

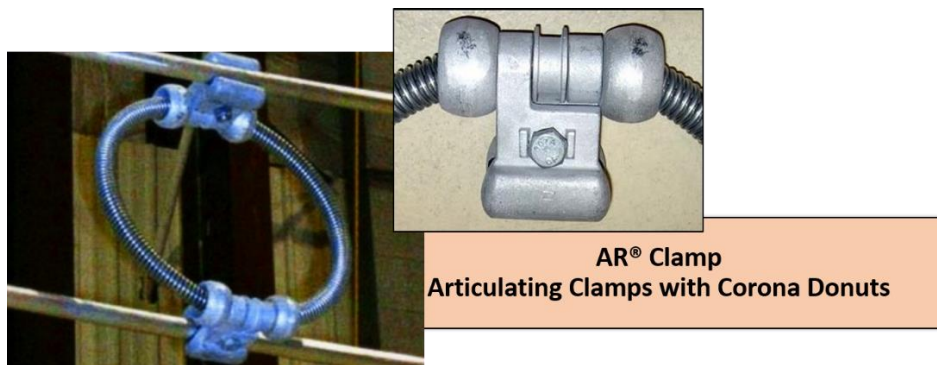


Product Testing

Corona/RFI Testing of the AR®Clamp AR®Spacer Damper

In 2004, the AR®Clamp and AR®Spacer Damper were tested for RIV measurements and corona photographs. Tests were completed in the independent testing laboratory at NEETRAC, a research center of Georgia Institute of Technology.

The study evaluated corona performance of the AR®Clamp within five different spacer/damper assemblies. RIV measurements and corona photographs were recorded. The RIV measurements unless otherwise specified were recorded using a narrow band 1MHz radio noise meter.



Subject

The AR®Spacer Damper assemblies include two articulating AR®Clamps on a powder coat, steel ring spacer. This model AR Clamp is used in all models of the AR Spacer Damper, AR Lightweight Spacer Damper, AR Spacer|Twister and AR Twister|Slider.

Purpose

To determine if the test samples will develop corona photographs and radio interference voltage.

Testing

NEETRAC performed corona and RIV testing on five assemblies all in vertical double suspensions. For each of these test assemblies, the RIV level was recorded per the NEMA 107 method from approximately 1.2 times the corona extinction voltage until the RIV level was $<50\mu\text{V}$.

Equipment

Biddle 700 kV Series Resonant Set CQ2102

Singer-Stoddart NM-21 FFT Radio Noise Meter CQ2124

Princo Barometer CQ2215

Cole-Parmer Psychrodyne CN2157

Stoddart Electro Systems NM-25T Radio Interference and Field Intensity Meter

Procedure

Five different vertical double test assemblies were constructed at the NEETRAC High Voltage Laboratory during the test period. The hardware for each test was assembled and centered on the 18' span length. The complete assemblies were then positioned 12' from the ground plane. Care was taken to eliminate corona from all sources other than the test samples.

A test voltage was applied using a 60 Hz, 700kV Biddle series resonant test set. In a darkened laboratory, the voltage was raised to a level where substantial corona activity was detected. RIV measurements were taken for the assemblies using the procedure specified by NEMA 107- 1987(R1993). The voltage was lowered in steps until the RIV levels were in the background noise. RIV measurements were taken at each step. A Singer Stoddard NM21 FFT Radio Noise Meter was used to measure the RIV level in the 1MHz narrow band. An RIV factor of 0.286 was used to refer the RIV meter reading to the level actually present on the sample. This factor compensates for the attenuation through the voltage divider and power separation filter. Corona photographs were recorded, taken with a professional Polaroid camera using instant black and white film with an ASA rating of 3000 and a print size of 3" x 4". The lens aperture setting and exposure time are noted at the bottom of each corona photograph. A light intensifier was used to locate noise sources not visible to the naked eye. The light intensifier was a Javelin Model 222. This model is a second-generation unit with a gain of up to 70,000.

Conclusion

RIV and Corona test indicates AR Clamps are free of corona and RIV well above 345kV.

