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COOPER POWER SERIES

CERTIFIED
TEST REPORT

Eaton's Cooper Power™ Series

DEADFRONT ARRESTERS

Powering Business Worldwide

Eaton's Cooper Power Series

DEADFRONT ARRESTERS

CERTIFICATION

Statements made and data shown are, to the best of our knowledge and belief, correct and within the usual limits of commercial testing practice.

Paul M. Roscizewski
Chief Engineer

June 29, 2015

Date

INTRODUCTION

Eaton's Cooper Power™ series Deadfront M.O.V.E. and Parking Stand arresters are used to optimize the surge protection of deadfront URD systems.

The arresters are designed to operate easily with a hotstick. The designs are compact and provide a clean profile within the smallest pad-mounted cabinets.

Eaton's Cooper Power series 15 kV and 25 kV Class deadfront M.O.V.E. arresters are offered with the interface that mates to the 200 Amp loadbreak bushing that meets the dimensional requirements of IEEE Std 386™-2006 standard for separable connectors. The duty-cycle ratings offered are 3 kV to 21 kV.

Eaton's Cooper Power series 35 kV Class deadfront M.O.V.E arresters meet the dimensional requirements of IEEE Std 386™-2006 standard figure 8, No. 1A. The duty-cycle ratings offered are 3 kV to 36 kV.

Eaton's Cooper Power series 15 kV and 25 kV Class deadfront Parking Stand M.O.V.E arresters are offered with the 200 Amp loadbreak bushing interface that meets the dimensional requirements of IEEE Std 386™-2006 standard for the separable connectors. The duty-cycle ratings offered are 3 kV to 21 kV.

Eaton's Cooper Power series 25 kV Class deadfront POSI-BREAK™ M.O.V.E arresters are offered with the interface that mates to the 200 Amp loadbreak bushing that meets the dimensional requirements of IEEE Std 386™-2006 standard for separable connectors. The duty cycle ratings offered are 3 kV to 21 kV.

Eaton's Cooper Power series 35 kV Class DirectConnect™ M.O.V.E arresters are offered with an interface that with the use of an additional adapter mates to 35 kV Class 600 A deadbreak bushings that meet the dimensional requirements shown in IEEE Std 386™-2006 standard Figure 13. The duty-cycle ratings offered for the M.O.V.E arresters are 27 kV to 36 kV.

TEST PROGRAM

Objective:

To demonstrate that Eaton's Cooper Power series M.O.V.E. deadfront arresters tested meet each design test listed on this page below.

To demonstrate that Eaton's Cooper Power series POSI-BREAK M.O.V.E. deadfront arrester meets all performance requirements listed on page 5 of this document.

To demonstrate that Eaton's Cooper Power series DirectConnect M.O.V.E. arrester meets all performance requirements listed on page 6 of this document.

Procedure:

The following design tests were performed on a sufficient number of samples to demonstrate that both Eaton's Cooper Power series M.O.V.E. deadfront arrester meets all performance requirements.

Design Tests:

A. Discharge Voltage Current Characteristics ..... Per IEEE Std C62.11™-2005 standard, Para. 8.3.2.1
B. Discharge Voltage Time Characteristics ..... Per IEEE Std C62.11™-2005 standard, Para. 8.3.2.2
F. Accelerated Aging Procedure ..... Per IEEE Std C62.11™-2005 standard, Par. 8.5
G. Duty Cycle ..... Per IEEE Std C62.11™-2005 standard, Par. 8.14
H. Low-Current, Long-Duration ..... Per IEEE Std C62.11™-2005 standard, Par. 8.13
I. High-Current, Short-Duration ..... Per IEEE Std C62.11™-2005 standard, Par. 8.12
J. Temporary Overvoltage ..... Per IEEE Std C62.11™-2005 standard, Par. 8.15
K. Deadfront Arrester Failure Mode ..... Per IEEE Std C62.11™-2005 standard, Par. 8.20
L. Corona Testing of Housing ..... Per IEEE Std 386™-2006 standard, Par. 7.4
M. Impulse Testing of Housing ..... Per IEEE Std 386™-2006 standard, Par. 7.5.3
N. AC Hipot Testing of Housing ..... Per IEEE Std 386™-2006 standard, Par. 7.5.1
O. DC Hipot Testing of Housing ..... Per IEEE Std 386™-2006 standard, Par. 7.5.2

Results:

See following design tests A through O for results.

