

GENERAL  ELECTRIC

RESEARCH
AND
DEVELOPMENT
CENTER

SCHENECTADY, NEW YORK

CLASS 1

THE USE AND MISUSE OF MULTIPLE REGRESSION
IN IDENTIFYING IMPORTANT PROCESS VARIABLES

by

G. J. Hahn and S. S. Shapiro

Report No. 66-C-178

May 1966

GENERAL  ELECTRIC

RESEARCH
AND
DEVELOPMENT
CENTER

SCHENECTADY, NEW YORK

CLASS 1

THE JOINT ASSESSMENT OF NORMALITY
OF SEVERAL INDEPENDENT SAMPLES

by

S. S. Shapiro and M. B. Wilk*
Information Sciences Laboratory

Report No. 67-C-322

August 1967

*Bell Telephone Laboratories, Inc.

GENERAL ELECTRIC

SPECIAL INFORMATION PRODUCTS DEPARTMENT

TECHNICAL INFORMATION SERIES

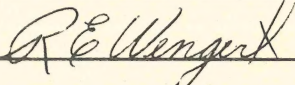
AUTHORS C.E. Pangburn C. Arabadjis	SUBJECT Statistics	NO. R67SIPD12 DATE 18 April 1967
TITLE The Log-Normal Distribution		GE CLASS 1 GOVT. CLASS. Unclassified
REPRODUCIBLE COPY FILED AT Guidance Library, SIPD, Rm. N-4, CSP-5, Syracuse, New York		NO. PAGES
SUMMARY This report provides engineers and technicians with tools by which they can determine whether data is log-normally distributed, and if it is so distributed, provides a means by which they can best find the estimator of the mean and variance of the distribution. In providing these tools, the log-normal distribution was first analyzed and such expressions as those for moments and cumulative probabilities were derived. Estimation techniques are discussed, and a comparison of errors is graphically presented. Four time-sharing BASIC programs have been written, and these are discussed fully. The programs are used to: describe log-normal distributions, estimate the mean and variance of log-normally distributed data, and test data for log-normality, using a chi-squared goodness-of-fit test.		
KEY WORDS Estimation, time sharing, probability density function, confidence limits, reliability, mean-squared error.		

INFORMATION PREPARED FOR _____

TESTS MADE BY _____

AUTHORS C.E. Pangburn and C. Arabadjis

COMPONENT Systems Development Engineering

APPROVED R.E. Wengert 

CAPACITANCE AND POWER
FACTOR BRIDGE
T.N. - 63035

GENERAL  ELECTRIC

INDEX FOR
FILE SYSTEM

GENERAL  ELECTRIC

Dielectrics
Ther 7

GENERAL ELECTRIC
Research Laboratory

THE BREAKDOWN OF DIELECTRICS. I.

by

J. C. Devins and S. I. Reynolds

Report No. 60-RL-2446 C

May 1960

CLASS 1

SCHENECTADY, NEW YORK

1
B E Kingsbury
Insulator Dept.
General Electric Co
Baltimore Md.

GENERAL ELECTRIC
Research Laboratory

METHODS OF MEASUREMENT OF THE DIELECTRIC CONSTANT,
LOSS, AND BREAKDOWN OF SOLIDS

by

Shepard Roberts and A. Harry Sharbaugh

Report No. 57-RL-1812

October 1957

CLASS 1

SCHENECTADY, NEW YORK

GENERAL  ELECTRIC

RESEARCH
AND
DEVELOPMENT
CENTER

SCHENECTADY, NEW YORK

CLASS 1

METHODS AND COMPUTER PROGRAM FOR ESTIMATING PARAMETERS
IN A REGRESSION MODEL FROM CENSORED DATA

by

G.J. Hahn and J.M. Miller
Information Sciences Laboratory

Report No. 68-C-277

July 1968

GENERAL  ELECTRIC

RESEARCH
AND
DEVELOPMENT
CENTER

SCHENECTADY, NEW YORK

CLASS 1

NOTES ON PLANNING ENGINEERING EXPERIMENTS STATISTICALLY

by

G. J. Hahn and S. S. Shapiro
Information Sciences Laboratory

Report No. 67-C-048

February 1967

GENERAL  ELECTRIC

GENERAL ELECTRIC COMPANY
CORPORATE RESEARCH AND DEVELOPMENT

Schenectady, N.Y.

GRAPHICAL ANALYSIS OF ACCELERATED LIFE TEST DATA
WITH DIFFERENT FAILURE MODES

by

Wayne Nelson
Information Science and Engineering

Report No. 73CRD001

October 1973

TECHNICAL INFORMATION SERIES

CLASS 1

GENERAL  ELECTRIC

RESEARCH
AND
DEVELOPMENT
CENTER

SCHENECTADY, NEW YORK

CLASS 1

NOTES ON PLANNING ENGINEERING EXPERIMENTS STATISTICALLY

by

G. J. Hahn and S. S. Shapiro
Information Sciences Laboratory

Report No. 67-C-048

February 1967

GENERAL  ELECTRIC

RESEARCH
AND
DEVELOPMENT
CENTER

SCHENECTADY, NEW YORK

CLASS 1

A CATEGORIZED BIBLIOGRAPHY ON DECISION AND RISK ANALYSIS

by

G. J. Hahn, Information Sciences Laboratory

Report No. 69-C-189

April 1969

GENERAL  ELECTRIC

RESEARCH
AND
DEVELOPMENT
CENTER

SCHENECTADY, NEW YORK

CLASS 1

OPTIMUM TESTS WITH GROUPED DATA
FROM AN EXPONENTIAL DISTRIBUTION

by

W. B. Nelson
Information Sciences Laboratory

Report No. 66-C-398

October 1966

GENERAL  ELECTRIC

RESEARCH
AND
DEVELOPMENT
CENTER

SCHENECTADY, NEW YORK

CLASS 1

REGRESSION ANALYSIS FOR CENSORED DATA--
GRAPHICAL METHODS

by

G. J. Hahn and W. B. Nelson
Information Sciences Laboratory

Report No. 70-C-383

November 1970

GENERAL  ELECTRIC

**GENERAL ELECTRIC COMPANY
CORPORATE RESEARCH AND DEVELOPMENT**

Schenectady, N.Y.

**COMPUTER PLOTS FOR MORE INFORMATIVE REGRESSION
ANALYSES--EXAMPLES AND PLOTTING INSTRUCTIONS**

by

**P.I. Feder
Information Science and Engineering**

Report No. 73CRD333

December 1973

TECHNICAL INFORMATION SERIES

CLASS 1

GENERAL  ELECTRIC

**GENERAL ELECTRIC COMPANY
CORPORATE RESEARCH AND DEVELOPMENT**

Schenectady, N.Y.

**GRAPHICAL TECHNIQUES IN STATISTICAL DATA ANALYSIS --
TOOLS FOR EXTRACTING INFORMATION FROM DATA**

by

**P. I. Feder
Information Science and Engineering**

Report No. 72CRD127

April 1972

TECHNICAL INFORMATION SERIES

CLASS 1

GENERAL  ELECTRIC

RESEARCH
AND
DEVELOPMENT
CENTER

SCHENECTADY, NEW YORK

CLASS 1

A SYSTEM OF CATEGORIES FOR FAILURE MECHANISMS -
A TOOL FOR DIRECTING PHYSICS-OF-FAILURE RESEARCH
AND REMEDIAL ACTION

by

R.H. Norris
Mechanical Technology Laboratory

Report No. 65GL21

February 1965

GENERAL  ELECTRIC

**GENERAL ELECTRIC COMPANY
CORPORATE RESEARCH AND DEVELOPMENT**

Schenectady, N.Y.

**MINIMUM SIZE SAMPLING PLANS FOR
PRODUCT DEMONSTRATION**

by

**G. J. Hahn
Information Science and Engineering**

Report No. 73CRD147

May 1973

TECHNICAL INFORMATION SERIES

CLASS 1



GENERAL ELECTRIC COMPANY
CORPORATE RESEARCH AND DEVELOPMENT

Schenectady, N.Y.

STATISTICAL METHODS FOR ACCELERATED LIFE TEST DATA -
THE INVERSE POWER LAW MODEL

by

W. B. Nelson
Information Science and Engineering

Report No. 71-C-011

December 1970

TECHNICAL INFORMATION SERIES

CLASS 1

GENERAL  ELECTRIC

RESEARCH
AND
DEVELOPMENT
CENTER

SCHENECTADY, NEW YORK

CLASS 1

ADDITIONAL FACTORS FOR CALCULATING PREDICTION INTERVALS
FOR SAMPLES FROM A NORMAL DISTRIBUTION

by

G. J. Hahn, Information Sciences Laboratory

Report No. 69-C-329

September 1969

GENERAL  ELECTRIC

RESEARCH
AND
DEVELOPMENT
CENTER

SCHENECTADY, NEW YORK

CLASS 1

FACTORS FOR CALCULATING ONE-SIDED PREDICTION LIMITS
FOR SAMPLES FROM A NORMAL DISTRIBUTION

by

G.J. Hahn, Information Sciences Laboratory

Report No. 68-C-412

November 1968

Mechanics

1949

RLM

possible

cost reduction

to wiring

(FV pl. reduction & R22)

- 1/2 inch

GENERAL ELECTRIC
Research Laboratory

COLD WELDING

by

Floyd C. Kelley

Data Folder No. RL-263

August 1949

SCHENECTADY, NEW YORK

Mechanics

GENERAL ELECTRIC
Research Laboratory

ANELASTIC DEFORMATION

by

R. P. Carreker

Report No. RL-332

February 1950

SCHENECTADY, NEW YORK

Mechanics

GENERAL ELECTRIC
Research Laboratory

**A SIMPLE DEVICE FOR APPROXIMATING CONSTANT
STRESS DURING TENSILE CREEP TESTS**

by

R. L. Fullman, R. P. Carreker, and J. C. Fisher

Report No. RL 109

October, 1948

SCHENECTADY, NEW YORK

*GE Bulletin*GENERAL  ELECTRIC

Technical Report

Plastics

PERMAFIL

*For Use of G-E Employees Only***Insulating Coil Structures****Leak-proofing Porous Materials****Impregnating Construction Materials****Impregnating and Coating Papers and
Fabrics for Lamination and Bonding****Adhesives and Cements****Polymers****Potting, Filling and Molding (by Casting)**

Permafil is manufactured by the Resin and Insulation Materials Division, Chemical Department, General Electric Company, Schenectady 5, N. Y. Inquiries regarding the Permafiles should be addressed to that Division.

Plastics

TECHNICAL INFORMATION SERIES

REPORT NO. 49TP311-1

TITLE PREPARATION AND TESTING OF IN-
ORGANIC SEMI-CONDUCTING COMPOUNDS--
PROGRESS REPORT

AUTHOR G.S. GORDON
J.A. PARODI
R.R. RALSTON

SEPTEMBER 20, 1949

This folder is the property of the General Electric Company, and must not be retained except by special permission, or used directly or indirectly in any way detrimental to the interest of the Company.

FN-612 (12-48)

GENERAL  ELECTRIC

GENERAL  ELECTRIC

Plastics

General Engineering
and
Consulting Laboratory

SOME PROPERTIES AND APPLICATIONS OF EPOXY RESINS

by

C. D. DOYLE

SCHENECTADY, NEW YORK

51-156
~~RFM~~
~~JFS~~
Plastics

GENERAL  ELECTRIC

General Engineering Laboratory

Electrophoretic Deposition
of
Silicone—Teflon Combinations

by
W. G. Morrison, Jr.

SCHENECTADY, NEW YORK

67773

RECEIVED

MAY 24 1968

E. S. WHEELER

ELECTRICAL INSULATION CONFERENCE 1967

Paper D2

RESINS & PLASTICS - "Epoxide resins-applications
in casting and impregnating"

by

G. Walton,
R.E. Stolton,
"Shell" Research Ltd.

GENERAL  ELECTRIC

RESEARCH
AND
DEVELOPMENT
CENTER

SCHENECTADY, NEW YORK

CLASS 1

BAYESIAN AND CLASSICAL UPPER ONE-SIDED CONFIDENCE LIMITS
ON FAILURE RATE

by

J. J. Fleck, Information Sciences Laboratory

Report No. 69-C-150

February 1969

GENERAL  ELECTRIC

GENERAL ELECTRIC COMPANY
CORPORATE RESEARCH AND DEVELOPMENT

Schenectady, N.Y.

CONFIDENCE LIMITS AND DEMONSTRATION TESTS
FOR PRODUCT FAILURE RATES

by

W. B. Nelson
Information Science & Engineering

Report No. 71-C-042

January 1971

TECHNICAL INFORMATION SERIES

CLASS 1

ENGINEERING AND STATISTICAL PROBLEMS ASSOCIATED
WITH THE INSPECTION OF MOLDS

by

George J. Hurwitz

Army Chemical Center

In the past the members of the Baltimore Section have been treated to talks by personnel from the Quality Assurance Division, Chemical Corps Materiel Command on the need for coordination between the statistician and the engineer and the benefits which can result from such a coordinated effort. The problem to be discussed aptly illustrates this team work which resulted in a substantial dollar and manpower saving, and the resolution of a difficult although very interesting problem. All of the statistics shown were prepared by Quality Assurance Division statisticians and will illustrate the F Test, "t" Test, Analysis of Variance and Wilcoxon Ranking Method.

The problem involved the dimensional inspection of vacuum forming molds used in the fabrication of a certain type of gas mask. A vacuum forming mold is a metallic device shaped in the form that will cure the rubber into the shape it will ultimately assume. Chemical Corps specifications require that the molds used by the fabricator be approved by the Chemical Corps prior to use. In addition, since the molds become Government property at termination of the contract, inspection is also required prior to placing in storage for subsequent use on another contract.

The usual procedure is to mount the mold on a flat plate, rule off lines 1/2" apart in both the horizontal and vertical directions and then determine the distance of the intersections from the base line. By this procedure approximately 500 individual points on the mold are determined and compared with the drawing. Set up time was approximately 7 hours and an equal time was required to make the measurements. Total cost in labor to inspect one mold was \$42.00. Although the cost of the mold is not a factor since the mold can be used to produce a large quantity of masks, it is interesting to note that the cost of initial inspection was 21% of the cost of the mold. Since another inspection would be required at the end of the contract, it can be seen that the cost of mold inspection could become a sizeable sum, particularly as in this case about fifty molds were involved. The problem therefore was to determine what savings could be accomplished in inspection cost and still have sufficient information upon which to base a decision with respect to the following:

INTRODUCTION TO WORK SAMPLING

Stanley R. Kalin
Chief Industrial Engineer

The National Plastics Products Company
Odenton, Maryland

The p, or percent defective chart is a device well known in the quality field for its ability to provide an estimate of percent defective in a run. It owes its utility to the basic statistical truth that a sample taken in a random manner from a universe will tend to reflect the characteristics of that universe. Ordinarily the characteristics are length, diameter, tensile strength or other quality features. But if we were to consider a universe consisting of all the minutes in the day of a production machine at random minutes and noting if it were productive or idle, we should then be able to estimate how the day was divided into productive and idle time.

The eminent British Statistician L. H. C. Tippett first used this technique, which was later to become known as Ratio Delay Study, when he applied statistical sampling to the problem of predicting loom breakdown in a textile mill in England. (1) The first appearance in this country was in 1940. (2) The term "work sampling" is currently used to describe an expanded concept in which the technique is used to gather facts not only about machines but about men as well. (3)

As an example of how Work Sampling might apply to an actual case, let us assume Department X of our plant has submitted a request for an additional bench grinder on the ground that the one in the department cannot keep up with the amount of grinding to be done. To check this allegation we might elect to use work sampling techniques, in which case we would proceed as follows: Mark a piece of paper productive and idle, in two columns, and wander through department X at random intervals observing the grinder. If the grinder is operating when observed, place a tally mark in the Productive column, and if idle, place a tally mark in the Idle column. Do this at random throughout the day, and repeat until somewhere between 500 and 3000 observations are recorded. Take the number of tallies in the Idle column and divide by the total number of observations made. This fraction times 480, the number of minutes in an 8 hour working shift, gives the total minutes the grinder is idle per day on the average. If the amount of idle time is sufficient to care of the excess work load complained of, the new machine is probably not justified.

Work Sampling is based on the binomial distribution. Confidence limits are easily computed by means of the following:

$$\sigma = \sqrt{\frac{p q}{n}}$$

Transactions Paper

(Reviewed and Accepted for Publication)



Healey

FACTORS AFFECTING THE LIGHTNING PERFORMANCE OF TRANSMISSION LINES

J. H. Hagenguth
Fellow AIEE

J. G. Anderson
Member AIEE

Both of:
General Electric Co.
Pittsfield, Mass.

A paper recommended by the AIEE Transmission and Distribution Committee and approved by the AIEE Technical Operations Department for presentation at the AIEE Fall General Meeting, Chicago, Ill., October 7-11, 1957. Manuscript submitted May 31, 1957; made available for printing August 20, 1957.

Price: 40¢ To Members
80¢ To Nonmembers

(5¢ per copy additional if
first class mailing desired)

All Rights Reserved by the
American Institute of Electrical Engineers
33 West 39th Street, New York 18, N. Y.
Litho in USA

Paper No.

57-1079

Discussion in Duplicate Due October 23, 1957.

Transactions Paper

(Reviewed and Accepted for Publication)

A
E E
I

THE PRESTRIKE THEORY AND OTHER EFFECTS IN THE LIGHTNING STROKE

Theory

S. B. Griscom
Fellow AIEE
Westinghouse Electric Corp.
East Pittsburgh, Pa.

RECEIVED

JUN 2 1958

H. A. FREY

A paper recommended by the AIEE Transmission and Distribution Committee and approved by the AIEE Technical Operations Department for presentation at the AIEE Summer General Meeting and Air Transportation Conference, Buffalo, N. Y., June 22-27, 1958. Manuscript submitted March 10, 1958; made available for printing April 11, 1958.

Price: 40¢ To Members
80¢ To Nonmembers

(5¢ per copy additional if
first class mailing desired)

All Rights Reserved by the
American Institute of Electrical Engineers
33 West 39th Street, New York 18, N. Y.
Litho in USA

Paper No.

58-829

Discussion in Duplicate Due July 9, 1958.

Transactions Paper

(Reviewed and Accepted for Publication)



Theory

THE LIGHTNING STROKE

C. F. Wagner
Fellow AIEE

A. R. Hileman
Associate Member AIEE

Both of:
Westinghouse Electric Corp.
East Pittsburgh, Pa.

A paper recommended by the AIEE Transmission and Distribution Committee and approved by the AIEE Technical Operations Department for presentation at the AIEE Winter General Meeting, New York, N. Y., February 2-7, 1958. Manuscript submitted October 14, 1957; made available for printing October 31, 1957.

Price: 40¢ To Members
80¢ To Nonmembers

(5¢ per copy additional if
first class mailing desired)

RECEIVED

NOV 27 1957

H. A. FREY

All Rights Reserved by the
American Institute of Electrical Engineers
33 West 39th Street, New York 18, N. Y.
Litho in USA

Paper No.

58-24

Discussion in Duplicate Due February 19, 1958.

Transactions Paper

(Reviewed and Accepted for Publication)



Lightning Theory

ARC DROP DURING TRANSITION FROM SPARK DISCHARGE TO ARC

C. F. Wagner
Fellow AIEE

C. M. Lane
Associate Member AIEE

C. M. Lear
Associate Member AIEE

All of:
Westinghouse Electric Corp.
East Pittsburgh, Pa.

RECEIVED

DEC 11 1957

H. A. FREY

A paper recommended by the AIEE Transmission and Distribution Committee and approved by the AIEE Technical Operations Department for presentation at the AIEE Winter General Meeting, New York, N. Y., February 2-7, 1958. Manuscript submitted October 10, 1957; made available for printing November 14, 1957.

Price: 40¢ To Members
80¢ To Nonmembers

(5¢ per copy additional if
first class mailing desired)

All Rights Reserved by the
American Institute of Electrical Engineers
33 West 39th Street, New York 18, N. Y.
Litho in USA

Paper No.

58-176

Discussion in Duplicate Due February 19, 1958.

Conference Paper



Lightning Theory

ANOMALOUS FLASHOVERS ON TRANSMISSION LINES -- PART II

Charles J. Miller, Jr.
Fellow AIEE
The Ohio Brass Company
Barberton, Ohio

Submitted in abstract or outline form only to the AIEE Transmission and Distribution Committee for the AIEE Winter General Meeting, New York, N. Y., February 2-7, 1958. Manuscript submitted November 6, 1957; made available for printing November 19, 1957.

Price: 40¢ To Members
80¢ To Nonmembers

(5¢ per copy additional if
first class mailing desired)

All Rights Reserved by the
American Institute of Electrical Engineers
33 West 39th Street, New York 18, N. Y.
Litho in USA

Paper No. **CP**

58-189

Lightning Theory

THE TEINOGRAPH - A NEW HIGH-VOLTAGE SURGE RECORDER

J. G. Anderson
Member - AIEE

R. U. Giacomoni
Associate Member - AIEE

Both of:
General Electric Co.
Pittsfield, Mass.

To be presented at the AIEE Middle Eastern District Meeting,
Baltimore, Md., May 19, 1959

Spec

TM 5-680F

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

ELECTRICAL FACILITIES

SUBSTATIONS

REPAIRS AND UTILITIES

DEPARTMENT OF THE ARMY

• OCTOBER 1947

TM 11-2617

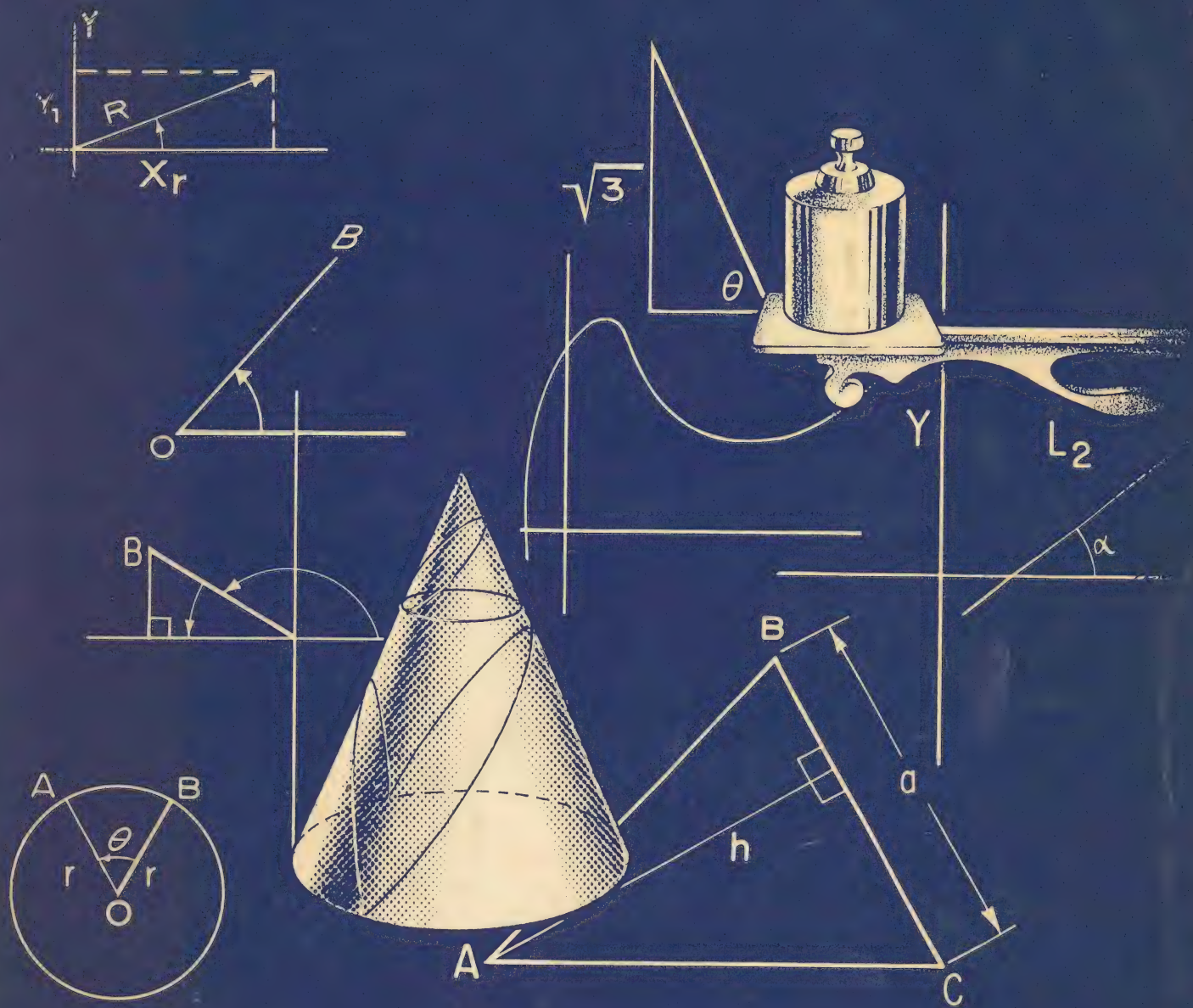
WAR DEPARTMENT TECHNICAL MANUAL

ANTENNA KIT FOR RHOMBIC TRANSMITTING ANTENNA (DRAWING ES-E-368-D)

WARNING: This manual is the property of the United States Government, and is printed and distributed solely for the use of the military, naval, and civilian personnel of the War and Navy Departments, and may not be published or reproduced in whole or in part, or in any manner or form (except by lawful copyright holders who may reproduce their copyrighted material in its original form) unless specifically approved by authorized military public relations agencies.

WAR DEPARTMENT

31 MARCH 1945



MATHEMATICS, VOL. 2

224

BUREAU OF NAVAL PERSONNEL
NAVY TRAINING COURSE NAVPERS 10071-B

GENERAL ENGINEERING LABORATORY

Corrosion Symposium
CORROSION SYMPOSIUM

- 1955 -

Edited By
R. T. Foley

RECEIVED

JUN 8 1956

H. A. FREY.

Report No. R56GL69

April 25, 1956

GENERAL  ELECTRIC

JUN 16 1966

Res. Lab. Reprint 5271

GENERAL ELECTRIC
Research Laboratory

ARCS AND ARCING CONTACTS

by

J.D. Cobine

SCHENECTADY, NEW YORK

GENERAL ELECTRIC
Research Laboratory

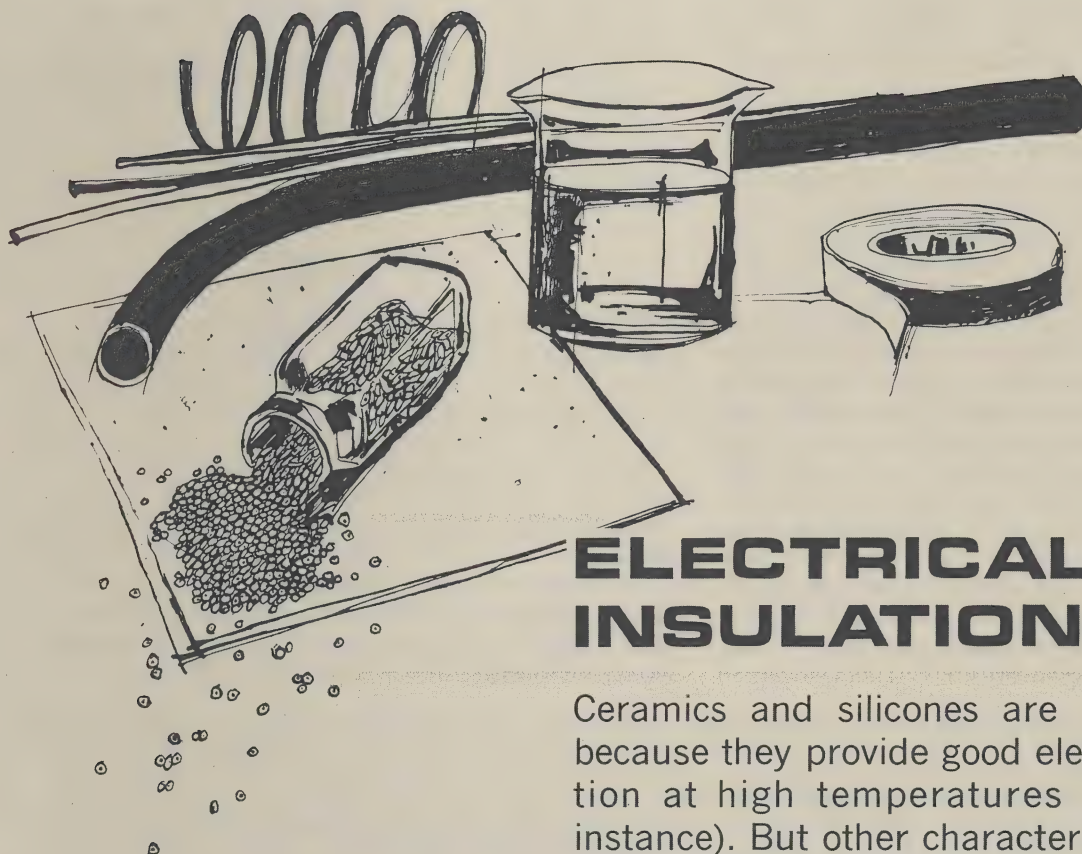
ARC RECOVERY AND PASCHEN'S LAW

by

G. A. Farrall and J. D. Cobine

SCHENECTADY, NEW YORK

A.L.2 36y



ELECTRICAL INSULATION: 1966

Ceramics and silicones are making news because they provide good electrical insulation at high temperatures (700°C , for instance). But other characteristics—formability, weight, moisture resistance—make epoxy resins and polyurethane foams equally important. New techniques, such as transfer molding, permit substantial cost reductions in semiconductor components. Here are some of the latest advances in insulation materials and forming processes—with data for comparing them.

