Recognized as an
American National Standard (ANSI)

IEEE Std 792-1995
(Reaffirmation of IEEE Std 792-1988)

IEEE Recommended Practice for the Evaluation of the Impulse Voltage Capability of Insulation Systems for AC Electric Machinery Employing Form-Wound Stator Coils

Sponsor
**Rotating Machinery Committee
of the
IEEE Power Engineering Society**

Approved 14 June 1995
IEEE Standards Board

Approved 12 January 1996
American National Standards Institute

Abstract: A test procedure for evaluation of the impulse voltage capability of insulation systems of form-wound alternating current rotating electrical machinery is outlined.
Keywords: ac electric machinery, form-wound stator coils, impulse voltage capability, insulation systems

---

The Institute of Electrical and Electronics Engineers, Inc

345 East 47th Street, New York, NY 10017-2394, USA

Foreword

(This Foreword is not a part of IEEE Std 792, IEEE Trial-Use Recommended Practice for the Evaluation of the Impulse Voltage Capability of Insulation Systems for AC Electric Machinery Employing Form-Wound Stator Coils.)

This test procedure was developed by the Insulation Subcommittee of the Rotating Machinery Committee of the Power Engineering Society. It is intended to provide a means to evaluate the capability of an insulation system on a multi-turn coil to withstand steep fronted voltage surges. It is also designed to simulate aging of the machine so that relative comparisons between insulation systems can be made.

The following persons were on the Working Group that developed this document:

J. C. Botts, *Chair*
C. A. Wilson, *Secretary*

E. J. Adolphson
D. Arndt
E. L. Brancato
L. Braun
T. R. Butman, Jr
P. Chen
J. A. Ciesar
F. Cook
C. C. Cummins
S. A. Drinkut
A. B. Giesecke
A. L. Guild
D. W. Jackson
A. Koutsoukos
W. Larzelere
T. J. Lorenz
C. Y. Lu
H. Meyer
P. Mlynar
O. M. Nassar
E. L. Owen
R. Pretorius
C. M. Rowe
D. E. Schump
D. K. Sharma
R. L. Schultz
K. C. Tornroos
R. E. Wootton

The following persons were on the balloting committee that approved this document for submission to the IEEE Standards Board:

P. D. Agarwall
J. C. Andreas
R. H. Auerbach
R. G. Bartheld
L. W. Buchanan
G. W. Buckley
A. W. W. Cameron
C. C. Chan
M. V. K. Chari
J. L. Cohon
J. L. Craggs
N. A. Demerdash
W. C. Dumper
J. S. Edmonds
J. S. Ewing
C. Flick
N. K. Ghai
B. E. B. Gott
D. R. Green
F. H. Grooms
H. B. Hamilton
G. E. Herzog
G. W. Herzog
M. H. Hesse
T. J. Higgins
V. B. Honsinger
R. F. Horrell
W. D. Jones
H. E. Jordan
J. L. Kirtley
W. H. Koch
S. B. Kuznetsov
R. H. Landrieu
T. A. Lipo
T. J. Lorenz
H. Majmudar
W. J. Martiny
C. H. Merrifield
E. J. Michaels
L. W. Montgomery
R. C. Moore
E. H. Myers
N. E. Nilsson
P. I. Nippes
D. W. Novotny
J. L. Oldenkamp
J. A. Oliver
W. B. Penn
M. Poloujadoff
J. V. Pospisil
E. P. Priebe
M. A. Rahman
G. M. Rosenberry
C. M. Rowe
M. S. Sarma
P. W. Sauer
R. M. Saunders
D. K. Sharma
M. W. Sheets
W. J. Sheets
E. P. Smith
J. F. Szablya
P. H. Trickey
P. J. Tsivitse
J. P. Voglewede
P. Walker
T. C. Wang
R. F. Weddleton
J. C. White
E. C. Whitney
J. J. Wilkes
E. J. Woods

When the IEEE Standards Board approved this standard on September 10, 1987, it had the following membership:

CLAUSE PAGE

IEEE Recommended Practice for the Evaluation of the Impulse Voltage Capability of Insulation Systems for AC Electric Machinery Employing Form-Wound Stator Coils

1. Introduction

1.1 Scope and Purpose

This recommended practice outlines a test procedure for the evaluation of the impulse voltage capability of insulation systems of form-wound alternating current rotating electrical machinery.

This test procedure forms a base for the accumulation, analysis, and reporting of information concerning impulse voltage withstand strength of ground and turn insulation, both new and aged. The immediate goal is a better understanding of relevant aging mechanisms; the ultimate aim of this document is to aid in estimating life of an insulation system under specified service conditions.

It must be emphasized that this test procedure is intended, at this time, for trial use. Future revisions, made after experience with it, should result in more definitive specifications being possible.

This procedure recommends the use of multi-factor aging tests, combining thermal and electrical aging in order to address the withstand capability of micaceous insulation. Variations of this procedure may be tried, such as for voltage ratings other than 6.9 kV and 13.8 kV, for turn insulations other than mica, and for various impulse wave forms.

The procedure is primarily directed toward providing a qualification test for the turn insulation in regard to its ability to withstand impulses that might be impressed on the terminals of a machine and that result from switching surges, lightning, or other disturbances. It will also provide information on the ability of the ground insulation to withstand impulses. In addition, the test model used in the tests described herein will be suitable for testing the strand insulation, if that is desired, although it is not a function of this qualification test procedure.

1.2 References

This trial-use recommended practice shall be used in conjunction with the following publications.[1]

[1] ANSI/IEEE Std 1-1986, IEEE Standard General Principles for Temperature Limits in the Rating of Electric Equipment and for the Evaluation of Electrical Insulation.[2]

[2] ANSI/IEEE Std 4-1978, IEEE Standard Techniques for High Voltage Testing.

[3] ANSI/IEEE Std 99-1980, IEEE Recommended Practice for the Preparation of Test Procedures for the Thermal Evaluation of Insulation Systems for Electric Equipment.

[4] ANSI/IEEE Std 275-1981, IEEE Recommended Practice for Thermal Evaluation of Insulation Systems for AC Electric Machinery Employing Form-Wound Pre-Insulated Stator Coils, Machines Rated 6900 V and Below.