TEST PROGRAM –

Deadfront POSI-BREAK M.O.V.E Arrester

The design of the arrester portion of Eaton's Cooper Power series M.O.V.E. deadfront arrester has not been modified in any way, and the functionality of this product has not been altered. All expected electrical performance and surge protection provided by a specifically rated M.O.V.E deadfront arrester is maintained when substituting to the POSI-BREAK design interface.

The only design change implemented in the POSI-BREAK M.O.V.E. deadfront arrester is in the mating interface of the rubber elbow housing. In addition, the current POSI-BREAK probe is used in place of the present M.O.V.E. deadfront probe.

In order to demonstrate that the design of Eaton's Cooper Power series POSI-BREAK M.O.V.E. deadfront arrester meets the performance requirements to prevent partial vacuum induced switching flashovers and normal operating requirements, a sufficient number of samples shall pass the requirements of the tests listed below:

P. Operating Force Test.....Per IEEE Std 386™-2006 standard, Par. 7.14
Q. Operating Interface AC Withstand Test.....Per IEEE Std 386™-2006 standard, Annex B, Option B
R. Corona Testing of Housing .....Per IEEE Std 386™-2006 standard, Par. 7.4
S. Impulse Testing of Housing .....Per IEEE Std 386™-2006 standard, Par. 7.5.3
T. AC Hipot Testing of Housing.....Per IEEE Std 386™-2006 standard, Par. 7.5.1
U. DC Hipot Testing of Housing .....Per IEEE Std 386™-2006 standard, Par. 7.5.2

Results:

See following design tests P through U for results.

TEST PROGRAM –

Deadfront DirectConnect M.O.V.E Arrester

The design of the arrester portion of Eaton's Cooper Power series DirectConnect M.O.V.E. arrester has not been modified in any way, and the functionality of this product has not been altered. All expected electrical performance and surge protection provided by a specifically rated deadfront M.O.V.E arrester is maintained when substituting to the DirectConnect arrester design interface.

The only design change implemented in the deadfront DirectConnect M.O.V.E. arrester is in the mating interface of the rubber elbow housing.

P. Operating Force Test……..... Per IEEE Std 386™-2006 standard, Par. 7.14
R. Corona Testing of Housing…… ..... Per IEEE Std 386™-2006 standard, Par. 7.4
S. Implulse testing of Housing……..... Per IEEE Std 386™-2006 standard, Par. 7.5.3
T. AC Hipot Testing of Housing……..... Per IEEE Std 386™-2006 standard, Par. 7.5.1
U. DC Hipot Testing of Housing……..... Per IEEE Std 386™-2006 standard, Par. 7.5.2

Results:

See following design tests P through U for results.

TEST A

DISCHARGE VOLTAGE CURRENT CHARACTERISTICS

Objective:

To determine the maximum discharge voltage characteristics of the arrester at 0.5, 1.5, 3.0, 5.0, 10.0 and 20 kA crest in accordance with IEEE Std C62.11™-2005 standard, Paragraph 8.3.2.1.

Procedures:

- Sample arresters were connected directly to ground without using the normal 3 foot ground leads.
- The samples were impulsed using an 8x20 μs wave shape at 0.5, 1.5, 3.0, 5.0, 10.0 and 20 kA crest.
- The discharge voltage crest was measured.

Results:

Chart 1 shows the maximum discharge voltages for deadfront M.O.V.E. arresters.

TEST B

DISCHARGE VOLTAGE TIME CHARACTERISTICS

Objective:

To obtain the front-of-wave protective level of the arrester based on 5 kA crest impulse that results in a discharge voltage cresting in 0.5 μs in accordance with IEEE Std C62.11™-2005 standard, Paragraph 8.3.2.2.

Procedures:

- Sample arresters were connected directly to ground without using the normal 3 foot ground leads.
- A classifying current of 5 kA crest was used to determine the protective level.
- The arresters were impulsed using front times of 8 μs, 2 μ and 1 μs.
- The maximum discharge voltage and the time to voltage crest were measured.
- The voltage/time measurements were plotted on linear voltage versus log time paper and the maximum voltage at 0.5 μs was determined.

Results:

Chart 1 shows the front-of-wave protective levels for deadfront M.O.V.E. arresters.

