

REPORT OF COMMITTEE

D-27 ON ELECTRICAL INSULATING LIQUIDS AND GASES

Committee D-27 on Electrical Insulating Liquids and Gases, held three meetings during the calendar year. The regular spring meeting was held on March 11 to 14, 1973, at the Houston Oaks Hotel in Houston, Tex. Minutes No. 43 gave details of this meeting to all our members, with current activities of subcommittees and sections. The second meeting of Committee D-27 was held in conjunction with the Annual Meeting of the Society in Philadelphia, Pa., on June 24 to 27, 1973. Committee D-27 met at the Holiday Inn, while other activities of the Society took place at the Bellevue Stratford Hotel, the Benjamin Franklin Hotel, and the Sheraton Hotel. Our members received Minutes No. 44 in which was related the business transacted at the several sessions. One of the highlights was the annual dinner for members of the Society and their guests held in the spacious ballroom of the Bellevue Stratford Hotel. The final meeting of the year was convened at the Statler Hilton Hotel in Boston, Mass., on October 14 to 17, 1973. Minutes No. 45 were distributed early in January 1974 covering details of the numerous section and subcommittee meetings.

The average attendance at the three meetings was 39 members and 7 guests. The spring meeting in Houston attracted 38 members and 10 guests. The Annual Meeting in Philadelphia was attended by 37 members and 4 guests, while the Boston meeting had the highest number with 41 of our people and 8 guests. A perfect record of attendance was attained by 24 members, while 46 members returned their ballots prior to all three meetings. Thirteen members failed to return any ballots.

The membership of the committee totals 83 as 1973 closes, with 69 voting representatives. The diversion of the members is 25 producers (or 30%), 32 consumers (or 39%), and 26 general interest members (or 31%). These percentage figures are of interest as the Society requires a 60% return of ballots from the voting members to establish a local ballot. The minimum return based upon the voting representatives in Committee D-27 is 42 ballots (or 60%). Although the membership is slightly lower than it was a year ago, the total of consumer and general interest members is well over the 50% mark required by the Society. The committee has 70% in these combined categories, and cannot be said to be dominated by the producer interests.

In past years, the Society found that tentative methods were used by industry as if they were the finally approved standard, and they appeared to have the same prestige as standards. It was noted that many tentative methods became standards with little or no revision. Permission to bypass the tentative period was decreed and the committee has responded by offering all its newest methods as "standards." Since the revision of a standard or a tentative method requires the same rigorous scrutiny, there has been no relaxation of vigilance in the preparation of these new methods. The committee now has no tentative methods in its lists.

The Society requires standard methods to be reaffirmed every five years, if no revision has been approved. When a revision is accepted by letter ballot, the year of the approval date is indicated in the ASTM designation. All the methods and specifications under the jurisdiction of the com-

REPORT OF COMMITTEE D-27

mittee are examined each year and recommended for reapproval if the five year rule applies.

The International Electrotechnical Commission (IEC) is the European organization with aims and functions similar to ASTM. The Conference Internationale des Grands Reseaux Electriques (CIGRE) is an operating group with activities similar to the Institute of Electrical and Electronic Engineers (IEEE) in the United States. During the past year, E. L. Raab has been the chief delegate, and he has continued to head Technical Committee 10A on Insulating Liquids. Other representatives from the committee have been V. R. Mulhall for the Canadian Standards Association, F. C. Benignus who is a member of Technical Committee 10-B on Insulating Liquids Other Than Hydrocarbon Oils, and T. W. Dakin is on Technical Committee 10-C on Gaseous Insulants. These three technical committees have many projects scheduled for discussion during the coming year. Many of these relate to new procedures and specifications promulgated by Committee D-27. The above members will monitor the IEC meetings and keep Committee D-27 informed on pertinent subjects.

Late in the year, Dr. T. K. Sloat was advised by the U.S. National Advisory Group of the IEC that it proposed to vest the IEC representation in Committee D-27. Considerable thought is now being given to the most suitable procedure for selecting the U.S. representation, and the Committee D-27 bylaws will reflect the selection process.

The activities of Committee D-2 include several subjects closely associated with Committee D-27 test methods. We are fortunate to have H. W. McCulloch, Jr., as a co-member of both committees. He keeps the committee informed on matters of mutual interest. One item of interest in petroleum circles has been the various methods for determining the flash point of products. An ad hoc group is investigating several methods and plans to develop a new precise method which will help to narrow the large variations in the present methods. The determination of neutralization number has been made more precise and easier to duplicate

within narrower limits as a result of similar committee work.

