

**LIGHTNING IMPULSE TESTS ON THE ERITECH ERICORE (E3)  
LIGHTNING DOWNCONDUCTOR CABLE**

**for ERICO Inc., USA**

**SUMMARY**

This report presents the results of destructive lightning impulse tests carried out on 9 samples of the ERITECH ERICORE (E3) downconductor cable. The samples were stripped and terminated at both ends with Raychem "TFT-35 kV" series cold shrink terminations.

The cable samples were tested to destruction (either a tracking or catastrophic failure).

**The mean, loaded withstand voltage from the tests was 263 kV.**

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## INTRODUCTION

Nine terminated samples of the ERICORE cable were tested in order to determine the withstand voltage of the upper termination under lightning impulse (1.2/50  $\mu$ s) conditions.

Nine ERICORE E3 cable samples, each approx. 2.5 m long, terminated at both ends with the appropriate Raychem cold-shrink kits, and prepared according to the manufacturer's instructions were presented for testing.

Destructive lightning impulse tests on all cable samples supplied by ERICO were performed in the Tyco Electronics HV laboratory.

This report summarises the calibration, set-up, procedure, and results of the tests. In all of the tests, the impulse voltage was applied according to the procedure given in IEC 60230.

### Calibration Of Impulse Generator Output Voltage

Connection : The impulse generator was connected using eight stages in series.  
 $R_{\text{front\_internal}} 20 \Omega/\text{stage}$        $R_{\text{tail\_internal}} 138 \Omega/\text{stage}$

Atmospheric Conditions : Barometer 29.35 in.Hg, Dry Bulb 22.5°C, Humidity 46%

Waveform : Required rise time :  $1.2 \pm 30\%$       Required tail time :  $50 \mu\text{sec.} \pm 20\%$

Calibration : The overall measuring system is calibrated according to the manufacturer's specification and is traceable to NIST.

### Set-up

The cable was suspended across suitable insulating stands of height  $\sim 1$  m, ensuring that the distances were sufficient to avoid flashover at the highest test potential. At the midpoint of the length of cable the semi-conducting outer jacket of the cable was grounded. The test arrangement is shown in Figure 1.

All cable samples were tested in exactly the same manner, except for one (sample #2). In this case, the sample was subjected to a series of high current surges, ranges from 50 to 90 kA. The cable successfully handled these surge currents and hence was marked and placed in the batch of 9 cables to be tested with lightning impulse voltages. The test arrangement for the high-current surge tests on sample #2 is shown in Figure 2.

### Destructive Impulse Testing

Tests commenced at a peak voltage of  $< 200$  kV for all samples. Oscilloscope traces were used to measure and record the peak voltage applied to the cable. The voltage was increased in 10 kV steps until evidence of tracking or catastrophic breakdown occurred. A summary of the test results appears in Table 1. Appendix A shows some of the oscilloscope traces recorded during the tests.