[5] ANSI/IEEE Std 429-1972, IEEE Standard Test Procedure for the Evaluation of Sealed Insulation Systems for AC Electric Machinery Employing Form-Wound Stator Coils.

[6] IEEE Std 101-1972 (R1980), IEEE Guide for the Statistical Analysis of Thermal Life Test Data.[3]

[7] IEEE Std 522-1977 (R1981), IEEE Guide for Testing Turn-to-Turn Insulation on Form-Wound Stator Coils for AC Rotating Electric Machines.

[8] IEC 505-1975, Guide for the Evaluation and Identification of Insulation Systems of Electrical Equipment.[4]

[9] IEC 610-1978, Principal Aspects of Functional Evaluation of Electrical Systems: Aging Mechanisms and Diagnostic Procedures.

[10] IEC 727-1982, Evaluation of Electrical Endurance of Electrical Insulation Systems- Part 1: General Considerations and Evaluation Procedures Based on Normal Distributions.

[11] IEC 792-1984, Multifactor Functional Testing of Electrical Insulation Systems.

1.3 General

It is recognized that there are several aging factors that can affect the life of an electrical insulation system in a rotating machine. Those aging factors are temperature, electrical stress, environmental (ambient) conditions, and mechanical stress. These four factors are discussed in great detail in IEC 505-1975 [8].[5]

The best understood of these factors is the effect of temperature. The thermal limitations of electrical insulation are described in ANSI/IEEE Std 1-1986 [1] and ANSI/IEEE Std 99-1980 [3]. There have been several IEEE test procedures on comparative thermal evaluation of rotating machine insulation based on these two publications.

[1] When any of the publications referred to in this document are superseded by an approved revision, the revision shall apply.
[2] ANSI/IEEE publications can be obtained from the Sales Department, American National Standards Institute, 1430 Broadway, New York NY 10018, or from the IEEE Service Center, the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331.
[3] IEEE publications can be obtained from the IEEE Service Center, the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331.
[4] IEC publications are available in the US from the Sales Department, American National Standards Institute, 1430 Broadway, New York, NY 10018.
[5] The numbers in brackets correspond to those of the references in 1.2.

The thermal test procedure for ac form-wound coils is ANSI/IEEE Std 275-1981 [4]. For purposes of maintaining consistency in IEEE documents, ANSI/IEEE Std 275-1981 [4] has been used as a model in the preparation of this test procedure. It should be noted that in that document only the effect on thermal life is evaluated and only thermal effects are accelerated. The other three factors (electrical, ambient, mechanical) are used as diagnostics to detect thermal degradation.

Another reference on thermal aging is ANSI/IEEE Std 429-1972 [5].

The second best understood aging factor is electrical stress. lEC 727-1982 [10], is a description of some of the aspects of electrical aging.

IEC 505-1975 [8] recognizes that more than one of the aging factors might be accelerated in the evaluation of an insulation system. IEC 792-1984, [11], is a description of some of the aspects of multifactor testing. IEC 610-1978 [6], deals with the subject of assessing the insulation to determine if detrimental aging has occurred. In order to assess the insulation condition, it is usually necessary to make some other type of diagnostic test, eg mechanical stress or electrical stress. In addition, these diagnostic tests can be used in combination to determine the condition of the insulation.

This procedure is a multi-factor aging test combining thermal aging and electrical aging. For comparison and indication of interactions of the two accelerated factors, the procedure includes testing two other equivalent groups of samples, each with only one of the two aging factors, voltage with no temperature (ie, room temperature) and temperature without voltage. The effects of ambient conditions and mechanical stresses are not used as aging factors in this test procedure. However, a mechanical vibration is applied prior to breakdown of the specimens, which indicates whether or not the mechanical properties of the insulation have deteriorated to the extent that the vibration produces disintegration, thus reducing voltage strength to some arbitrary breakdown level. In the case of this procedure, the mechanical vibration is not intended as an aging factor as a function of time, but is applied to help seek out electrical/thermal deterioration prior to breakdown. In this case, the mechanical vibration is only a diagnostic tool.

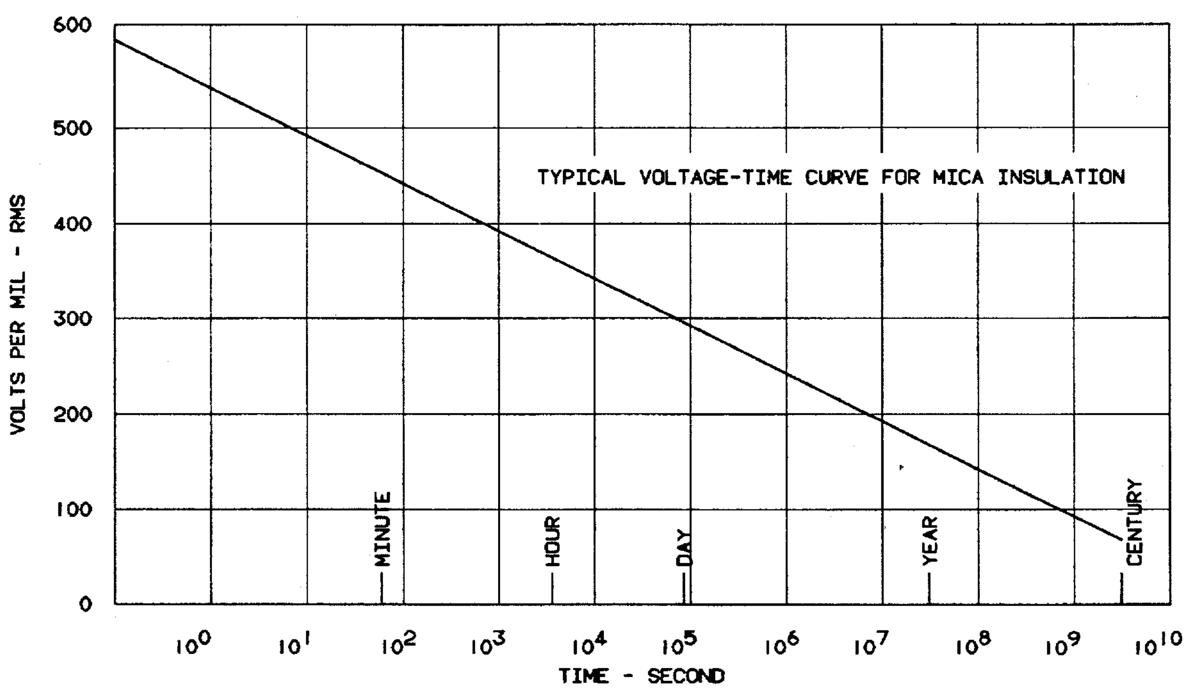

Figure 1—AC Voltage Endurance of Rotating Machine Insulation on Coils

1.4 Methods of Evaluation

When making multi-factor aging tests, the test procedure can be set up on a basis of either simultaneous application of the aging factors or sequential application. This test procedure has been designed to apply two aging factors simultaneously and one sequentially. Two types of electrical aging are used in addition to thermal aging.