The IEEE Fluids Subcommittee, with E. L. Raab as chairman, has completed work on a new revision of the *Guide for Acceptance and Maintenance of Insulating Oil in Equipment*. A new revision of the *Guide for Maintenance of Transformer Askarels* will be issued shortly. Work is continuing on a *Guide on Generated Gases in Oil-Immersed Transformers*.

Several years ago, when controversies arose on the prerogatives of Committees D-9 and D-27, the scopes of which overlap to some extent, it was decided to form a D-9/D-27 Liaison Group with equal representation from both committees. This has been an excellent proving ground for discussion and has been the means of reconciling several negative votes on standard testing procedures. J. A. Dwyer serves as the permanent secretary and the present chairman, C. F. Ackerman, will complete his tenure in September 1974.

When Society Headquarters started the distribution of the new Membership Book to each member of all technical committees, it was felt desirable to include the committee bylaws. In order to keep in close touch with changes in the Society Regulations Governing ASTM Technical Committees, H. W. McCulloch, Jr., was appointed by the chairman to head a new Subcommittee D27.92 to monitor these changes.

Subcommittee D27.91 on Symposia and Research under the leadership of R. L. Peeler has been conducting panel discussions twice a year at the spring and fall meetings to discuss matters of current interest and to project ideas for the future. The environmental problems associated with the acid treating of transformer oil, the shortage of optimum crudes, and the need for new oil-purifying techniques have made these discussions both interesting and instructive. The panelists have pointed out the probable shortcomings of the new oils in certain electrical industry functions and the possible need, to use paraffin base crudes in the future. These discussions will be continued during the coming year.

There were several resignations and retirements during 1973. An old friend and

REPORT OF COMMITTEE D-27

member of long standing, Dr. George H. vonFuchs, passed away in April. He had been a member of the committee since 1935. Among the retiring members were C. R. Ions, P. K. Fink and Tor Orbek.

RECOMMENDATIONS ON STANDARDS ACCEPTED BY THE SOCIETY

Subsequent to the last annual report, Committee D-27 submitted the following recommendations for letter ballot of the Society, which were approved by the Society on the dates indicated:

New Standards:

D 3255 - 73, Investigating the Compatibility of Transformer Insulation and Construction Materials in Askarels (Subcommittee D27.02) (approved Sept. 27, 1973)

The interaction of transformer askarel with materials used for dielectric or structural purposes is a complex phenomena. This test provides information for selecting insulating and structural materials that will not adversely affect the dielectric and chemical properties of the askarel. The information generated from the use of this test method should not be used to evaluate the effects of long time service characteristics.

D 3277 - 73, Test for Moisture Content in Oil-Impregnated Cellulosic Insulation (Subcommittee D27.07) (approved Oct. 29, 1973)

Moisture has an adverse effect on dielectric strength, dielectric loss, d-c resistivity, and aging characteristics of oil impregnated cellulosic insulation materials. When cellulosic insulation such as paper and pressboard are impregnated with and immersed in oil, there is an interchange of moisture between the cellulose and oil until they attain equilibrium with respect to their relative saturation with moisture.

D 923 - 73, Specification for Air as an Electrical Insulating Material (Subcommittee D27.03) (approved Nov. 27, 1973)

This specification is designated as applying to Type I, "Gaseous Air," and will apply to both atmospheric air and to air synthesized by blending oxygen and nitrogen in

proper proportions. The specification was prepared in order to hold contaminants such as carbon monoxide and dioxide to minimum limits and to provide a low limit of moisture.

D 3284 - 73, Test for Combustible Gases in Electrical Apparatus in the Field (Subcommittee D27.07) (approved Nov. 27, 1973)

This method covers the detection and estimation of combustible gases in the gas blanket above the oil, or in gas detector relays in transformers using portable field instruments. It is only applicable with transformers using mineral oil as the dielectric fluid. Gases dissolved in the oil and non-combustible gases are not determined.