The corona and RIV properties of the hardware configurations were observed in this testing. Each assembly under test was energized and the voltage raised until the assembly was in full corona. The voltage was lowered in steps, and RIV values recorded using the procedure in NEMA 107 until the RIV levels were in the background noise. For all test assemblies, the RIV level fell below 50 μ V at a test voltage of 235kV, 150kV, 165kV, 190kV and 70kV respectively. All test voltages are line to ground values.

See Attached NEETRAC Report and Test Data

AR®Products using this AR®Clamp

- **AR Spacer Damper MOD2**
- **AR Twister | Slider**
- **AR Lightweight Spacer Damper**
- **AR Spacer Twister**

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Corona/RFI Testing of AR spacer/damper & AR clamp

NEETRAC Project Number 04-125

The test assembly consisted of a 15” hoop spacer damper installed approximately 4’ away from the corona ring at the end of the assembly. It was installed on the side of the configuration furthest away from the voltage supply. This spacer damper was installed between the two conductors on a diagonal. Before installing on the conductors, an insulating neoprene pad was placed on one half of each clamp. The corona sources from the line guards were covered with putty to remove their effects from the evaluation of the spacer damper unit (see Figure 14.). Corona rings were mounted at the ends of the 18’ span to eliminate corona from the aluminum tubing. Figure 15 contains a picture of the test as assembled in the laboratory.

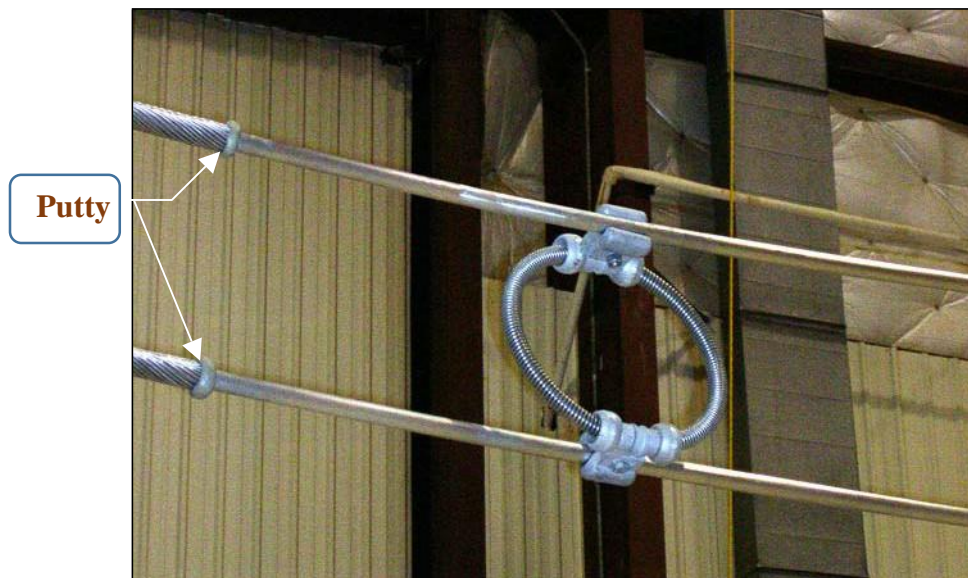


Figure 14: Close up view of Test Assembly #4 in Diagonal Configuration

The corona inception and extinction levels for this assembly were 255kV and 250kV respectively when the unit was 12’ from the ground plane. The RIV levels were recorded for the assembly at 12’ above the ground plane and are contained in Datasheet 4 and Figure 16. The corona photographs taken are presented in Figure 17.