When performing aging tests such as are described in this test procedure, there are three possible methods to determine when the end point has been reached:

Method 1) Allow the test specimens to run until failure occurs due to an aging stress, eg, electrical breakdown. In this case, the aging stress also becomes the diagnostic test.

Method 2) Periodically apply a proof test to all specimens during the aging process to determine if the specimens have deteriorated to some predetermined level. An overvoltage test is a proof test.

Method 3) Periodically select a portion of the specimens and subject them to a predetermined breakdown test, eg, a one-minute step-by-step electric breakdown test.

Method 1 is generally used for measuring the effect of voltage stress. Figure 1 is a typical voltage endurance curve that has been generated by applying fixed voltages at several different levels to groups of practically identical specimens until failure occurs.

For thermal evaluation it is necessary to use Method 2 or 3, since there is no manifestation of a thermal failure such as is the case in an electrical failure or breakdown. ANSI/IEEE Std 275-1981 [4] uses Method 2 above, as characterized by Fig 2, although Method 3 could be used equally well. The advantage of Method 2 over 3 is that it usually requires fewer specimens to generate statistically sound data. The advantage of Method 3 is that the experimenter has a better idea as to how close he is to an arbitrary, preselected end point and can better adjust the test procedure.

This test procedure is based on Method 3 because at this point it is not possible to preselect a proof test. In future revisions of this test procedure, it may be desirable to convert to a proof test method. However, since one of the electrical stresses is applied continuously and the other is applied periodically, it is possible that the failure mechanism will essentially be of the Method 1 or Method 2 type.

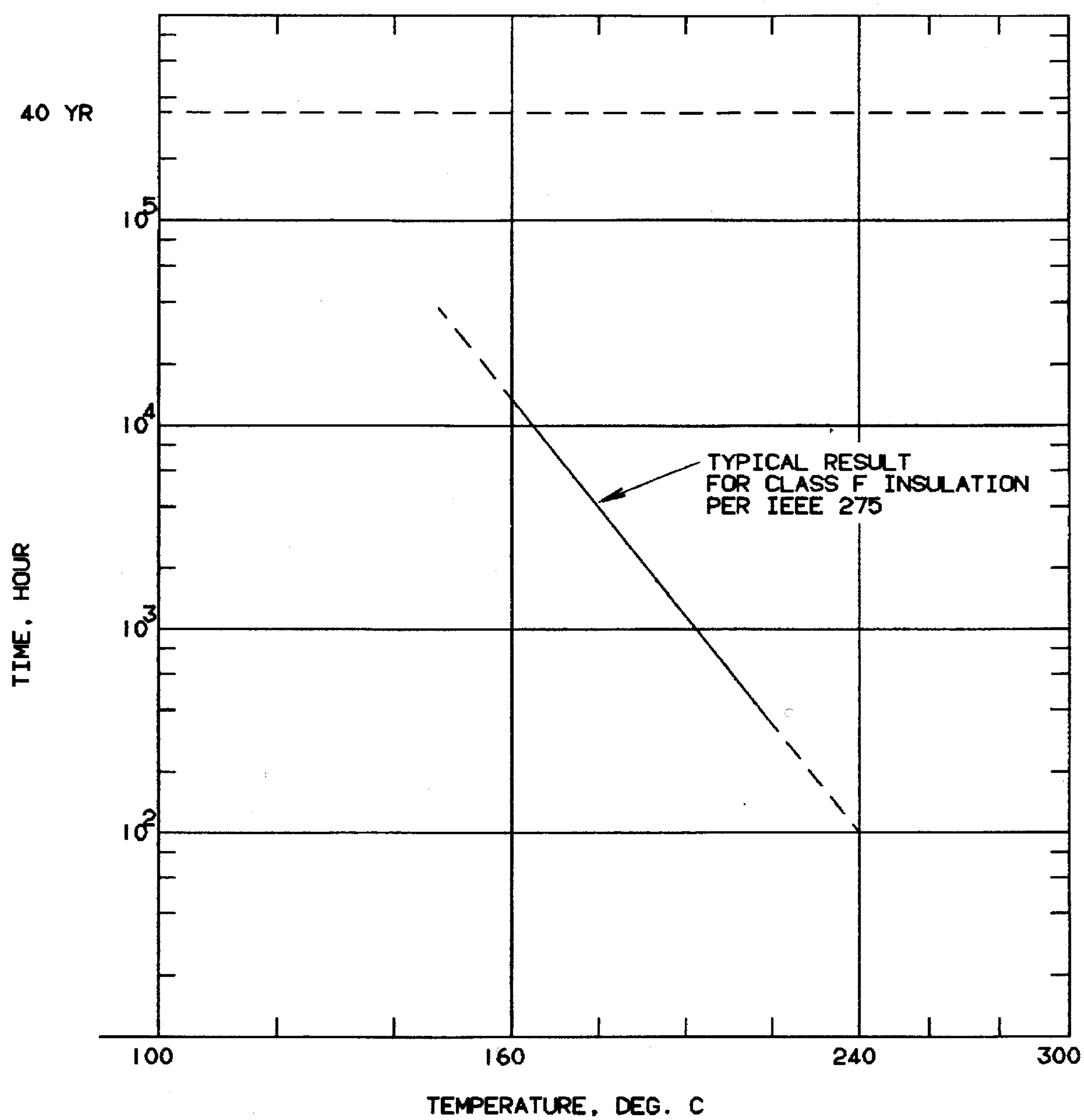

Figure 2—Thermal Endurance

NOTE — Temperature Scale is Reciprocal of Absolute Temperature.