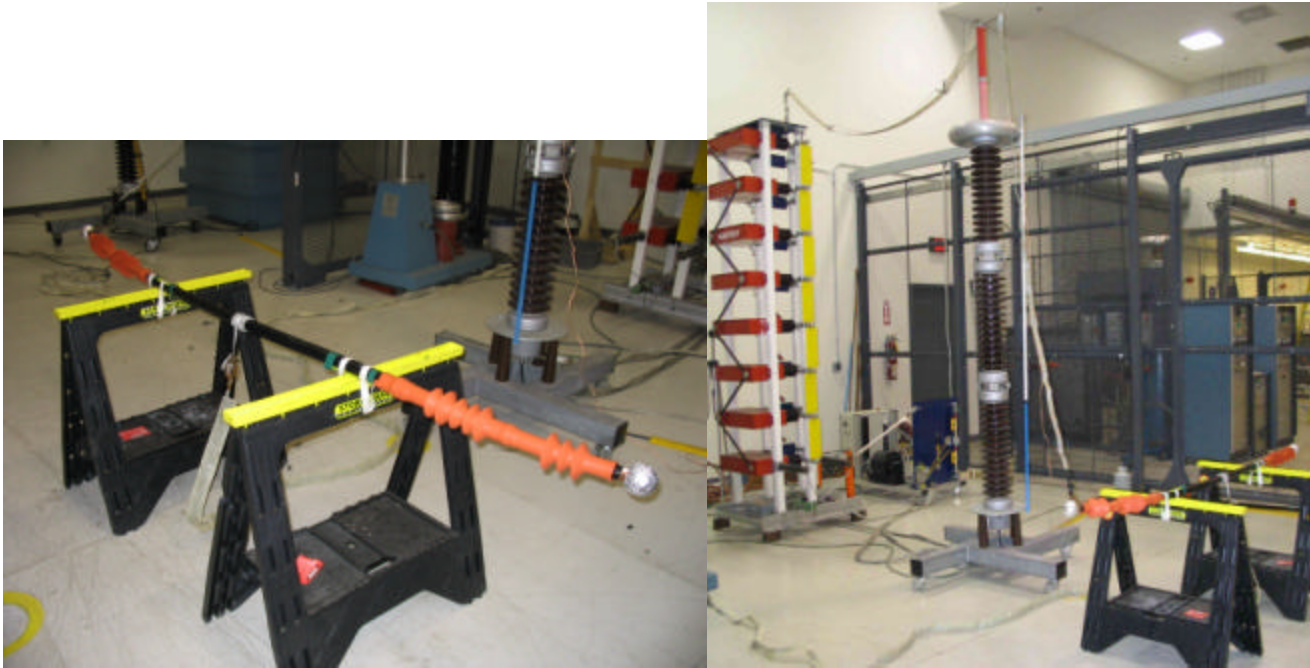


Figure 1: Test arrangement for the lightning impulse tests.

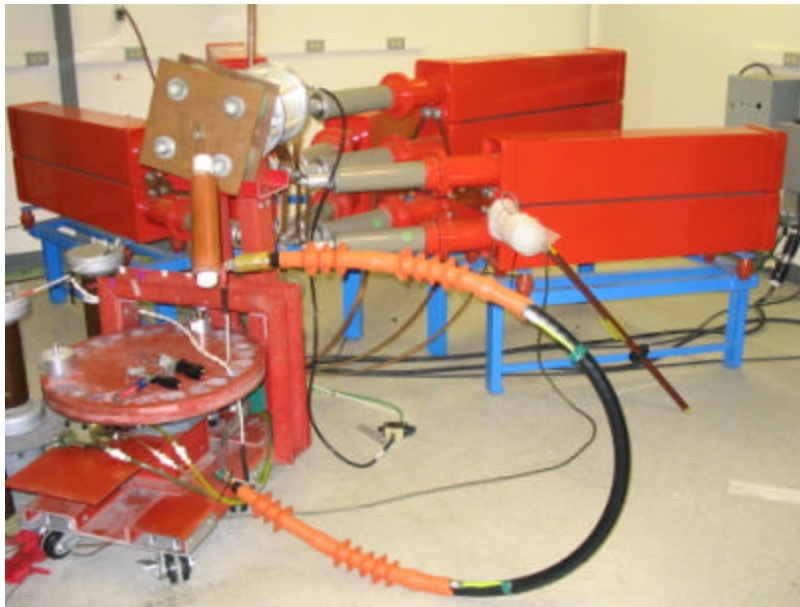


Figure 2: Test arrangement for the high-current surge test on cable sample #2.

**Table 1:** Breakdown voltages for the upper termination of 9 samples of ERITECH ERICORE (E3) cable.

| Sample number | Voltage polarity | Loaded withstand voltage (kV) | Comments   |
|---------------|------------------|-------------------------------|--|
| 1             | +                | 270                           | Start voltage 96 kV, tracking started @ 275 kV.    |
| 2             | -                | 250                           | Start voltage 138 kV, tracking started @ 253 kV.   |
| 3             | -                | 260                           | Start voltage 165 kV, puncture failure @ ~ 270 kV. |
| 4             | -                | 266                           | Start voltage 167 kV, puncture failure @ ~ 270 kV. |
| 5             | -                | 275                           | Start voltage 192 kV, tracking failure @ ~ 280 kV. |
| 6             | -                | 256                           | Start voltage 190 kV, cable failure @ ~ 266 kV.    |
| 7             | -                | 266                           | Start voltage 190 kV, tracking started @ 266 kV.   |
| 8             | -                | 263                           | Start voltage 191 kV, tracking started @ 266 kV.   |
| 9             | -                | 265                           | Start voltage 191 kV, tracking started @ 274 kV.   |

### Conclusion

From the tests conducted, it can be concluded that the mean, loaded withstand voltage of the samples supplied was:

$$263 \pm 7 \text{ kV}$$

Hence, it can be concluded that the upper termination of the ERITECH ERICORE (E3) cable is able to reliably withstand voltages in excess of 250 kV.