TEST F

ACCELERATED AGING PROCEDURE

Objective:

To verify the K_C and K_R ratios of Eaton's Cooper Power series deadfront arrester in accordance with IEEE Std C62.11™-2005 standard, Paragraph 8.5.

K_C = MCOV Ratio
K_R = Duty Cycle Ratio

These ratios were determined to calculate the test values of MCOV and duty cycle voltages used during testing.

Procedures:

- Samples were placed in an oven at 115 °C and energized at MCOV for 2,000 hours.
- The watts loss was measured at 5 hours at the MCOV and duty cycle voltage levels.
- The watts loss was remeasured at 2,000 hours at MCOV and duty cycle voltage levels.

- $K_C = \frac{\text{Watts Loss @ 2,000 Hrs @ MCOV}}{\text{Watts Loss @ 5 Hrs @ MCOV}}$

- $K_R = \frac{\text{Watts Loss @ 2,000 Hrs @ DC Voltage}}{\text{Watts Loss @ 5 Hrs @ DC Voltage}}$

- If K_C and $K_R \leq 1$, then K_C and K_R are equal to 1.

Results:

- K_C and $K_R = 1$.

TEST G

DUTY CYCLE

Objective:

To demonstrate that Eaton's Cooper Power series deadfront arresters meet the duty cycle requirements in accordance with IEEE Std C62.11™-2005 standard, Paragraph 8.14.

Procedures:

- Each sample was impulsed with a 5 kA crest, 8x20 μs wave and the discharge voltage measured.
- Each sample was energized at K_R times the duty cycle voltage (K_R = 1), for the duration of time needed to allow 20 impulses.
- Each sample was impulsed with a 5 kA crest surge of 8x20 μs wave shape.
- The impulse occurred at approximately 60° before the crest on the power frequency wave.
- Each sample was impulsed once every 50 to 60 seconds for 20 consecutive impulses.
- After the 20^{th} impulse, the sample was de-energized and placed into an oven until it stabilized at 85 °C.
- Each sample was removed from the oven and immediately energized at K_R times the duty cycle voltage, K_R = 1 and impulsed twice more.
- Immediately after, the samples were energized at K_C times MCOV, (K_C =1), for 30 minutes minimum to show that there was no thermal recovery problem.
- Each sample was impulsed with a 5 kA crest 8x20 μs wave and the discharge voltage measured. The discharge voltage was compared to the discharge voltage taken prior to duty cycle to make sure that it did not vary by more than ±10%.
- The samples were inspected after testing to assure that no physical damage occurred.

Results:

Eaton's Cooper Power series deadfront arresters met the duty cycle test requirements of 22 impulses, thermal recovery, <10% change in discharge voltage, and no physical damage.

TEST H

LOW-CURRENT, LONG-DURATION

Objective:

To demonstrate that Eaton's Cooper Power series deadfront arresters meet the low-current, long-duration requirements in accordance with IEEE Std C62.11™-2005 standard, Paragraph 8.13.

Procedures:

- Each sample was impulsed with a 5 kA crest, 8x20 μs wave and the discharge voltage measured.
- Each sample was impulsed six times, once every 50 to 60 seconds. The sample was allowed to cool to room temperature. This procedure was repeated two more times.
- Immediately after the 18th shot, the sample was placed into an oven until it stabilized at 85 °C.
- The sample was removed from the oven and impulsed two more times.
- Immediately after the 20th shot, the sample was energized at K_C times MCOV (K_C = 1) for 30 minutes minimum to show that there was no thermal recovery problem.
- Each sample was impulsed with a 5 kA crest 8x20 μs wave and the discharge voltage measured. The discharge voltage was compared to the discharge voltage taken prior to the low-current, long-duration testing to make sure that it did not vary by more than ±10%.
- The samples were inspected after testing to assure that no physical damage occurred.

Results:

Eaton's Cooper Power series deadfront arresters met the low-current, long-duration requirements of 20 impulses, thermal recovery, <10% change in discharge voltage, and no physical damage.

TEST I

HIGH-CURRENT, SHORT-DURATION

Objective:

To demonstrate that Eaton's Cooper Power series deadfront arresters meet the high-current, short-duration requirements in accordance with IEEE Std C62.11™-2005 standard, Paragraph 8.12.