M. Kaminski

" Kingsbury

" Vohr

Notes + file for reference

GENERAL ELECTRIC
Research Laboratory

SURFACES, STRESS-DEPENDENT REACTIONS, AND STRENGTH

by

W. B. Hillig and R. J. Charles

Report No. 64-RL-3756 M

October 1964

CLASS 1

SCHENECTADY, NEW YORK

A High-Voltage Pulse Generator and Tests on an Improved Deflecting System of a Cold-Cathode Oscillograph

Harold N. Cones

An improved deflecting system for a cold-cathode oscillograph is described. This deflecting system reduces transit-time errors and eliminates errors due to impedance mismatch between the signal coaxial cable and the deflector.

A high-voltage pulse generator for producing single pulses in the millimicrosecond range was devised, and its use in testing the improved deflecting system is explained.

1. Introduction

The cathode-ray oscillograph (CRO) is an indispensable tool in high-voltage surge testing and research. However, the requirements of an oscillograph for his work are somewhat different from the requirements of the usual laboratory oscillograph. Sensitivity is not an important factor, as ample signal voltage is available. In fact, the available voltage is usually limited only by the flashover voltage of the fittings on the coaxial cable between the source of voltage to be measured and the oscillograph.

High writing speed is essential, as it is necessary to record on film single transients of a few millimicroseconds duration. This high writing speed is attained by the use of high accelerating voltages for the electron beam, and in many cases by allowing the beam to impinge directly on the photographic emulsion instead of photographing a trace on a fluorescent screen.

Cold-cathode oscillographs of the type described by Ackermann [1]¹ are used in the Bureau's high-voltage laboratory and are entirely adequate for ordinary surge work.

However, with increasing interest in studies of steep-front voltage surges, the ability to faithfully record single transients of approximately 50-m μ sec duration is essential. A resolution of time intervals of the order of 1 m μ sec for the current and voltage records is highly desirable in making a detailed study of the mechanism of spark breakdown.

To record such rapid transient variations, a very high writing speed is necessary. Also, recording errors in the oscillograph, as well as those arising from its connections, which are not significant at lower recording speeds, become important and must be reduced or eliminated. Actually, a sufficiently high writing speed was insured by using Park's method of beam intensification [2]. Therefore, the recording errors introduced by the oscillograph itself and the means adopted for their elimination form the basis of the present study.

2. Cathode-Ray Oscillograph Recording Errors

Two sources of error of the CRO are of concern when very short transients are to be recorded. One is the error due to the transit time of the electrons in passing from one end to the other of the deflecting plates. The other error is caused by impedance mismatch in connecting the deflecting-plate circuit to a coaxial cable.

A typical cold-cathode oscillograph uses an accelerating voltage of 50 kv and has deflecting plates 3 cm long. The velocity of 50-kv electrons is 1.23×10^{10} cm/sec, and the corresponding transit time is 2.44×10^{-10} sec. The error arising from transit time will be 5 percent at 600 Mc for a pure sine wave.² For a steeply rising pulse the error will be 5 percent for a pulse with a rise time of 2.4 m μ sec.³ Although, in general, for steep-front surge work, errors due to transit time can be neglected, pulses with rise times of this order occur and are important in studies of spark breakdown.

The errors arising from impedance mismatch are more serious. The capacitance of the deflecting plates in the typical cold-cathode oscillograph is about 15×10^{-12} f, and the associated lead inductance is about 2 or 3×10^{-8} h, giving rise to a resonance frequency of 200 to 300 Mc. Hence, for all but somewhat lower frequencies, disturbing reflections will occur, giving rise to a voltage at the deflecting plates that may be quite different from the voltage at the input end of the cable. Furthermore, steeply rising pulses will force the deflecting-plate system into oscillation. The modification of an oscillograph to reduce these errors and the testing of the modified oscillograph are now described.

3. Redesign of Deflecting Plate System

One method of reducing the above errors is to drastically reduce the size of the deflecting plates. The transit time can in this way be reduced by the

² See the appendix, which is a discussion by J. H. Park of transit-time errors. This discussion is an excerpt from an unpublished informal communication.

³ These values do not take into account the effect of fringing field at the ends of the plates. This increases the effective length of the plates and increases the error due to transit time.

¹ Figures in brackets indicate the literature references at the end of this paper.



INSTRUCTION MANUAL FOR:

GENERAL ELECTRIC

CABINET SGA-2
EXCITER _____
POWER SUPPLY _____
DATE SHIPPED _____
PURCHASE ORDER NO. 083-5614
MB SALES ORDER NO. V-10382

MB ELECTRONICS

A DIVISION OF TEXTRON ELECTRONICS, INC.
NEW HAVEN, CONNECTICUT



INSTRUCTION MANUAL FOR:
GENERAL ELECTRIC

CABINET TT10031
EXCITER CI
POWER SUPPLY _____
DATE SHIPPED _____
PURCHASE ORDER NO. 083-5641
MB SALES ORDER NO. V-10382

MB ELECTRONICS

A DIVISION OF TEXTRON ELECTRONICS, INC.
NEW HAVEN, CONNECTICUT



INSTRUCTION MANUAL FOR:
GENERAL ELECTRIC

CABINET SGA-2
EXCITER _____
POWER SUPPLY _____
DATE SHIPPED _____
PURCHASE ORDER NO. 083-5614
MB SALES ORDER NO. V-10382

MB ELECTRONICS

A DIVISION OF TEXTRON ELECTRONICS, INC.
NEW HAVEN, CONNECTICUT

Shimoda

Transactions Paper

(Reviewed and Accepted for Publication)

Discussion in Duplicate Due July 5, 1963.



SPARKOVER CHARACTERISTICS OF LARGE GAP SPACES AND LONG INSULATION STRINGS

T. Udo

Central Research Institute of Electric Power Industry
Tokyo, Japan

A paper recommended by the IEEE Transmission and Distribution Committee and approved by the IEEE Technical Operations Committee for presentation at the IEEE Summer General Meeting and Nuclear Radiation Effects Conference, Toronto, Ont., Canada, June 16-21, 1963. Manuscript submitted March 15, 1963; made available for printing May 23, 1963.

Price: \$.60 To Members
\$1.00 To Nonmembers

(10¢ per copy additional if
first class mailing desired)

(Minimum Mail Order \$1.00)

All Rights Reserved by
The Institute of Electrical and Electronics Engineers,
Inc.,

P. O. Box A,
Lenox Hill Station,
New York 21, N. Y.

Litho in USA

Paper No.

63-1040

CHIEF OPERATING OFFICER
G. R. McDONALD

ENGINEERING QUALITY CONTROL
MANAGER
B. E. KINGSBURY

TRAINING &
SAFETY OFFICER
V. L. GUN

MANUFACTURING
MANAGER
J. KILPATRICK

SALES
MANAGER
J. J. KENT

FINANCE & CONTROLLER
MANAGER
T. LINDSEY

AIRPORT STATION
MANAGER
F. C. R. HOLLAND

INSULATION ENGINEERING
PRODUCT ENGINEERS
J. H. JESATO
R. WELLS
P. MOY
R. A. YOEHN

PRODUCT SPECIFICATIONS

CERAMIC LABORATORY
MANAGER
T. H. BRESSETT, JR.

MATERIAL SPECIFICATIONS

E. V. BERG, INSULATOR
MANAGER
J. C. YOEHN

GAGE CALIBRATION ELECTRICAL

QUALITY CONTROL
ENGINEER
R. T. FLEMING, JR.

QUALITY SYSTEM

GAGE CALIBRATION MECH.

INCOMING HARD, ISSP.

LOT ACCEPTANCE

AIRPORT INSPECTION
ASSEMBLY AND HARD. DEPTS.

MATERIALS
MANAGER
C. A. CALVERTS

PRODUCTION CONTROL-LINE
MANAGER
D. FISHER

PRODUCTION CONTROL-APPARATUS
MANAGER
H. F. PATTEN

PURCHASING
MANAGER
M. STICKLES

TRAFFIC & SHIPPING
MANAGER
J. E. MEZIANE

SHOP OPERATIONS - LINE
MANAGER
F. L. PAGE

100% INSPECTION AND TEST
SWITCH AND SUSPENSION INS.

SHOP OPERATIONS - APPARATUS
MANAGER
E. H. BIGGLES

PLANT REPAIR & MAINT.
MANAGER
M. B. TAYLOR

MANUFACTURING ENGINEERING
MANAGER
W. B. JOHNSBURY

FIELD, PLAN & WORK DESIG.
MANAGER
J. H. JOHNSON

PROCESS CONTROL
MANAGER
N. C. GIBBS

AIRPORT INSPECTION EXCEPT
ASSEMBLY & HOME. DEPTS.

INCOMING INSPECTION
CERAMIC MATERIALS

7.0. - Ins.

Transactions Paper

(Reviewed and Accepted for Publication)



THE INFLUENCE OF WATER RESISTIVITY AND PRECIPITATION RATE UPON SIXTY-CYCLE WET FLASHOVER VOLTAGE

AIEE Working Group on Rain Tests
of the
AIEE Subcommittee on Techniques for Dielectric Tests

A paper recommended by the AIEE Special Instruments and Auxiliary Committee and approved by the AIEE Technical Operations Department for presentation at the AIEE Winter General Meeting, New York, N. Y., February 2-7, 1958. Manuscript submitted October 15, 1957; made available for printing October 31, 1957.

For personnel of AIEE Working Group on Rain Tests, see page 1 of text.

Price: 40¢ To Members
80¢ To Nonmembers

(5¢ per copy additional if
first class mailing desired)

All Rights Reserved by the
American Institute of Electrical Engineers
33 West 39th Street, New York 18, N. Y.
Litho in USA

Paper No.

58-27

Discussion in Duplicate Due February 19, 1958.

EEI No. TDJ-52
NEMA No. 140-1952

ASA
Reg. U. S. Pat. Off.
C29.2-1955
UDC 621.315.624

American Standard

Wet-Process Porcelain Insulators

(Suspension Type)

Sponsor

ELECTRICAL STANDARDS BOARD

Approved August 5, 1955

AMERICAN STANDARDS ASSOCIATION
INCORPORATED

ASA
C76.1 - 1943

AIEE
No. 21
June 1942

American Standards
for
APPARATUS BUSHINGS
AND
TEST CODE FOR APPARATUS BUSHINGS

APPROVED

American Standards Association

July 23, 1943



SPONSOR

Electrical Standards Committee

Published by
THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
33 West Thirty-ninth Street, New York

ASA
C68.1
1953
UDC 621.317.32

AIEE
No. 4

American Standard
for
MEASUREMENT of VOLTAGE
in DIELECTRIC TESTS

Approved as American Standard by the
American Standards Association
September 11, 1953



SPONSOR
American Institute of Electrical Engineers

Published by
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
33 West Thirty-ninth Street, New York 18, N. Y.

American Standard Methods of Measurement of

Radio-Noise Voltage and Radio-Noise Field Strength

0.015 to 25 Megacycles/Second
Low-Voltage Electric Equipment
and Nonelectric Equipment

USA Standard

This USA Standard is one of nearly 3000 standards approved as American Standards by the American Standards Association. On August 24, 1966, the ASA was reconstituted as the United States of America Standards Institute. Standards approved as American Standards are now designated USA Standards. There is no change in their index identification or technical content.

Sponsor
National Electrical Manufacturers Association

Approved March 28, 1963
AMERICAN STANDARDS ASSOCIATION
INCORPORATED

25 CM. SPHERES

6 CM. SPACING

NEGATIVE POLARITY

MEASUREMENT DIVIDER

HIGH SIDE = 7-125 Ω CARDS

LOW SIDE = 4.07 Ω SHUNT

25 CM. SPHERES

6 CM. SPACING

NEGATIVE POLARITY

MEASUREMENT DIVIDER

HIGH SIDE = 2-500 Ω CARDS

LOW SIDE = 4.07 Ω SHUNT

Thermodynamics

GENERAL ELECTRIC
Research Laboratory

SURFACE EFFECTS IN FLOW AND FRACTURE

by

A. N. Holden

Report No. RL-411

August 1950

SCHENECTADY, NEW YORK

DESIGN DATA



DESIGN OF APPARATUS TO WITHSTAND
SHORT-CIRCUIT FORCES

July 20, 1953

GENERAL ELECTRIC STANDARDS

Transactions Paper

(Reviewed and Accepted for Publication)

Excerpt from
Mechanics



RESULTS OF HIGH-CURRENT TESTS ON 161-KV DISCONNECTING SWITCHES

A. M. McNerney
Associate Member AIEE
Tennessee Valley Authority
Knoxville, Tenn.

A paper recommended by the AIEE Committee on Switchgear and approved by the AIEE Committee on Technical Operations for presentation at the AIEE Winter General Meeting, New York, N. Y., January 31-February 4, 1955. Manuscript submitted September 30, 1954; made available for printing October 27, 1954.

Price: 30¢ To Members
60¢ To Nonmembers

(5¢ per copy additional if
first class mailing desired)

All Rights Reserved by the
American Institute of Electrical Engineers
33 West 39th Street, New York 18, N. Y.
Litho in USA

Paper No.

55-9

Discussion in Duplicate Due February 16, 1955.

Transactions Paper

(Reviewed and Accepted for Publication)



BEHAVIOR OF HIGH VOLTAGE BUSES AND INSULATORS DURING SHORT CIRCUITS

R. M. Milton
Member AIEE
Chief, Elec. Engg. Branch
Tennessee Valley Authority
Chattanooga, Tenn.

Fred Chambers
Member AIEE
Assistant to Chief Power Engineer
Tennessee Valley Authority
Chattanooga, Tenn.

A paper recommended by the AIEE Committee on Switchgear and approved by the AIEE Committee on Technical Operations for presentation at the AIEE Winter General Meeting, New York, N. Y., January 31-February 4, 1955. Manuscript submitted August 16, 1954; made available for printing October 27, 1954.

Price: 30¢ To Members
60¢ To Nonmembers
(5¢ per copy additional if
first class mailing desired)

All Rights Reserved by the
American Institute of Electrical Engineers
33 West 39th Street, New York 18, N. Y.
Litho in USA

Paper No.

55-11

Discussion in Duplicate Due February 16, 1955.

Transactions Paper

(Reviewed and Accepted for Publication)

Equip - T&D
Mechanics



HIGH-CURRENT TESTING OF AIR-DISCONNECT SWITCHES

B. F. Gostin
Member AIEE
Supervisor, Electrical Laboratory
Tennessee Valley Authority
Chattanooga, Tenn.

A paper recommended by the AIEE Committee on Switchgear and approved by the AIEE Committee on Technical Operations for presentation at the AIEE Winter General Meeting, New York, N. Y., January 31-February 4, 1955. Manuscript submitted September 20, 1954; made available for printing October 29, 1954.

Price: 30¢ To Members
60¢ To Nonmembers

(5¢ per copy additional if
first class mailing desired)

All Rights Reserved by the
American Institute of Electrical Engineers
33 West 39th Street, New York 18, N. Y.
Litho in USA

Paper No.

55-13

Discussion in Duplicate Due February 16, 1955.

Ref. Bruce Knigebury

Mechanics

TECHNICAL INFORMATION SERIES

Title Page

AUTHOR	SUBJECT CLASSIFICATION	NO.
	Stress & Strain	56TP458
	(Deflection Measurements)	DATE
WM Pafenbach, Jr.		8 - 3 - 56
TITLE		
A NEW TECHNIQUE IN LARGE DEFLECTION MEASUREMENTS		

FOR USE OF G-E EMPLOYEES ONLY

GENERAL  ELECTRIC

TRANSFORMER AND ALLIED PRODUCTS DIVISION

Mechanics

Conference Paper



A DYNAMIC TORQUEMETER UTILIZING THE RECIPROCAL WIEDEMANN EFFECTS

M. J. O'Neill
Associate Member AIEE
The Perkin-Elmer Corporation
Norwalk, Conn.

RECEIVED

JAN 25 1957

H. A. FREY

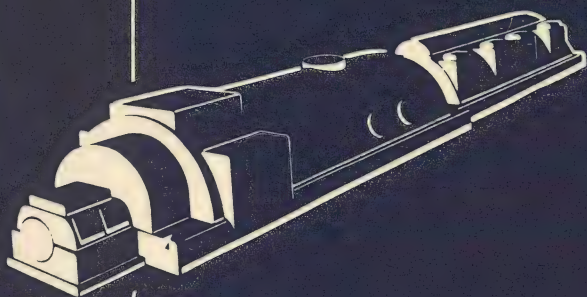
A paper recommended by the AIEE Committee on Special Instruments and Auxiliary Apparatus for the AIEE Winter General Meeting, New York, N. Y., January 21-25, 1957. Manuscript submitted October 18, 1956; made available for printing January 9, 1957.

Price: 40¢ To Members
80¢ To Nonmembers

(5¢ per copy additional if
first class mailing desired)

All Rights Reserved by the
American Institute of Electrical Engineers
33 West 39th Street, New York 18, N. Y.
Litho in USA

Paper No. CP
57-112



Mechanics

The Calculation of Residual Stresses in Thick Plates Using
the Solution of the Problem of an Infinite Plate with a
Circular Hole.

M. Gurtin

TR-57-TG-178

4-22-58

LARGE STEAM TURBINE-GENERATOR DEPARTMENT

GENERAL  ELECTRIC

SCHENECTADY, N. Y.

Elw

OPERATING 300 KV.

IN QUEBEC

BY

H.W. HABERL

ASSISTANT CHIEF ENGINEER

QUEBEC HYDRO ELECTRIC POWER COMMISSION

MONTREAL-QUEBEC

CANADA

RECEIVED

MAY 12 1958

ENG. DEPT.

TECHNICAL INFORMATION SERIES

Title Page

AUTHOR	SUBJECT CLASSIFICATION	NO.
JG Anderson	Transmission Lines	58-PT-373
		DATE
		4/16/58
TITLE		
Preliminary Insulation Estimates for the G. E. Extra-High Voltage Project		

Frey
Weller
Walter
Kammerer
Jesatho
Kingsbury
File Evaluation

FOR USE OF G-E EMPLOYEES ONLY

GENERAL  ELECTRIC

TRANSFORMER AND ALLIED PRODUCTS DIVISION

4

EHV

345 KV DOUBLE CIRCUIT TRANSMISSION

David Burns - The Detroit Edison Company

Edison Electric Institute
Transmission and Distribution Committee
Muehlebach Hotel
Kansas City, Missouri
May 2, 1957

W. F. Bodenstern

PAPER NO. 13-2

INFLUENCE OF TOWER DESIGNS ON
TRANSMISSION-LINE LIGHTNING PERFORMANCE

By F. A. Fisher
J. G. Anderson

SOUTHWESTERN IEEE CONFERENCE
Dallas, Texas

April 20, 1967

EHV

FIELD CONTROL OF INSULATORS
FOR MODERN HIGH VOLTAGE LINES

BY

JOHN M. SHEADEL
DEVELOPMENT ENGINEER
OHIO BRASS COMPANY

PRESENTED AT THE
FALL MEETING
ELECTRICAL EQUIPMENT COMMITTEE
IN JOINT SESSION WITH
TRANSMISSION AND DISTRIBUTION COMMITTEE
PENNSYLVANIA ELECTRIC ASSOCIATION
READING, PENNSYLVANIA

OCTOBER 9, 1953

General Installation and Operation of Kenotron Tubes

Installation

MECHANICAL

The handling of a kenotron in transportation and storage requires great care since the tube may be permanently damaged if subjected to shock. Each tube is suspended within its shipping carton so that it will not come in contact with the sides of the carton during shipment. The tube should be stored in the carton and should be protected from moisture and extreme temperature changes. Furthermore, while the tube is being handled it should be kept in a vertical position with the cathode end down. Under no circumstances should crated tubes be piled on top of one another.

The kenotron should be installed in a vertical position with the cathode base down.

In installations where a nonrigid anode connection is used, reasonable flexibility must be provided to prevent placing a strain on the cathode base. Since the bulb becomes hot during continuous operation, it should not come in contact with any metallic body, nor be subjected to the drops or spray of any liquid.

The accumulation of dust and metallic particles on the outer surface of the glass walls will increase the leakage over this surface. As this may result in tube failure from arc-over, periodic cleaning of these surfaces should be maintained.

When a kenotron is operated at voltages above 75 kv peak inverse, harmful x-rays may be generated. Adequate protection against these x-rays should be provided.

COOLING

Free circulation of cool air around the glass bulb should be maintained. High-temperature air from other apparatus should be prevented from circulating around the tubes. If desired the tubes may be immersed in a tank of oil with the transformers.

*Note: The ratings and characteristics of a particular tube are given under Technical Information on the Description and Rating Sheet for that tube.

ELECTRICAL

Filament power should be supplied from a filament lighting transformer insulated for the proper voltage. This transformer should be provided with a secondary midtap for the plate circuit return lead. The filament excitation supply must be provided with suitable resistors or other regulating devices to apply the power to the filament gradually and to adjust it accurately during operation. The filament voltage should be measured directly at the filament terminals.

The high initial rush of current through the filament when the switch is first closed should be limited by the use of some form of filament starter. The proper use of the filament regulating devices will prevent this initial rush of current from destroying the filament. In any case, the current through the filament should never, even instantaneously, exceed twice the *rated value.

When the apparatus in which the tube is used is to be idle for periods not exceeding two hours, voltage should be maintained on the filament. However, if desired, provision may be made to reduce the filament voltage to approximately 80 per cent of the *rated value during "standbys." Where stand-by periods exceed two hours the filament voltage may be removed.

The plate circuit should be provided with a time-delay relay which will prevent application of plate voltage until the filament has reached normal operating temperature.

Automatic protective devices should be installed to prevent over-plate-voltage, over-plate-current, or under-filament-voltage conditions.

In the case of multi-phase installations, the plate transformer is usually designed for rectifier use. In the case of a double Y rectifier, the use of an inter-phase transformer is recommended. The cathode base should not be connected to ground or to any other part of the circuit.

The installation of all wires and connections should be made so that they do not lie on or close to the glass of the kenotron. An air space of approximately the length of the tube should be main-

Tidd 500-Kv Test Project

Transmission of Electric Power at Extra High Voltages
and
Field Test Facilities
to Study
Corona, Radio Influence, and Other Features

Participating Group

American Gas and Electric Service Corporation (Sponsor)
Aluminum Company of America
American Bridge Company
Anaconda Wire and Cable Company
General Cable Corporation
General Electric Company
Locke Insulator Corporation
Ohio Brass Company
Westinghouse Electric Corporation

The American Institute of Electrical Engineers

Chv

OHIO EDISON 345 KV SYSTEM

LYNN FIRESTONE
GENERAL SYSTEM PLANNING ENGINEER
OHIO EDISON COMPANY
AKRON, OHIO

E. A. ROTHFUS
CHIEF ELECTRICAL ENGINEER
OHIO EDISON COMPANY
AKRON, OHIO

RECEIVED

MAR 16 1959

H. A. FREY

TECHNICAL INFORMATION SERIES

TECHNICAL INFORMATION SERIES

Title Page

AUTHOR <i>H. K. Farr</i> (for R.P.B.) R. P. Bass	SUBJECT CLASSIFICATION <i>Bushings - Capacitors</i>	NO. 50TP170-1
TITLE The Operation of 5 Kv Glass and Porcelain Bushings in Salt-Fog Atmosphere Report II		DATE 7/19/51

FOR USE OF G-E EMPLOYEES ONLY

GENERAL  ELECTRIC

TRANSFORMER & ALLIED PRODUCT DIVISIONS

4

TECHNICAL INFORMATION SERIES

AUTHOR G. Camilli W.P. Tootill	SUBJECT CLASSIFICATION BUSHINGS	NO. 51TP1325 DATE 5-1-51
TITLE Bushings for Low Voltage Circuits.		
ABSTRACT		

FOR USE OF G-E EMPLOYEES ONLY

GENERAL  ELECTRIC

TRANSFORMER AND ALLIED PRODUCT DIVISIONS

Transactions Paper

(Reviewed and Accepted for Publication)



LIGHTNING REFERENCE BIBLIOGRAPHY 1950-1960

AIEE Working Group of the Lightning and Insulation Subcommittee
of the
AIEE Transmission and Distribution Committee

A paper recommended by the AIEE Transmission and Distribution Committee and approved by the AIEE Technical Operations Department for presentation at the AIEE Summer General Meeting, Denver, Colo., June 17-22, 1962. Manuscript submitted March 19, 1962; made available for printing April 27, 1962.

For personnel of the AIEE Working Group of the Lightning and Insulation Subcommittee, see page 1 of text.

Price: \$.50 To Members
\$1.00 To Nonmembers

(5¢ per copy additional if
first class mailing desired)

All Rights Reserved by the
American Institute of Electrical Engineers
345 East 47th Street, New York 17, N. Y.
Litho in U.S.A.

Paper No.

62-1102

Discussion in Duplicate Due July 6, 1962.

MIL-STD-105B

SUPERSEDING

31 December 1958

MIL-STD-105A

11 September 1950

APPENDIX

27 April 1955

MILITARY STANDARD

SAMPLING PROCEDURES AND TABLES FOR INSPECTION BY ATTRIBUTES



R. WELER

MIL-STD-105A

11 September 1950

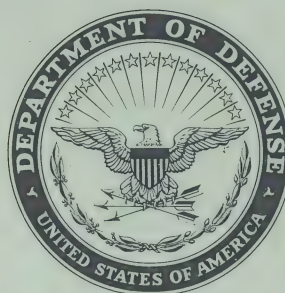
SUPERSEDING

JAN-STD-105

16 February 1949

MILITARY STANDARD

SAMPLING PROCEDURES AND TABLES FOR INSPECTION BY ATTRIBUTES



QUALITY CONTROL REPORTS

No. 9

September 1945

Statistical Quality Control at Lockheed

By

James R. Crawford

and

Preston C. Hammer



Issued by
Quality Control Program, Carnegie Institute of Technology
Pittsburgh 13, Pennsylvania
for Office of Production Research and Development
War Production Board

QUALITY CONTROL REPORTS

No. 12

September 1945

Some Experiments Illustrating Principles of Quality Control

By

Irving W. Burr



Issued by
Quality Control Program, Carnegie Institute of Technology
Pittsburgh 13, Pennsylvania
for Office of Production Research and Development
War Production Board

QUALITY CONTROL REPORTS

No. 3

August 1945

Statistical Quality Control at the St. Louis Division of American Stove Company

By

Lester A. Kauffman



Issued by
Quality Control Program, Carnegie Institute of Technology
Pittsburgh 13, Pennsylvania
for Office of Production Research and Development
War Production Board

QUALITY CONTROL REPORTS

No. 4

August 1945

Quality Control at the Lukas-Harold Corporation

By

Carl G. Schmid



Issued by
Quality Control Program, Carnegie Institute of Technology
Pittsburgh 13, Pennsylvania
for Office of Production Research and Development
War Production Board

QUALITY CONTROL REPORTS

No. 5

September 1945

Statistical Quality Control in Radio Manufacture

By

Fred Trowbridge

and

John T. Clark



Issued by
Quality Control Program, Carnegie Institute of Technology
Pittsburgh 13, Pennsylvania
for Office of Production Research and Development
War Production Board

QUALITY CONTROL REPORTS

No. 6

September 1945

An Application of Statistical Quality Control at the Hoover Ball and Bearing Company

By

Russell C. Trombly



Issued by
Quality Control Program, Carnegie Institute of Technology
Pittsburgh 13, Pennsylvania
for Office of Production Research and Development
War Production Board

QUALITY CONTROL REPORTS

No. 7

September 1945

An Adaptation of Statistical Quality Control at Aldens'

By

James M. Ballowe



Issued by
Quality Control Program, Carnegie Institute of Technology
Pittsburgh 13, Pennsylvania
for Office of Production Research and Development
War Production Board

QUALITY CONTROL REPORTS

No. 1

May 1945

Introduction of Statistical Quality Control at Illinois Testing Laboratories

By

James A. Fizzell



Distributed by

Office of the Publication Board * Department of Commerce
Washington 25, D. C.