It is always desirable that non-destructive test techniques be used when possible. It is strongly recommended that such things as partial discharge or dissipation factor be periodically measured during the tests so that possible correlation might be found for future revisions. Any non-destructive test results should be included in the report of test results.

2. Test Models

2.1 Formette Frame

As in ANSI/IEEE Std 275-1981 [4], the term “Formette” is used to describe the wound model. A suggested formette frame is shown in Fig 3. The frame is a modification of the suggested frame in ANSI/IEEE Std 275-1981 [4]. The modifications are made to accommodate the differences in test procedures that must exist, and yet make it similar enough that costs can be minimized for a laboratory using this procedure and ANSI/IEEE Std 275-1981 [4].

Figure 3 is a formette frame suggested for use with an insulation system for a machine operating at 14 400 V or below. The slot dimensions are the same as in ANSI/IEEE Std 275-1981 [4] but three of the simulated slots have been mounted in a different plane. Past experience with ANSI/IEEE Std 275-1981 [4] has indicated it is difficult to make a coil when the coils are in the same plane. This formette frame will hold three coils, with one coil side lying in each simulated slot. This means that one coil will have two sides lying in slots one and four, one coil will lie in slots two and five, and the third coil in slots three and six.

The dimensions of the formette frame are not mandatory in this procedure, but it is the responsibility of the test laboratory (or manufacturer) to be certain that the dimensions reasonably represent the spectrum of machines to which the insulation system is to be applied.

2.2 Formette Coils

Since each manufacturer must have freedom to design the electric machine, it is not possible to specify in this procedure the exact cross section dimensions of the formette coil. If the designer elects to use the suggested models shown in Fig 3, then he does have the restraints imposed by those formette frames. These frames impose a restraint on the cross section of the formette coil in the slot portion of 0.75 inches wide by 2 inches deep. The restraint on the cross section of the formette coil before the ground wall is then (.75O-2xGWT) by (2-2xGWT) inches where G is the ground wall thickness.

It is suggested that the formette coils be constructed in five turns, but with two turns wound together, similar in construction to a bifilar winding, so that if a cross section is taken through the formette coil at any point, it will give the appearance of having ten turns. Each of the two turns wound together will contain all the components of the strand insulation and the turn insulation. It should be possible to select wire sizes with the restraints of the models described in this test procedure to have four strands per simulated turn. In a cross section within the formette coil, as shown in Fig 4, twenty strands deep by two strands wide would be observed, making a total of forty strands.

In addition to the strand insulation and the turn insulation, each pair of simulated turns should be treated as two circuits in the area where the start and finish lead leave the formette coil as shown in Fig 5. This area of the formette coils should be constructed to simulate practices used in the machine being qualified, since this area is a vital one in the operation of a machine and will be subject to electrical tests during the evaluation procedures. The method of reinforcing this area where the lead crosses the other turns varies with manufacturers, and it is the responsibility of the formette coil manufacturer to accomplish this and make certain this crossover insulation is electrically stressed during the tests.

The formette coils should be wound into the formette frames using the practices of the manufacturer. This procedure is intended to be used with all processes for making coils and windings such as (1) “Vacuum Pressure Impregnation,” either as individual coils or as wound stators, (2) the “loaded tape” or “resin rich” coils, using either mechanical presses or hydraulic pressure, or (3) coils made with tapes (or wrappers) that are complete after application of the insulation. The manufacturers should simulate as many of these practices as is practical when assembling the formettes.

It will not be possible, with this model, to adequately simulate the problems involved in putting the last coils into place. This is usually referred to as “closing the throw.” It must be assumed that the manufacturer is able to place all the coils into the stator without inflicting damage or is able to find damaged coils by special tests. In the present state of the art, there is no universally recognized test that can detect turn-to-turn damage, although IEEE Std 522-1977 (R1981) [7], provides guidance. Many manufacturers have their own test procedures. A prime objective of the Rotating Machinery Insulation Subcommittee of the IEEE Power Engineering Society in developing this procedure is to generate information that will allow test levels to be developed. There are recognized standards for testing the ground insulation.