Procedures:

- Samples were preheated to 45 °C.
- Each sample was impulsed with a 40 kA crest current wave with a wave shape of 4x10 μs.
- After one impulse, the sample was placed back into a 45 °C oven and stabilized at that temperature.
- Each sample was impulsed a second time.
- Immediately following the second impulse, the sample was energized at K_C times MCOV (K_C = 1) for 30 minutes to show that there was no thermal recovery problem.
- The samples were inspected after testing to make sure that no physical damage occurred to make them operate differently.

Results:

Eaton's Cooper Power series deadfront arresters met the high-current, short duration requirements of two impulses, thermal recovery, and no physical damage.

SECTION J

T.O.V. TEMPORARY OVERVOLTAGE

Objective:

To verify what levels of 60 cycle temporary overvoltage Eaton's Cooper Power series deadfront arresters survive in accordance with IEEE Std C62.11™-2005 standard, Paragraph 8.15.

Procedures:

- Each sample was impulsed with a 5 kA crest, 8x20 μs wave and the discharge voltage measured.
- Samples were preheated to 85 °C.
- Each sample was removed from the oven and immediately placed onto the bushing and energized at the overvoltage.
- The overvoltage was removed before sample failure.
- Within 1 second, each sample was energized at MCOV for 30 minutes. Sample current and temperature were monitored for thermal runaway.
- Each sample was impulsed with a 5 kA crest 8x20 μs wave and the discharge voltage measured. The discharge voltage was compared to the discharge voltage taken prior to the Temporary Overvoltage testing to make sure that it did not vary by more than ±10%.
- The samples were inspected after testing to assure that no physical damage occurred.
- Minimum recovery points were plotted.

Results:

Graph 1 and Chart 2 show the performance results for deadfront M.O.V.E. arresters.

TEST K

DEADFRONT ARRESTER FAILURE MODE

Objective:

To verify that Eaton's Cooper Power series deadfront arresters are able to withstand valve block failures without ejecting arrester parts through the body of the housing, in accordance with IEEE Std C62.11™-2005 standard, Paragraph 8.20.

Procedures:

- 10 kV rated 15 kV Class M.O.V.E. arresters were used for this test.
- Samples were electrically failed using a higher than rated voltage from a low-current source transformer at 60 Hz.
- The overvoltage was left on the samples until the short circuit current level of the source transformer was reached.
- The overvoltage was turned off, and within a few cycles, rated voltage was applied.
- Three samples were tested with an available fault current of 500 Amps for 0.3 seconds.
- Three samples were tested with an available fault current of 10,000 Amps for 0.17 seconds.

Results:

Eaton's Cooper Power series deadfront arrester samples withstood valve block failures without ejecting arrester parts through the body of the housing.

TEST L

CORONA VOLTAGE LEVEL TEST

Objective:

To verify that Eaton's Cooper Power series deadfront arresters meet corona extinction levels in accordance with IEEE Std 386™-2006 standard, Paragraph 7.4.

Procedures:

- Ten samples of each size and type of housing were tested.
- The test voltage was raised to 20% above the minimum corona voltage level.
- If the corona was less than 3 pC, the sample passed the tests.
- If the corona exceeded 3 pC, the test voltage was lowered to the minimum corona voltage.
- Corona readings were taken after 3 sec. and before 60 sec. The readings could not exceed 3 pC.

kV Class	Max. Voltage Rating (kV rms)	Min. Corona Voltage Level (kV rms)
15	8.3 / 14.4	11
25	15.2 / 26.3	19
35	21.1 / 36.6	26

Results:

Eaton's Cooper Power series deadfront arrester samples all passed the minimum corona requirements of IEEE Std 386™-2006 standard, Paragraph 7.4.

TEST M

IMPULSE WITHSTAND VOLTAGE TEST (BIL)

Objective:

To demonstrate that Eaton's Cooper Power series deadfront arrester housings meet the impulse withstand voltage test in accordance with IEEE Std 386™-2006 standard, Paragraph 7.5.3.

Procedures:

- Ten samples of each size and type of housing were tested.
- The samples were subjected to 3 positive and 3 negative 1.2x50 μs impulses. The crest values are listed below.
- The samples had to withstand all impulses without flashover or puncture.

kV Class	Max. Voltage Rating (kV rms)	Crest Voltage (kV)
15	8.3 / 14.4	95
25	15.2 / 26.3	125
35	21.1 / 36.6	150

Results:

Eaton's Cooper Power series deadfront arrester samples all passed the impulse requirements of IEEE Std 386™-2006 standard, Paragraph 7.5.3.