All secrecy restrictions on the contents of this document have been lifted. In quoting or citing the report, please give proper credit to the authors and the sponsoring agency. In distributing this report, the Office of the Publication Board assumes no responsibility for its completeness and accuracy or for any opinions expressed. Products and processes described may be the subject of U. S. patents, and the usual patent search is recommended before making practical applications.

16-47922-1 GPO

Issued by

Quality Control Program, Carnegie Institute of Technology
Pittsburgh 13, Pennsylvania
for Office of Production Research and Development
War Production Board

Transactions Paper

(Reviewed and Accepted for Publication)

DISCUSSION IN QUADRUPLICATE DUE February 14, 1969.



FLASHOVER PROBABILITY OF PARALLEL MULTI-GAP

Toshio Suzuki
Central Research Institute
of Electric Power Industry
Tokyo, Japan

Isamu Kishijima
Central Research Institute
of Electric Power Industry
Tokyo, Japan

Yunosuke Ohuch
Tokyo Electric Power Co.
Tokyo, Japan

Koichiro Anjo
Chubu Electric Power Co.
Nagoya, Japan.

A paper recommended by the IEEE Transmission and Distribution Committee of the IEEE Power Group for presentation at the IEEE Winter Power Meeting, New York, N.Y., January 26-31, 1969. Manuscript submitted August 8, 1968; made available for printing November 22, 1968.

Price: \$1.00
(75¢ at meeting)

All Rights Reserved by
The Institute of Electrical and Electronics Engineers,
Inc.,
345 East 47th Street
New York, N. Y. 10017

Litho in USA

Paper No.

69 TP 68 - FWR

Transactions Paper

(Reviewed and Accepted for Publication)

DISCUSSION IN QUADRUPLICATE DUE February 14, 1969.



THE METHOD OF MAXIMUM LIKELIHOOD APPLIED TO THE ANALYSIS OF FLASHOVER DATA

Gordon W. Brown
Member IEEE
Westinghouse Electric Corp.
East Pittsburgh, Pa.

A paper recommended by the IEEE Transmission and Distribution Committee of the IEEE Power Group for presentation at the IEEE Winter Power Meeting, New York, N.Y., January 26-31, 1969. Manuscript submitted June 14, 1968; made available for printing November 21, 1968.

Price: \$1.00
(75¢ at meeting)

All Rights Reserved by
The Institute of Electrical and Electronics Engineers,
Inc.,
345 East 47th Street
New York, N. Y. 10017
Litho in USA

Paper No.

69 TP 69 - PWR

GENERAL  ELECTRIC

RESEARCH
AND
DEVELOPMENT
CENTER

SCHENECTADY, NEW YORK

CLASS 1

TESTING FOR NORMALITY WITH SPECIFIED PARAMETERS

by

S. S. Shapiro and M. B. Wilk*
Information Sciences Laboratory

Report No. 67-C-323

August 1967

*Bell Telephone Laboratories, Inc.

GENERAL  ELECTRIC

RESEARCH
AND
DEVELOPMENT
CENTER

SCHENECTADY, NEW YORK

CLASS 1

TWO-SAMPLE PREDICTION

by

W. B. Nelson, Information Sciences Laboratory

Report No. 68-C-404

November 1968

GENERAL  ELECTRIC

RESEARCH
AND
DEVELOPMENT
CENTER

SCHENECTADY, NEW YORK

CLASS 1

PREDICTION INTERVALS TO CONTAIN FUTURE
MEANS AND SOME OTHER STATISTICAL INTERVALS

by

G. J. Hahn
Information Sciences Laboratory

Report No. 70-C-270

July 1970

GENERAL  ELECTRIC

**GENERAL ELECTRIC COMPANY
CORPORATE RESEARCH AND DEVELOPMENT**

Schenectady, N.Y.

**A SURVEY OF PREDICTION INTERVALS AND
THEIR APPLICATIONS**

by

**G. J. Hahn and W. B. Nelson
Information Science and Engineering**

Report No. 72CRD027

January 1972

TECHNICAL INFORMATION SERIES

CLASS 1

GENERAL  ELECTRIC

**GENERAL ELECTRIC COMPANY
CORPORATE RESEARCH AND DEVELOPMENT**

Schenectady, N.Y.

**SOME FURTHER SIMULTANEOUS
PREDICTION INTERVALS**

by

**G. J. Hahn
Information Science and Engineering**

Report No. 72CRD274

September 1972

TECHNICAL INFORMATION SERIES

CLASS 1

GENERAL  ELECTRIC

RESEARCH
AND
DEVELOPMENT
CENTER

SCHENECTADY, NEW YORK

CLASS 1

FACTORS FOR CALCULATING TWO-SIDED PREDICTION INTERVALS
FOR SAMPLES FROM A NORMAL DISTRIBUTION

by

G J. Hahn, Information Sciences Laboratory

Report No. 68-C-392

October 1968

STATISTICAL ANALYSIS OF 1967 20,000 LB.
SUSPENSION INSULATOR M&E TEST DATA

May 17, 1968
by
W. B. Lounsbury

Insulator Department

Manufacturing Problems Analysis-I

GENERAL  ELECTRIC

Mathematical

GENERAL  ELECTRIC

DEFENSE ELECTRONICS DIVISION

TECHNICAL INFORMATION SERIES

NO. R58EMH-20

TITLE

Table of Laplace Transforms

AUTHOR H. J. Lyness, A. E. P.

G.E. CLASS

2

GOVERNMENT CLASSIFICATION

Unclassified

This document contains proprietary information of the General Electric Company and is restricted to distribution and use within the General Electric Company unless designated above as GE Class I or unless otherwise expressly authorized in writing.

(RTD-639-21) (5-58)

GENERAL  ELECTRIC

Transactions Paper

(Reviewed and Accepted for Publication)



A NEW APPROACH TO THE CALCULATION OF THE LIGHTNING PERFORMANCE OF TRANSMISSION LINES

Theory

C. F. Wagner
Fellow AIEE
Westinghouse Electric Corp.
East Pittsburgh, Pa.

A paper recommended by the AIEE Committee on Transmission and Distribution and approved by the AIEE Committee on Technical Operations for presentation at the AIEE Summer and Pacific General Meeting, San Francisco, Calif., June 25-29, 1956. Manuscript submitted March 28, 1956; made available for printing May 15, 1956.

Price: 40¢ To Members
80¢ To Nonmembers

(5¢ per copy additional if
first class mailing desired)

All Rights Reserved by the
American Institute of Electrical Engineers
33 West 39th Street, New York 18, N. Y.
Litho in USA

Paper No.

56-733

Discussion in Duplicate Due July 11, 1956.

Transactions Paper

(Reviewed and Accepted for Publication)



SAFE CLEARANCES AND PROTECTION AGAINST SHOCKS DURING LIVE LINE WORK

A. Elek
Associate Member AIEE

J. W. Simpson
Associate Member AIEE

Both of:
The Hydro-Electric Power Commission
of Ontario
Toronto, Ont., Canada

RECEIVED

SEP 12 1961

H. A. EREY

A paper recommended by the AIEE Transmission and Distribution Committee and approved by the AIEE Technical Operations Department for presentation at the AIEE Fall General Meeting, Detroit, Mich., October 15-20, 1961. Manuscript submitted June 14, 1961; made available for printing August 4, 1961.

Price: \$.50 To Members
\$1.00 To Nonmembers

(5¢ per copy additional if
first class mailing desired)

All Rights Reserved by the
American Institute of Electrical Engineers
33 West 39th Street, New York 18, N. Y.
Litho in USA

Paper No.

61-1019

Discussion in Duplicate Due November 3, 1961.

Transactions Paper

(Reviewed and Accepted for Publication)



Therby

A NEW APPROACH TO THE CALCULATION OF THE LIGHTNING PERFORMANCE OF TRANSMISSION LINES

C. F. Wagner
Fellow AIEE
Westinghouse Electric Corp.
East Pittsburgh, Pa.

A paper recommended by the AIEE Committee on Transmission and Distribution and approved by the AIEE Committee on Technical Operations for presentation at the AIEE Summer and Pacific General Meeting, San Francisco, Calif., June 25-29, 1956. Manuscript submitted March 28, 1956; made available for printing May 15, 1956.

Price: 40¢ To Members
80¢ To Nonmembers

(5¢ per copy additional if
first class mailing desired)

All Rights Reserved by the
American Institute of Electrical Engineers
33 West 39th Street, New York 18, N. Y.
Litho in USA

Paper No.

56-733

Discussion in Duplicate Due July 11, 1956.

District Conference Paper

Misc.



CONTROL OF FLICKER ON DISTRIBUTION SYSTEMS

L. R. Gardner
Associate Member AIEE
Houston Lighting and Power Co.
Houston, Tex.

W. T. Kittinger
Associate Member AIEE
University of Houston
Houston, Tex.

Submitted in abstract or outline form only to the AIEE Transmission and Distribution Committee for presentation at the AIEE Southwest District Meeting, Houston, Tex., April 4-6, 1960. Manuscript submitted February 1, 1960; made available for printing February 10, 1960.

Price: \$.50 To Members
\$1.00 To Nonmembers

(5¢ per copy additional if
first class mailing desired)

All Rights Reserved by the
American Institute of Electrical Engineers
33 West 39th Street, New York 18, N. Y.
Litho in USA

Paper No. DP

60-530

RECEIVED
MAR 17 1960
H. A. FREY

Some Fundamental Aspects of Recovery Voltages

J. ZABORSZKY
MEMBER AIEE

J. W. RITTENHOUSE
FELLOW AIEE

Summary: Whether any load-interrupter switch successfully interrupts when called upon to do so depends solely upon how the recovery voltage builds up across the switch as a function of time in comparison with the build-up of dielectric strength between the switch contacts. This paper deals with recovery voltages in a graphical manner, so that a visual concept of recovery voltage versus time across a switch is provided in both single- and 3-phase cases involving resistive loads, inductive loads, and capacitive loads. As a special case, the recovery voltage across a switch in a loop-sectionaliz-

ing application is also treated in this paper.

IN RECENT DECADES electric load densities in the United States have been increasing at exceedingly high rates. This has gradually produced increased interest in the basic fundamentals relating to load interruption.

It is the purpose of this paper to demonstrate some of the fundamental properties of recovery voltages in relation to different kinds of switching problems, with a

view to demonstrating the differences in voltage conditions to which load-interrupter equipment might be subjected.

The treatment will illustrate the well-known fact that the ability of a given commercial product to interrupt a flow of power is as much a function of the circuit containing the switch as of the design of the switch itself.

It is hoped that the simplified and sequential approach presented here will serve as a stimulus for future extension of this review.

Paper 62-244, recommended by the AIEE Switchgear Committee and approved by the AIEE Technical Operations Department for presentation at the AIEE Winter General Meeting, New York, N. Y., January 28-February 2, 1962. Manuscript submitted August 1, 1961; made available for printing December 8, 1961.

J. ZABORSZKY is with Washington University, St. Louis, Mo., and J. W. RITTENHOUSE is with the Hi-Voltage Equipment Company, Cleveland, Ohio.



TELEPHONE
AREA CODE (513) 631-8903

SO-LOW ENVIRONMENTAL EQUIPMENT CO., INC.

CLENEAY INDUSTRIAL CENTER

1743 CLENEAY AVENUE • CINCINNATI, OHIO 45212

INSTRUCTIONS

INSTALLATION AND OPERATION OF

SO-LOW CHILLING CABINET

MODEL NO. AD50-F

SERIAL NO. 6970199

Model No. AD50-F So-Low low temperature chilling machine has an air cooled condenser. The unit should be located in a suitable location so that it receives good air circulation. Be sure there is good air circulation available. The condenser fan is situated so as to draw air through the condenser, and over the compressor. An increase in the operating time and cost will result if this air flow is restricted, as well as decreasing the efficiency of the refrigeration system.

Model No. AD50-F is wired for 480 Volts, 1 Phase, 60 Cycle operation.

The system is powered by 1 HP motor, and the motor is thermally protected by a thermostatic overload protector within the terminal box, motor will automatically re-set.

September 1947
Litho in USA



ENV

TRANSMISSION OF ELECTRIC POWER AT EXTRA-HIGH VOLTAGES

Philip Sporn
Fellow AIEE

American Gas and Electric Service Corp.,
New York, N. Y.

A. C. Monteith
Fellow AIEE

Westinghouse Electric Corporation,
East Pittsburgh, Pa.

Advance Copy
Not Released for Publication

All Rights Reserved by the
American Institute of Electrical Engineers
33 West 39th Street, New York 18, N.Y.

A paper recommended by the AIEE committee on transmission and distribution for presentation at the AIEE Midwest general meeting, Chicago, Ill., November 3-7, 1947. Manuscript submitted August 28, 1947; made available for printing September 19, 1947.

PRICE:

To Members
To Nonmembers

BY
MAIL

25¢
45¢

AT HEADQUARTERS
OR MEETING

20¢
40¢

GENERAL  ELECTRIC**INSTRUMENT DEPARTMENT****TECHNICAL INFORMATION SERIES**

Title Page

AUTHOR Multiple	SUBJECT CLASSIFICATION Nontracking Electrical Insulations	NO. DF56MI-146 DATE 8/10/56
TITLE INSULATION CONFERENCE ON NONTRACKING ORGANIC MATERIALS		
ABSTRACT This data folder consists of technical papers presented at the "Insulation Conference on Non-tracking Organic Materials" held at the Measurements Laboratory, Instrument Department on April 5, 1956.		
G.E. CLASS 4	REPRODUCIBLE COPY FILED AT Technical Data Sub-Unit West Lynn Works	NO. PAGES 55
GOV. CLASS. None		
CONCLUSIONS See "concluding remarks" and appendix.		

By cutting out this rectangle and folding on the center line, the above information can be fitted into a standard card file.

For list of contents—drawings, photos, etc. and for distribution see next page (FN-610-2).

INFORMATION PREPARED FOR _____

TESTS MADE BY _____

COUNTERSIGNED _____ UNIT _____

INSTRUMENT DEPARTMENT _____ LOCATION **WEST LYNN, MASS.**



INSTANTANEOUS CURRENT RELAYS



Type PJC

LOW VOLTAGE SWITCHGEAR DEPARTMENT
GENERAL  ELECTRIC
PHILADELPHIA, PA.



THE COMPLETE LINE

DROP FORGED
HI-LINE
HARDWARE

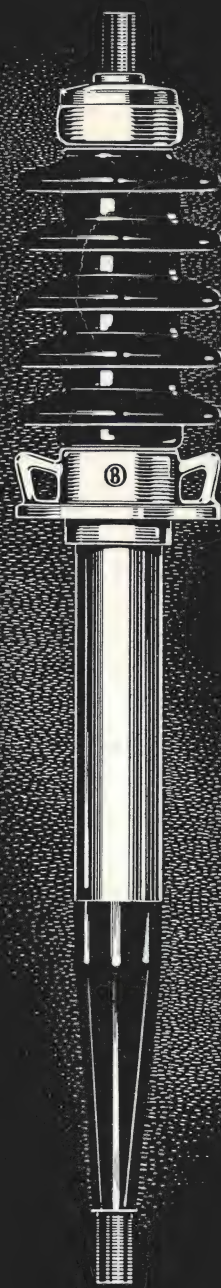


COMPARISON
LIST

Hi-Line
Hardware Division  Workers in Metal
Since 1834
BREWER-TITCHENER CORPORATION
Subsidiary of Joslyn Mfg. and Supply Co.
Cortland, New York 13045

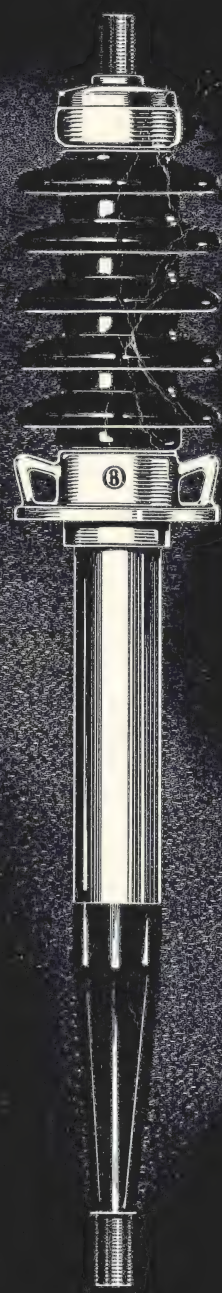
Announcing

O-B'S NEW ASA STANDARD BUSHING



Announcing

O-B'S NEW ASA STANDARD BUSHING



GENERAL  ELECTRIC

HYDRO-QUEBEC
700-KV TRANSMISSION PROJECT



ELECTRIC UTILITY ENGINEERING

PROPOSAL FOR

SUBMITTED BY

LOCKE
INCORPORATED

March 1951
Litho in USA



SYSTEM ECONOMICS OF EXTRA HIGH-VOLTAGE TRANSMISSION

H. P. St. Clair
Fellow AIEE

E. L. Peterson
Member AIEE

Both of:
American Gas and Electric Service Corporation
New York, N. Y.

Advance Copy
Not Released for Publication

All Rights Reserved by the
American Institute of Electrical Engineers
33 West 39th Street, New York 18, N.Y.

A paper recommended by the AIEE Committee on Transmission and Distribution and approved by the AIEE Technical Program Committee for presentation at the North Eastern District Meeting, Syracuse, N. Y., May 2-4, 1951. Manuscript submitted January 30, 1951; made available for printing March 2, 1951.

PRICE: 30¢ To Members
60¢ To Nonmembers

May 1951
Litho in USA



LINE INSULATOR LOSS UNDER NORMAL CONDITIONS —
500-KV TEST PROJECT OF THE AMERICAN GAS AND ELECTRIC COMPANY

O. Naef American Gas and Electric Service Corp.
Member AIEE New York, N. Y.

R. L. Tremaine
Associate AIEE

Both of:
Westinghouse Electric Corp.
East Pittsburgh, Pa.

A. R. Jones
Associate AIEE

Advance Copy
Not Released for Publication

All Rights Reserved by the
American Institute of Electrical Engineers
33 West 39th Street, New York 18, N.Y.

A paper recommended by the AIEE Committee on Transmission and Distribution and approved by the AIEE Technical Program Committee for presentation at the AIEE Summer General Meeting, Toronto, Ont., Canada, June 25-29, 1951. Manuscript submitted March 28, 1951; made available for printing May 15, 1951.

PRICE: 30¢ To Members
60¢ To Nonmembers

AIEE
Technical Paper
54-33

November 1953
Litho in USA



Discussion for publication
must be postmarked on or before
February 3, 1954.

DIELECTRIC AND OTHER PROBLEMS IN THE DESIGN OF A NEW 330 KV
OUTDOOR AIR SWITCH

A. H. Powell
Member AIEE
General Electric Company
Philadelphia, Pa.

Advance Copy
Not Released for Publication

All Rights Reserved by the
American Institute of Electrical Engineers
33 West 39th Street, New York 18, N.Y.

A paper recommended by the AIEE Committee on Switchgear and approved by the AIEE Committee on Technical Operations for presentation at the AIEE Winter General Meeting, New York, N. Y., January 18-22, 1954. Manuscript submitted October 20, 1953; made available for printing November 16, 1953.

PRICE: 30¢ To Members (5¢ per copy additional if
60¢ To Nonmembers first class mailing desired)

Conference Paper



RESEARCH FOR THE ELECTRIC POWER AND ELECTRIC UTILITY INDUSTRIES IN SWEDEN

Gunnar Jancke
Nonmember AIEE

Ivar Herlitz
Member AIEE

Both of:
Swedish State Power Board
Stockholm, Sweden

Submitted in abstract or outline form only to the AIEE Committee on Research for the AIEE Winter General Meeting, New York, N. Y., January 30-February 3, 1956. Manuscript submitted December 6, 1955; made available for printing December 9, 1955.

Price: 40¢ To Members
80¢ To Nonmembers

(5¢ per copy additional if
first class mailing desired)

All Rights Reserved by the
American Institute of Electrical Engineers
33 West 39th Street, New York 18, N. Y.
Litho in USA

Paper No. **CP**

56-294

Conference Paper

(Accepted for Publication in the
Proceedings of the American Power Conference)



EXTRA-HIGH-VOLTAGE CABLE RESEARCH --

CHALLENGE OF THE FUTURE

Clement S. Schifreen
Fellow AIEE
Philadelphia Electric Company
Philadelphia, Pa.

A paper recommended by the Electrical Program Committee of the American Power Conference and approved for presentation at the American Power Conference, Chicago, Ill., March 31-April 2, 1959. Manuscript submitted January 26, 1959; made available for printing January 30, 1959.

Price: 40¢ To Members
80¢ To Nonmembers

(5¢ per copy additional if
first class mailing desired)

All Rights Reserved by the
American Institute of Electrical Engineers
33 West 39th Street, New York 18, N. Y.
Litho in USA

Paper No. **CP**

59-495

~~W. A. Brown~~
~~W. A. Brown~~
~~W. A. Brown~~
EAV HAFrey

Conference Paper

(Accepted for Publication in the
Proceedings of the American Power Conference)



RECEIVED

APR 6 1959

H. A. FREY

EXTRA-HIGH-VOLTAGE CABLE RESEARCH --

CHALLENGE OF THE FUTURE

RECEIVED

MAY 5 1959

H. A. FREY

Clement S. Schifreen
Fellow AIEE
Philadelphia Electric Company
Philadelphia, Pa.

RECEIVED

APR 13 1959

ENG. DEPT.

A paper recommended by the Electrical Program Committee of the American Power Conference and approved for presentation at the American Power Conference, Chicago, Ill., March 31-April 2, 1959. Manuscript submitted January 26, 1959; made available for printing January 30, 1959.

Price: 40¢ To Members
80¢ To Nonmembers

(5¢ per copy additional if
first class mailing desired)

All Rights Reserved by the
American Institute of Electrical Engineers
33 West 39th Street, New York 18, N. Y.
Litho in USA

Paper No. CP

59-495

RECEIVED

APR 19 1959

Transactions Paper and Conference Papers



Paper No. 60-186

P R O J E C T E H V

(5 Papers)

- TP Project EHV - Preliminary Corona Investigations; The Effect of Harmonics on Corona Losses by A. H. Foley, Associate Member AIEE, and F. Olsen, Nonmember AIEE.
(Discussion in Duplicate Due February 19, 1960.)
- CP Project EHV - Technical Plan by P. A. Abetti, Member AIEE; D. D. Davis, Member AIEE; and J. H. Hagenguth, Fellow AIEE
- CP Project EHV - Insulation Design by J. G. Anderson, Member AIEE; J. H. Hagenguth, Fellow AIEE; I. B. Johnson, Fellow AIEE; A. J. Schultz, Member AIEE
- CP Project EHV - North Station and Portal-Type Towers by S. Minneci, Member AIEE; A. H. Powell, Member AIEE; R. E. Larson, Associate Member AIEE; G. E. Fortney, Nonmember AIEE; S. D. Alpert, Nonmember AIEE
- CP Project EHV - Conductors, Insulators and Conductor Accessories by J. J. LaForest, Associate Member AIEE; J. Kaminski, Jr., Member AIEE; R. E. Larson, Associate Member AIEE

Papers recommended by the AIEE Transmission and Distribution Committee, TP approved by the AIEE Technical Operations Department, for presentation at the AIEE Winter General Meeting, New York, N. Y., January 31-February 5, 1960. Manuscript submitted November 2, 1959; made available for printing December 15, 1959.

Price: \$ 2.00 To Members
\$ 4.00 To Nonmembers

(5¢ per copy additional if
first class mailing desired)

All Rights Reserved by the
American Institute of Electrical Engineers
33 West 39th Street, New York 18, N. Y.
Litho in USA

Paper No.

60-186

EHV

Conference Paper



DATA GATHERING AND TRANSMISSION SYSTEM FOR PROJECT EHV

P. A. Abetti
Member AIEE

D. W. Caverly
Associate Member AIEE

D. D. Davis
Member AIEE

E. A. Whepley
Associate Member AIEE

All of:
General Electric Co.
Pittsfield, Mass.

A paper recommended by the AIEE Transmission and Distribution Committee for presentation at the AIEE Power Industry Computer Application Conference, St. Louis, Mo., November 9-11, 1960. Manuscript submitted August 12, 1960; made available for printing September 22, 1960.

RECEIVED
NOV 7 1960
H. A. EREY

Price: \$.50 To Members
\$1.00 To Nonmembers

(5¢ per copy additional if
first class mailing desired)

All Rights Reserved by the
American Institute of Electrical Engineers
33 West 39th Street, New York 18, N. Y.
Litho in USA

Paper No. CP
60-1407

EHV

Mr. Boyd

Conference Paper



PROJECT EHV - SYSTEM DESIGN AND NORTH STATION EQUIPMENT

C. B. Lindh
Member AIEE
General Electric Co.
Pittsfield, Mass.

S. H. Law
Member AIEE
Western Massachusetts Electric Co.
Springfield, Mass.

A paper recommended by the AIEE Transmission and Distribution Committee for presentation at the AIEE Fall General Meeting, Chicago, Ill., October 9-14, 1960. Manuscript submitted August 8, 1960; made available for printing September 14, 1960.

RECEIVED

OCT 7 1960

G. M. BOYD

Price: \$.50 To Members
\$1.00 To Nonmembers

(5¢ per copy additional if
first class mailing desired)

All Rights Reserved by the
American Institute of Electrical Engineers
33 West 39th Street, New York 18, N. Y.
Litho in USA

Paper No. CP

60-1284

RECEIVED

OCT 6 1960

H. A. EREY

Transactions Paper

(Reviewed and Accepted for Publication)



650-KV SUBSTATIONS FOR PROJECT EHV

P. A. Abetti
Member AIEE
General Electric Co.
Pittsfield, Mass.

A. H. Powell
Member AIEE
General Electric Co.
Philadelphia, Pa.

R. E. Larson
Associate Member AIEE
Aluminum Co. of America
Pittsburgh, Pa.

M. D. Robinson
Associate Member AIEE
Stone and Webster Engg. Corp.
Boston, Mass.

A paper recommended by the AIEE Substations Committee and approved by the AIEE Technical Operations Department for presentation at the AIEE Winter General Meeting, New York, N. Y., January 29-February 3, 1961. Manuscript submitted November 2, 1960; made available for printing December 14, 1960.

Price: \$.50 To Members
\$1.00 To Nonmembers

(5¢ per copy additional if
first class mailing desired)

All Rights Reserved by the
American Institute of Electrical Engineers
33 West 39th Street, New York 18, N. Y.
Litho in USA

Paper No.

61-155

Discussion in Duplicate Due February 17, 1961.