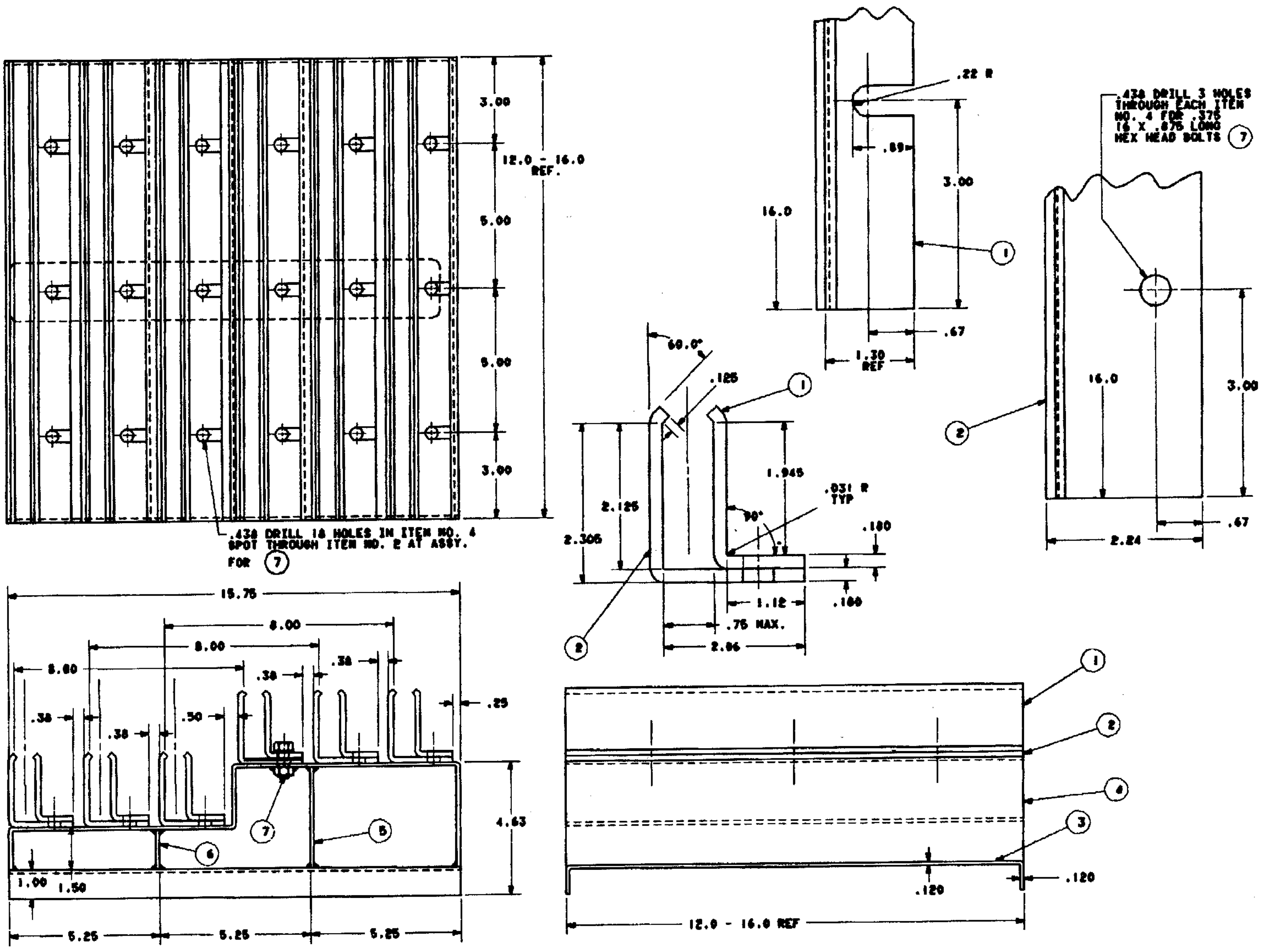

Figure 3—Formette Frame

NOTE — All dimensions in inches.

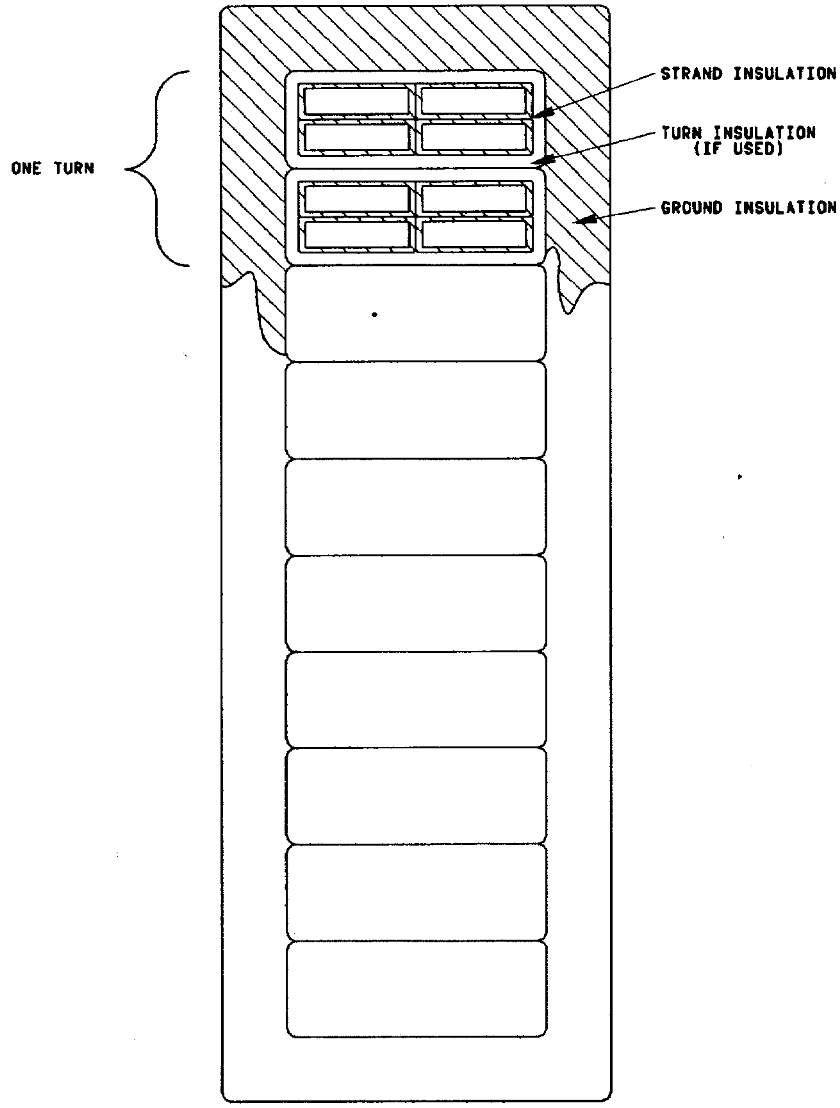

Figure 4—Cross Section of Formette Coil With Two Simulated Turns Wound as One Turn

NOTE — In some cases, the strand insulation may serve as the turn insulation.

If the testing laboratory considers closing the throw as a significant factor in assessing the life of the insulation, the distortion can be simulated on a work bench by clamping one coil side in a vise and moving the other coil side an amount comparable to what is necessary during winding. If this is done, then it should be reported with the results.

Wedging of the coils into the slots will be simulated, but end turn bracing and support will not be simulated, since accelerated mechanical stresses are not a part of this procedure. The leads of the coils are not connected, but are left accessible for applying voltage. This means that a total of four leads will be coming out of each coil.

As noted above, each formette frame will hold three coils. It is suggested that a minimum of eight formette frames will be needed with a total of 24 coils to run the tests described in this procedure. The eight formettes will be used for the combined thermal electrical aging.

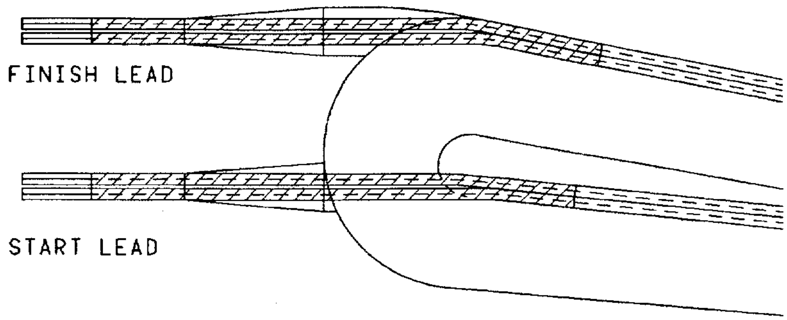

Figure 5—View of Leads on Formette Coil

3. Tests

3.1 General

As noted earlier, this aging procedure will combine thermal and electrical stress simultaneously. It will also apply another electrical stress sequentially. Mechanical stress will be used for diagnostic purposes.