TEST N

AC WITHSTAND VOLTAGE TEST

Objective:

To verify that Eaton's Cooper Power series deadfront arrester housings meet the ac withstand voltage levels in accordance with IEEE Std 386™-2006 standard, Paragraph 7.5.1.

Procedures:

- Ten samples of each size and type of housing were tested.
- The test voltage was raised to the specified voltage withstand level listed below for one minute minimum.
- No flashover of puncture was allowed.

kV Class	Max. Voltage Rating (kV rms)	AC Withstand Level (kV)
15	8.3 / 14.4	34
25	15.2 / 26.3	40
35	21.1 / 36.6	50

Results:

Eaton's Cooper Power series deadfront arrester samples all passed the ac withstand test in accordance with IEEE Std 386™-2006 standard, Paragraph 7.5.1.

TEST O

DC WITHSTAND VOLTAGE TEST

Objective:

To verify that Eaton's Cooper Power series deadfront arrester housings meet the dc withstand voltage level in accordance with IEEE Std 386™-2006 standard, Paragraph 7.5.2.

Procedures:

- Ten samples of each size and type of housing were tested.
- The test voltage was raised to the specified voltage withstand level listed below for 15 minutes minimum.
- No flashover or puncture was allowed.

kV Class	Max. Voltage Rating (kV rms)	DC Withstand Level (kV)
15	8.3 / 14.4	53
25	15.2 / 26.3	78
35	21.1 / 36.6	103

Results:

Eaton's Cooper Power series deadfront arrester samples all passed the dc withstand test in accordance with IEEE Std 386™-2006 standard, Paragraph 7.5.2.

TEST P

Operating Force Test

Objective:

To verify that the force necessary to operate Eaton's Cooper Power series deadfront POSI-BREAK M.O.V.E. arrester and DirectConnect arrester meet the requirements of Paragraph 7.14 of IEEE Std 386™-2006 standard.

Procedures:

- Four samples of the POSI-BREAK M.O.V.E. arrester and four samples of the DirectConnect M.O.V.E. arrester were tested.
- The elbows were assembled with a probe and MOV block assembly. The connector system was lubricated in accordance with the manufacturer's instructions.
- The temperature of the components was set at –20 ^{o}C, +25 ^{o}C and +65 ^{o}C respectively, for three separate tests.
- Each test consisted of closing the connector and then reopening it within 10 minutes.
- The force was applied to the operating eye parallel to the axis of the probe at a rate of 127 mm/min (5 in/min).
- The required operating force over the environmental range of –20 ^{o}C to +65 ^{o}C shall be between 50-200 lbf.

Results:

Eaton's Cooper Power series deadfront POSI-BREAK M.O.V.E. arrester samples and deadfront DirectConnect M.O.V.E. arrester samples all passed the operating force test in accordance with IEEE Std 386™-2006 standard, Paragraph 7.14. Each set of four connector/bushing insert assemblies had operating forces between 50 lbf and 200 lbf at –20 ^{o}C, +25 ^{o}C and +65 ^{o}C.

TEST Q

Operating Interface AC Withstand Test – Annex B, Option B

Objective:

To demonstrate that Eaton's Cooper Power series deadfront POSI-BREAK M.O.V.E. arresters are capable of performing an opening operation under high operating force, low temperature, elevated voltage and zero load current conditions without a flashover to ground.

Procedures:

- Insulative plugs were assembled into 16 POSI-BREAK M.O.V.E. arrester housings in place of the arrester blocks.
- The 16 samples were then installed onto 25 kV bushing inserts with beveled latch ring – catalog # LBI225 (p/n 2690557D53 rev. 70). The 200 Amp operating interface was lubricated according to the manufacturer's instructions with the complete contents of the packet of silicone grease supplied with the M.O.V.E arrester.
- All 16 connector assemblies were heat aged at 120 °C $\pm$ 5 ^{o}C for a total of 3 weeks.
- After the full 3 weeks in the oven at 120 °C $\pm$ 5 ^{o}C, all the connector assemblies were removed and allowed to cool to ambient. The test samples were then placed in a cold chamber at –20 to –25 ^{o}C for a minimum of 16 hours.
- For 12 of the 16 test samples, one sample was removed at a time from the cold chamber and mounted to the faceplate of a grounded test stand. Adjacent grounds were not required. The face plate mounting was equipped with threaded mounting studs and a bushing well clamp located in a manner duplicating a typical field application. The separable connector, POSI-BREAK M.O.V.E. arrester, was separated from the bushing within 5 minutes after removal from the cold chamber. The opening operation was performed with a positive continuous motion applied by a mechanical actuator at 35-in/sec average speed over the initial 1 inch of travel. The force was applied to the operating eye of the connector using suitable live-line tool or equivalent.
- The test circuit and circuit parameters are detailed in the following Figure A and Table A. The line-to-ground test voltage for the 15.2/26.3 kV rated connectors was 30.5 kV rms. (2x Rated L-G voltage.)
- The opening force of the four remaining samples was measured. A force was applied to the operating eye parallel to the axis of the probe at a rate of 5-in/min.