Conference Paper



METAL TOWERS FOR 650-KV OPERATION ON PROJECT EHV

S. D. Alpert
Nonmember AIEE
Stone & Webster Engg. Corp.
Boston, Mass.

G. E. Fortney
Nonmember AIEE
United States Steel Corp.
Pittsburgh, Pa.

H. B. White
Associate Member AIEE
Aluminum Company of Canada, Ltd.
Montreal, Que., Canada

J. H. Foote
Fellow AIEE
Commonwealth Associates Inc.
Jackson, Mich.

D. D. MacCarthy
Fellow AIEE
General Electric Company
Pittsfield, Mass.

J. E. Williams
Nonmember AIEE
Aluminum Company of America
Pittsburgh, Pa.

RECEIVED

JAN 30 1961

H. A. FREY

A paper recommended by the AIEE Transmission and Distribution Committee for presentation at the AIEE Winter General Meeting, New York, N. Y., January 29-February 3, 1961. Manuscript submitted November 2, 1960; made available for printing December 28, 1960.

Price: \$.50 To Members
\$1.00 To Nonmembers

(5¢ per copy additional if
first class mailing desired)

All Rights Reserved by the
American Institute of Electrical Engineers
33 West 39th Street, New York 18, N. Y.
Litho in USA

Conference Paper



A STUDY OF USE OF ALUMINUM GUYED TOWERS FOR EXTRA HIGH VOLTAGE TRANSMISSION SYSTEMS

L. H. J. Cook
Member AIEE

B. Cooper

Both of:
International Power and Engineering
Consultants Limited
Vancouver, Canada

Submitted in abstract or outline form only to the AIEE Transmission and Distribution Committee for presentation at the AIEE Fall General Meeting, Detroit, Mich., October 15-20, 1961. Manuscript submitted August 7, 1961; made available for printing August 14, 1961.

Price: \$.50 To Members
\$1.00 To Nonmembers

(5¢ per copy additional if
first class mailing desired)

All Rights Reserved by the
American Institute of Electrical Engineers
345 E. 47th St., New York 17, N.Y.
Litho in USA

Conference Paper



EXPERIMENTS WITH GALLOPING SPANS

James J. Ratkowski
Associate Member AIEE
Commonwealth Edison Co.
Chicago, Ill.

A paper recommended by the AIEE Transmission and Distribution Committee for presentation at the AIEE Winter General Meeting, New York, N. Y., January 28-February 2, 1962. Manuscript submitted October 16, 1961; made available for printing November 17, 1961.

Price: \$.50 To Members
\$1.00 To Nonmembers

(5¢ per copy additional if
first class mailing desired)

All Rights Reserved by the
American Institute of Electrical Engineers
345 East 47th Street, New York 17, N. Y.
Litho in U.S.A.

Paper No. **CP**

62-62

Conference Paper



RESEARCH AND DEVELOPMENT LEADING TO THE HIGH-POWER VACUUM INTERRUPTER -- AN HISTORICAL REVIEW

J. D. Cobine
Member AIEE
General Electric Company
Schenectady, N. Y.

A paper recommended by the AIEE Switchgear Committee for presentation at the AIEE Winter General Meeting, New York, N. Y., January 28-February 2, 1962. Manuscript submitted October 23, 1961; made available for printing November 20, 1961.

Price: \$.50 To Members
\$1.00 To Nonmembers

(5¢ per copy additional if
first class mailing desired)

All Rights Reserved by the
American Institute of Electrical Engineers
345 East 47th Street, New York 17, N. Y.
Litho in U.S.A.

Paper No. **CP**

62-67

Transactions Paper

(Reviewed and Accepted for Publication)



PERFORMANCE OF 161-KV AND 115-KV TRANSMISSION LINES

Fred Chambers
Member AIEE

C. P. Almon, Jr.
Fellow AIEE

Both of:
Tennessee Valley Authority
Chattanooga, Tenn.

A paper recommended by the AIEE Transmission and Distribution Committee and approved by the AIEE Technical Operations Department for presentation at the AIEE Winter General Meeting, New York, N. Y., January 28-February 2, 1962. Manuscript submitted October 31, 1961; made available for printing December 12, 1961.

Price: \$.50 To Members
\$1.00 To Nonmembers

(5¢ per copy additional if
first class mailing desired)

All Rights Reserved by the
American Institute of Electrical Engineers
345 East 47th Street, New York 17, N. Y.
Litho in U.S.A.

Paper No.

62-116

Discussion in Duplicate Due February 16, 1962.

R. L. McCoy Jan 28, 1962

Transactions Paper

(Reviewed and Accepted for Publication)



BIBLIOGRAPHY ON EXTRA-HIGH-VOLTAGE SYSTEMS --

FIRST SUPPLEMENT

P. A. Abetti
Member AIEE
General Electric Co.
Schenectady, N. Y.

A paper recommended by the AIEE Transmission and Distribution Committee and approved by the AIEE Technical Operations Department for presentation at the AIEE Winter General Meeting, New York, N. Y., January 28-February 2, 1962. Manuscript submitted November 9, 1961; made available for printing November 21, 1961.

Price: \$ 1.50 To Members
\$ 3.00 To Nonmembers

(5¢ per copy additional if
first class mailing desired)

All Rights Reserved by the
American Institute of Electrical Engineers
345 East 47th Street, New York 17, N. Y.
Litho in U.S.A.

Paper No.

Discussion in Duplicate Due February 16, 1962.

62-99

Transactions Paper

(Reviewed and Accepted for Publication)



BIBLIOGRAPHY ON EXTRA-HIGH-VOLTAGE SYSTEMS --

FIRST SUPPLEMENT

P. A. Abetti
Member AIEE
General Electric Co.
Schenectady, N. Y.

A paper recommended by the AIEE Transmission and Distribution Committee and approved by the AIEE Technical Operations Department for presentation at the AIEE Winter General Meeting, New York, N. Y., January 28-February 2, 1962. Manuscript submitted November 9, 1961; made available for printing November 21, 1961.

Price: \$ 1.50 To Members
\$ 3.00 To Nonmembers

(5¢ per copy additional if
first class mailing desired)

All Rights Reserved by the
American Institute of Electrical Engineers
345 East 47th Street, New York 17, N. Y.
Litho in U.S.A.

Paper No.

62-99

Discussion in Duplicate Due February 16, 1962.

Transactions Paper

(Reviewed and Accepted for Publication)



RADIO NOISE FROM HIGH-VOLTAGE TRANSMISSION LINES

AIEE Radio Noise Subcommittee
of the
AIEE Transmission and Distribution Committee

A paper recommended by the AIEE Transmission and Distribution Committee and approved by the AIEE Technical Operations Department for presentation at the AIEE Winter General Meeting, New York, N. Y., January 28-February 2, 1962. Manuscript submitted October 18, 1961; made available for printing December 6, 1961.

Members of the AIEE Radio Noise Subcommittee: H. L. Rorden, Chairman; L. O. Barthold, P. L. Bellaschi, H. H. Brustle, F. C. Creed, F. R. Dallye, H. M. Ellis, C. D. Fiero, H. A. Gauper, E. H. Gehrig, R. E. Graham, F. L. Greene, N. S. Kent, J. J. LaForest, J. R. Leslie, T. W. Liao, R. J. Mather, C. J. Miller, A. C. Neaderland, W. E. Pakala, B. M. Pickens, M. G. Poland, L. M. Robertson, R. H. Schlomann, L. N. Stone, E. R. Taylor, F. L. Taylor, F. J. Trebby, P. D. Tuttle, F. C. Vose, F. A. Denbrock, H. M. Mather.

Price: \$.50 To Members
\$1.00 To Nonmembers

(5¢ per copy additional if
first class mailing desired)

All Rights Reserved by the
American Institute of Electrical Engineers
345 East 47th Street, New York 17, N. Y.
Litho in U.S.A.

Paper No.

Discussion in Duplicate Due February 16, 1962.

62-106

Mr. Hare
Product Engineer

DIELECTRIC MATERIALS IONIZATION STUDY

FOR

**U.S. NAVY DEPARTMENT BUREAU OF SHIPS
WASHINGTON, D. C.**

RECEIVED

SEP 14 1953

ENG. DEPT.

Attention Code 814

INTERIM ENGINEERING REPORT NO. 3

July 31, 1953

W. B. Hare
R. H. Hare
J. H. Hare
E. H. Hare
B. E. Hare

Index No.:	NE-111273, Subtask 3
Contract No.:	GE-69177
Customer Order No.:	NOBSR-57408
GE Requisition No.:	W-86046

GENERAL ENGINEERING LABORATORY

GENERAL  ELECTRIC

SCHENECTADY, NEW YORK

~~Mr. Dose~~
"Kenzaburg"

H. A. Frey
Locke Dept.
Baltimore, Md.

GENERAL ELECTRIC
Research Laboratory

RECEIVED
NOV 16 1953
ENG. DEPT.

CATHODE EFFECTS IN THE DIELECTRIC BREAKDOWN OF LIQUIDS

by

J. K. Bragg, A. H. Sharbaugh, and R. W. Crowe

Report No. RL-953

September 1953

CLASS 1

SCHENECTADY, NEW YORK

~~Mr. H. A. Gray~~
Kingsbury

H. A. Gray
Locke Dept.
Baltimore, Md.

RECEIVED

GENERAL ELECTRIC
Research Laboratory

FEB 8 1954

ENG. DEPT.

ON THE TOWNSEND MECHANISM OF SPARK BREAKDOWN OF GASES

by

R.W. Crowe, J.K. Bragg and V.G. Thomas

Report No. RL-1011

January 1954

CLASS 1

SCHENECTADY, NEW YORK

Space Charge Phenomena in Liquid Dielectrics

By D. W. GOODWIN†

Department of Physics, The University of Birmingham

Communicated by K. A. Macfadyen; MS. received 19th August 1955

Abstract. By means of the electro-optical Kerr effect, distortion by space charge of the uniform potential gradient between electrodes in purified chlorobenzene has been observed. Evidence is presented suggesting that the conduction process occurs in filaments. The modified distribution of field strength is in qualitative agreement with a previous theory.

§ 1. INTRODUCTION

A THEORY of electrical breakdown in liquid dielectrics (Goodwin and Macfadyen 1953) suggests that field distortion is produced in a liquid at high field strengths as a result of electron emission from the cathode and the movement of ions between the electrodes. One important prediction of this theory is that the cathode field strength becomes enhanced in comparison with the anode field strength as the applied field strength is increased to that value required to produce breakdown. It is the purpose of this paper to describe investigations into such an increase in cathode field strength and to compare its magnitude with the predicted value.

Space charge effects in liquids have been observed previously (Dantscher 1931, Vafiadis 1939) using the Kerr electro-optical effect under conditions of continuously applied fields. In the experiments to be described space-charge effects, resulting from the application of rectangular voltage pulses, have been revealed using the Kerr effect. The use of pulsed voltages has been shown previously to overcome experimental difficulties associated with liquids under high electric stress.

§ 2. APPARATUS AND EXPERIMENTAL METHOD

2.1. *The Experimental Method*

The application of a strong electric field to an insulating liquid will make it doubly refracting. If now light, plane polarized in a direction at 45° to that of the electric field, passes through the liquid it will be elliptically polarized. The phase difference Δ between the two components is given by Kerr's law

$$\Delta = BEl^2 \quad \dots\dots(1)$$

where l is the distance the light travels through a field of strength E ; B is known as Kerr's constant. Transmission can then occur through an analyser crossed with the polarizer under zero field strength conditions. Differences in transmission across the gap can be correlated with space charge phenomena (Dillon 1930). The phase difference Δ can be measured with a Rayleigh compensator (Rayleigh 1902), a strip of photo-elastic material under cantilever

† Now at the Radar Research Establishment, Great Malvern, Worcs.

RECEIVED

JUL 10 1952

ENG. DEPT.

TECHNICAL INFORMATION SERIES

AUTHOR	SUBJECT CLASSIFICATION	NO.
WA Hixson <i>W.H. Hixson</i>	1. Dielectrics - Phenomena 2. Bushings - Power 3. Gaps - Air	52TP21
TITLE		DATE
Effect of Ground Plane Protrusions on the Sixty-Cycle and Impulse Flashover Mechanism of Bushings.		3/10/52
ABSTRACT		

FOR USE OF G-E EMPLOYEES ONLY



TRANSFORMER AND ALLIED PRODUCTS DIVISION

GENERAL  ELECTRIC

RESEARCH
AND
DEVELOPMENT
CENTER

SCHENECTADY, NEW YORK

RECEIVED
OCT 18 1966

ENG.

CLASS 1

A DIRECT-CURRENT TRANSFORMER

by

I. Giaever, General Physics Laboratory

Report No. 66-C-263

August 1966

RECEIVED

AUG 13 1956

ENG. DEPT.

Mr. Kingsbury

*J. C. Vose
Insulator Dept
Ballinacree Ind*

GENERAL ELECTRIC
Research Laboratory

Dielectric

ROTATING PROBE ELECTROMETER

by

J. C. Devins and S. I. Reynolds

Report No. 56-RL-1594

August 1956

CLASS 1

SCHENECTADY, NEW YORK

~~Mr. J. H. Frey~~
~~Mr. J. H. Frey~~
~~Mr. J. H. Frey~~
Mr. Kingsbury

Mr. J. H. Frey.
Locke Dept.
Baltimore, Md

GENERAL ELECTRIC
Research Laboratory

RECEIVED
DEC 2 1955
ENG. DEPT.

SEMI-EMPIRICAL CALCULATION OF THE TOWNSEND α

by

Peter L. Auer

Report No. 55-RL-1447 November 1955

CLASS 1

SCHENECTADY, NEW YORK

*Mr. King Johnson
Note: filed*

*W. A. Frey
Locke Dept
Baltimore, Md*

GENERAL ELECTRIC
Research Laboratory

RECEIVED

DEC 16 1955

ENG. DEPT.

Dielectric

THE SECOND TOWNSEND COEFFICIENT FOR INSULATING SURFACES

by

J. C. Devins

Report No. 55-RL-1437 November 1955

CLASS 1

SCHENECTADY, NEW YORK

PUBLISHED

Dielectrics

U.D.C. 537.529

THE ELECTRICAL RESEARCH ASSOCIATION



Short-Time Electrical Breakdown of Solids by External Discharges.

by K.W.Ogilvie, Ph.D.

TECHNICAL REPORT L/T352

1956

Price 12/6d.

THE BRITISH ELECTRICAL AND ALLIED INDUSTRIES RESEARCH ASSOCIATION
THORNCROFT MANOR, DORKING ROAD,
LEATHERHEAD, SURREY.

Telephone Leatherhead 3423

JAN 29 1958

Diel

Conference Paper



INTERNAL OXIDATION MECHANISM FOR NON-TRACKING ORGANIC INSULATIONS

R. S. Norman
Associate Member AIEE

A. A. Kessel
Nonmember AIEE

Both of:
General Electric Company
West Lynn, Mass.

A paper recommended by the AIEE Dielectrics Committee for the AIEE Winter General Meeting, New York, N. Y., February 2-7, 1958. Manuscript submitted October 14, 1957; made available for printing December 6, 1957.

Price: 40¢ To Members
80¢ To Nonmembers

(5¢ per copy additional if
first class mailing desired)

All Rights Reserved by the
American Institute of Electrical Engineers
33 West 39th Street, New York 18, N. Y.
Litho in USA

Paper No. CP

58-211

*Equipment
Testing*

*H. A. Tracy
C. D. Crosby
J. B. Horton
C. D. Brunner
W. A. Weldon
O. M. Dewand*

TECHNICAL INFORMATION SERIES

NO. R - 50TL187

TITLE PURIFICATION OF WATER FOR CHEMICAL PROCESSING
BY DEMINERALIZATION

AUTHOR

A. E. DURKIN
THOMSON LABORATORY

This folder is the property of the General Electric Company, and must not be retained except by special permission, or used directly or indirectly in any way detrimental to the interest of the Company.

FN-612 (12-48)

GENERAL  ELECTRIC

May 1951
Litho in USA



THE LINASCOPE TRANSMISSION LINE FAULT LOCATOR

K. H. Kidd

Associate AIEE

The Hydro-Electric Power Commission of Ontario
Toronto, Ont., Canada

Advance Copy
Not Released for Publication

All Rights Reserved by the
American Institute of Electrical Engineers
33 West 39th Street, New York 18, N.Y.

A paper recommended by the AIEE Committee on Transmission and Distribution and approved by the AIEE Technical Program Committee for presentation at the AIEE Summer General Meeting, Toronto, Ont., Canada, June 25-29, 1951. Manuscript submitted March 27, 1951; made available for printing May 16, 1951.

PRICE: 30¢ To Members
60¢ To Nonmembers

GENERAL  ELECTRIC

RESEARCH
AND
DEVELOPMENT
CENTER

SCHENECTADY, NEW YORK

CLASS 1

TIME-SHARING COMPUTER PROGRAMS
FOR ESTIMATING PARAMETERS OF SEVERAL NORMAL POPULATIONS
AND FOR REGRESSION ESTIMATION FROM CENSORED DATA

by

G.J. Hahn and J.M. Miller*
Information Sciences Laboratory

Report No. 68-C-366

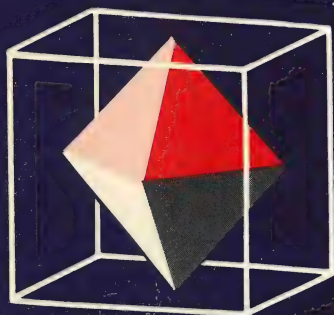
September 1968

*Telecommunications and Information Processing Operations,
2500 Cambridge Road, Schenectady, N. Y.

Al_2O_3

MgO

BeO



Coors

/ CERAMICS

Porcelain for High Voltage Insulators

In this paper the mechanical failure of porcelain is discussed with special reference to 3 seldom recognized characteristics: the effect of the porcelain surface on the strength, the apparent anomalous distribution of individual mechanical test values, and the effect of time on mechanical strength. A method of evaluating the result of these factors on electrical insulator performance is suggested.

By
D. H. ROWLAND
ASSOCIATE A.I.E.E.

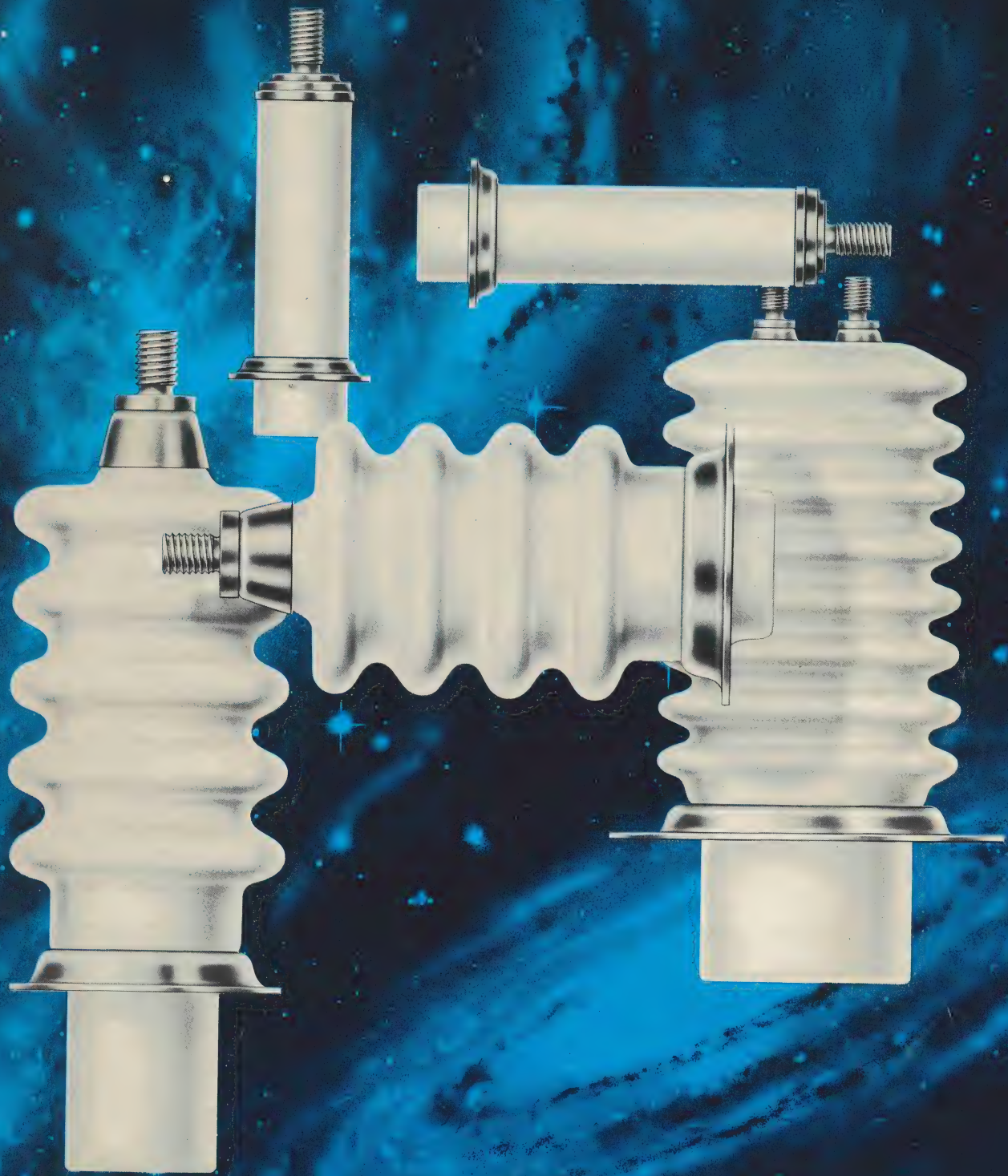
Locke Insulator Corp.,
Baltimore, Md.

THERE CAN BE little argument as to what mechanical characteristics are desirable in high voltage insulators, but the factors which contribute to such characteristics are concealed, more often than not, by an extraordinary amount of sophistic data. Modern high voltage insulators on

the average have improved enormously in the past decade. This improvement has been brought about in most cases by expensive and tedious cut and try tests conducted on assembled insulators. The procedure has been to assume that certain features of the completed units such as mechanical strength, ability to withstand immersion first in boiling water and then in ice water, imperviousness to moisture, and other qualities would insure insulators capable of standing up in service, which, after all, is the only real criterion of insulator worth. Finally specifications such as the A.I.E.E. Standards No. 41 for the testing of high voltage insulators were evolved and it may here be stated, unequivocally, that insulators which will successfully pass these specifications will give an unusually good account of themselves in the field. However, just because 2 groups of insulators of different manufacture successfully pass a certain specification it cannot be assumed that their maintenance cost in the field will be the same. How will they stand up under mechanical shock such as the impact from stones or bullets? What effect will time under load have upon their life? What is the maximum load that they will withstand? Is actual experience over a period of years the only way to find out? The purpose of this discussion is to provide engineers with a greater insight into some of the more recently investigated and rather peculiar mechanical characteristics of ceramic materials with the hope that an understanding of this work will help them to answer these questions and to point out that some of the characteristics which have been viewed with alarm by the uninitiated are really a true part of the whole scheme while other factors which have been unknown, or neglected, have been of major importance. A realization of this is bound to lead to still greater efficiency of systems dependent on the insulating qualities of such materials.

A paper recommended for publication by the A.I.E.E. committee on power transmission and distribution, and scheduled for discussion at the A.I.E.E. summer convention, Pasadena, Calif., June 22-26, 1936. Manuscript submitted March 25, 1936; released for publication April 23, 1936.

10. For numbered references see list at end of paper.



Coors

**STANDARD
INSULATORS**

HP 7103

AC/DC kilovoltmeters

(analog series)

...self storing



laboratory precision . . . yet rugged enough for field service!

ACCURACY GUARANTEED TO 0.5% DC AND 1.0% AC

- Hipotronics AC/DC kilovoltmeters are precision instruments for laboratory use — yet ruggedly designed and packaged for field and portable service
- Calibrated with our standard, which is certified by the National Bureau of Standards to have better than 0.1% accuracy on DC and better than 0.5% accuracy on AC
- Models to 200 KV are available from stock; other models with ratings to 1 megavolt are available on request

High Potential Technology

HIPOTRONICS®
HIPOTRONICS, INC.

HEWLETT · PACKARD
C O R P O R A T I O N

400D/H

VACUUM TUBE VOLTMETER

OPERATING AND SERVICING MANUAL

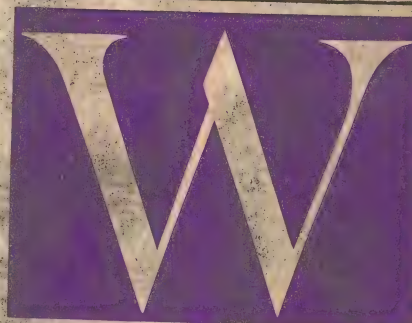
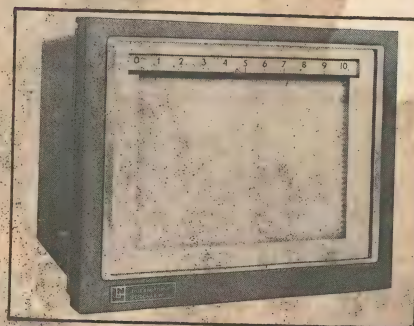