Figure 6 has been created from Figs 1 and 2. The abscissa coordinate is based on the temperature aging used in ANSI/IEEE Std 275-1981 [4]. Provision is made for evaluating Class A, B, F or H insulation systems but it can easily be modified to accommodate any other temperature classification. The block of numbers of days running diagonally from the lower left to the upper right represents the number of days that an ANSI/IEEE 275-1981 [4] formette would be anticipated to last under the test conditions of ANSI/IEEE Std 275-1981 [4].

The ordinate coordinate is based on the voltage endurance curve shown in Fig 1, assuming an operating stress of approximately 60 V per mil (2.4 kV/mm) rms. The average length of time that an insulation system would be expected to last has been used on the ordinate to equate it in terms of thermal life. To illustrate the meaning of Fig 6 by means of an example, it can be noted that 320 days would be a reasonable time for a 13.8 kV insulation system to last at 24 kV and also 320 days at 170 C would be the average life expectancy for a Class F insulation system when tested under the conditions of ANSI/IEEE Std 275-1981 [4].

There is not enough known about the synergistic effects of applying temperature and voltage simultaneously, and in fact whether it might be positive or negative synergism. However, as a starting point in this test procedure, which might have to be changed in future revisions, it is suggested that an equivalent test level for temperature and voltage be selected. The recommendation of this test procedure is Levels 3 and l. Level 3 translates to 80 days and Level 1 to 320 days on the diagonal line of days.

3.2 Aging Conditions

The eight formettes should then be divided into four groups of two formettes (six coils) for aging under four different conditions. The conditions of aging should be selected in relation to the diagonal line of days and would be as follows for a class F, 13.8 kV insulation.

28 kV rms	@ 190ºC
28 rms	@ room temperature
No voltage	@ 190ºC
24 kV rms	@ 170ºC

This would enable the aging to be done at two temperatures. An ac test set could be used with two taps on it to supply the voltage, although two separate transformers could be used. It is anticipated that test laboratories will select less than the full four groups in early testing using this procedure.

During aging, formette coil leads should be connected to the high voltage and the frame should be grounded. After a coil has failed the ground test (See 3.4.2) then those leads should also be grounded as aging continues on unfailed coils.

NOTE — If the test laboratory wishes to evaluate a 13.8 kV insulation system as Class B, the temperatures become 165ºC and l45 ºC respectively. If the test laboratory wishes to evaluate another voltage class (eg 6.9) then the voltages become 14 kV and 12 kV respectively. This adjustment is consistent with Fig 6.

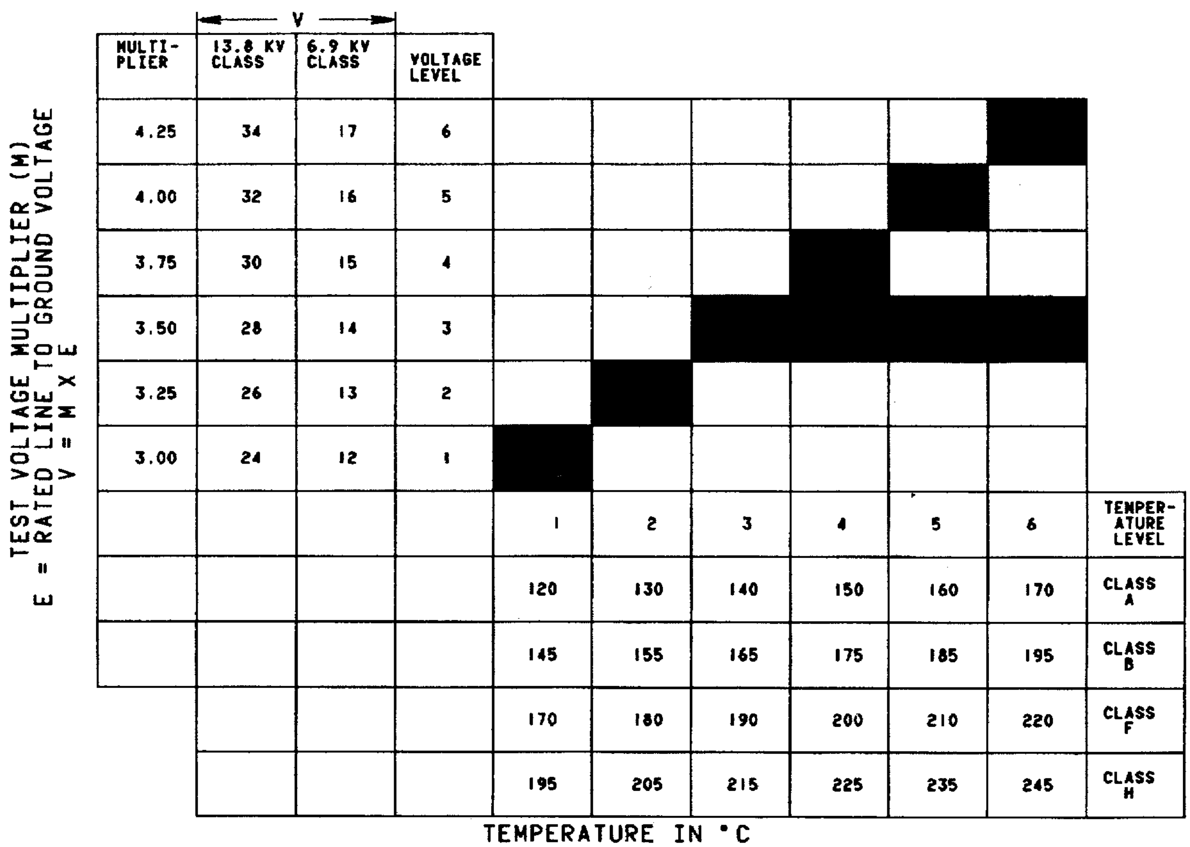

Figure 6—Equivalent Electrical and Thermal Aging in Days

3.3 Vibration

Prior to aging and after each aging sequence, each formette should be mounted on a shake table and operated for a period of one hour with a 60 Hz oscillating motion. Peak-to-peak amplitude should be approximately 8 mils (0.2 mm), corresponding to a peak acceleration of about 1.5 times the acceleration due to gravity. The formettes should be so mounted so that the motion occurs at a right angle to the plane of the coils. This vibration should be made after the formettes have cooled to room temperature and with no voltage applied. The purpose of the vibration is diagnostic to help detect incipient weaknesses.

