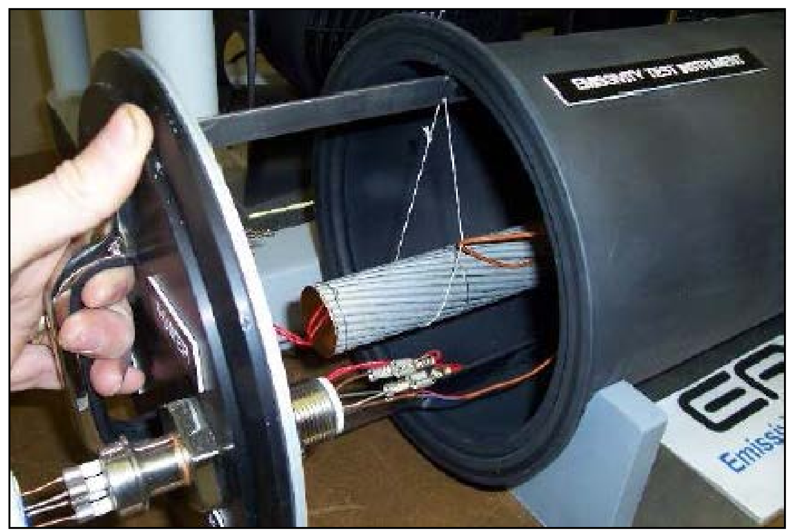
Summary of impact of variables at 90°C vs. 200°C



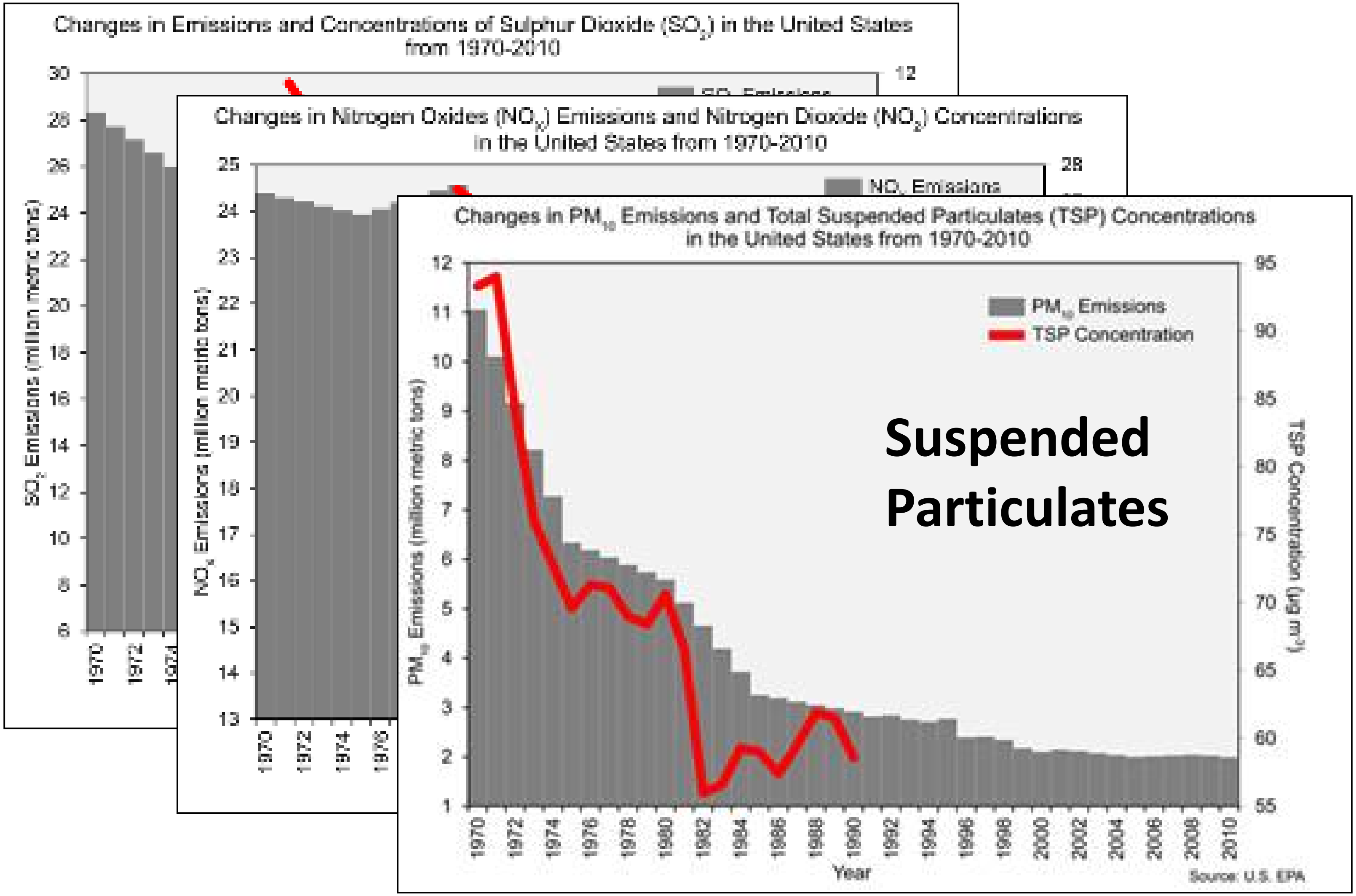
EPRI test results from Texas. What value to use?