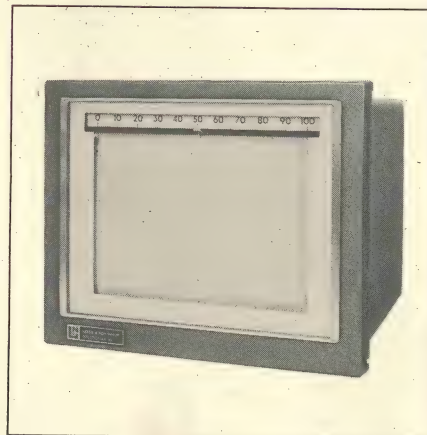
LEEDS & NORTHRUP

DIRECTIONS 177232 • ISSUE 5

SPEEDOMAX[®] W MANUAL



PARTS CATALOG FOR SPEEDOMAX® W



LEEDS & NORTHRUP COMPANY / *Pioneers in Precision*



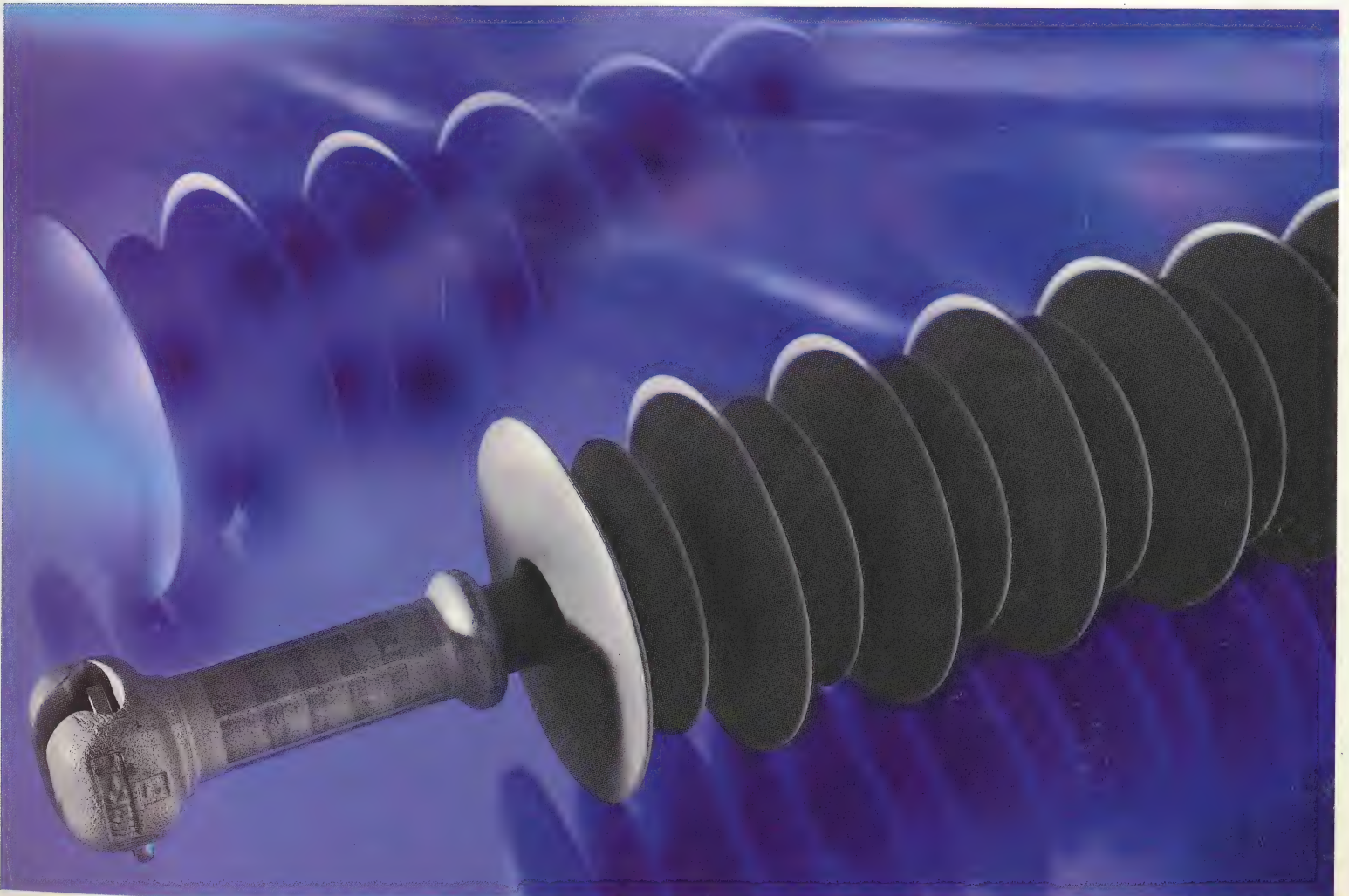
LEEDS & NORTHRUP

DIRECTIONS 177451 • ISSUE 2

CLEERTREND[®]
PRINT MECHANISM
ADJUSTMENT MANUAL

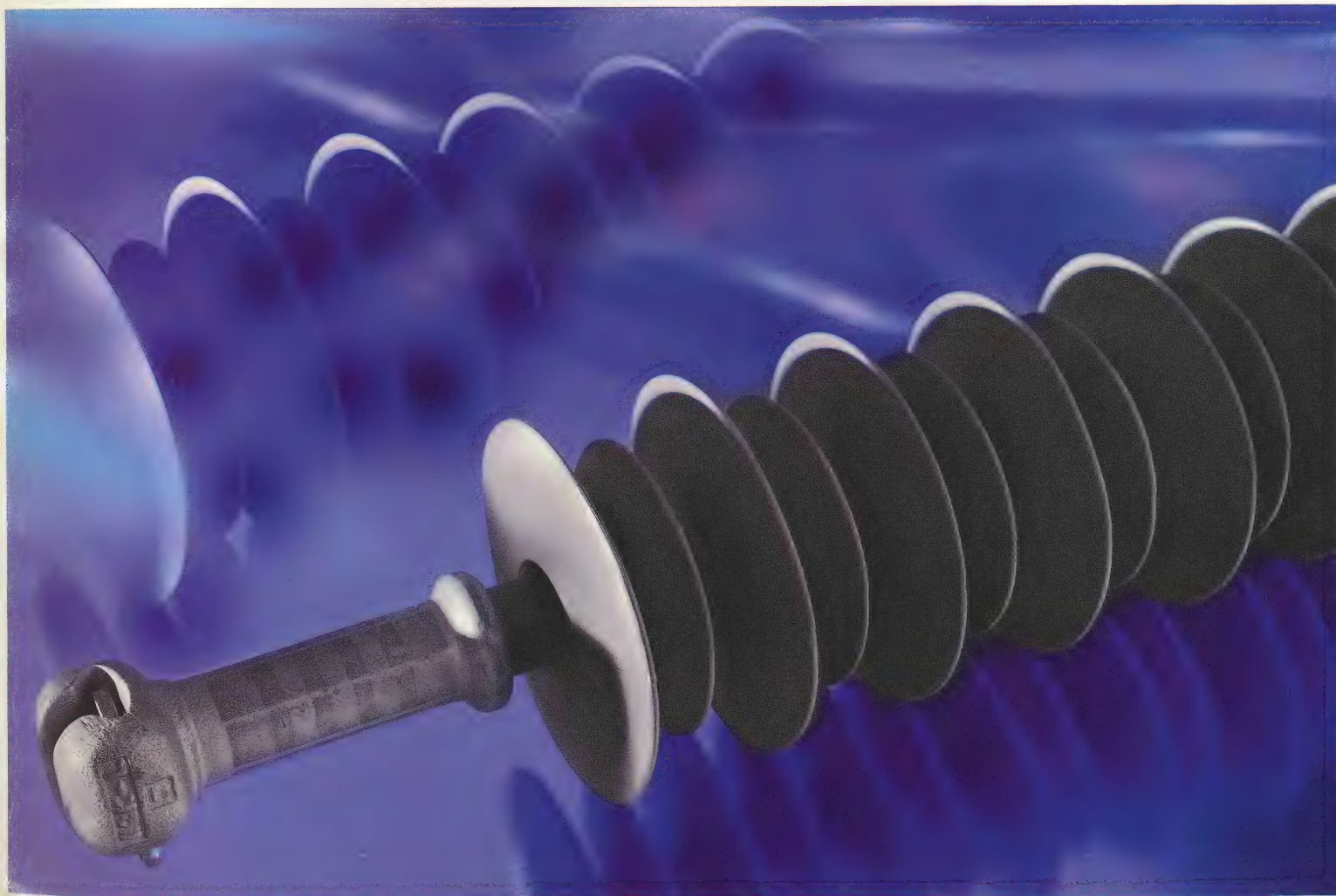


NGK-LOCKE POLYMER INSULATORS, INC.





NGK-LOCKE POLYMER INSULATORS, INC.



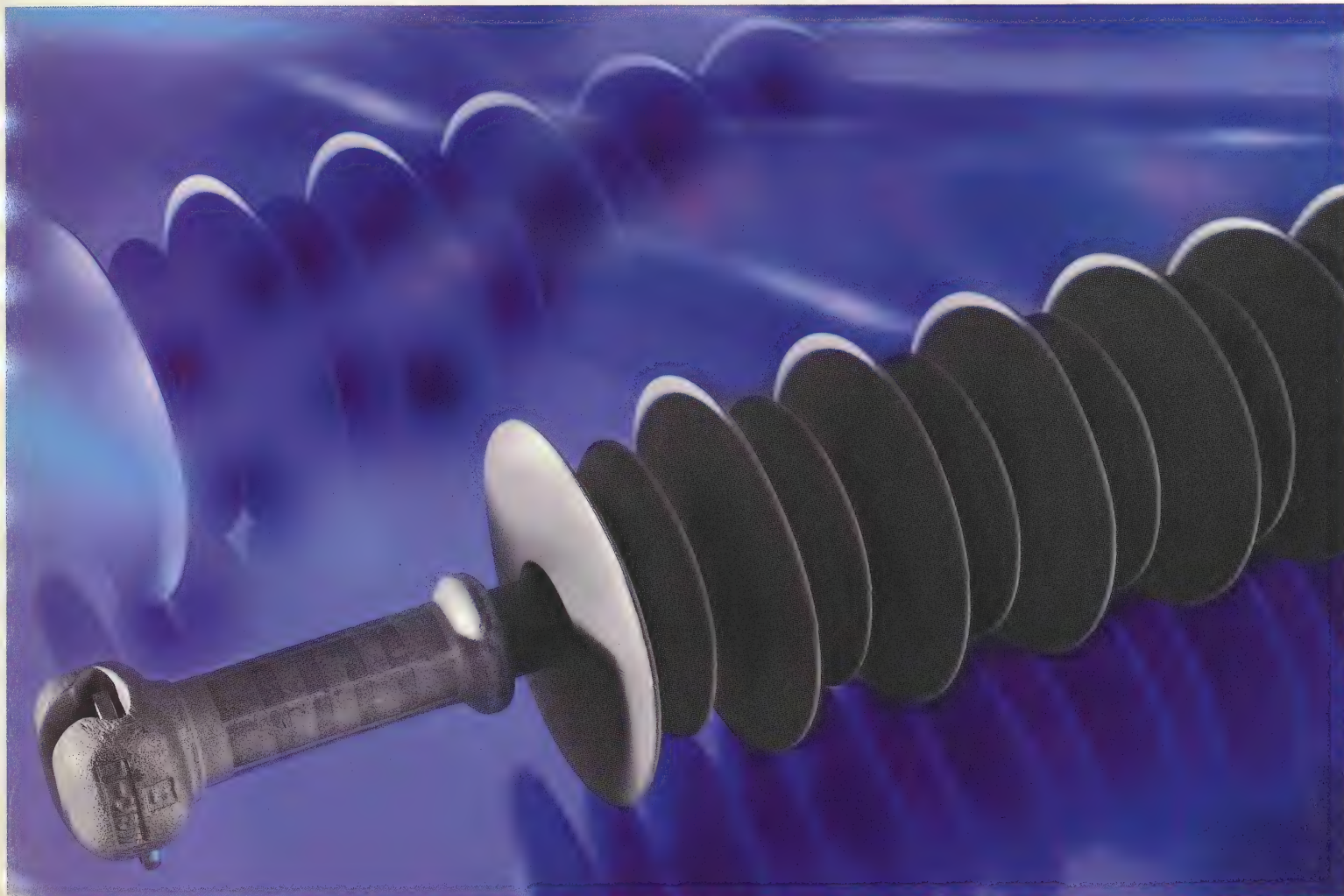


NGK-LOCKE POLYMER INSULATORS, INC.





NGK-LOCKE POLYMER INSULATORS, INC.



R. H. Lester

BREAKER TYPE D. C. AMPLIFIER



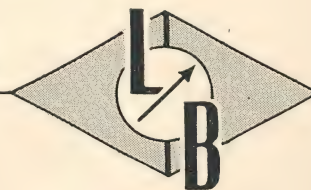
MODEL 14

An electronic amplifier to replace high sensitivity galvanometers.

Foremost Manufacturer of Infra-Red Gas Analyzers

LISTON-BECKER

INSTRUMENT COMPANY, INC.
STAMFORD • CONNECTICUT • U.S.A.



MANUFACTURERS OF SCIENTIFIC ELECTRONIC INSTRUMENTS

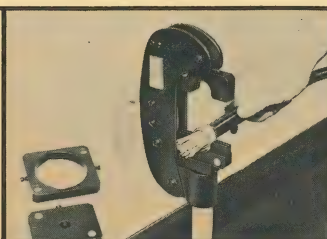
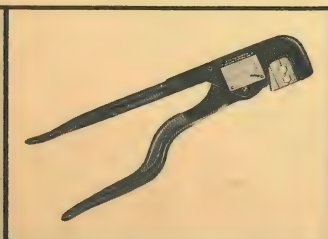
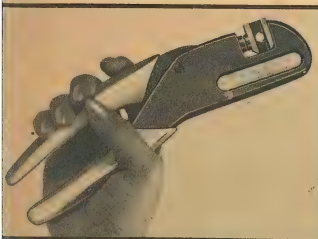
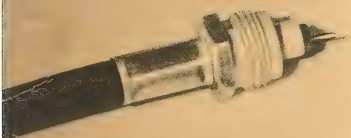
STAMFORD, CONN.



400.1

SHIELD-KON™

**GROUNDING CONNECTORS
AND ADAPTERS FOR
SHIELDED AND
COAXIAL CABLE**



**New Tools Improve
Reliability and Lower
Costs of Installation**



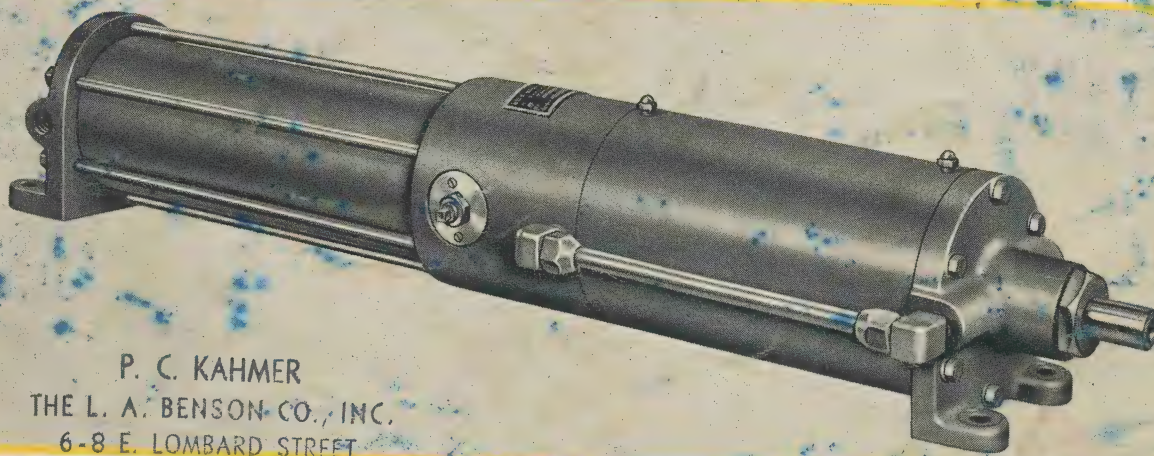
THOMAS & BETTS

Logan

AIR AND HYDRAULIC EQUIPMENT

Air-Draulic Cylinders

AIR POWERED **OIL REGULATED**



P. C. KAHMER
THE L. A. BENSON CO., INC.
6-8 E. LOMBARD STREET
BALTIMORE 2, MD.
PLAZA 0340

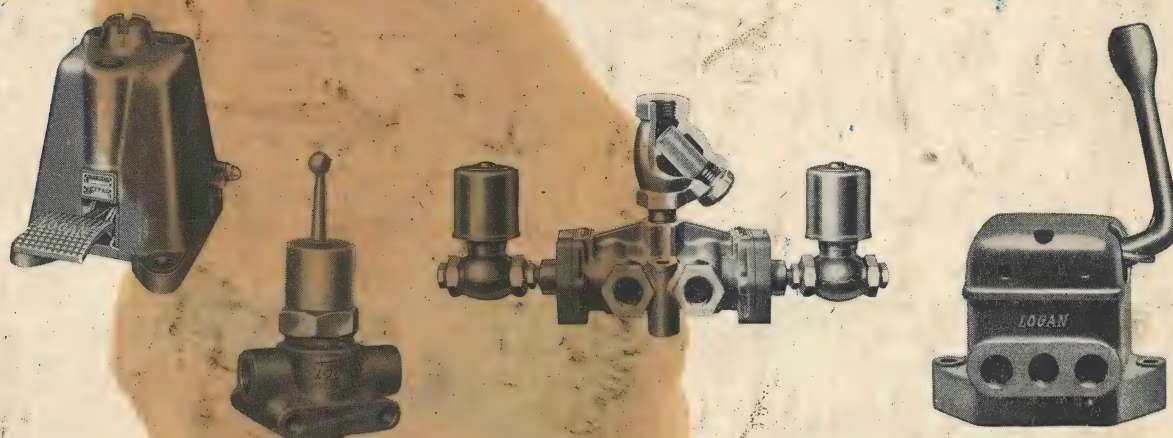
CATALOG 471

LOGANSPORT MACHINE CO. INC., LOGANSPORT, INDIANA

Logan

AIR AND HYDRAULIC EQUIPMENT

Air Control Valves *and Accessory Equipment*



CATALOG 90

LOGANSPORT MACHINE CO. INC., LOGANSPORT, INDIANA

**SECTION 2
CATALOG NO. 61
SUSPENSION
INSULATORS**

INSULATOR DEPARTMENT • GENERAL ELECTRIC CO. • BALTIMORE, MD.

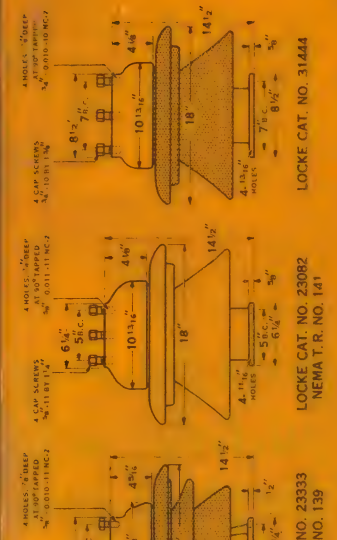
BIL-1050-1470 KV
SEE REVERSE SIDE
FOR 900 KV AND
BELOW

SELECTOR SWITCH AND BUS INSULATOR STACK COMBINATIONS

BASIC INSULATION LEVEL, KV	1300
CANTILEVER STRENGTH, LBS., UPRIGHT	1000
UNDERHUNG	950
DEFLECTION, INCHES PER 100 POUNDS	.380
STACK HEIGHT, INCHES	101½
LEAKAGE DISTANCE, INCHES	231
DRY ARCING DISTANCE, INCHES	102
LOW FREQUENCY FLASHOVER, KV, DRY	745
WET	660
IMPULSE FLASHOVER, KV, POS.	1410
NEG.	1650
LOW FREQUENCY WITHSTAND, KV, DRY	610
WET	525
TENSION, POUNDS	20,000
TORSION, INCH POUNDS	40,000

To serve the Electric Power Industry, the Insulator Department welcomes opportunities to give you unusual services regarding Switch and Bus Insulators and other high voltage insulation. Please contact your local representative or address your requests to Insulator Dept., General Electric Co., P.O. Box 57, Baltimore 3, Md.

LOCKE CAT. NO. 30153 NEMA T.R. NO. 53	LOCKE CAT. NO. 7785 NEMA T.R. NO. 140	LOCKE CAT. NO. 23333 NEMA T.R. NO. 139	LOCKE CAT. NO. 23082 NEMA T.R. NO. 141	LOCKE CAT. NO. 31444
--	--	---	---	----------------------



NOTES:

Electrical characteristics of combination stacks involving T. R. 140 units and T. R. 141 units must be reduced below the established NEMA Standards for stacks of the same height. This is necessary because of the capacitive unbalance that exists between the T. R. 140 and T. R. 141 insulators. Where the No. 23333 (T. R. 139) insulator is used instead of the T. R. 141, this unbalance does not exist and the electrical characteristics are equal to ratings of non-mixed stacks. Flashover and withstand voltage values are predicated on the use of a 3½" high subbase.

High strength insulator No. 23333 and extra high strength insulator No. 31444 are shown above and on slide with gray tone, indicating our new gray glaze. This color coding, which is optional on these units, makes high strength insulator identification quick and positive at a glance.

*Trademark of the General Electric Company
TIA-181 Copyright 1960 General Electric Co.

INSULATOR DEPARTMENT
GENERAL ELECTRIC
BALTIMORE, MARYLAND

VOLUME 24 JANUARY, 1936 NUMBER 1

PROCEEDINGS
of
The Institute of Radio
Engineers



Application Blank for Associate Membership on Page IX

VOLUME 23

APRIL, 1935

NUMBER 4

PROCEEDINGS
of
**The Institute of Radio
Engineers**



**Tenth
Annual Convention**
Detroit, Michigan
July 1, 2, and 3, 1935

Application Blank for Associate Membership on Page XI

Fatigue of Metals in Engineering and Design

By

R. E. Peterson



EDGAR MARBURG LECTURE

1962

PRESENTED BEFORE THE SIXTY-FIFTH ANNUAL MEETING
OF THE AMERICAN SOCIETY FOR TESTING AND MATERIALS

Published by the

American Society for Testing and Materials
1916 Race Street, Philadelphia 3, Pa.



ELECTRONICS

PROGRESS IN RECTIFIER COMPONENT TECHNOLOGY

RECEIVED

MAY 10 1963

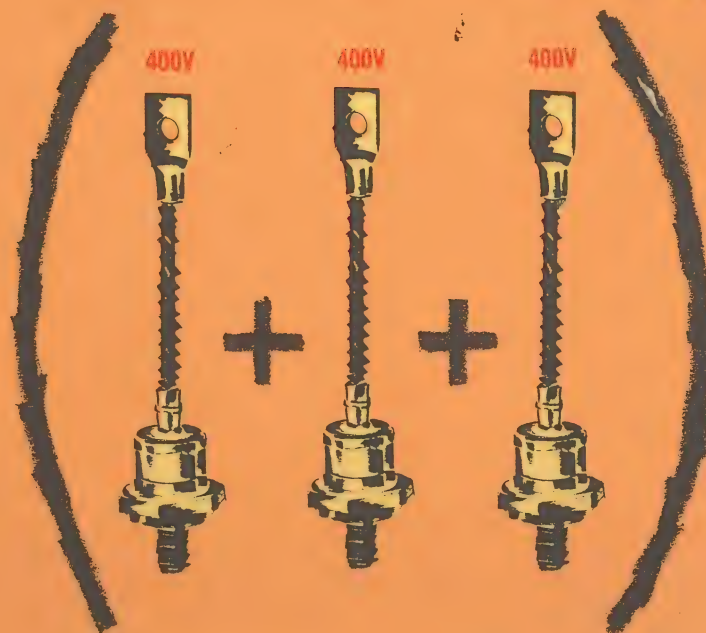
HIGH CURRENT / HIGH VOLTAGE DIODES

H. A. FREY



Mr. Kengalbray

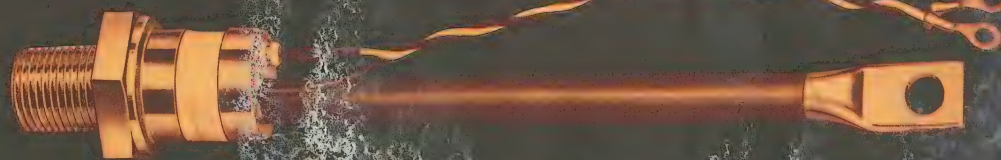
= 65%



Formula: One 1200 volt diode
replaces three 400 volt diodes
for a 35% cost saving!

General Electric Rectifier Component Design Packet

SILICON CONTROLLED RECTIFIERS



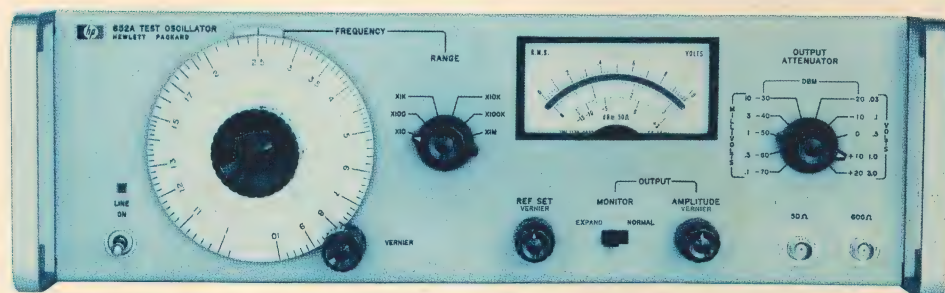
New, **LOWER** SCR prices open the
door to **NEW** applications!

Volume One/Folio One

OPERATING AND SERVICE MANUAL

TEST OSCILLATOR

652A



HEWLETT  PACKARD

IMPULSE TESTING
EQUIPMENT

GENERAL  ELECTRIC




CCGV

Rec'd To.
Design. Dept.
120pt.
R. LAB.

INSTRUCTIONS
AND
MANUAL OF RADIO FREQUENCY MEASUREMENTS
FOR Q-METERS
TYPE 100-A
TYPE 160-A
TYPE 170-A

June 1941

BOONTON RADIO CORPORATION
BOONTON, NEW JERSEY
U. S. A.



Johnson
electronic equipment

OPERATING MANUAL
VIKING RANGER II
TRANSMITTER/EXCITER



E. F. Johnson Company

W A S E C A , M I N N E S O T A

CATALOG NO. 831-A

LOCKE SOLID-CORE STATION POST INSULATORS



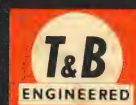
LOCKE[®]
INSULATORS

BALTIMORE, MARYLAND



LOCKE
INSULATORS

THE *TY-RAP* SYSTEM OF RELIABILITY FOR CABLING AND HARNESSING



TY-RAP[®]
CABLE TIES

SOLID-CORE PORCELAIN LINE POST INSULATORS



NGK INSULATORS, LTD.

CATALOG NUMBER D12A

THE OHIO BRASS COMPANY

BARBERTON DIVISION

BARBERTON, OHIO, U. S. A.



THE INFLUENCE OF WATER RESISTIVITY AND
PRECIPITATION RATE UPON 60-CYCLE
WET FLASHOVER VOLTAGE

AIEE Committee Report

The Working Group on Rain Tests was appointed in January 1957, for the purpose of studying problems associated with wet flashover and wet holding tests on high voltage insulators such as are used on transmission and distribution lines. These problems are intimately concerned with the resistivity of the water used in the tests and the rate of precipitation with which it falls on the test specimen. In connection with the latter, a study of suitable methods for applying the water to the test specimen may well be an area for investigation particularly for use in wet flashover or holding tests on extra high voltage insulation.

Present European standards for wet testing specify a water resistivity of 10000 ohms per centimeter cube (3900 ohms per inch cube) and a precipitation rate of 3 millimeters per minute (0.118 inch per minute) while present American standards specify a water resistivity of 7000 ohms per inch cube and a precipitation rate of 0.2 inch per minute.

Wet flashover and wet holding voltages have been specified for practically all classes of high voltage equipment including

This report was prepared by the Working Group on Rain Tests of the Subcommittee on Techniques for Dielectric Tests. The personnel of this working group are: C. J. Miller, Jr., Chairman, T. L. Dyer, Jr., H. E. Fiegal, B. E. Kingsbury, and D. L. Whitehead. The material for this paper was accumulated mostly in 1938 to 1940 by the General Electric Company, The Ohio Brass Company, and the Westinghouse Electric Corporation.

GENERAL  ELECTRIC

SUBJECT

COPIES:

LABORATORIES DEPARTMENT, PHILADELPHIA
October 3, 1957

Messrs: G. E. Adams, Schenectady
J. G. Anderson, Pittsfield
V. L. Cox, Philadelphia
S. B. Crary, Schenectady
H. A. Frey, Baltimore
J. H. Hagengath, Pittsfield
I. B. Johnson, Schenectady
A. J. Schultz, Schenectady
C. H. Titus, Philadelphia
W. R. Wilson, Philadelphia

Enclosed is a copy of the discussion which I propose to submit on the paper, "CALCULATION OF TRANSMISSION LINE LIGHTNING VOLTAGES BY FIELD CONCEPTS", by Professor Lundholm, Dick Finn, and W. S. Price at the coming Chicago Convention. I should be very much interested in any comments that you may have on it. I expect to arrive at the Morrison Hotel in Chicago late on the seventh and shall be there until after the session on the tenth.

Wilfred F. Skeats

W. F. Skeats
CONSULTING ENGINEER
ENGINEERING RESEARCH AND DEVELOPMENT LABORATORIES

Enclosure

WFS/jg

RECEIVED

OCT 4 1957

H. A. FREY

Lightning Theory

*75
459
534*

42/8

*6'6" = 1 9/16 = 27/16
6 1/2 = 13/2 = 22/16
1/4 = 1*

Theory

A HYPOTHESIS CONCERNING
LIGHTNING PHENOMENA AND TRANSMISSION LINE FLASHOVER

by

I. B. Johnson*
Member AIEE

A. J. Schultz*
Member AIEE

Conference Paper Presented at
AIEE Northeastern District Meeting
Pittsfield, Massachusetts

Thursday, May 2, 1957

*General Electric Company, Schenectady, New York

Paper No. DP 57-568

1

Theory

A HYPOTHESIS CONCERNING
LIGHTNING PHENOMENA AND TRANSMISSION LINE FLASHOVER

by

I. B. Johnson*
Member AIEE

A. J. Schultz*
Member AIEE

Conference Paper Presented at
AIEE Northeastern District Meeting
Pittsfield, Massachusetts

Thursday, May 2, 1957

*General Electric Company, Schenectady, New York

Paper No. DP 57-568

Henry

AIEE DISTRICT PAPER 57-561

FACTORS AFFECTING THE LIGHTNING PERFORMANCE
OF TRANSMISSION LINES

J. H. Hagenguth
Fellow - AIEE

J. G. Anderson
Member - AIEE

Power Transformer Department
General Electric Company
Pittsfield, Massachusetts.

Presented at the AIEE Northeastern District Meeting,
Pittsfield, Mass., May 1-3, 1957

P A P E R N O.