3.4 Electrical Tests

Prior to aging and after each aging sequence, one coil from each group of six at each aging condition should be electrically broken down at room temperature. All coils not under test should be grounded to the formette frame.

3.4.1 Turn-to-Turn Test

Test across the five turns with a 0.1 to 0.2 microsecond wave front at a voltage level of 3 per unit. The decay or “tail” of the impulse should be at least 10 times the rise time or “front.” Unit voltage is defined as $\sqrt{2}/\sqrt{3}E$ or $0.82E$ where E is the rated line-to-line rms voltage in a three-phase machine. In the case of 13.8 kV insulation, three per unit is 33.8 kV. Apply the voltage three times. Then apply that same voltage three times between the two simulated turns within the actual five turn coil. If no failures occur, increase the voltage ten percent and repeat the impulse tests, first across the five turns three times and then across the two simulated turns three times. Continue to increase the voltage in increments of ten percent of the starting level until failure occurs. The failure will probably occur between the two simulated turns within the five turns. For uniformity, the break down test should be made at room temperature.

3.4.2 Ground Test

After the turn insulation has failed, apply a similar test with approximately a 1 to 5 μsec front between all the leads of the formette coil being tested and the formette frame. The decay or “tail” of the impulse should be at least 10 times the rise time or “front.” This test should start at 5 per unit and increase in the same manner as the turn tests. Five per unit is approximately 56.3 kV for 13.8 kV insulation. As an alternative, since the electric strength of the ground insulation is so high, use dc voltage to break down the ground insulation at the same level that would be used with impulse, since dc gives about the same level for break down as impulse. If dc is used, then this fact must be included in the test report.

It is recognized that when turn insulation is broken down, there may be damage to the ground insulation. This may invalidate conclusions about the ground insulation-particularly if the turn failures occurred in the slot portion of the coil.

After the breakdown of one coil in each group of six, begin the aging at the four conditions.

3.4.3 Measurement Circuits

When testing with impulse voltages, particularly with very steep fronts (0.1 to 0.2 μsec) it is essential that the investigator ascertain the characteristics of the impulse and the response of the measuring circuit. It is therefore strongly recommended that the principles of testing and measuring the voltage follow the principles and techniques outlined in ANSI/IEEE Std 4-1978 [2].

3.5 Aging Cycles

Based on the following timetable, test both the turn insulation and the ground insulation as follows:

Level (Refer to Fig 6) Voltage	Temperature	Number of Days From Start To Select Coil for Breakdown
3	3	4, 8, 16, 32, 64
3	0*	8, 16, 32, 64, 128
0*	3	8, 16, 32, 64, 128
1	1	16, 32, 64, 128, 256

*0 level represents room temperature or no voltage.

3.6 Simulated Impulses

After each aging time apply a further electrical aging stress at room temperature to all unfailed coils in the formettes prior to the breakdown tests.

The purpose of this stress is to simulate a number of surges. Assuming that each aging period represents 5 years of service and a machine might be subjected to 20 impulses per day, apply 36 000 impulses with a front of 0.1 to 0.2 μsec at a level of 2 per unit. This can be accomplished by using a test set that is triggered at a 60 Hz rate and applying the voltage for 10 min. The voltage should be applied across the terminals of the coils (not across the two turns wound in parallel).

It should be noted that this test is not accelerating the voltage level but is accelerating the frequency of surges (ie, 20 per day for 5 years).

Table 1 is a summary of the test sequence.

4. Reporting of Data

The report should state the results of the impulse breakdown tests after the specified periods of aging. Figs 7 and 8 indicate, as an illustration only, a graphic example of the data for turn insulation and ground insulation, respectively. The specified level (or end point) for each condition is also shown in Figs 7 and 8 as "*x*" percent for turn insulation and "*y*" percent for ground insulation. At the present state of the art, the values of *x* and *y* cannot be specified until there is considerable experience with this test procedure.

It should be noted that the number of samples at any point is not sufficient for rigorous statistical treatment. It may be desirable, in future revisions, to increase the number of test specimens at each condition.

However, the data should be treated statistically as much as possible. By the recommendations in this test procedure, it will be possible to calculate the average (x) and the standard deviation (s) in the unaged condition, since it is recommended that a coil from each pair of formettes be broken down when new. Therefore, the number of samples in the as-made condition will be four. In Figs 7 and 8 the curves indicated at various levels of temperature and voltage should be plotted using regression analysis. IEEE Std 101-1972 (R1980) [6], is a good reference for handling the data. However, the ordinate of impulse capability in Figs 7 and 8 will have to be used in place of the reciprocal of absolute temperature.