FIGURE A
Circuit Diagram

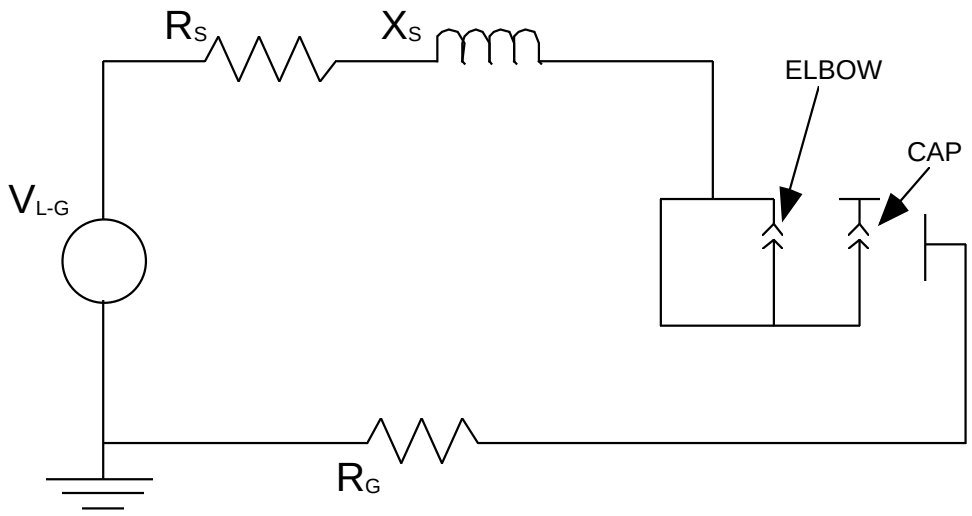


TABLE A
Circuit Parameters

V_{LG} = 2 X (RATED L-G Voltage)

$Z_S = X_S + R_S$

X_S/R_S = 5.0 – 7.0

$Z_S \geq 0.10 \times R_G$

$I_F = V/(Z_S + R_G) \geq 50$ Amps

Results:

Twelve consecutive Eaton's Cooper Power series deadfront POSI-BREAK M.O.V.E. arresters were successfully switched when mated with an Eaton's Cooper Power series 25 kV bushing insert with beveled latch ring without flashover to ground at 30.5 kV line-to-ground test voltage in accordance with Annex B, Option B of IEEE Std 386™-2006 standard. The opening force measured ranged from 165 – 258 lbf.

TEST R

CORONA VOLTAGE LEVEL TEST
25 kV – POSI-BREAK Interface
35 kV – DirectConnect Interface

Objective:

To verify that Eaton's Cooper Power series deadfront POSI-BREAK M.O.V.E. arrester and DirectConnect M.O.V.E. arrester meet corona extinction levels in accordance with IEEE Std 386™-2006 standard, Paragraph 7.4.

Procedures:

- Ten samples of the POSI-BREAK M.O.V.E. arrester housing and ten samples of the DirectConnect M.O.V.E. arrester were tested.
- The test voltage was raised to 20% above the minimum corona voltage level.
- If the corona was less than 3 pC, the sample passed the tests.
- If the corona exceeded 3 pC, the test voltage was lowered to the minimum corona voltage.
- Corona readings were taken after 3 sec. and before 60 sec. The readings could not exceed 3 pC.

kV Class	Max. Voltage Rating (kV rms)	Min. Corona Voltage Level (kV rms)
25	15.2 / 26.3	19

Results:

Eaton's Cooper Power series deadfront POSI-BREAK M.O.V.E. arrester samples and DirectConnect M.O.V.E. arrester samples all passed the minimum corona requirements of IEEE Std 386™-2006 standard, Paragraph 7.4.

