DAYTON
PHOENIX
GROUP

engineered to move

DPG vs Competition Comparison Results

@ 945 Amps

Dayton-Phoenix Group

Competition

@ 945 Amps

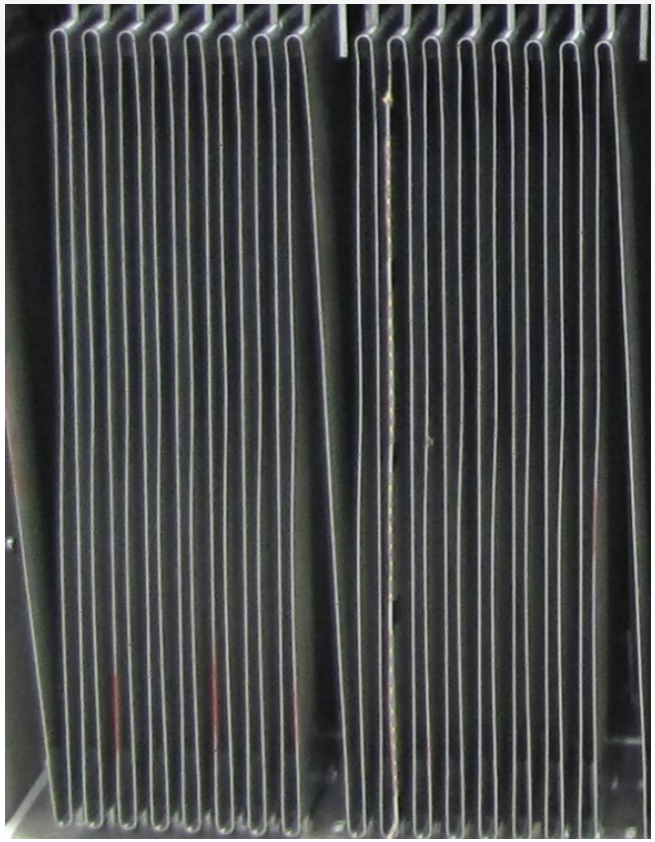
MAX TEMPS →	Element	Insulation	Terminal	Outlet Air
Dayton-Phoenix Group	1106	241	615	349
Competition	1319	429	713	521
Delta degrees	213	188	98	172
% Increase	19%	78%	16%	49%

Electrical Characteristics →	Avg. Current	Avg. Voltage	Avg. Power	Cold Resistance	Hot Resistance	Delta Resistance
Dayton-Phoenix Group	945 A	336 V	317.5 kW	0.3348	0.3556	6.2%
Competition	944 A	398 V	375.7 kW	0.3581	0.4216	17.7%