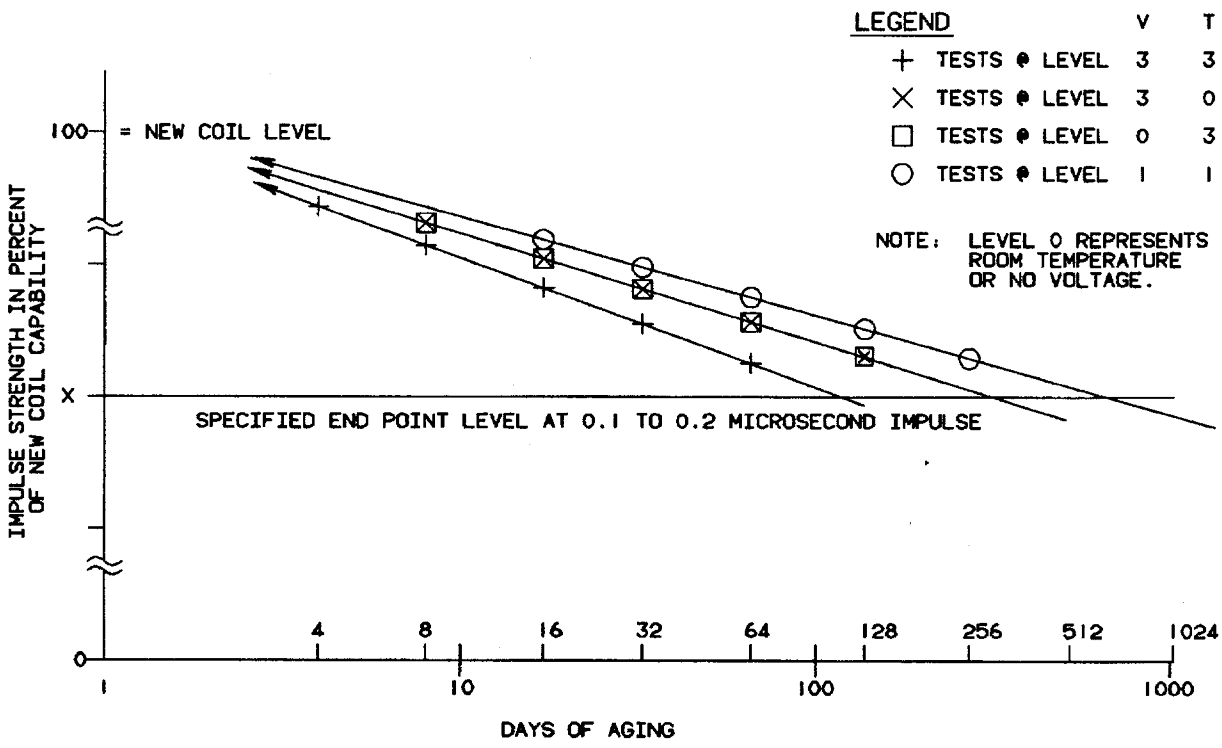

Figure 7—Combined Stress Aging of Turn Insulation

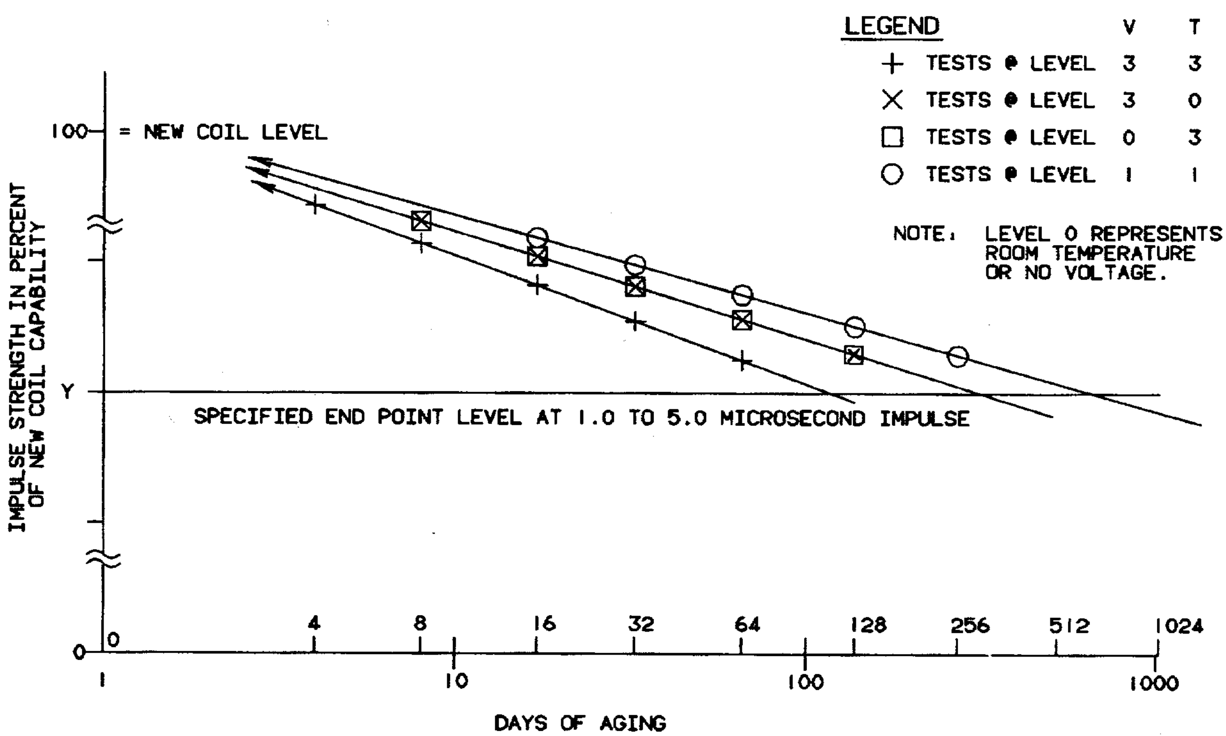

Figure 8—Combined Stress Aging of Ground Insulation

Table 1—Manufacturing and Test Sequence of Each Insulation System

A.	Make eight formettes, each containing three formette coils. (Section 2.)
B.	Allocate two formettes for each aging condition. (3.2)
C.	Mechanically vibrate all formettes on “shake” table. (3.3)
D.	Select one formette coil from each group and breakdown turn insulation with impulse of 0.1 to 0.2 μsec front and a tail at least l0 times the front. (3.4.1)
E.	Breakdown ground insulation of formette coil selected in D with impulse of 1 to 5 μsec front and a tail at least 10 times the front. (3.4.2) NOTE: A dc voltage may be used as an alternate.
F.	Age formettes at 4 conditions of temperature and voltage. (3.2 and 3.5)
G.	Subject all unfailed coils to simulated 5 years of surges: 36 000 impulses with 0.1 to 0.2 μsec front at 2 per unit. (3.6)
H.	Repeat C through G until all formette coils have failed.

Future revisions of this procedure will have to provide more definitive methods of handling the data. As mentioned earlier in this procedure, it may be possible, after some experience, to change to a proof test after each aging period rather than a breakdown test. This would make it possible to set up more specific end point criteria.

5. Future Revisions

It should be emphasized that this test procedure is intended at this time for trial use. As noted many times in this document, future revisions made after experience with it should result in more definitive specifications being possible.