TEST S

IMPULSE WITHSTAND VOLTAGE TEST (BIL) 25 kV – POSI-BREAK Interface 35 kV – DirectConnect Interface

Objective:

To demonstrate that Eaton's Cooper Power series deadfront POSI-BREAK M.O.V.E. arrester and DirectConnect M.O.V.E. arrester housings meet the impulse withstand voltage test in accordance with IEEE Std 386™-2006 standard, Paragraph 7.5.3.

Procedures:

- Ten samples of the POSI-BREAK M.O.V.E. arrester housing and ten samples of the DirectConnect M.O.V.E. arrester housing were tested.
- The samples were subjected to 3 positive and 3 negative 1.2x50 μs impulses. The crest values are listed below.
- The samples had to withstand all impulses without flashover or puncture.

kV Class	Max. Voltage Rating (kV rms)	Crest Voltage (kV)
25	15.2 / 26.3	125

Results

Eaton's Cooper Power series Deadfront POSI-BREAK M.O.V.E. arrester samples and DirectConnect M.O.V.E. arrester housings all passed the impulse requirements of IEEE Std 386™-2006 standard, Paragraph 7.5.3.

TEST T

AC WITHSTAND VOLTAGE TEST

25 kV – POSI-BREAK Interface
35 kV – DirectConnect Interface

Objective:

To verify that Eaton's Cooper Power series deadfront POSI-BREAK M.O.V.E. arrester and Deadfront DirectConnect M.O.V.E. arrester housings meet the ac withstand voltage levels in accordance with IEEE Std 386™-2006 standard, Paragraph 7.5.1.

Procedures:

- Ten samples of the POSI-BREAK M.O.V.E. arrester housing and ten samples of the DirectConnect M.O.V.E. arrester housing were tested.
- The test voltage was raised to the specified voltage withstand level listed below for one minute minimum.
- No flashover of puncture was allowed.

kV Class	Max. Voltage Rating (kV rms)	AC Withstand Level (kV)
25	15.2 / 26.3	40

Results:

Eaton's Cooper Power series deadfront POSI-BREAK M.O.V.E. arrester samples and Deadfront DirectConnect M.O.V.E. arrester housings all passed the ac withstand test in accordance with IEEE Std 386™-2006 standard, Paragraph 7.5.1.

TEST U

DC WITHSTAND VOLTAGE TEST

25 kV – POSI-BREAK Interface
35 kV – DirectConnect Interface

Objective:

To verify that Eaton's Cooper Power series deadfront POSI-BREAK M.O.V.E. arrester and Deadfront DirectConnect M.O.V.E. arrester housings meet the dc withstand voltage level in accordance with IEEE Std 386™-2006 standard, Paragraph 7.5.2.

Procedures:

- Ten samples of the POSI-BREAK M.O.V.E. arrester housing and ten samples of the DirectConnect M.O.V.E. arrester housing were tested.
- The test voltage was raised to the specified voltage withstand level listed below for 15 minutes minimum.
- No flashover or puncture was allowed.

kV Class	Max. Voltage Rating (kV rms)	DC Withstand Level (kV)
25	15.2 / 26.3	78

Results:

Eaton's Cooper Power series deadfront POSI-BREAK M.O.V.E. arrester samples and Deadfront DirectConnect M.O.V.E. arrester samples all passed the dc withstand test in accordance with IEEE Std 386™-2006 standard, Paragraph 7.5.2.

CHART 1

M.O.V.E. ARRESTERS

DUTY CYCLE VOLTAGE RATING (kV)	MCOV kV	EQUIVALENT FRONT-OF-WAVE (kV)	MAXIMUM DISCHARGE VOLTAGE (kV CREST) 8/20 μs Current Wave)				
			1.5kA	3kA	5kA	10kA	20kA
3	2.55	11.0	9.0	9.7	10.4	11.4	13.0
6	5.1	22.0	18.0	19.4	20.8	22.7	26.0
9	7.65	31.7	26.0	28.0	30.0	32.8	37.4
10	8.4	33.0	27.0	29.1	31.2	34.1	38.9
12	10.2	41.5	33.9	36.6	39.2	42.9	48.9
15	12.7	51.8	42.4	45.7	49.0	53.6	61.1
18	15.3	62.2	50.9	54.9	58.8	64.3	73.4
21	17.0	66.0	54.0	58.2	62.4	68.2	77.9
24	19.5	77.0	63.0	67.9	72.8	79.6	90.8
27	22.0	87.2	71.4	76.9	82.4	90.1	103.0
30	24.4	97.1	79.5	85.7	91.8	100.0	115.0
33	27.0	108.0	87.8	95.1	102.0	112.0	127.0
36	29.0	116.0	95.3	103.0	110.0	120.0	137.0