Appendix A

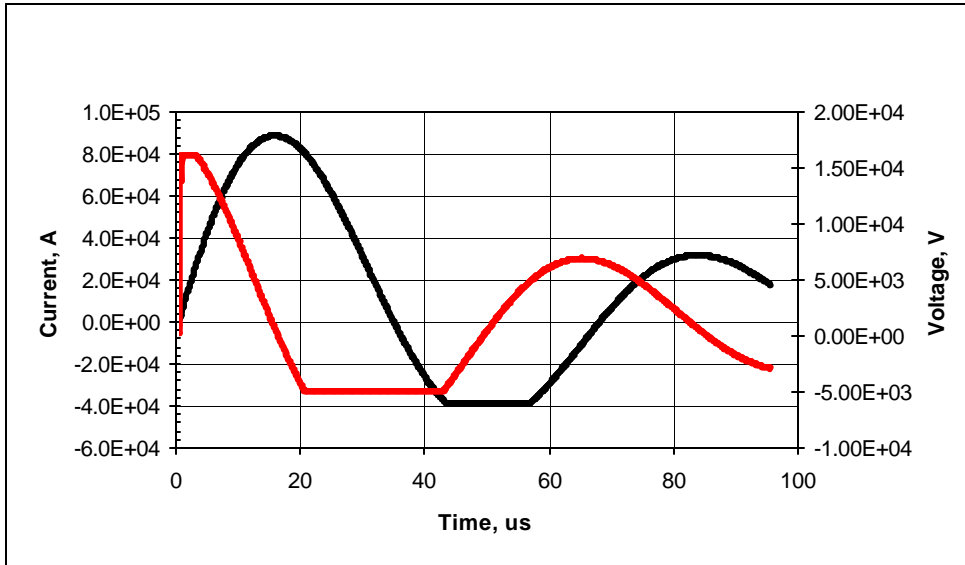


Fig. A1: 90 kA surge current applied to Sample #2.

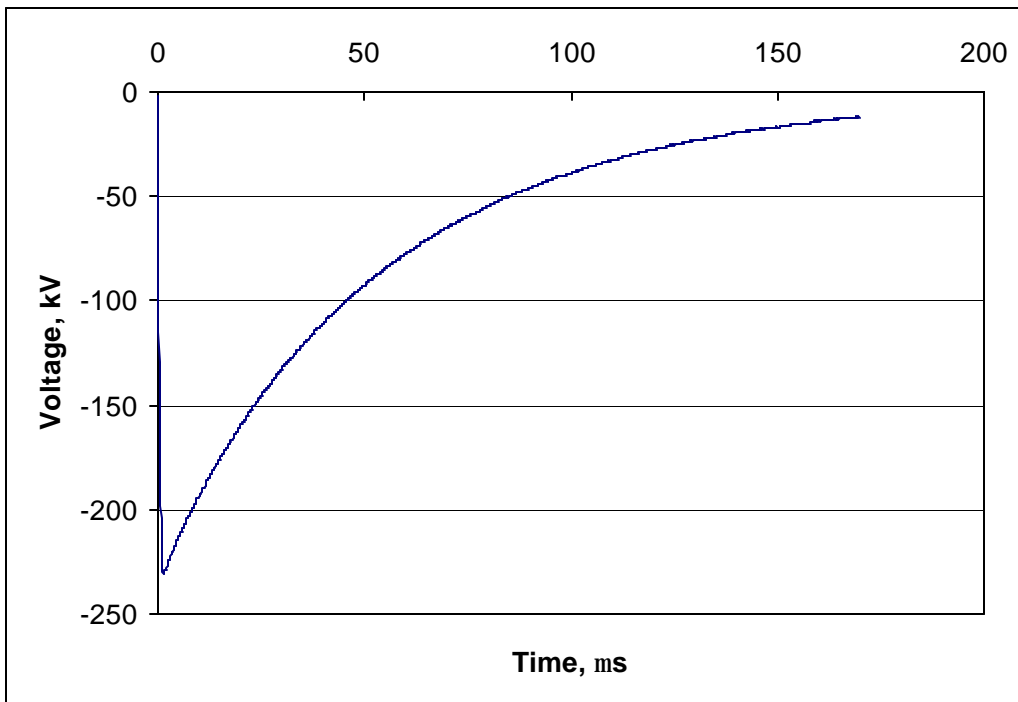


Fig. A2: Example of impulse voltage applied to the cable terminations (x axis is in  $\mu$ s).