Arcing, corona discharge, and localized overheating in the insulation system of transformers result in chemical decomposition of the insulating oil and other insulating materials, with the formation of various gases, some of which are combustible. Detection of these gases is frequently the first available indication of a malfunction. Portable combustible gas-meters are a convenient means of detecting the presence of generated gases. Normal operation of a transformer may result in the formation of some combustible gases. The detection of an incipient fault, if present, by this method involves an evaluation of the amount of combustible gases present, the rate of generation of these gases, and their rate of escape from the transformer.

Revision of Standards:

D 901 - 73 (formerly D 901 - 71), Testing of Askarels (Subcommittee D27.02) (approved Nov. 27, 1973)

This revision involved the addition of a statement on environmental impact in handling and disposing of askarels.

D 923 - 73 (formerly D 923 - 70), Sampling Electrical Insulating Liquids (Subcommittee D27.07) (approved March 1, 1973)

A special method for sampling insulating liquids containing dissolved gases has been developed, where a syringe-type device has been used successfully.

REPORT OF COMMITTEE D-27

D 1040 - 73 (formerly D 1040 - 72), Specification for Uninhibited Mineral Insulating Oil for Use in Transformers and Oil Circuit Breakers (Subcommittee D27.01) (approved Nov. 27, 1973)

The revision added a statement on refining methods and the selection of crude oil types as related to insulating oil quality.

D 2112 - 73 (formerly D 2112 - 68 (1973), Test for Oxidation Stability of New Mineral Insulating Oils Containing 2,6-Ditertiary-Butyl Para-Cresol by Rotating Bomb (Subcommittee D27.06) (approved Oct. 29, 1973)

The precision statements were rewritten, replacing the old ones, in order to obtain easier interpretation.

D 2233 - 73a (formerly D 2233 - 70), Specification for Chlorinated Aromatic Hydrocarbons (Askarels) for Capacitors (Subcommittee D27.02) (approved Oct. 29, and Nov. 27, 1973)

A revision of the scope indicated that certain askarel combinations were in useful service, although they were no longer supplied by manufacturers. A statement on Environmental Impact was added.

D 2283 - 73a (formerly D 2283 - 71a), Specification for Chlorinated Aromatic Hydrocarbons (Askarels) for Transformers (Subcommittee D27.02) (approved Oct. 29, and Nov. 27, 1973)

A revision of the scope stated that certain askarel compositions were no longer being supplied, but these now obsolete combinations were still in useful service in the industry. A statement on Environmental Impact was also added.

D 2864 - 73b (formerly D 2864 - 72b), Definitions of Terms Relating to Electrical Insulating Liquids and Gases (Subcommittee D27.04) (approved Feb. 9, July 13, and Nov. 27, 1973)

Six new definitions were added in January 1973. An introduction and two additional definitions were approved in October 1973.

D 3146 - 73 (formerly D 3146 - 72), Specification for Oxidation-Inhibited Mineral Insulating Oil for Use in Trans-

formers and in Oil Circuit Breakers (Subcommittee D27.01) (approved Nov. 27, 1973)

The revision consisted of the addition of a statement to the specification on refining methods and the selection of crude oil types as related to insulating oil quality.

Reapproval of Standards:

D 831 - 63 (1973), Test for Gas Content of Cable and Capacitor Oils (Subcommittee D27.07) (approved Oct. 29, 1973)

D 924 - 65 (1973), Test for Power Factor and Dielectric Constant of Electrical Insulating Liquids (Subcommittee D27.05) (approved Oct. 29, 1973)

D 1169 - 64 (1973), Test for Specific Resistance (Resistivity) of Electrical Insulating Liquids (Subcommittee D27.05) (approved Oct. 29, 1973)

D 1315 - 63 (1973), Test for Water in Insulating Oils by Extraction (Subcommittee D27.07) (approved Oct. 29, 1973)

D 1533 - 61 (1973), Test for Water in Insulating Liquids (Karl Fischer Method) (Subcommittee D27.06) (approved Oct. 29, 1973)

D 1534 - 64 (1973), Test for Approximate Acidity of Used Electrical Insulating Liquids by Color-Indicator Titration (Subcommittee D27.06) (approved Oct. 29, 1973)

D 1698 - 64 (1973), Test for Sediment and Soluble Sludge in Service-Aged Insulating Oils (Subcommittee D27.07) (approved Oct. 29, 1973)

D 1701 - 69 (1973), Test for Scavenger Content in Askarels (Subcommittee D27.06) (approved Oct. 29, 1973)