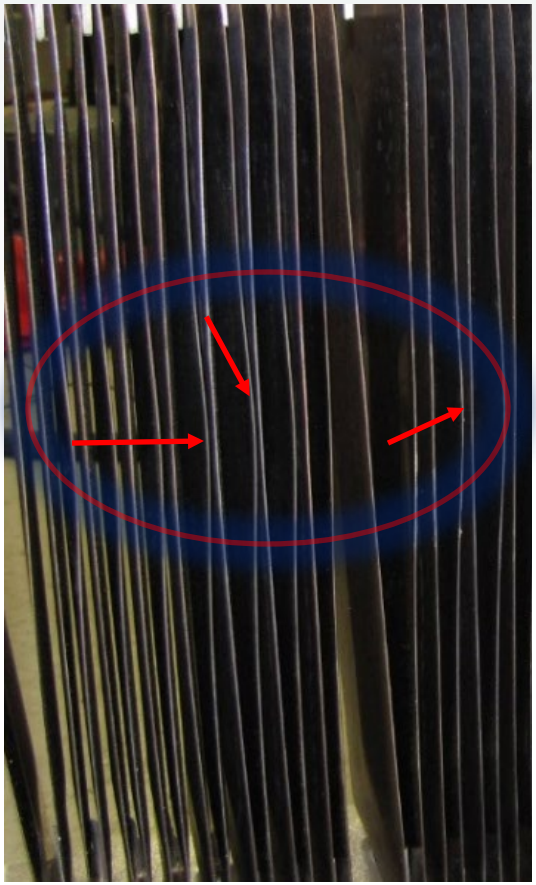
Grid to Grid Spacing – Competition

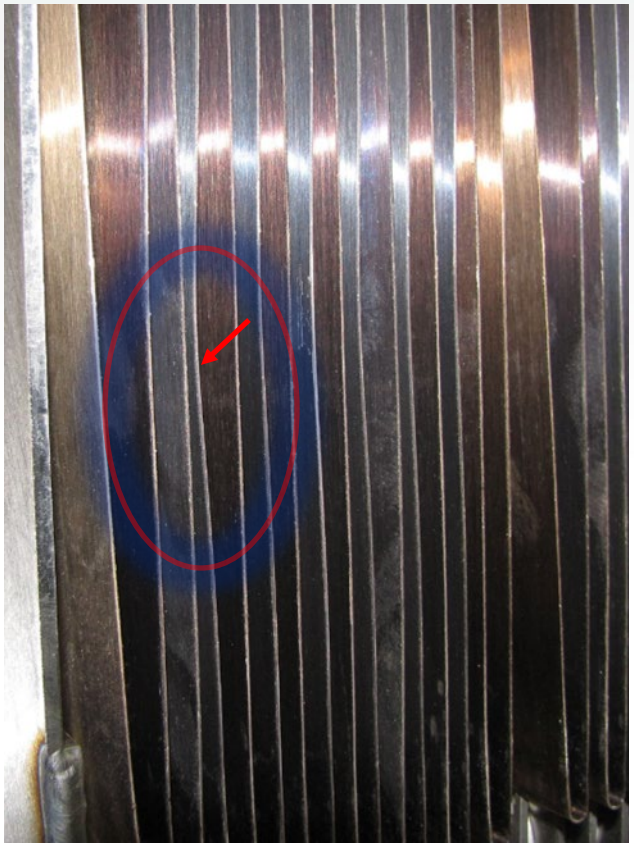
Tested at 900 A, 920 A, & 945 A

Before testing - Fairly uniform and even spacing



After testing – Uneven spacing with grids almost touching

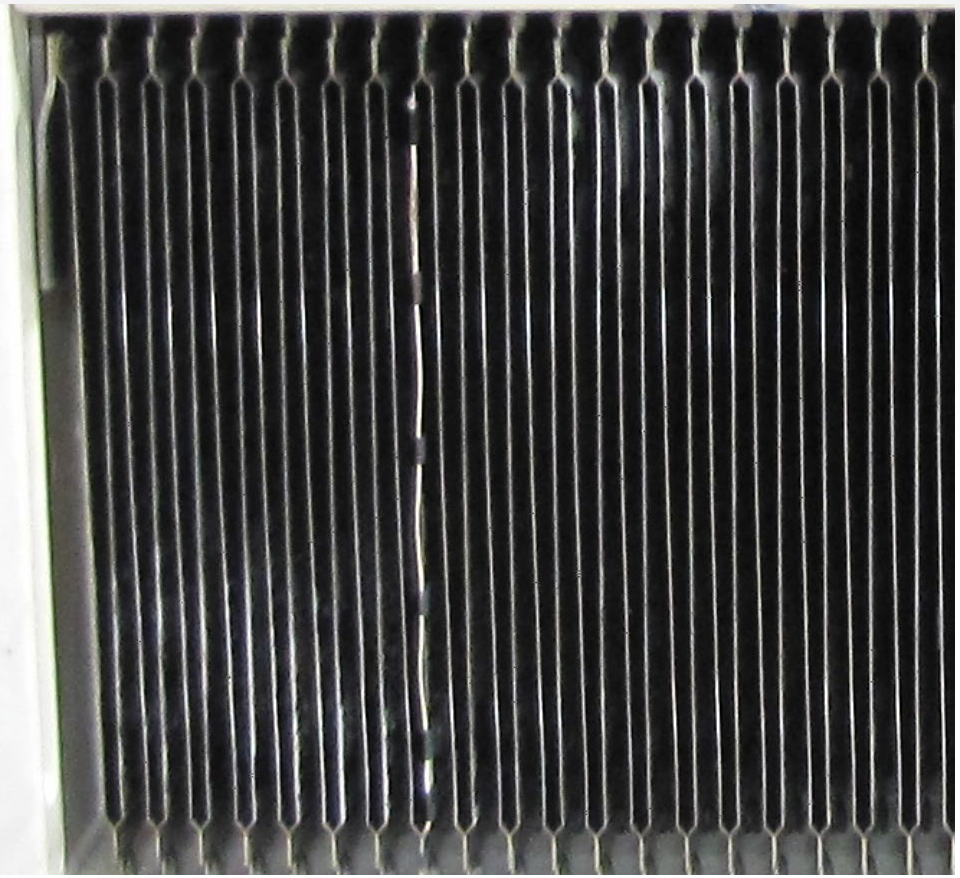




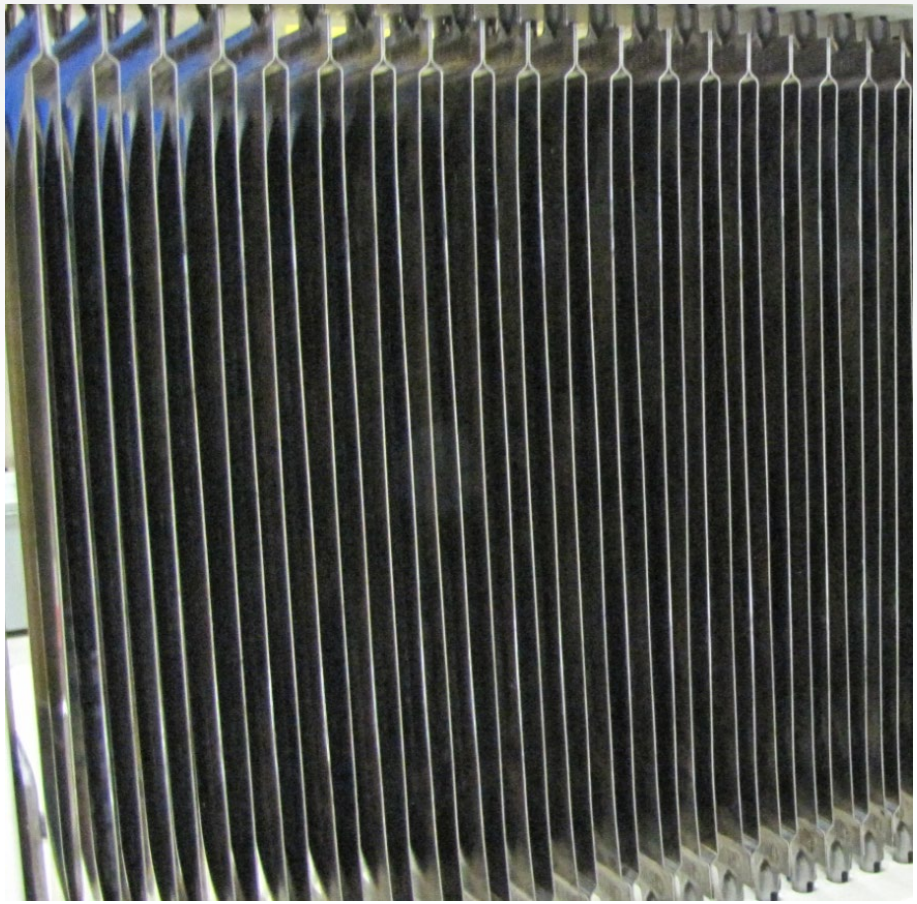
Grid to Grid Spacing – DPG

Tested at 900 A, 920 A, 945 A & *1,012 A*

Before testing - Uniform and even spacing

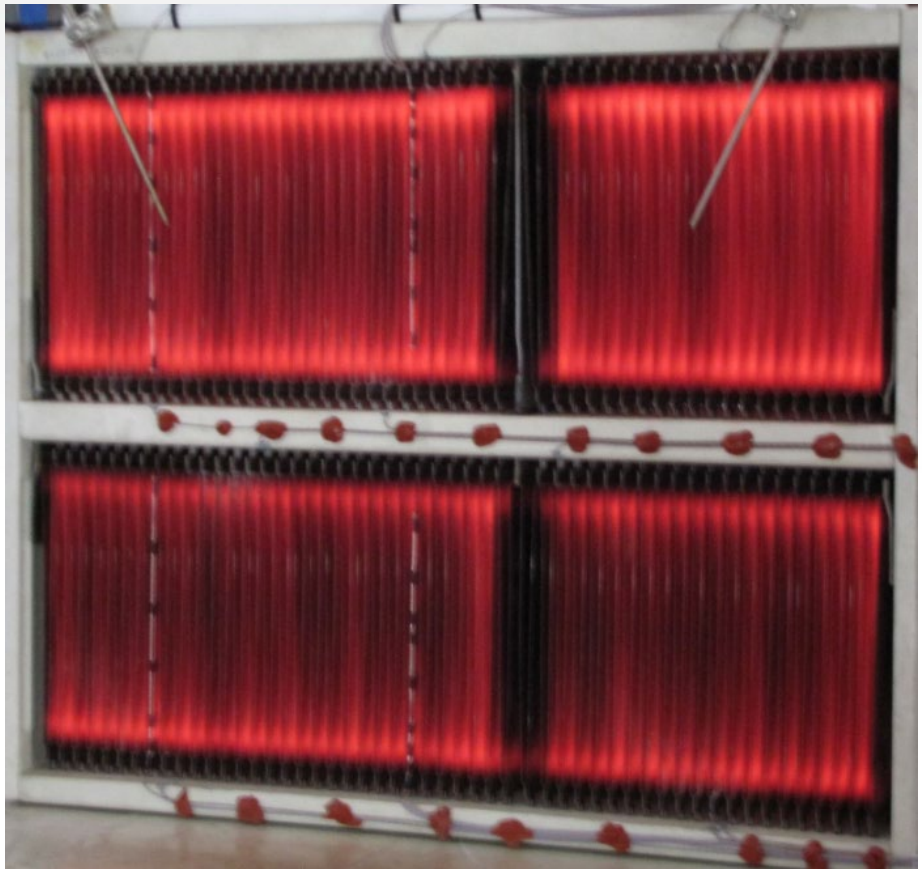


After testing – Uniform and even spacing



@ 1012 Amps

Dayton-Phoenix Group

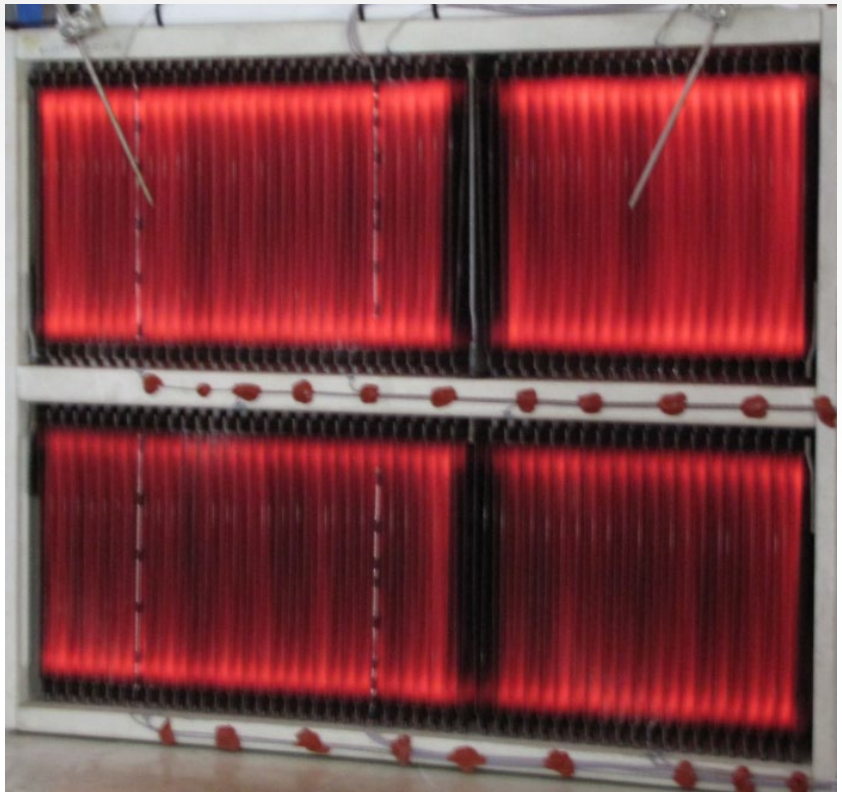


Competition

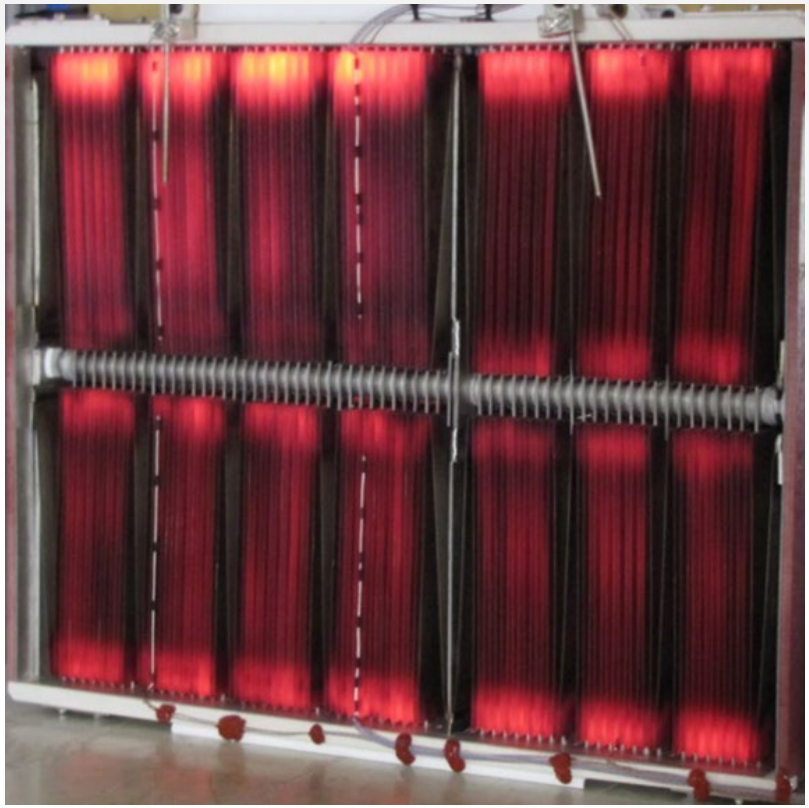
DPG Engineering would not run competition at this level for safety reasons.