DP 57-561

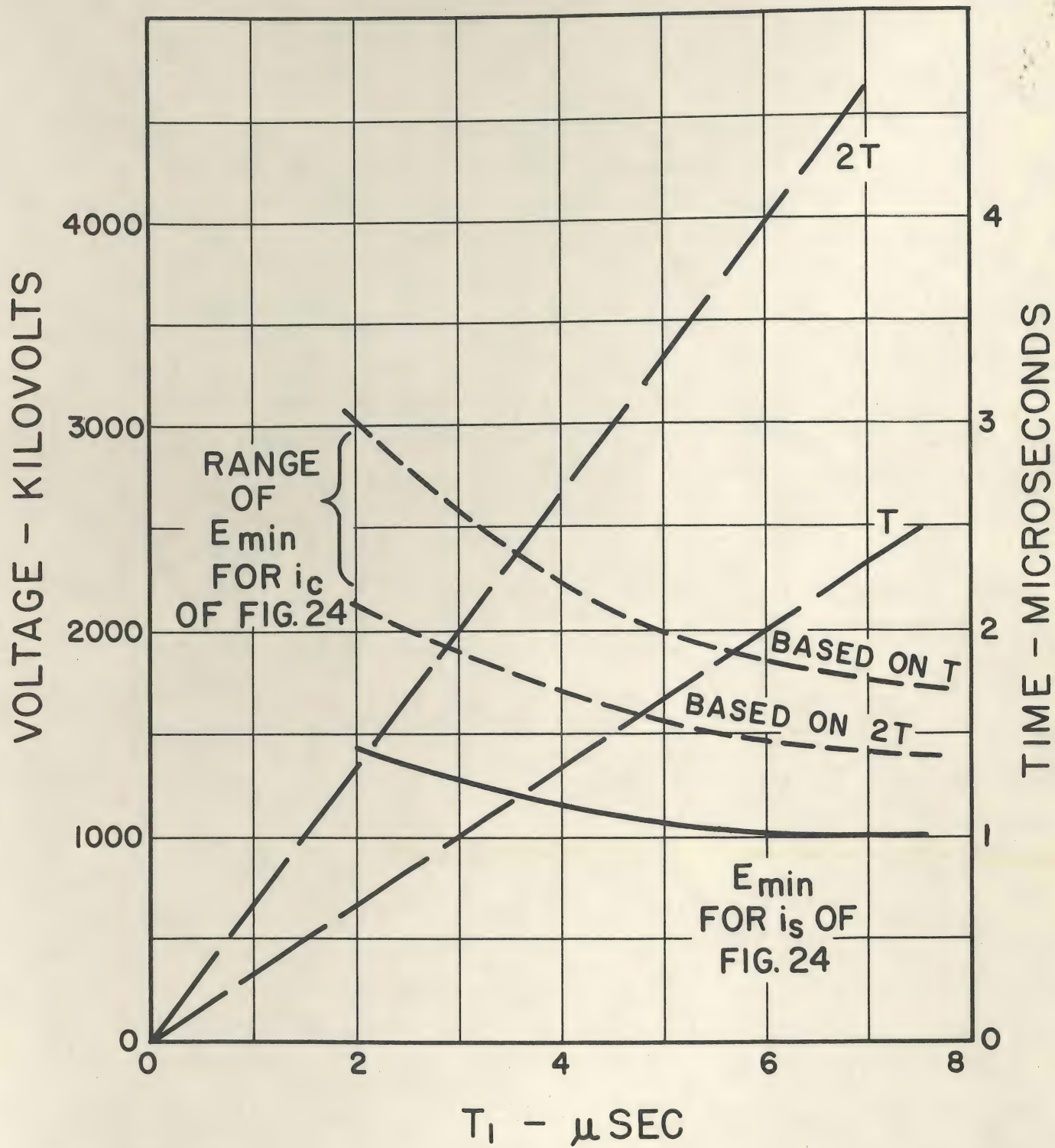


FIG. 25. MINIMUM VOLTAGES USED FOR CALCULATIONS IN FIG. 24.

CHOOSING AND USING INDUSTRIAL DATA

Francis J. Cullen
Industrial Statistician

The National Plastic Products Company
Odenton, Maryland

I am going to discuss three broad phases of Industrial Statistics and illustrate with examples from one of our products, namely, saran monofilament, widely used for seat covers and outdoor furniture which presents unique quality problems not found in other products. The basic principles which I am about to discuss, however, apply to our product and to most any other product including the products developed in the office.

The three broad phases under discussion:

- I Basic Statistical Method
- II Methods of Process Control
- III Methods of Product Control

My discussion shall certainly not include all the techniques in these fields, but I shall try to tie together and follow Statistical Quality Control-wise one product from inception to end use while using some statistical technique from each phase listed above.

I repeat: My examples are all taken, naturally, from the Plastics industry but the basic principles apply whether we are dealing with nuts and bolts or office procedures.

I Basic Statistical Method

In Industrial Statistics basic statistical techniques are often used to define and measure patterns of variation. Statistics may be defined as a "study in variation" and the statistician is often defined as an "expert in identifying and measuring patterns of variation."

Variation is the stuff from which statistics are manufactured. By variation I refer to the inability of nature or man to produce things exactly alike. They may be alike for all practical purposes but if measured finely enough a tendency will be observed for the measurements to concentrate about one value while at the same time there is a spread of the measurements in a definite pattern on each side of the point of concentration.

Thus if we measure selected samples, plot the measurements, observe the pattern formed and compute a few statistics, we will find it much easier to analyze the data and draw proper conclusions.

GENERAL  ELECTRIC

**GENERAL ELECTRIC COMPANY
CORPORATE RESEARCH AND DEVELOPMENT**

Schenectady, N.Y.

**METHODS FOR PLANNING AND ANALYZING
ACCELERATED TESTS**

by

**W. B. Nelson
Information Science and Engineering**

Report No. 73CRD034

March 1973

TECHNICAL INFORMATION SERIES

CLASS 1

This paper is for presentation at the 4th Annual Reliability and Maintainability Conference, July 28 through 30, 1965 in Los Angeles.

PROBABILISTIC LIFE CONSUMED ANALYSIS ON HIGH
TEMPERATURE, HIGHLY STRESSED STRUCTURAL PARTS

By

G. W. Weber, Manager
Reliability Applications
Reliability & Design Methods Engineering
Large Jet Engine Department
General Electric Company
Cincinnati 15, Ohio

April 9, 1965

Introduction

The reliability of complex equipment can be predicted, based on experience with similar equipment and the anticipated effects of changes in the design and application details. Frequently overall equipment goals or requirements are established on the basis of such predictions and then apportioned down to the part level to provide specific part or component reliability goals. In critical jet engine structural design areas, the part probability of failure goals are frequently of the order of .001 to .0001 per 1000 hour life or overhaul period. Classical design approaches, which are based on factor of safety criteria, cannot translate these probability numbers into design decisions regarding dimensions, material properties, stresses, etc. because they are, of necessity, deterministic

GENERAL  ELECTRIC

RESEARCH
AND
DEVELOPMENT
CENTER

SCHENECTADY, NEW YORK

CLASS 1

HAZARD PLOTTING FOR RELIABILITY ANALYSIS
OF INCOMPLETE FAILURE DATA

by

W. B. Nelson
Information Sciences Laboratory

Report No. 68-C-313

August 1968

8-332-6185

Mark Humphrey - Tape

THE QC ANALYSIS SYSTEM

by

J. L. Bemesserfer

Presented at

R & D C Symposium on Applications of
Probability and Statistics in General Electric
Schenectady, N. Y. June 10-11, 1969

A MACHINE SHOP SIMULATION USING GPSS

April 1969

D.C. Hogue

Systems Analysis Engineer
Systems Engineering and Analysis Branch
Information Sciences Laboratory
Schenectady, N.Y.



TECHNICAL INFORMATION SERIES

Title Page

AUTHOR A.F. PETRIE	SUBJECT STATISTICAL ANALYSIS COMPUTER PROGRAM	NO. 68 APD - 3 DATE 12/31/68
TITLE "LIMIT", REJECT ANALYSIS--PLOTS HISTOGRAM, SUGGESTS TEST LIMITS.		G.E. CLASS II GOVT. CLASS NONE
REPRODUCIBLE COPY FILED AT AUDIO PRODUCTS DEPT., DECATUR, ILLINOIS		NO. PAGES 15
SUMMARY PURPOSE: 1. ESTIMATE PRACTICAL TEST LIMITS FROM SAMPLE MEASUREMENTS DURING PILOT RUNS. 2. ESTIMATE VENDOR REJECT RATE DUE TO SORTING TO SPECIFIED LIMITS AND DETERMINE POTENTIAL IMPROVEMENT DUE TO CHANGING LIMITS. 3. MAKE ENGINEERING, MANUFACTURING, OR VENDOR FACE FACTS ON PRODUCT QUALITY DURING SAMPLE RUN, BEFORE PRODUCTION. FEATURES: 1. USES RAW, UNSORTED INPUT DATA. 2. PLOTS HISTOGRAM, CALCULATES REJECTS, SUGGESTS LIMITS. 3. MANY GROUPS OF DATA MAY BE HANDLED IN SAME RUN. 4. HANDLES SKEWED DATA WITH REASONABLE ACCURACY. LIMITATIONS: HANDLES SKEWED DISTRIBUTIONS BY DIVIDING THEM INTO TWO "HALF GAUSSIAN" DISTRIBUTIONS AT THE PEAK OR MODE, YIELDING PESSIMISTIC PREDICTIONS ON HIGHLY SKEWED DATA. LANGUAGE: XBASIC AND MK II BASIC		
KEY WORDS STATISTICAL ANALYSIS, HISTOGRAM, SKEWED, REJECT.		

INFORMATION PREPARED FOR _____

TESTS MADE BY _____

AUTHOR ADELORE F. PETRIECOMPONENT AUDIO PRODUCTS DEPT., DECATUR, ILLINOISAPPROVED M West

VARIABILITY OF THE VARIABILITY
Probability Plot Methods of Study

Normal probability plotting has been extremely useful in the analysis of data of various kinds particularly the non-normal distributions that one encounters in actual factory situations. The use of a probability plot of "contrasts" to analyze designed two level experiments by Daniel¹ suggested to us that the method might logically be used in the analysis of process variability. We had always used either $\bar{R}$ or $\hat{R}$ to estimate the inherent (short time) process variability (capability) not only for process control purposes but for process analysis as well. Now it seemed that the range of two plotted on a suitable probability paper might improve our ability to study the variability of process variability. It was anticipated that this might provide advantages similar to these obtained by the use of normal probability paper in studying process variability.

This investigation led to the use of "half-normal" probability paper and the delta plot (difference of two plotted on normal probability paper). To understand these two methods we need to recognize that the difference (keep the sign) between consecutive values from a normal distribution will also be a normal distribution. If the process is stable (in statistical control) the expected peak or average of the distribution is zero, with half the values plus and half minus. Hence a plot on normal probability paper should plot as a straight line. The variability of delta (difference of two) is related to the parent distribution variability as follows:

$$\sigma_{\Delta} = \sqrt{\sigma_X^2 + \sigma_X^2} = \sigma_X \sqrt{2}$$

$$\text{or } \sigma_X = \frac{\sigma_{\Delta}}{\sqrt{2}} = .707 \sigma_{\Delta}$$

Therefore it is a simple matter to convert the estimated variability of delta to an estimate of the variability of the process (parent distribution). If the delta plot was made from the difference of consecutive values in their order of production, then the estimated variability does not include the variability associated with process drifts or other time related effects, except as reflected in consecutive values. If the process under study is stable, both the probability plot of the individual values and the delta plot should be straight lines and the results that we get from this analysis would agree quite well with the conventional $\bar{X}$, σ & R estimates.

1. Cuthbert Daniel, "Use of Half Normal Plots in Interpreting Factorial Two-Level Experiments", *Technometrics* Volume I Number 4 November 1959.

To: RECORDS RETENTION CENTER
2-67

Order No. 955

Date May 30, 1969

Please forward the following reports:

No. of Copies

1. TM 67 FPD 1034 (Class 3 OK to send) 1
- 2.
- 3.
- 4.
- 5.

TO: General Electric Co.
R. Weller
Insulator Dept.
2525 Insulator Drive
Baltimore, Maryland 21230
X7-272-9226

J. M. Wannemacher/M. Paltrinieri
Technical Information Center
Bldg. 24001 Ext. 2441

FORWARDED BY
ISSUED BY

DISTRIBUTION

ALL INFORMATION ON THIS PAGE

RECEIVED

JUN - 5 1969

ENG.

SMALL AIRCRAFT ENGINE DEPARTMENT

TECHNICAL MEMORANDUM

OPERATION Systems Analysis
PROJECT _____ REPORT NO. TRW/EPD/C37
G. E. CLASS 3
TITLE:

STATISTICAL DISPLAY OF DATA (STADON)

114
PREPARED BY W. L. Smith
APPROVED BY W. L. Smith

DISTRIBUTION

AND DISTRIBUTION ON BACK PAGE

RECEIVED

JUN - 5 1969

ENG.

ATL RELIABILITY MEMO 35

INTRODUCTION TO RELIABILITY

by

Paul F. Albrecht, ATL Reliability

May 5, 1965

1. Need for Reliability

Every material device is subject to failure. Some things "hardly ever fail", such as bridges and aircraft structures. But even these devices can - and sometimes do - fail. Other devices fail "quite frequently", such as TV sets and automobiles. Still other devices fail between these two extremes, such as power transformers and turbine generators.

The fact that all material devices are subject to failure gives rise to the field of RELIABILITY. However, it is not simply the existence of failures which is responsible for the inception and growth of reliability. Material failures have always existed, but "reliability" as a distinct field is relatively new - less than 15 years old.

Equipment capabilities and performance levels have increased enormously in the past 15 years, but only at the expense of a corresponding increase in equipment complexity levels. As complexity increases, the frequency of failure likewise tends to increase. Eventually, the point is reached where the equipment is "down for repairs" most of the time. It was this situation which the Defense Department found in the late 1940's. That is, "failures" had become an obstacle to further state-of-the-art advances.

Concurrently with the increase in failure frequency due to increased complexity, an increase in failure cost occurred with the advent of the missile age. A single part failure in a large rocket would destroy several million dollars worth of equipment. In fact, reliability can trace its origin to the German V-1 rocket development at Peenemunde during World War II.

It is these two factors - increased failure frequency and increased failure cost - which are primarily responsible for the development and rapid growth of reliability as a distinct technology.

DM 64-49

RELIABILITY ANALYSIS AND PREDICTION FOR TURBOJET ENGINES

RESULTS VS. NEEDS

February 7, 1964
(Revised)

D. D. Freberg and R. B. Spector

**Reliability Engineering Operation
Large Jet Engine Department
General Electric Company
Cincinnati 15, Ohio**

ABSTRACT

The Reliability Design Review is an effective tool in assisting designers towards achieving higher levels of Reliability early in the program. The Designer in the end is solely responsible for the Reliability achievement of his component. In this context Reliability activities of the sort described in this paper are a service to the Design Engineer in achieving his goals. Three Reliability prediction techniques and typical examples of the achieved results of each are described:

1. Controls and accessories Reliability Design Review practices and results of the 1959-60 Era.
2. Mechanization of the routine aspects of the Reliability Design Review procedure.
3. Probabilistic approach to failure rate estimation of basic engine structural parts.

SIMULATION METHOD APPLIED TO RELIABILITY ANALYSIS OF TURBOJET
ENGINE COMPONENTS OPERATING IN AIRLINE SERVICE

R.S. Dorsey and H.A. Truscott
Aircraft Engine Group
General Electric Company
Evendale, Ohio
Dial Comm 8*332-4205
June 10, 1969

ABSTRACT

A brief description of a computer program generated to assess the reliability of a turbojet engine compressor disk is given. System simulation and Monte Carlo techniques are methods used in the program. The effects and interactions of Airline maintenance policy and component and engine design parameters are investigated. Results and discussion of a sample problem is given.

INTRODUCTION

Designers of turbojet engine components are seeking realistic answers to vital questions about the reliability of their components when they are exposed to airline service. Some of these questions are:

- What is the probability of component failure?
- When, in calendar time, will a failure occur?
- What effect do factors such as frequency of inspection, inspection capability, unscheduled engine removal rate, monthly utilization, maintenance policy, etc. have on these answers?

The designers must have new tools to generate meaningful answers to this set of complex questions. The answers require several random and deterministic variables. His normal stress/strain-load analysis technique is inadequate for complete answers. Simulation of the real-world process appears to be the approach most likely to achieve realistic answers.

This report describes a computer program that simulates the flow of components through an airline service operational system. Monte Carlo technique is used to simulate the occurrence of the random events in the system and to obtain distributions that provide clues to the statistical behavior of the system. The simulation utilizes IBM's General Purpose System Simulator (GPSS) II language [1,2] .

represented by the largest percentage of tests having the smallest per cent range, other factors being equal. It can be seen that the ASA method shows 75% of the tests yielding data with less than 4.5% range, while the IEC method shows 75% of the tests yielding data with less than 6.5% range. Figs. 3 and 4 show similar results for fog-type suspensions, and all suspensions, respectively. The 75% level of test frequency for fog-types shows 7% voltage range for the ASA method and a 10% voltage range for the IEC method. For all suspensions, the 75% level shows 5 and 7% ranges, respectively, for the ASA and IEC methods. If a range of 5% is desired for all suspensions (Fig. 4) the IEC method will meet this requirement 45% of the time, the ASA method 78%.

Strings of nine of the conventional suspension insulators were also tested using the compromise test method and the results are as shown in Table II.

APPARATUS INSULATORS, CAP AND PIN TYPE FOR USE ABOVE 69 KV

Cap and pin type insulators for use above 69 kv were tested in stacks of 2, 4, 6, and 8 units. Both the IEC and ASA test methods yielded almost identical results (Fig. 5), and both show tendencies of proportionality with respect to arcing distance. Even more so than for suspension insulators, these apparatus insulators have much higher per cent voltage range on each specimen with the IEC test method than with the ASA test method as shown on Fig. 6. For 75% of the tests the IEC method indicated a 9% range, or almost twice the 5% range for the ASA test method. Curves have also been plotted on Fig. 7 to show how the two test methods result in a total variation of all arcs on the four different insulator combinations. Each individual flashover value has been expressed as a percentage of the average of all flashovers on each type of insulator and all of the data can be consolidated on single curves for each test method. These cumulative probability curves will give an indication of the variability to be expected in performing a wet test. The 100% voltage point on the abscissa represents the average flashover value, and, as shown, it would be expected that this average would occur at the median of the number of individual arcs.

The compromise proposal of test method was used to test several stacks of four high of the cap and pin apparatus insulators. Flashover values were obtained which were identical to those obtained with the ASA and IEC test methods (Table III).

APPARATUS INSULATORS, CAP AND PIN TYPE FOR USE BELOW 69 KV

The cap and pin type apparatus insulators, below 69 kv, showed essentially equal performance when tested under either of the two test methods (Fig. 8). A lower mean IEC value of approximately 7% was obtained for the 15 kv insulator, but the remainder of the sizes which were tested yielded practically identical results with either method. No difference existed in the variation in test voltages either on individual specimens or overall.

APPARATUS INSULATORS, POST TYPE, FOR USE BELOW 69 KV

Substantial disagreement between the ASA and IEC test methods is evident in the results obtained on post type insulators below 69 kv. As shown in Fig. 9, the results are very consistent for each method and show good indications of the flashover voltage being proportional to arcing distance. But, the IEC results are approximately 10% lower overall than the ASA results with specific mean values differing by 4 to 19%. This trend is very indicative of the IEC test method being quite incompatible with this type of insulator if the present test voltage levels are to be maintained. As with the cap and pin insulators, the post type insulators yield very consistent data with approximately equal, and quite small, variations in the flashover voltages from arc to arc.



GENERAL ELECTRIC COMPANY
CORPORATE RESEARCH AND DEVELOPMENT

Schenectady, N.Y.

HIGH DENSITY, CONDUCTING MIST TEST
FOR INSULATOR EVALUATION

by

J. M. Atkins and R. L. Gingrich
Physical Chemistry Laboratory

Report No. 71-C-050

January 1971

TECHNICAL INFORMATION SERIES

CLASS 1

PACIFIC GAS & ELECTRIC COMPANY
MOSS LANDING Contamination Test Program

NATURAL FOG

Report Prepared By
R. L. Thompson

ELECTRIC UTILITY ENGINEERING OPERATION
A-C TRANSMISSION ENGINEERING SECTION
AND
HIGH VOLTAGE LABORATORY
November 30, 1965

GENERAL  ELECTRIC
SCHENECTADY, NEW YORK

TABLES

FIGURES

APPENDIX I

APPENDIX II

APPENDIX III

RECEIVED

GENERAL ELECTRIC

JUL 8 1970

TECHNICAL INFORMATION SERIES
Title Page

JES. WHEELER

AUTHOR F. S. Nichols	SUBJECT Hydrated Alumina and common dehydration	NO. 70-MATL-201
		DATE 6/29/70
TITLE Drying and Dehydration of Hydrated Alumina		GE CLASS II
		NO. PAGES 25
ORIGINATING COMPONENT Chemical and Processes Section		
The drying and dehydration of hydrated alumina has been investigated using thermal analysis techniques. In spite of literature references claiming loss of combined water at low temperature, drying of hydrated alumina is not a critical operation. There was no significant loss of combined water after drying for periods up to 14 days at 125°C or one day at 150°C in a circulating air oven. Even after one week at 150°C the combined water was 34% against a theoretical 34.6%.		
KEY WORDS Hydrated alumina, dehydration, epoxy		

INFORMATION PREPARED FOR RDT, IPD, DPED, PTAdditional Hard Copies Available From Materials and Technology Laboratory,
Pittsfield, MassachusettsMicrofiche Copies Available From --- Technical Information Exchange
P.O. Box 43 Bldg. 5, Schenectady, N.Y., 12301

SAMPLE: _____ RUN NO.: _____

SAMPLE: 209804 NO FILLER ORIGIN:	SIZE 0.00404 gms	ATM. N ₂ 62 PH	RUN NO. 1
	REF. Empty pan	T ΔT	DATE APR 8 '97
	PROG. MODE DSC HEAT	SCALE 5.0 $\frac{^\circ C}{IN}$ 1.0 $\frac{^\circ C}{IN}$	OPERATOR JH
	RATE 15 $\frac{^\circ C}{MIN}$ START 98 $^\circ C$	SHIFT -2 IN.	BASE LINE SLOPE

ACTUAL 1540 / MIN

246 298 343 430 480 530 580 630 680 730 780 830 880 900

INTRODUCTION

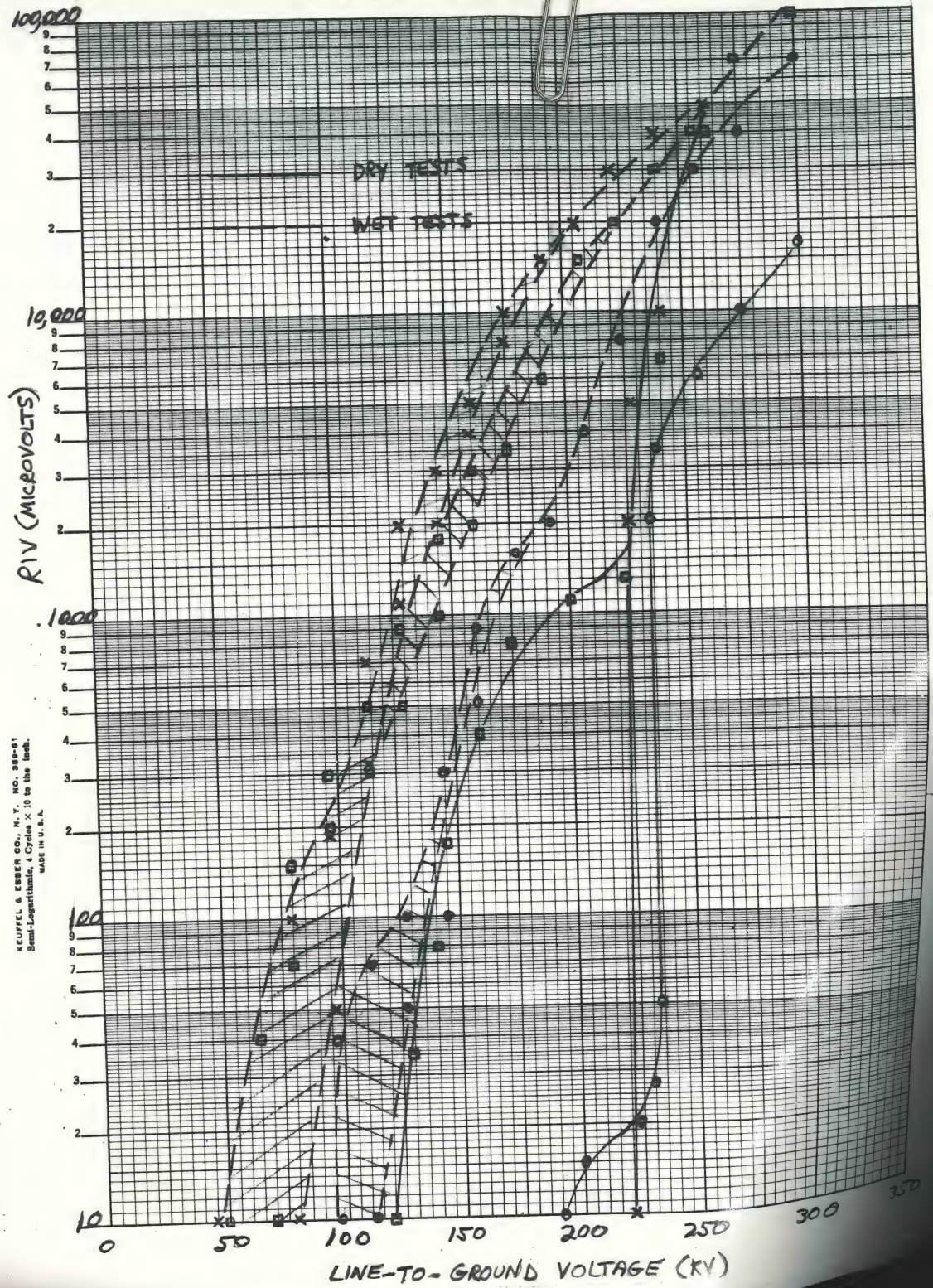
Wet flashover and wet withstand tests provide a necessary ^{means} ~~measure~~ ^{to evaluate the electrical characteristics} of the characteristic ~~to be used in the evaluation~~ of many types of high voltage equipment used on transmission and distribution lines and in substations. The American Standard for wet tests, ASA-C77.1-1943, was developed in order to establish a general standard method for tests that could be performed in the laboratory which ^{and} ~~in turn could be~~ related to levels of acceptable performance in the field. ^{an environment similar} It was intended that this test embody ~~conditions which are like~~ ^{to that} those encountered in the field but yet the test was to be one in which only those ^{with} ~~elements over which reasonable control can be exercised~~ ^{over specified elements.} are specified. A reasonable degree of reproducibility was paramount.

The present American Standard has fulfilled these requirements and the practice of the standard has established specific wet flashover and withstand voltages.

Europe has similarly established a standard, each country having slightly different variations. ~~All these are quite different from the American standard.~~ The European standard specifies a water resistivity of 10,000 ohms per centimeter cube (3930 ohms per inch cube) and a rate of precipitation of three millimeters per minute (0.118 inches per minute) as contrasted to the American standard which specifies a water resistivity of 7,000 ohms per inch cube and a rate of precipitation of 0.2 inches per minute.

It is desirable that an international standard be established which could be used both in Europe and in America. One proposal advanced by the International Electrotechnical Commission (IEC) has been the adoption of the present European standard. In considering such a proposal, it is necessary to investigate the parameters which differ between the proposed European standard and the American standard. A preliminary investigation ⁽¹⁾ ~~reported in a paper, using~~ (58-27) which presented a treatment of some of the aforementioned variables.

~~The American standard as a base-line, presented a comparison of water the effects of water resistivity and rate of precipitation. These ~~variables~~ factors were investigated one at a time, that is, the IEC water resistivity was used, but, the ASA rate of precipitation~~



SCUFFEL & ESSER CO., N. Y. NO. 289-81
Semi-Logarithmic, 4 Cycles X 10 to the Inch.
MADE IN U.S.A.