Figure 15: Test Assembly

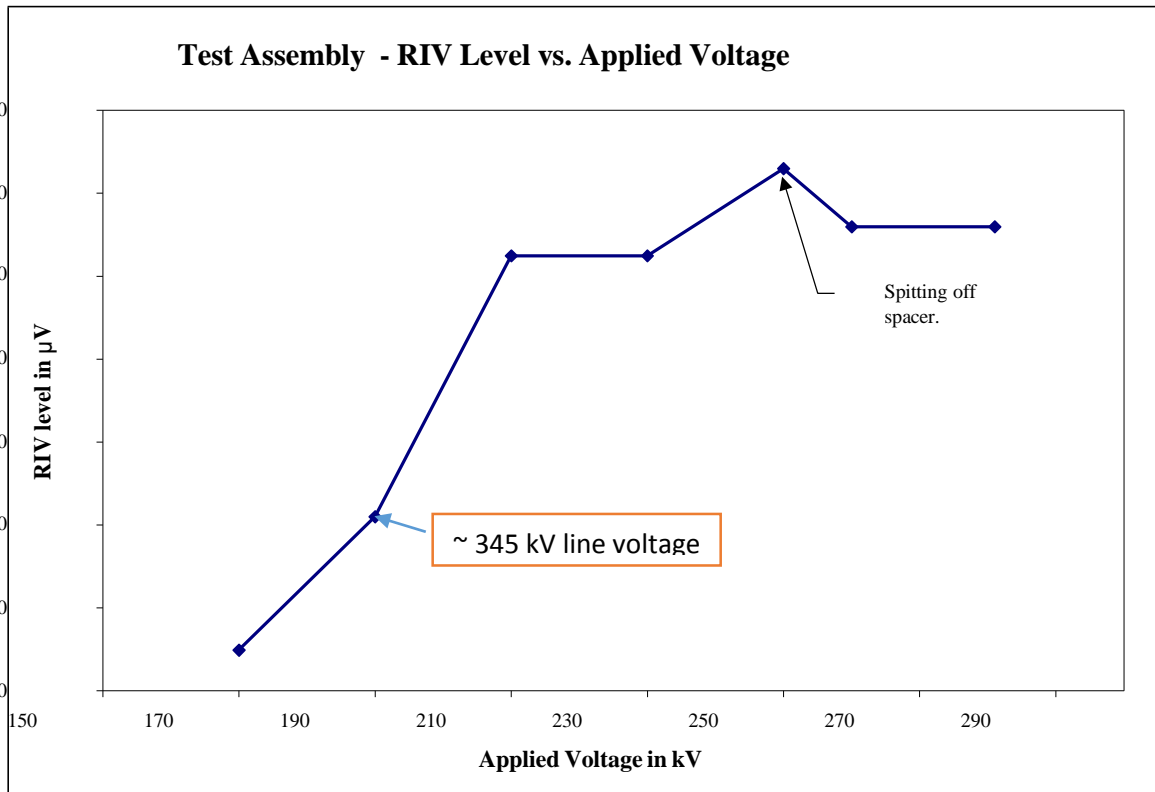


Figure 16: RIV Level Vs. Applied Voltage (Phase to Ground) for Test Assembly

**NEETRAC Project Number 04-125
AR Products, LLC
Hardware RIV Test
Test Assembly**

Performed By: Caryn M. Riley & David Harwell
Date: 6/10/2004

Equipment Used: CQ2102 - 700kV Series Resonant Test Set
- Singer Stoddart NM21FFT Radio Noise Meter

RIV Factor: 0.286 CQ2124

Atmospheric Conditions: 736.4 mmHg 63.5 °F Wet 74 °F Dry
Distance to Ground: 12' from bottom of lowest conductor to ground

Test Voltage (kV) L-N	RIV Meter Reading (uV)	Attenuation (dB)	RIV Level (uV)
281	16	0	56
260	16	0	56
250	18	0	63
230	15	0	52
210	15	0	52
190	60	-20	21
170	14	-20	5
Background	12	-20	4

Configuration Notes: Vertical Double Assembly
Two conductors - 1.25" OD Aluminum tubing
Item (4) - 15" hoop spacer with MOD VI-1-11/16" clamp with corona donuts with one steel washer inside donut, with 21" spring, with one spool between each half-clamp fitted on ring so that bolts point in opposite directions. Spacer/Damper is inside of bundle across the diagonal. One side of each clamp has neoprene pad insulator.