“Red Hot Comparison”

Dayton-Phoenix Group @ 1012 Amps



Competition @ 945 Amps



DPG grid shows more even distribution of load. Note significant hot spots on competition.

@ 1012 / 945 Amps

MAX TEMPS →	Element	Insulation	Terminal	Outlet Air
Dayton-Phoenix Group @ 1012 A	1279	309	666	455
Competition @ 945 A	1319	429	713	521
Delta degrees	40	120	47	66
% Increase	3%	39%	7%	15%

Electrical Characteristics →	Avg. Current	Avg. Voltage	Avg. Power	Cold Resistance	Hot Resistance	Delta Resistance
Dayton-Phoenix Group	1012 A	371 V	375.4 kW	0.3348	0.3666	9.5%
Competition	944 A	398 V	375.7 kW	0.3581	0.4216	17.7%

Summary

- Insulation Temperature reduction of 188° F: Every 20° F decrease in insulation temperature effectively doubles the life of the insulation material.
- Element Temperatures reduced by >200° F: Correlates to lower insulation temperatures, downstream resistor temperatures, and exhaust air temperatures.
- Element Integrity increase: DPG elements maintained pre-test shape and spacing even after testing at 25% over rated power. The competitor's elements displayed high levels of element movement after testing at rated current levels, leading to high susceptibility to elements touching and arcing.
- Resistance Change decrease: The DPG product experienced a change in resistance of 6.2% while the competitor had a 17.7% change. A high amount of resistance change may result in a reduction of braking effort. The DPG resistors may allow 9% more braking effort than the competitor due to this difference.
- Temperature Distribution: The DPG resistors showed a much more even distribution of heat. The competitor resistors developed multiple hot spots which result in high stress areas and disrupt the uniform airflow meant to cool them.

Based off of these results, it is expected that the DPG resistor will show a marked increase in reliability over the competitor product. Due to variation in haul profile, application, etc. it is very difficult to definitively quantify a reliability increase, however the test results conservatively suggest a 2x life improvement over the current product. Replacing all resistors on a locomotive with DPG resistors will result in a greater performance increase due to consistent airflow characteristics, in this case a 5x life improvement may be achievable.