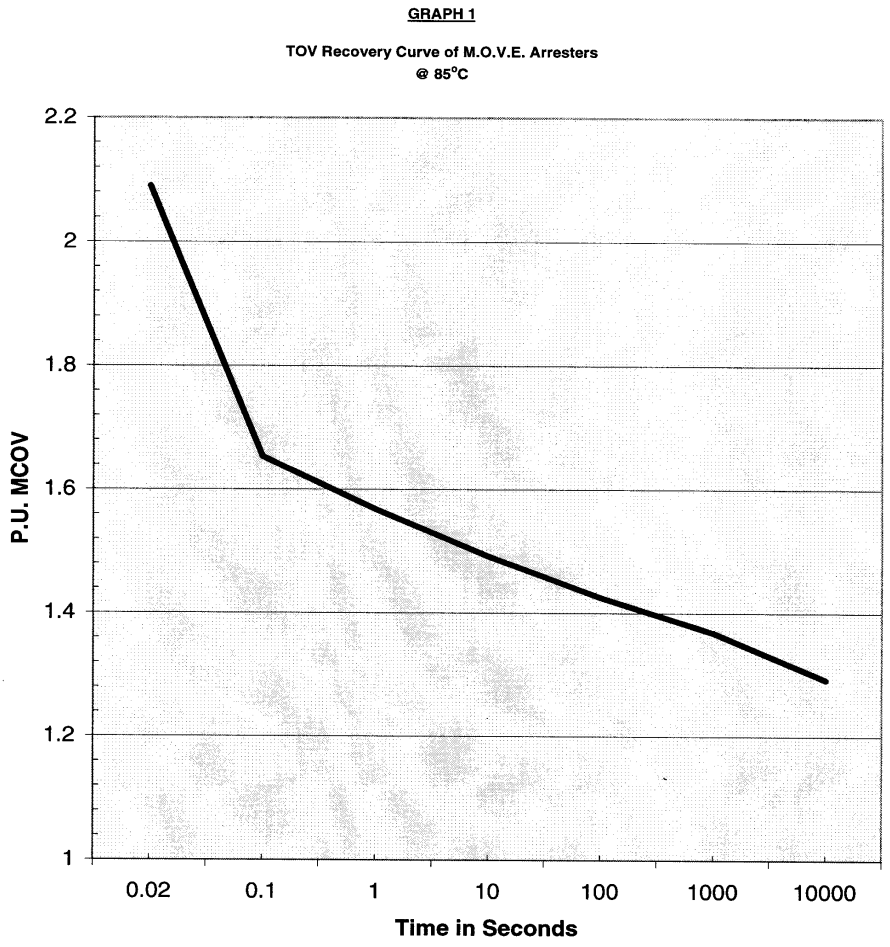
CHART 2

TOV RECOVERY CAPABILITY OF
M.O.V.E. ARRESTERS AT 85 °C

time, s	per unit of MCOV
0.02	2.090
0.1	1.653
1	1.568
10	1.492
100	1.425
1000	1.368
10000	1.292

GRAPH 1

TOV Recovery Curve of M.O.V.E. Arresters at 85°C



REVISION TABLE

REVISION NO.	DATE	WHAT WAS ADDED/CHANGED
3	9/21/04	Update standard references throughout report
4	3/01/07	Update Graph 1
5	3/20/07	Modify Chart 2
6	3/23/07	Modify report reference new standards
7	11/6/07	Add Test Results of POSI-BREAK M.O.V.E
8	9/15/10	Add 35 kV Class DirectConnect M.O.V.E. and VariGAP to Introduction
9	6/01/11	Add 36 kV Duty Cycle. Modify Chart 1 and Chart 3.
10	6/29/15	Removed VariGAP references, assigned new document number

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