Age (Years)	Measured Emissivity	Location	Conductor
0	0.24	-	ACSR-Drake
3	0.25	Amarillo	ACSS-Falcon
32	0.32	DFW	ACSR-Bittern
32	0.45	Austin	ACSR-Drake

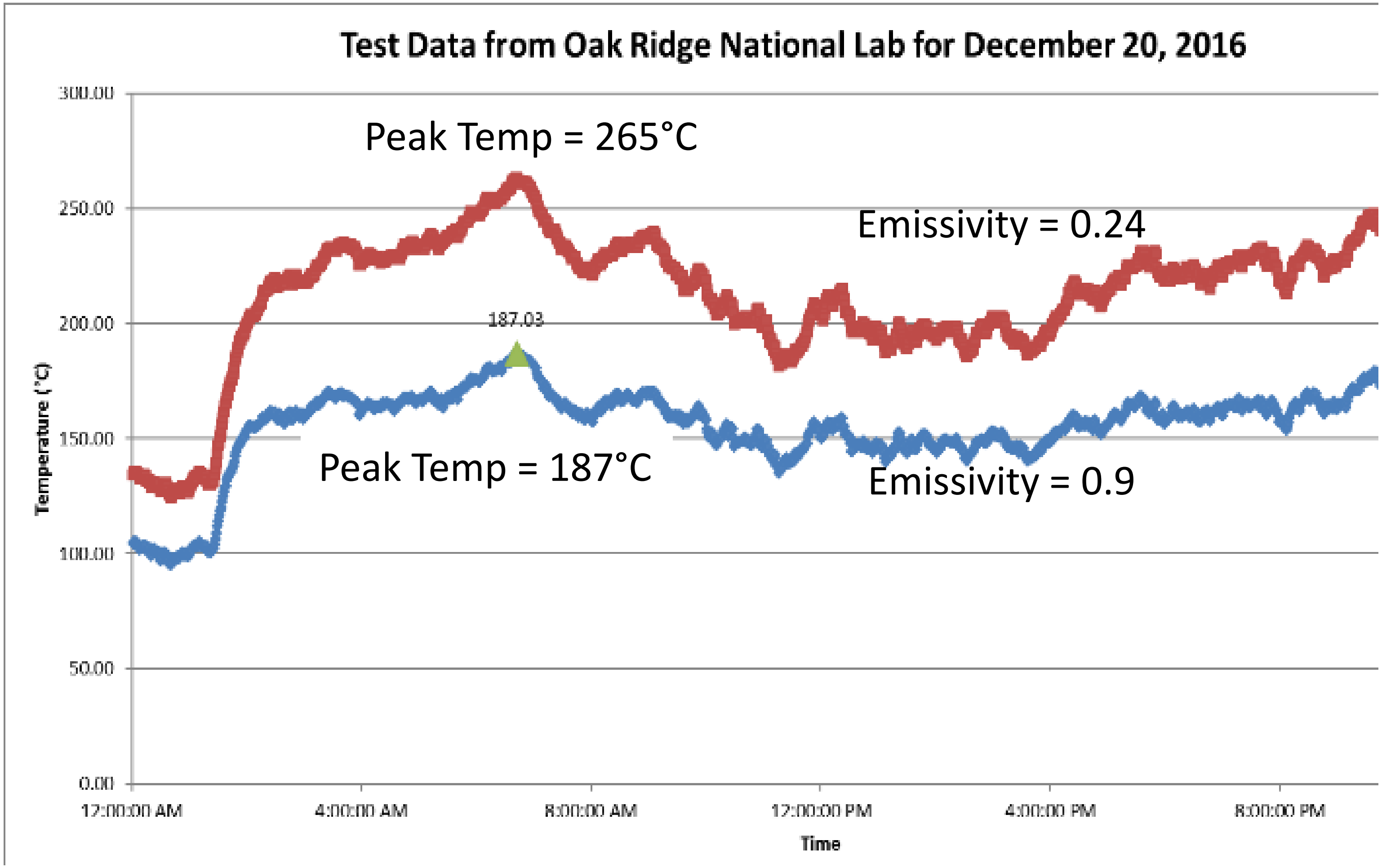




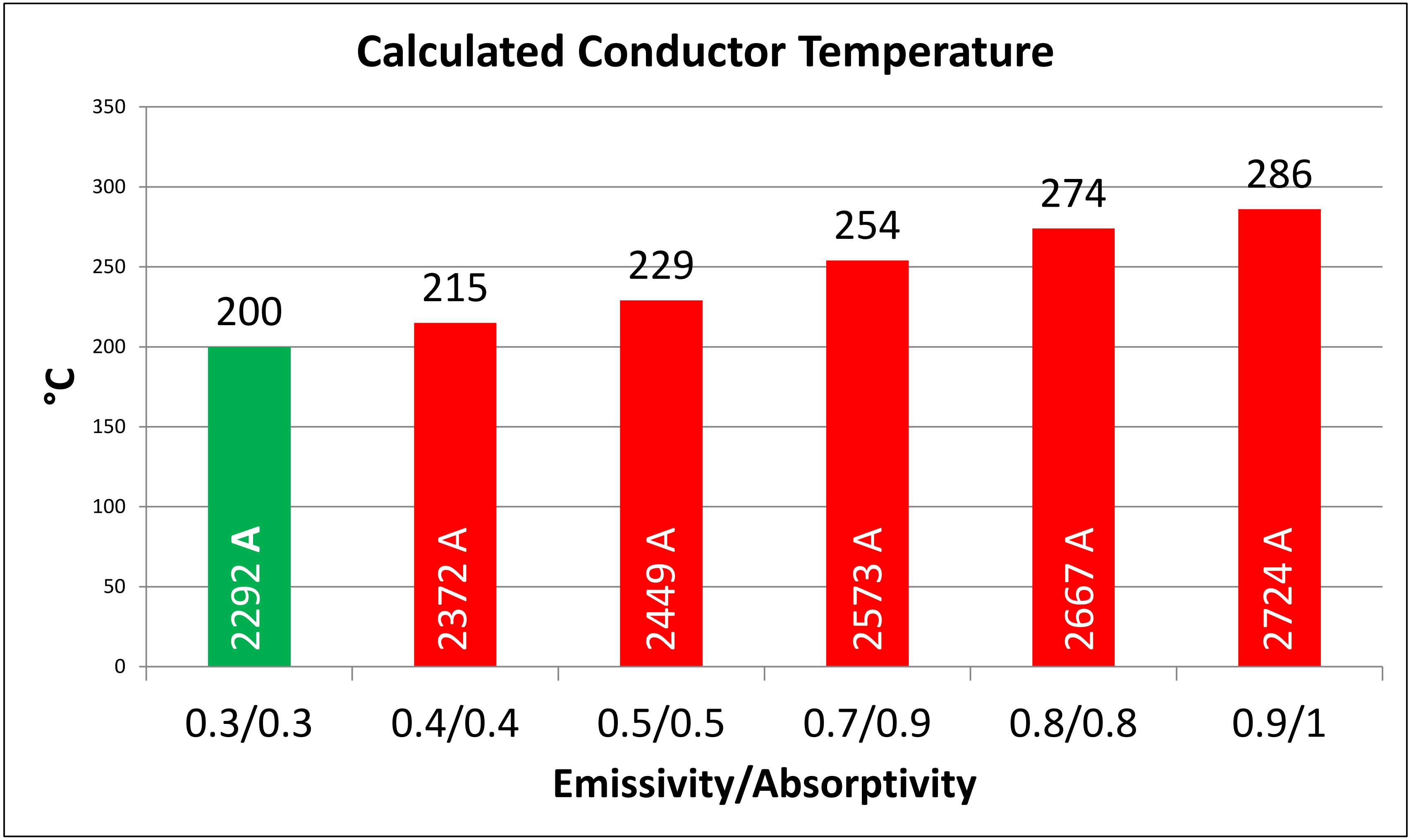
Lower Pollution equals lower emissivity



For HTLS Conductors, Emissivity Matters.



If actual ε =0.3/α =0.3, what would conductor temp be with commonly used rating methodology ε/α value sets?



Line Rating observations for High Temperature Lines

- **Emissivity and Wind Speed are major contributors**
- **Emissivity is measurable**
- **Actual emissivity values are likely lower than commonly used values**
- **HTLS conductor ratings are particularly sensitive to emissivity changes.**
- **Consistency of line rating "philosophy" should be reevaluated for HTLS conductors vs. traditional ACSR**