Ref to Bruce

A COMPARISON OF EUROPEAN AND AMERICAN
WET FLASHOVER TEST METHODS

Bruce E. Kingsbury

INTRODUCTION

Wet flashover and wet withstand tests provide a necessary means to evaluate the electrical characteristics of many types of high voltage equipment used on transmission and distribution lines and in substations. The American Standard for wet tests, ASA-577.1-1943, was developed in order to establish a general standard method for tests that could be performed in the laboratory and related to levels of acceptable performance in the field. It was intended that this test embody an environment similar to that encountered in the field but yet the test was to be one with reasonable control over specified elements. A reasonable degree of reproducibility was paramount.

The present American Standard has fulfilled these requirements and the practice of the standard has established specific wet flashover and withstand voltages.

The Europeans have proposed
~~Europe has similarly~~ established a standard, each country having slightly different variations. The European standard specifies a water resistivity of 10,000 ohms per centimeter cube (3930 ohms per inch cube) and a rate of precipitation of three millimeters per minute (0.118 inches per minute) as contrasted to the American standard which specifies a water resistivity of 7,000 ohms per inch cube and a rate of precipitation of 0.2 inches per minute.

It is desirable that an international standard be established which could be used both in Europe and in America. One proposal advanced by the International Electrotechnical Commission (IEC) has been the adoption of the present European ~~standard~~. In considering such a proposal, it is necessary to investigate the parameters which differ between the proposed European standard and the American standard. A preliminary investigation, using the American standard as a base-line, presented a comparison of the effects of water resistivity and rate of precipitation. These factors were investigated one at a time, that is, the IEC water resistivity was used, but, the ASA rate of precipitation was maintained. Then, the procedure was reversed with the IEC rate of precipitation used, but, the ASA water resistivity was maintained.

In the present investigation, the combined effect of changing water resistivity and rate of precipitation was measured on suspension, pin-type, and apparatus insulators. Thus the work of the preceding paper has been extended, but, there still remains a need for similar data on other electrical apparatus.

METHOD OF TEST

The American standard practices were followed throughout in this investigation except for the water resistivity and rate of precipitation. The tests, for both IEC and ASA methods, were conducted using the rain angle, nozzles, and pre-wetting techniques as specified by ASA.

Various voltage classes as well as different types of geometrically-shaped insulators were used. Suspension insulators were tested in strings of 1, 3, 5, 6, 7, 8, 9, 10, 12, 15, and 18 units using both conventional and fog-type units. One low voltage pin-type insulator and one high voltage pin-type insulator were tested. Apparatus insulators comprised the remainder of the specimens which were investigated. Insulators designed for operation at 15 kv, 23 kv, 34.5 kv, and 69 kv of both the cap and pin and post-type construction were tested. Above 69 kv, only apparatus insulators of the cap and pin type were tested in stacks of 2, 4, 6, and 8 units.

Baltimore, January 9, 1956.

CC: Mr. C. H. Linder - NEW YORK

To Those Attending the
High Voltage Conference.

Gentlemen:

At the November 22nd High Voltage Conference, I was asked to submit brief reports on the subjects of "Electrical Breakdown", "Withstand Tests", Altitude Derating Factors", "Leakage Distance" and "Clearance Distance". I am attaching copies of these reports.

It is needless to say none of these reports are complete; in an inclusive sense each could be made a very extensive paper in itself. What we have tried to do is to outline very briefly what I believe to be the major knowns and unknowns in the field. We have deliberately avoided a discussion of some of the conventional variables, such as the difference between I.E.C. and American test practices, and also the conventionalized withstand test levels which have been established by the various product sections of NEMA.

In the latter case we have attached to the report on "Withstand Values" a curve which shows the general trend in standardized product withstand levels. The shaded areas of this curve indicate those zones where there is a difference between the withstand levels specified for different types of product. In some cases there are probably very good reasons for these differences, and it was not my thought that you would use these meetings at this stage in their development to try to iron out such product variables.

Very truly yours,

H.A. Frey
Manager - Engineering
Locke Department.

HAFrey/LP

Conference Paper



FIRST 500 kv A-C TRANSMISSION LINE DESIGNS FOR THE BONNEVILLE POWER ADMINISTRATION'S GRID

A. A. Osipovich
Senior Member IEEE

M. G. Poland
Senior Member IEEE

Bonneville Power Administration
U. S. Department of the Interior
Portland, Oregon

A paper scheduled by the IEEE Transmission and Distribution Committee for presentation at the IEEE Summer General Meeting, Toronto, Ontario, Canada, June 16-21, 1963.

All Rights Reserved by
The Institute of Electrical and Electronics Engineers,
Inc.,

P. O. Box A,
Lenox Hill Station,
New York 21, N. Y.

Litho in USA

Paper No. **CP**

63-1164

Transactions Paper

(Reviewed and Accepted for Publication)



VOLTAGE GRADIENTS ON HIGH VOLTAGE TRANSMISSION LINES

G. E. Adams
Associate Member AIEE
General Electric Co.
Schenectady, N. Y.

A paper recommended by the AIEE Committee on Transmission and Distribution and approved by the AIEE Committee on Technical Operations for presentation at the AIEE Winter General Meeting, New York, N. Y., January 31-February 4, 1955. Manuscript submitted October 21, 1954; made available for printing November 10, 1954.

Price: 30¢ To Members
60¢ To Nonmembers

(5¢ per copy additional if
first class mailing desired)

All Rights Reserved by the
American Institute of Electrical Engineers
33 West 39th Street, New York 18, N. Y.
Litho in USA

Paper No.

55-22

Discussion in Duplicate Due February 16, 1955.

A REVIEW OF INSULATION AND CLEARANCE PRACTICES
of
HIGH VOLTAGE SUBSTATIONS

by
E. A. Williams

A paper presented to the joint meeting of the
Electrical Equipment and Transmission and
Distribution Committees, Pennsylvania Elec-
tric Association, Reading, Pa., October 8-9,
1953.

R & I E E Q U I P M E N T D I V I S I O N

I-T-E Circuit Breaker Company, Greensburg, Pennsylvania

MODERN CONCEPTS OF LIGHTNING PROTECTION FOR TRANSMISSION AND DISTRIBUTION SYSTEMS



BY

H. M. TOWNE

GENERAL ELECTRIC COMPANY

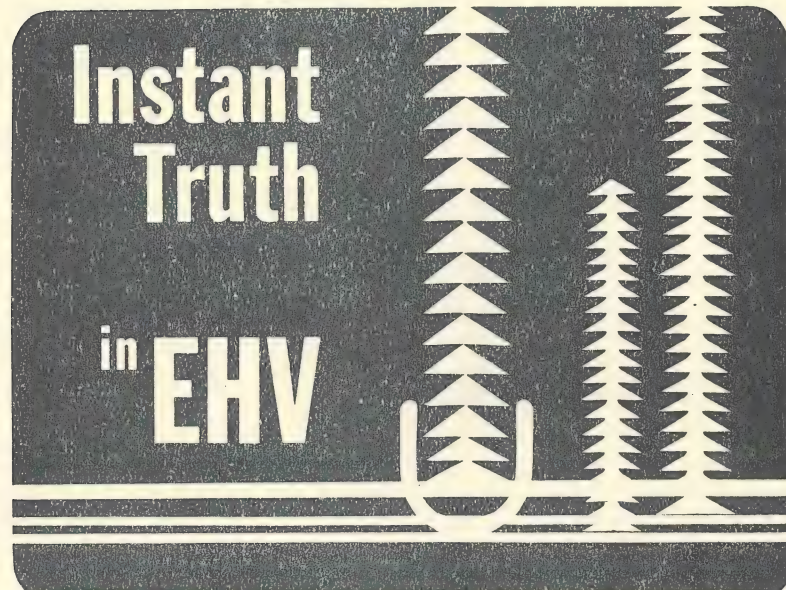
PITTSFIELD, MASS.

GENERAL  ELECTRIC

THIRD DRAFT

January 29, 1963

A motion picture script



prepared for

THE INSULATOR DEPARTMENT

Baltimore, Maryland

Client Representatives:

F. R. McVicker

M. Stack

Approved for production by:

Name _____

Date _____

Prepared by:

J. B. Updyke

Audio-Visual Communications
Schenectady, New York

METIFOR—A Statistical Method for Insulation Design of EHV Lines

J. G. Anderson, Senior Member IEEE L. O. Barthold, Senior Member IEEE

Summary: Using sequential hourly weather data available on punched cards from the United States Weather Bureau, digital weather models of the future climate in the vicinity of a proposed transmission line can be constructed. These models permit statistical forecasts of line performance. Application of the technique to line insulation strength is demonstrated. Performance can be predicted on an over-all basis, or can be studied at specific times of the day, or during fog periods or thunderstorms. Optimizing routines are presented that optimize or permit balancing

of flashover characteristics, and forecast performance as a function of line investment.

Paper 64-37, recommended by the IEEE Transmission and Distribution Committee and approved by the IEEE Technical Operations Committee for presentation at the IEEE Winter Power Meeting, New York, N. Y., February 2-7, 1964. Manuscript submitted November 6, 1963; made available for printing December 11, 1963.

J. G. ANDERSON is with the General Electric Company in Pittsfield, Mass., and L. O. BARTHOLD is with the same company in Schenectady, N. Y.

The authors gratefully acknowledge the contributions of their many associates whose research work, discussions, and direct assistance were of immense value. Of particular mention are the discussions and suggestions of H. C. S. Thom and G. J. Bulgarelli of the United States Weather Bureau; G. K. Carter, P. M. Cabral, and M. S. Dyrkacz for their programming of much of the work; D. D. MacCarthy and E. M. Hunter for their encouragement and guidance; A. F. Rohlf, F. J. Turner, and J. R. Meador for the flashover data to make METIFOR a realistic program; and the many other co-workers who contributed in numerous ways.

The recent upsurge in the use of extra-high-voltage (EHV) transmission has brought with it several new technical and economic attitudes. Both design philosophies and techniques have been reappraised in the light of the increased incentives for cost control and the greater opportunities for precision afforded by recent progress in industry research.

Any discussion of transmission-line design philosophy resolves itself into the consideration of three arguments: (1) the electrical and meteorological *environment* to which the line will be subjected, (2) the *criteria* assigned to its operating performance, and (3) the intrinsic design *dimensions* proposed to fulfill the criteria established.

While the discussion here is confined to electric systems, and more particularly to transmission lines themselves, the stated arguments are found to be inherent in practically any design problem.

Design criteria may be further subdivided into cases where noncompliance is catastrophic as opposed to those in which it is not. A bridge must never collapse, but its pavement need

EHV DC TRANSMISSION

BY E. M. HUNTER, G. D. BREUER AND C. C. HERSKIND
THE GENERAL ELECTRIC COMPANY

Reprinted from TRANSMISSION & DISTRIBUTION, September, 1965

460_{KV} = EHV

The Pennsylvania Electric Company has built the nation's first operating 460-KV power transmission line as part of its continuing program to develop and use the latest technology to provide customers with dependable service.

Penelec also regards the unusual engineering and construction work which has gone into this project as a contribution to the "art" of EHV transmission. The ultra-severe demands, of 460-KV service require:

WIRES—thick as a man's wrist

PORCELAIN INSULATORS—15 feet long

CROSS-ARMS—big as a barn beam

STRUCTURES—up to 130 feet high

TRANSFORMER—holding in its tank all of the oil carried by the largest railroad tank car

SWITCH BLADES—20 feet long, 4 inches in diameter

It took 260 working days to erect this transmission line. It required not only new hardware, but new construction methods as well. Despite this, it is a practical line, with pure EHV research and development a by-product.

During the next two years, intensive tests will be made to obtain a clearer understanding of stresses and strains, of behavior and of effectiveness of design. And, just as important, during that period the line will be performing the function for which Penelec exists—serving its customers.

PRODUCT REFERENCE FILE

THE TEINOGRAPH - A NEW HIGH-VOLTAGE SURGE RECORDER

J. G. Anderson

Member - AIEE

R. U. Giacomoni

Associate Member - AIEE

Both of:

General Electric Co.

Pittsfield, Mass.

To be presented at the AIEE Middle Eastern District Meeting,
Baltimore, Md., May 19, 1959

American Gas and Electric Company 500-Kv Test Project

Corona, Radio Influence, and Economics
on
High Voltage Transmission Lines
and
AG&E Co. 315-Kv System

Reprint of
Six Technical Papers including discussions presented
before the AIEE 1950-51 on the above subject

Group Participating in the Project

American Gas and Electric Service Corporation (Sponsor)
Aluminum Company of America
American Bridge Company
Anaconda Wire and Cable Company
General Cable Corporation
General Electric Company
Locke Insulator Corporation
Ohio Brass Company
Westinghouse Electric Corporation

The American Institute of Electrical Engineers

Transactions Paper

(Reviewed and Accepted for Publication)



THE CALCULATION OF THE RADIO INTERFERENCE LEVEL OF TRANSMISSION LINES CAUSED BY CORONA DISCHARGES

G. E. Adams
Associate Member AIEE
General Electric Company
Schenectady, N. Y.

A paper recommended by the AIEE Committee on Transmission and Distribution and approved by the AIEE Committee on Technical Operations for presentation at the AIEE Winter General Meeting, New York, N. Y., January 30-February 3, 1956. Manuscript submitted October 20, 1955; made available for printing December 20, 1955.

Price: 40¢ To Members
80¢ To Nonmembers

(5¢ per copy additional if
first class mailing desired)

All Rights Reserved by the
American Institute of Electrical Engineers
33 West 39th Street, New York 18, N. Y.
Litho in USA

Paper No.

56-222

Discussion in Duplicate Due February 15, 1956.

EUROPEAN TECHNOLOGY REPORT

EUROPEAN OFFICE
Lowenstrasse 29
Ch 8001 Zurich, Switzerland

For Cited References: Technical Information Exchange, Bldg. 5, Rm. 221, Schenectady, N. Y. • Dial Comm 8-235-5068

A22

72T7

February 21, 1972

HIGH VOLTAGE TECHNOLOGY

The 1972 International Symposium on High Voltage Technology will take place in Munich, W.Germany, on March 9-14, 1972. It is being organized by VDE (German Association of Electrical Engineers) and the IEEE Power Engineering Society. Scientific Chairman is Professor Hans Prinz of the High Voltage Institute, Technical University, Arcisstr.21, D-8 Munich 2, W.Germany.

The conference program is outlined below and a list of the 93 papers to be presented is also given. These papers have been compiled in a conference volume which is now available at the Technical Information Exchange Office of Corporate R&D, Bldg. 5, Room 221, P.O.Box 43, Schenectady, NY. When ordering copies of any of the papers, please indicate exact titles and numbers of the papers as well as the number of this report: 72T7.

A.M. Gurewitsch
A.M. Gurewitsch, Consultant
Applied Science and Technology - Europe
Zurich, Switzerland
AMG/mb

List of Papers to be Presented:

A. The Calculation of Electric Fields in High Voltage Devices

1. "Determination of Boundary Coordinates by means of Finite-Difference Methods" by K. Antolic, Micafil-Zurich, Switzerland

9. "The Electromagnetic Wave of the High Voltage Impulse" by H.Böcker, TU-Stuttgart

17. "Automatic Calculation of Electric Fields" by N.Flatabö et al., TU-Trondheim, Norway

23. "Safety Hazards beneath High Voltage Lines" by E.T.B.Gross, M.H.Hesse, Rensselaer Polytechnic, Troy, NY, USA

30. "Calculation of the Effectiveness of Shielding against Quasistatic Electric Fields" by G.Karady and N.Hyltén, Hydro-Quebec, Canada

36. "Potential Gradients on the Surface of Shielding Electrodes for Ultra-High Voltages" by J.Moeller et al., Messwandler-Bau GmbH, Bamberg, W.Germany

44. "Derivation of System Models Applying the Finite Element Method" by K.Reichert, BBC-Baden, Switzerland

52. "Computation of Electric Fields: Recent Developments and Practical Applications" by M.F.Scott et al., Reyrolle Parsons Ltd., Hebburn, UK

59. "The Electric Field of Polycon Electrodes" by H.Singer, TU, Munich, W.Germany

67. "Calculation of Maximum Stress in Gas Insulated Bus-Bars" by T.Takuma et al., Central Research Institute of Electric Power Industry, Tokyo, Japan

73. "Field Strength Effects in Two-Dielectric Arrangements" by P.Weiss, TU, Munich, W.Germany

B. The Measurement of Electric Field Strength in High Voltage Devices

81. "Contribution to Electric Field Measurement Technique by means of Probes" by J.Aubry et al., Electricité de France, Paris

86. "Electrical Field in Long Rod-Rod Gaps" by G.Baldo, M.Rea, Padova University, Italy

Transactions Paper

(Reviewed and Accepted for Publication)



EFFECT OF BUNDLE-CONDUCTOR FIELD INFLUENCE ON EHV TRANSMISSION LINE DESIGN

R. W. Harmon
Member AIEE
The Ohio Brass Company
Barberton, Ohio

RECEIVED

JAN 17 1961

G. M. BOYD

RECEIVED

JAN 17 1961

H. A. FREY

A paper recommended by the AIEE Transmission and Distribution Committee and approved by the AIEE Technical Operations Department for presentation at the AIEE Winter General Meeting, New York, N. Y., January 29-February 3, 1961. Manuscript submitted August 8, 1960; made available for printing December 2, 1960.

Price: \$.50 To Members
\$1.00 To Nonmembers

(5¢ per copy additional if
first class mailing desired)

All Rights Reserved by the
American Institute of Electrical Engineers
33 West 39th Street, New York 18, N. Y.
Litho in USA

Paper No.

61 171

Discussion in Duplicate Due February 17, 1961.

Transactions Paper 57-1077

SUSPENSION INSULATOR FLASHOVER UNDER HIGH IMPULSE VOLTAGES

by B. E. Kingsbury

Closure by B. E. Kingsbury

The discussions which have been presented by Messrs. Concordia, Fritz and Rohlfis are greatly appreciated.

Mr. Fritz asks some questions which are beyond the scope of this paper and will require further work and study before their answers can be forthcoming. In those cases where long counterpoise systems are required because of poor ground resistances, the advantage of several microseconds delay in flashover for the shorter spaced insulators would provide definite protection in view of the long periods before alleviation of the stricken structure can be effected.

As Mr. Rohlfis points out, the correlation of this and the companion paper are good and the data should provide benefits for transmission design.

By plotting the flashover voltage versus arcing distance, a particular type of insulator can be evaluated under both standards. By using the ASA standard as the base line, it can then be readily determined whether or not there exists a difference between the two standards for any one particular voltage class, and, also, whether or not the trend of the results using the IEC method agrees with the base line as the tests progress upward through the voltage classes. It is logical to consider that the resulting curve of flashover voltage versus arcing distance, while fairly linear as determined by the American standard for most types of insulators, may not be coincidental for the IEC standards. It may not have the same slope, and may not even have the same semblance of linearity. In plotting these curves, only the mean of the average values of similar test specimens is shown. The average curve drawn through these points would depict the expected true performance as obtainable with the particular test standard. This average curve would then be used to determine whether or not a plausible comparison exists both between the two standards and between the ratings and the European standards. The mean values of specific insulators can then be examined as to how well they fit the overall picture.

In some cases it is apparent that certain types of insulators do not show the same general pattern as do the majority of others. This, then, might indicate one further point to be gained from this investigation; i.e., that some geometrical shapes, while designed to adequately meet existing ASA standards, react in an aggravated manner to different conditions of test. That is, they are super-sensitive to various atmospheric conditions and may not perform as expected.

The reliability of the wet test is dependent upon there being as small a variation as possible between the high and low values obtained, upon which the average value is predicated. It was noted that the IEC ~~standards~~ seemed to consistently yield results which were more erratic than those of the American standard. This erratic performance exists not only from specimen to specimen, but also, from arc to arc on the same specimen. Data have been plotted so as to develop frequency distribution curves showing the cumulative percentage of tests as a function of the flashover voltage range. The range for each test has been expressed as a percentage based upon the average of the particular test so that all of the data for each type of insulator can be consolidated and plotted together. Comparisons can be made between the two standards for the different types of insulators tested.

SUSPENSION INSULATORS

Both conventional and fog-type insulators were tested so that the effect of geometry could be determined. The flashover test values for conventional insulators obtained with both the ASA and IEC test methods, when plotted against arcing distance, appear to be linear. The test values shown for the IEC method have a greater variability than the ASA values but do not deviate by more than 8.5% from the average curve values.

The mean values of the IEC test method for fog-type insulators are generally higher than are those for the ASA test method (Fig. 2). An average curve can be readily drawn through the means of the ASA data, and, in comparing specific IEC test data points with ASA mean curve, it is found that as much as a 24.3% difference exists. Such large differences indicate that more data should be obtained, and, if a like differential is determined, then no valid correlation would seem to exist.

The range on individual tests for conventional insulators is shown by Fig. 3. The range between the minimum and maximum flashover voltage for each test specimen is expressed as a percentage based upon the average flashover voltage for that specimen, and all the data was then consolidated so that the frequency of occurrence of tests could be plotted as a function of the per cent range. The preferred test method would be

TECHNICAL REPORT NO. LK-904

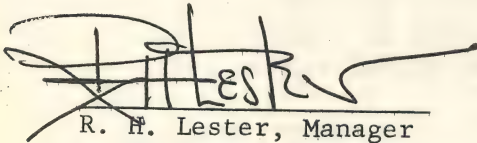
PROGRESS REPORT OF AGING TESTS ON THE 20,000 lb. INSULATORS

Author:



R. Weller
Product Engineer

Approved:



R. H. Lester, Manager
Ceramic Insulator Engineering

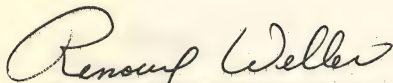
Distribution:

GM Boyd
ES Wheeler
CD Croskey
J Kaminski, Jr.
BE Kingsbury
RH Lester
WB Lounsbury
HM Williams

TECHNICAL REPORT NO. LK - 919

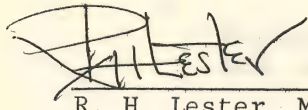
REPORT OF TESTS ON CAST ALUMINUM SUSPENSION
CAP BY ALCOA

Author:



R. Weller
Product Engineer

Approved:



R. H. Lester, Manager
Ceramic Insulator Engineering

Distribution:

ES Wheeler
J Kaminski, Jr.
J Kelenfy
BE Kingsbury
RH Lester
AL Libby
HM Williams

INSULATOR DEPARTMENT

GENERAL ELECTRIC COMPANY

BALTIMORE, MARYLAND
January 29, 1969

TECHNICAL REPORT LK-927

AGING TESTS ON INSULATORS HAVING
TWO COATS OF ADIPRENE

Author:

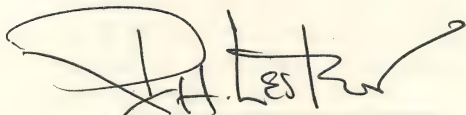


R. Weller
Product Engineer

Distribution:

ES Wheeler
WG Chiodi
JA Hart
BE Kingsbury
RH Lester
HM Williams

Approved:



R. H. Lester, Manager
Ceramic Insulator Engineering

TR 8380

TECHNICAL REPORT NO. LK-917
EVALUATION AND TESTS ON THE CATALOG 40S298
FOG TYPE INSULATOR

Author:

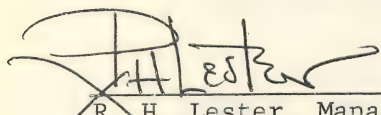


R. Weller
Product Engineer

Distribution:

ES Wheeler
J Kaminski, Jr.
J Kelenfy
BE Kingsbury
RH Lester
AL Libby
WB Lounsbury
HM Williams

Approved:



R. H. Lester, Manager
Ceramic Insulator Engineering

INSULATOR DEPARTMENT

GENERAL ELECTRIC COMPANY

BALTIMORE, MARYLAND
January 13, 1969

TECHNICAL REPORT LK-CR 201

HYDRAULIC TESTING OF NOs. 18290A - 40,000 lb. and
18380A - 50,000 lb. SUSPENSION SHELLS

AUTHOR:

C. D. Croskey
C. D. Croskey
Manager-Ceramic Laboratory

APPROVED:

E. S. Wheeler 8/15/68
E. S. Wheeler
Manager-Engineering

Distribution:

WM Nave
GM Boyd
KW Cermak
JM Jesatko
J Kaminski, Jr.
J Kelenfy
MD Kendall
BE Kingsbury
RH Lester
AL Libby
WB Lounsbury
FR McVicker
R Weller
HM Williams
RF Worden
CD Croskey (3)

INSULATOR DEPARTMENT

GENERAL ELECTRIC COMPANY

BALTIMORE, MD.

August 6, 1968

TECHNICAL REPORT LK-881

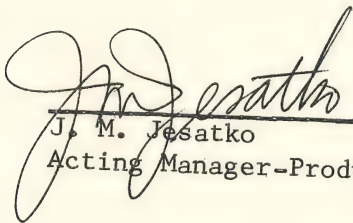
EVALUATION AND TESTS ON NGK SUSPENSION CAT. 525MC, 18,000 LB. INSULATOR

Author:



R. Weller
Product Engineer

Approved:



J. M. Jesatko
Acting Manager-Product Engineering

Distribution: CD Croskey
JM Jesatko
J Kaminski
WB Lounsbury
CH Matthews
ES Wheeler
HM Williams

TECHNICAL REPORT LK-879

EVALUATION AND TESTS ON THE LAPP
CAT. 8200 INSULATOR 20,000 LB. ASA CLASS 52-3

Author:



R. Weller
Product Engineer

Approved:



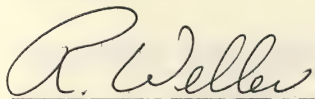
J. M. Jesatko
Acting Manager-Product Engineering

Distribution: CD Croskey
JM Jesatko
J Kaminski
BE Kingsbury
WB Lounsbury
CH Matthews
ES Wheeler
HM Williams

TECHNICAL REPORT LK-861-A
SUPPLEMENT NO. 1

EVALUATION AND TESTS ON THE OB CAT. 47310 SUSPENSION INSULATOR

Author:



R. Weller
Product Engineer

Approved:



J. M. Jesatko
Acting Manager-Product Engineering

Distribution: JM Jesatko
J Kaminski
BE Kingsbury
WB Lounsbury
CH Matthews
ES Wheeler

TECHNICAL REPORT LK-882

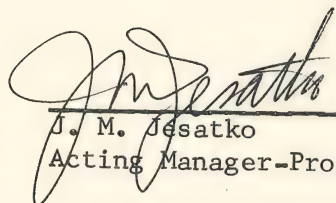
EVALUATION AND TESTS ON THE NGK CAT.
DA-500 MQ 25,000 LB, SUSPENSION INSULATOR

Author:



R. Weller
Product Engineer

Approved:



J. M. Jesatko
Acting Manager-Product Engineering

Distribution: CD Croskey
JM Jesatko
J Kaminski
BE Kingsbury
WB Lounsbury
CH Matthews
ES Wheeler
HM Williams

Insulator Department

Baltimore, Maryland

June 13, 1968

TECHNICAL REPORT LK-CR-209

STATUS OF RESEARCH ON STABILIZED GLAZED INSULATORS
FOR USE IN CONTAMINATED AREAS

Author:

C. D. Croskey

C. D. Croskey
Manager-Ceramic Laboratory

Approved:

E. S. Wheeler 2/26/69

E. S. Wheeler
Manager-Engineering

Distribution:

GM Boyd
ES Wheeler
BE Kingsbury
RH Lester
AL Libby
R Weller
HM Williams

TECHNICAL REPORT NO. LK-923

TIME-LOAD TESTS ON NGK SUSPENSION INSULATORS

Author:

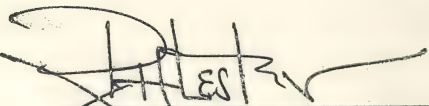


R. Weller
Product Engineer

Approved:

Distribution:

ES Wheeler
CD Croskey
BE Kingsbury
RH Lester
AL Libby
HM Williams

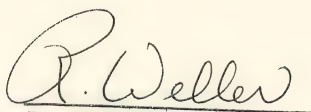


R. H. Lester, Manager
Ceramic Insulator Engineering

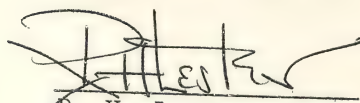
TECHNICAL REPORT NO. LK-924

DEVELOPMENT OF A PEARLITIC MALLEABLE IRON
CAP FOR 30,000 LB. INSULATOR

Author:


R. Weller
Product Engineer

Approval:

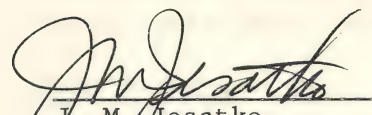

R. H. Lester, Manager
Ceramic Insulator Engineering

Distribution:

ES Wheeler
J Kelenfy
BE Kingsbury
RH Lester
AL Libby
HM Stickles

TECHNICAL REPORT LK-930
SOLID STATION POST INSULATORS

Author:


J. M. Jesatko
Product Engineer

Approved:


R. H. Lester, Manager
Ceramic Insulator Engineering

Distribution:

NE Dillow
GM Boyd
JS Craig
ES Wheeler
GF Young
HM Carmichael
KW Cermak
WG Chiodi
RT Fleming
JA Hart
WF Hiel
J Kelenfy
BE Kingsbury
RH Lester
AL Libby

TECHNICAL REPORT LK-CR 212

FEASIBILITY STUDY --- CONDUCTIVE GLAZES
TIN-ANTIMONY OXIDE TYPES

Author:

C.D. Croskey
C. D. Croskey, Manager
Ceramic Laboratory

Approved:

E. S. Wheeler 7/3/69
E. S. Wheeler
Manager-Engineering

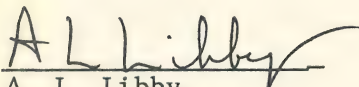
Distribution:

GM Boyd
TH Dressel, Jr.
PB Horton
JM Jesatko
BE Kingsbury
RH Lester
AL Libby
R Weller
HM Williams

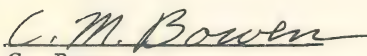
LK 932

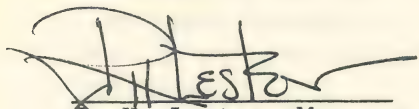
RECORD OF TESTS NO. 24242

THERMAL ENDURANCE TESTS
ON
SUSPENSION INSULATORS
FOR
CONEMAUGH PROJECT


A. L. Libby
Product Engineer


R. Weller
Product Engineer


C. Bowen
Baltimore Gas & Electric Co.


R. H. Lester, Manager
Ceramic Insulator Engineering

INSULATOR DEPARTMENT

GENERAL ELECTRIC COMPANY

BALTIMORE, MARYLAND
December 2, 1968

GENERAL ELECTRIC
INSULATOR PRODUCTS DEPARTMENT
BALTIMORE, MARYLAND
RECORD OF TESTS

No. 24597
Date Oct 31, 1969
Page 1 of 6

Nature of Tests: RADIO INFLUENCE VOLTAGE AND CORONA OBSERVATION		Material Dual Conductor Spacer
AT 60HZ ON DUAL CONDUCTOR SPACERS		
Refer to Data Sheet No. 24554	Test Req. No.	