Datasheet 4: RIV Levels for Test Assembly

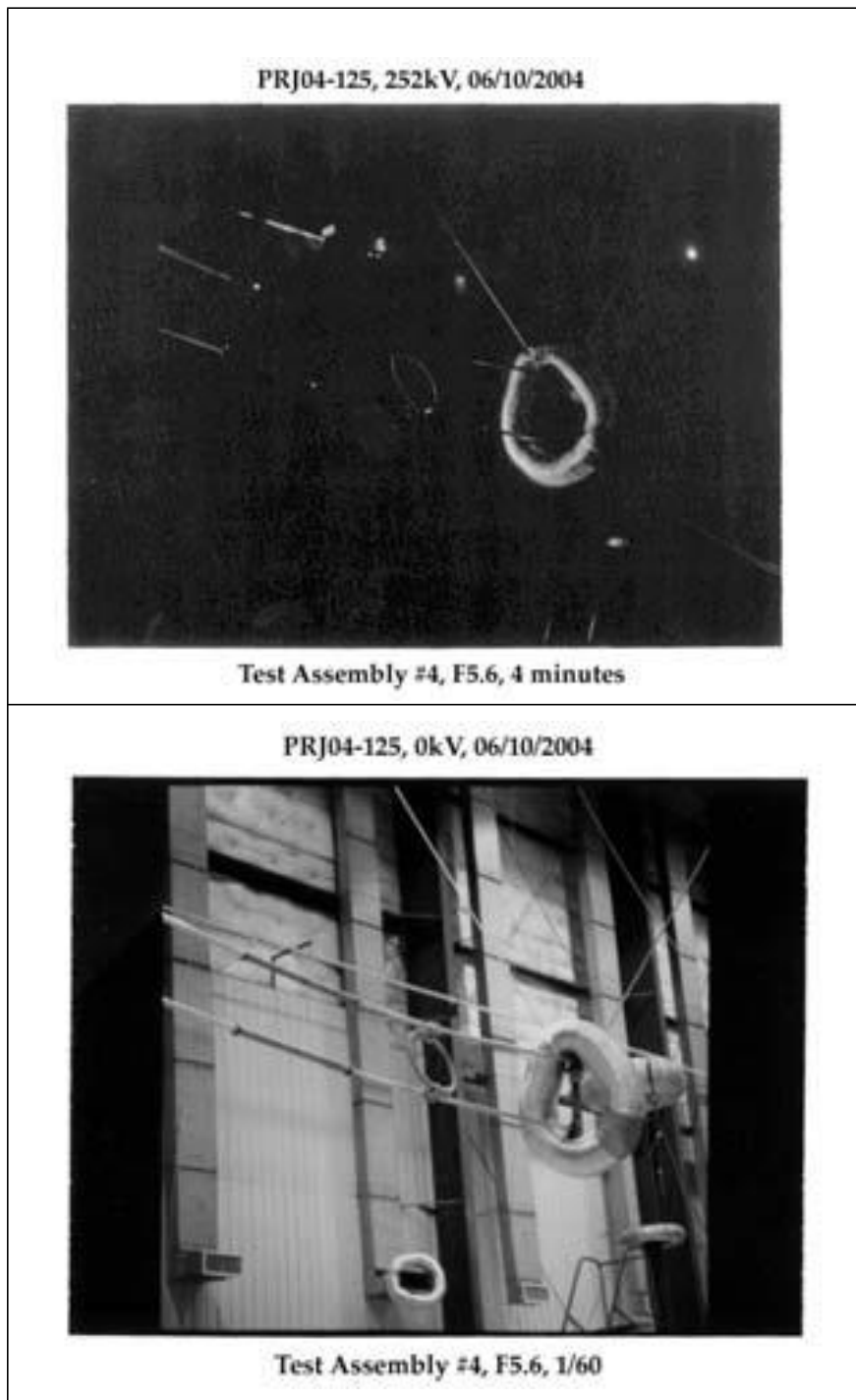


Figure 17: Corona photographs with test assembly in corona. Corona source is at the lower clamp washer area.