**Copies
to**

Preformed Line Products Co.
Dept. of Water & Power, City
of Los Angeles

I. GENERAL

The tests described below were performed in the High Voltage Laboratory, Insulator Products Department, General Electric Company on September 23, 1969 on 500Kv-AC rated two-conductor spacers.

II. CUSTOMER AND SPECIFICATIONS

These tests were made for the Preformed Line Products Company of Cleveland, Ohio. The tests were run to qualify conductor spacers for sale to The Department of Water and Power of the City of Los Angeles (abbreviated "LADWAP" on occasion) and specification No. 7248.

III. WITNESSES

The following persons, other than laboratory personnel, were present during all tests:

Mr. Tom Eistrat	Department of Water and Power, City of Los Angeles
Mr. Raymond J. Champa	Preformed Line Products Company
Mr. Mike Hathway	Preformed Line Products Company
Mr. Jim Jung	Preformed Line Products Company

IV. MATERIAL

The following material items were included in some or all of the tests performed:

1. Alcoa ACSR Conductor, 2050 MCM 76/19 Stranding, 1.700 inches outside diameter, with Alcan Aluminum fittings
2. Alcan All Aluminum Conductor, 2,500 MCM 91 strands, each 0.1657 inches in diameter, total outside diameter 1.823 inches with Alcan Aluminum fittings
3. Preformed Line Products Helical Spacer SU-MS-5462 (Dept. of Water & Power item #11-A)

TECHNICAL REPORT NO. LK-937

LEAKAGE CURRENT MEASUREMENTS ON 15 KV AND 34 KV
GEPOI® INSULATORS

Author:

Fred C. Vose
F. C. Vose, Manager
Polymer Insulator Engineering

Approved:

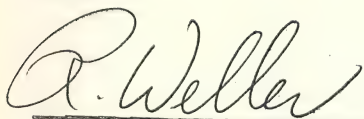
E. S. Wheeler 11/11/69
E. S. Wheeler
Manager-Engineering

Distribution:

HM Carmichael
J Kelenfy
BE Kingsbury
AL Libby
CS MacConney
M Tabor

TECHNICAL REPORT NO. LK-941
AGING TESTS ON 40S360 GO6 INSULATOR

Author:

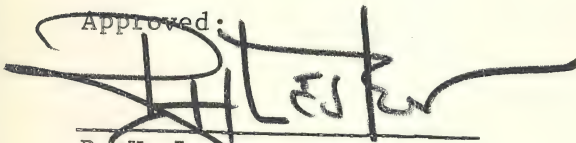


R. Weller
Product Engineer

Distribution:

ES Wheeler
RT Fleming
J Kelenfy
BE Kingsbury
RH Lester
AL Libby
HM Williams

Approved:



R. H. Lester, Manager
Ceramic Insulator Engineering

INSULATOR PRODUCTS DEPARTMENT

GENERAL ELECTRIC COMPANY

BALTIMORE, MARYLAND
December 5, 1969

TECHNICAL REPORT NO. LK-939-DR

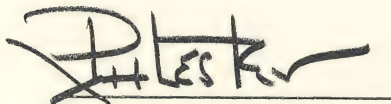
DESIGN TESTS ON THE CATALOG NO. 40S296 FOG TYPE INSULATOR

Author:



R. Weller
Product Engineer

Approved:



R. H. Lester, Manager
Ceramic Insulator Engineering

Distribution:

ES Wheeler
RT Fleming
J Kelenfy
BE Kingsbury
RH Lester
AL Libby
HM Williams

TECHNICAL REPORT NO. LK-938-DR

DESIGN TESTS ON CATALOG NO. 20S185 FOG TYPE INSULATOR

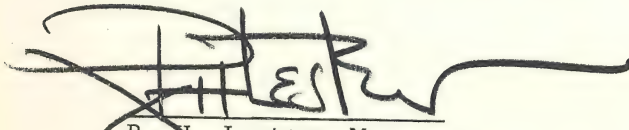
Author:


R. Weller
Product Engineer

Distribution:

ES Wheeler
J Kelenfy
BE Kingsbury
RH Lester
AL Libby
HM Williams

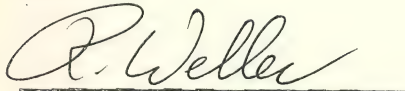
Approved:


R. N. Lester, Manager
Ceramic Insulator Engineering

TECHNICAL REPORT NO. LK-940-DR

DESIGN TESTS ON THE CATALOG 30S263
FOG TYPE INSULATOR

Author:

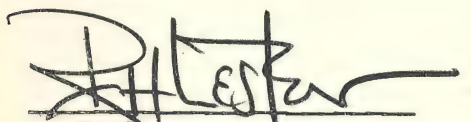


R. Weller
Product Engineer

Distribution:

ES Wheeler
RT Fleming
J Kelenfy
BE Kingsbury
RH Lester
AL Libby
HM Williams

Approved:



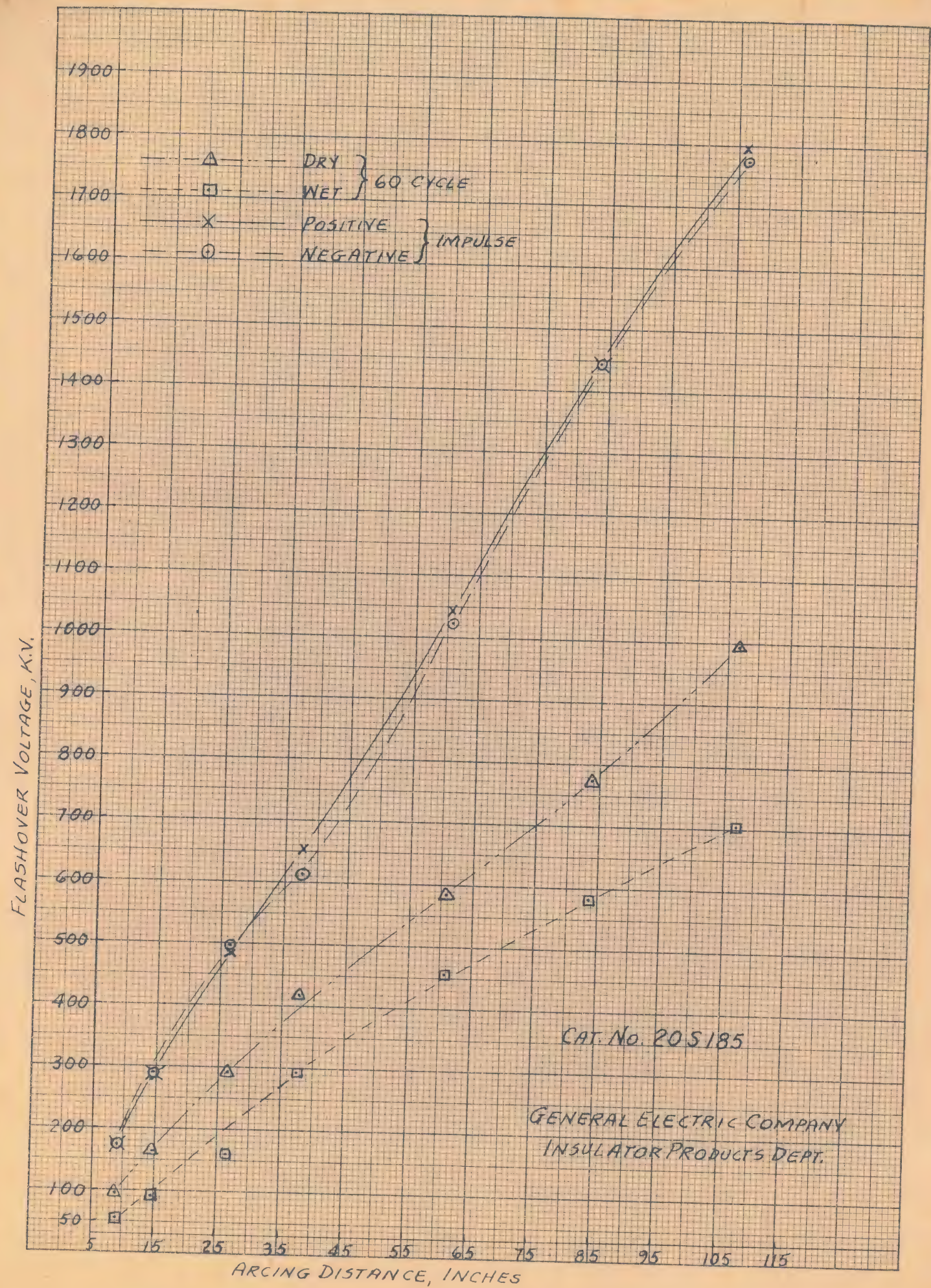
R. H. Lester, Manager
Ceramic Insulator Engineering

INSULATOR PRODUCTS DEPARTMENT

GENERAL ELECTRIC COMPANY

BALTIMORE, MARYLAND
November 18, 1969

RE
10 X 10 TO 1/2 INCH
SLUKEE & ROSEN CO.
NEW YORK
APR 1935



CAT. No. 205185

GENERAL ELECTRIC COMPANY
INSULATOR PRODUCTS DEPT.

1

TECHNICAL REPORT LK-936

THERMAL ENDURANCE TESTS
ON
SUSPENSION INSULATORS
FOR
PUBLIC SERVICE ELECTRIC AND GAS COMPANY

OCTOBER 27, 1969



A. L. Libby, Manager
High Voltage and Mechanical Laboratory

INSULATOR PRODUCTS DEPARTMENT

GENERAL ELECTRIC CO.

BALTIMORE, MARYLAND
November 5, 1969

TECHNICAL REPORT NO. LK-951-DR

INFLUENCE OF COATINGS ON THE AGING MECHANISM
OF SUSPENSION INSULATORS

Author:

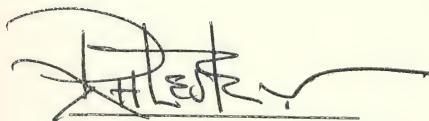


R. Weller
Product Engineer

Distribution:

ES Wheeler
CD Croskey
BE Kingsbury
RH Lester
AL Libby
HM Williams

Approval:



R. H. Lester, Manager
Ceramic Insulator Engineering

TECHNICAL REPORT LK-936

THERMAL ENDURANCE TESTS
ON
SUSPENSION INSULATORS
FOR
PUBLIC SERVICE ELECTRIC AND GAS COMPANY

OCTOBER 27, 1969



A. L. Libby, Manager
High Voltage and Mechanical Laboratory

INSULATOR PRODUCTS DEPARTMENT

GENERAL ELECTRIC CO.

BALTIMORE, MARYLAND
November 5, 1969

TECHNICAL REPORT NO. LK-942-DR

DESIGN TESTS ON THE CATALOG 30S268 FOG TYPE INSULATOR

Author:



R. Weller
Product Engineer

Approved:



R. H. Lester, Manager
Ceramic Insulator Engineering

Distribution:

ES Wheeler
J Kelenfy
BE Kingsbury
RH Lester
AL Libby
HM Williams

TECHNICAL REPORT LK-CR-219

THE EFFECT OF THICK CEMENT ON THE M&E STRENGTH
OF SUSPENSION INSULATORS WHEN STORED IN AIR AND
IN VACUUM

Author:

CDCroskey
C. D. Croskey, Manager
Ceramic Laboratory

Approved:

E. S. Wheeler
E. S. Wheeler
Manager-Engineering

Distribution:

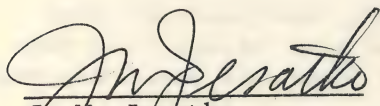
GM Boyd
ES Wheeler
EG Alcott
DW Binko
L. Farkas
JP Gochar
J. Kelenfy
RH Lester
AL Libby
JG McClellan
R. Weller
HM Williams

11

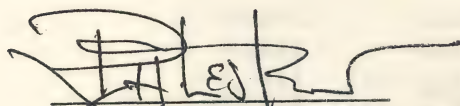
TECHNICAL REPORT LK-976-DR -- Sup. 1

CHARACTERISTICS OF PCB POSTS

Author:


J. M. Jesatko
Product Engineer

Approved:


R. H. Lester, Manager
Ceramic Insulator Engineering

Distribution:

ES Wheeler
HM Carmichael
CD Croskey
TH Dressel
PB Horton
BE Kingsbury
AL Libby
R Weller

INSULATOR PRODUCTS DEPARTMENT

GENERAL ELECTRIC COMPANY

BALTIMORE, MARYLAND
July 28, 1971

TECHNICAL REPORT LK-CR-220

A-30 EXPERIMENTAL ALUMINA BODY
LABORATORY PROGRAM
PROGRESS REPORT #1

Author:

David W. Binko

D. W. Binko, Engineer
Ceramic Laboratory

Approved:

C. D. Croskey

C. D. Croskey, Manager
Ceramic Laboratory

Distribution:

NE Dillow
GR MacDonald
ES Wheeler
GF Young
GM Boyd
CA Calkins
RT Fleming
PB Horton
JM Jesatko
RH Lester
AL Libby
JG McClellan
R Weller
HM Williams

INSULATOR PRODUCTS DEPARTMENT

GENERAL ELECTRIC COMPANY

BALTIMORE, MARYLAND

August 19, 1971

TECHNICAL REPORT LK-CR-221

REYNOLDS RC24-GF ALUMINA: SHOP TRIAL IN 304-3 and
A-30 FORMULATIONS

Author:

D. W. Binko
D. W. Binko, Engineer
Ceramic Laboratory

Approved:

C. D. Croskey
C. D. Croskey, Manager
Ceramic Laboratory

Distribution:

GR MacDonald
TH Dressel
RT Fleming
PB Horton
JM Jesatko
FH Judkins
J Kelenfy
BE Kingsbury
AL Libby
FL Page
EH Rickels
R Weller
HM Williams

GENERAL ELECTRIC COMPANY
PROTECTIVE EQUIPMENT PRODUCTS DEPARTMENT BALTIMORE, MARYLAND

May 1, 1972

CALCULATION OF TRANSMISSION LINE
LIGHTNING VOLTAGES BY FIELD CONCEPTS

Sherry

R. Lundholm

Associate Member AIEE

Professor Emeritus of Electrical Engineering
Chalmers Institute of Technology
Gothenburg, Sweden

R. B. Finn, Jr.

Associate Member AIEE

W. S. Price

Member AIEE

Both of American Gas and Electric Service Corporation
New York

District Paper Presented at
AIEE Northeastern District Meeting
Pittsfield, Massachusetts
May 2, 1957

DP 57-537

CALCULATION OF TRANSMISSION LINE
LIGHTNING VOLTAGES BY FIELD CONCEPTS

Thury

R. Lundholm

Associate Member AIEE

Professor Emeritus of Electrical Engineering
Chalmers Institute of Technology
Gothenburg, Sweden

R. B. Finn, Jr.

Associate Member AIEE

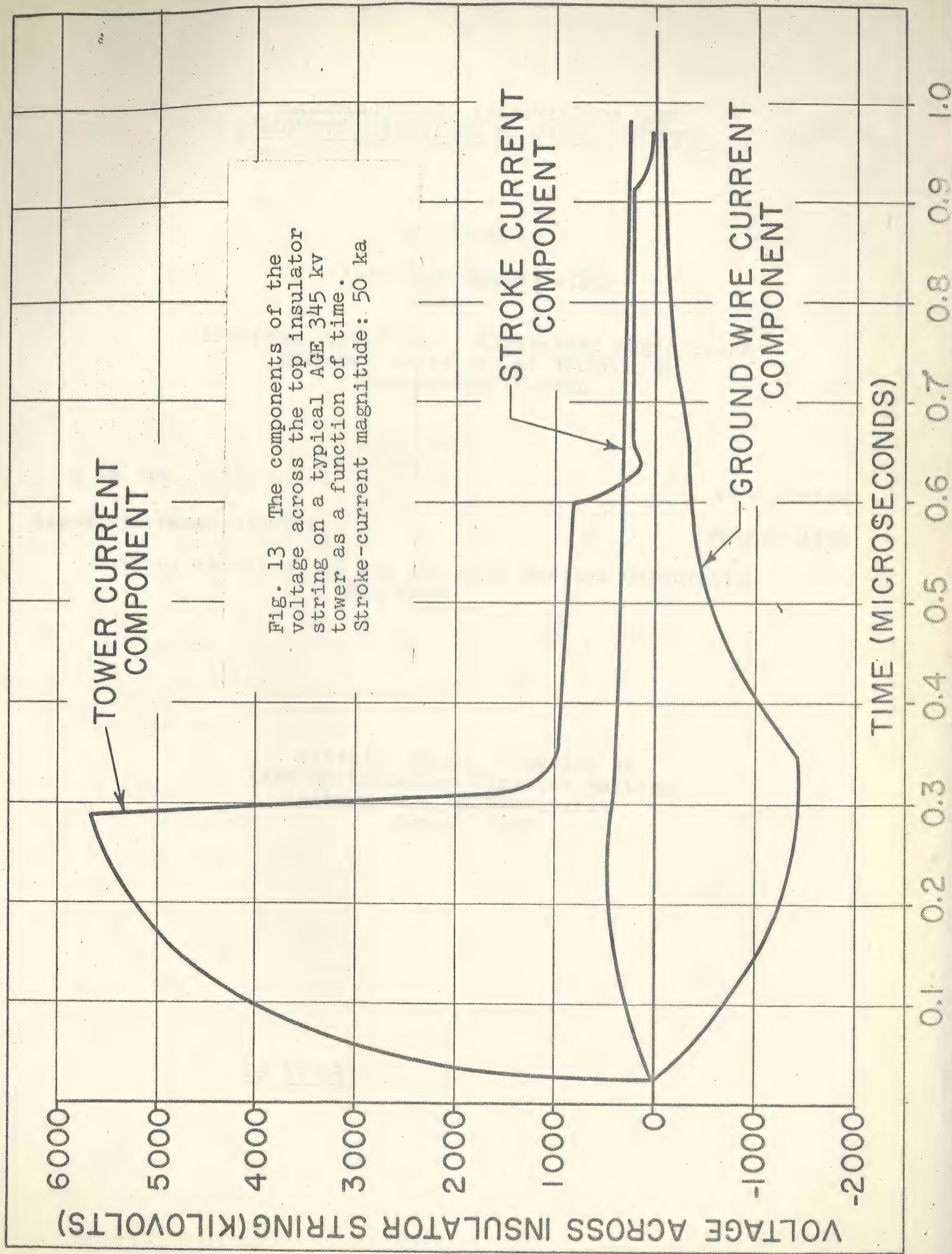
W. S. Price

Member AIEE

Both of American Gas and Electric Service Corporation
New York

District Paper Presented at
AIEE Northeastern District Meeting
Pittsfield, Massachusetts
May 2, 1957

DP 57-537



District Conference Paper



Lightning Theory

AN APPROXIMATE TRANSIENT SOLUTION OF THE TAPERED TRANSMISSION LINE

L. O. Barthold
Associate Member AIEE
General Electric Company
Schenectady, N. Y.

A paper recommended by the AIEE North Eastern District Meeting Committee for the AIEE North Eastern District Meeting, Pittsfield, Mass., May 1-3, 1957. Manuscript submitted February 27, 1957; made available for printing March 13, 1957.

Price: 40¢ To Members
80¢ To Nonmembers

(5¢ per copy additional if
first class mailing desired)

All Rights Reserved by the
American Institute of Electrical Engineers
33 West 39th Street, New York 18, N. Y.
Litho in USA

Paper No. DP

57-548

Lightning Theory

FIELD STUDIES OF THE SURGE RESPONSE OF A
345 KV TRANSMISSION TOWER AND GROUND WIRE

G. D. Breuer
Associate Member AIEE

R. H. Schlomann
Associate Member AIEE

W. S. Price
Member AIEE

A. J. Schultz
Member AIEE

AIEE Northeastern District Meeting
Pittsfield, Mass. - May 1-3, 1957

DP - 57 - 549

*The above is
for the
Sketch of Philk /*

*He arrived on
6910 11:00 we
furnished ins.
fo*

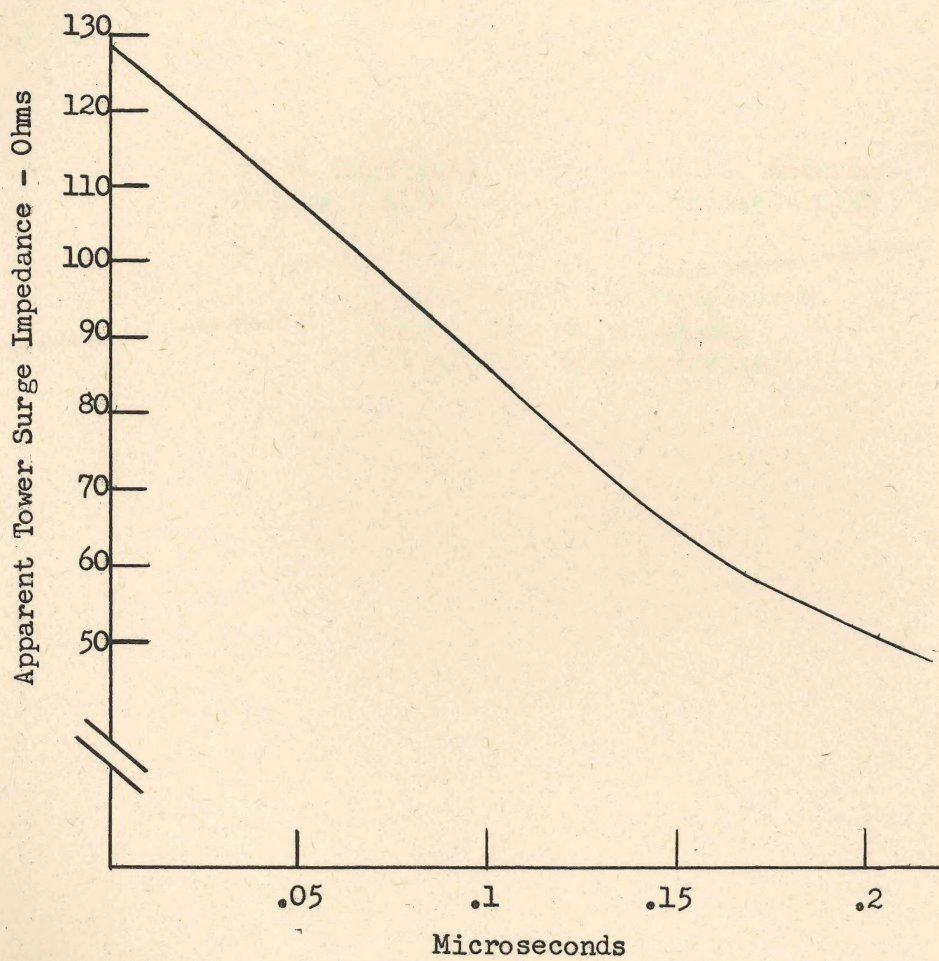


Fig. 9. Apparent Tower Surge Impedance
As A Function of Time
Data From Oscillogram of Fig. 8

FACTORS AFFECTING THE LIGHTNING PERFORMANCE OF TRANSMISSION LINES

J. H. Hagenguth
Fellow - AIEE

J. G. Anderson
Member - AIEE

INTRODUCTION

In recent years there have been an unexplained large number of outages on the 345 kv OVEC system. In a co-operative investigation several of the factors that may influence the outage rate have been investigated. The principal factors involved in the lightning performance problem are:

- Insulation .
- Configuration of line.
- Frequency of strokes to line.
- Frequency of occurrence of current - amplitude
 - front time
 - rate of rise
- Charge distribution in the leader channel and in the ground.
- Induced voltage.
- Ground resistance.
- Coupling effects.

This paper will discuss the charge distribution and resulting induced voltage, as well as a comparison method of calculating lightning performance, and will investigate available statistics to explain the flashover performance.

AN ELECTROSTATIC MODEL OF THE LIGHTNING STROKE PROCESS

It is now believed⁽¹⁾ that the concept of the lightning stroke as a simple generator (injecting a current into the line at the point struck) may be a drastic over-simplification for some lines. The stroke not only injects current into the stricken point, but also induces voltages into lines and towers by the electric and magnetic fields produced around the stroke channel. Calculations of these voltage components have been made by Wagner⁽¹⁾, Szpor⁽²⁾, and Razevig and Rozenfeld⁽³⁾, and experimental measurements of the electrostatic components were made by Akopian⁽⁴⁾. In such calculations the channel is generally assumed to be of constant charge density (or constant axial gradient) in order to facilitate solution, and solutions are based on field equation calculations.

However, for complex geometries and charge conditions, the use of the field equations becomes difficult because of the diversity of boundary conditions. A more direct method is the use of models of the lightning process. This is demonstrated in this paper by the use of a geometrical model to determine the currents induced on a phase wire by a direct stroke to an overhead ground wire at mid-span. By this method the buildup of charges on the phase conductors and groundwire by an approaching pilot streamer can be demonstrated, as well as the shielding effects of other conductors or upward streamers from the groundwire. It also permits a study of the buildup of electric fields at the surface of the earth, the measurement of the charges concentrated at various regions of the stroke channel, and an evaluation of phase-conductor induced voltages.

In Fig. 1, a model cloud 12' x 12' was suspended six feet above a conducting ground plane. Since this is a 250:1 model, it represents a cloud 1500 feet above the earth. Greater cloud height could not be obtained because of space limitations, but as long as the cloud is at a considerable distance from the transmission line, it is only the gradients produced near the line that are important, not the actual cloud height.