D 1807 - 64 (1973), Tests for Refractive Index and Specific Optical Dispersion of Electrical Insulating Liquids (Subcommittee D27.07) (approved Oct. 29, 1973)

D 1808 - 63 (1973), Test for Volume of Oil in Oil-Contaminated Askarels (Subcommittee D27.07) (approved Oct. 29, 1973)

D 1810 - 63 (1973), Test for Specific Gravity of Askarels (Subcommittee D27.07) (approved Oct. 29, 1973)

REPORT OF COMMITTEE D-27

→ D 1821 - 63 (1973). Test for Inorganic Chlorides in Askarels (Subcommittee D27.06) (approved Oct. 29, 1973)

→ D 1903 - 63 (1973). Test for Coefficient of Thermal Expansion of Electrical Insulating Liquids of Petroleum Origin, and Askarels (Subcommittee D27.07) (approved Oct. 29, 1973)

D 2112 - 68 (1973). Test for Oxidation Stability of New Mineral Insulating Oils Containing 2, 6-Diteriary-Butyl Para-Cresol by Rotating Bomb (Subcommittee D27.06) (approved March 1, 1973)

→ D 2129 - 64 (1973) Test for Color of Chlorinated Aromatic Hydrocarbons (Askarels) (Subcommittee D27.07) (approved Oct. 29, 1973)

Miscellaneous Changes in Standards:

D 2413 - 71, Standard Method for Preparing and Electrical Testing of Insulating Paper Impregnated with a Liquid Dielectric (Subcommittee D27.05)

This method has been under the joint Jurisdiction of Committees D-9 and D-27. Committee D-27 withdrew as a custodian giving Committee D-9 sole jurisdiction (approved July 24, 1973).

D 1275 - 71, Standard Test for Corrosive Sulfur in Electrical Insulating Oils (Subcommittee D27.06)

A note was added to this method referring to the identical properties of 240-grit silicon carbide paper and 150-mesh silicon carbide grains, pointing out that these sizes are identical.

D 2472 - 71, Standard Specification for Sulfur Hexafluoride (Subcommittee D27.03)

This specification indicated that further work on requirements for gas service were under consideration, but this sentence has been deleted from the Scope as no work is contemplated.

RECOMMENDATIONS ON ANSI STANDARDS

→ In past years standard methods and specifications prepared by Committee D-27

were recommended to the American National Standards Institute (ANSI) Committee Project C59 for consideration as ANSI standards. This is now an automatic project and no recommendation from Committee D-27 is required. No new approvals have been published in 1973.

ACTIVITIES OF SUBCOMMITTEES

Materials Subcommittee D27.01 on Mineral Oils (E. L. Raab, chairman) is concerned with methods of testing, and specifications for insulating oils for transformers, circuit breakers, cables, and accessories. At each of the three meetings, there has been prolonged discussion of the looming shortage of mineral insulating oil of the conventional quality to which the industry has been long accustomed. Almost overnight, the environmental problems associated with the acid refining method of mineral oil purification became so serious that new methods had to be introduced by some refiners. The question arose as to whether industry circles outside ASTM knew of the impending changes. The decision was reached that Committee D-27 should prepare a warning letter and place it in the hands of key personnel and industry organizations. This was done, and studies are now underway on a variety of new processes for the purification of mineral insulating oil. This was the subject of the panel discussion in October 1973, and will be continued at the first 1974 meeting to be held in Phoenix, Ariz., in March.

Section D27.01.01 on Survey (R. L. Peeler, chairman) will set up a task force to prepare specifications for the new insulating oils.

Section D27.01.02 on Transformer Oils (R. L. Peeler, chairman) obtained letter ballot approval for statements to be added to the specifications for the mineral grade of insulating oil (with no inhibitor) as well as the oxidation-inhibited material commenting on the effect of crude oil selection and refining preparation on oil quality.

A task force under T. G. Lipscomb will consider all classes of inhibitors and not limit its activity solely to antioxidants. It

REPORT OF COMMITTEE D-27

will also consider poor depressants, and retarders of all other categories separately.

A warning statement is being placed in the specification for the oxidation-inhibited oil, D 3146, to avoid loss of additive when dehydrating at elevated temperatures and reduced pressure.

Section D27.01.04 on Corona Phenomena (E. Simo, chairman) has gathered data and will call a meeting in 1974.

Section D27.01.05 on Effects of D-C Voltage on Fluids (E. L. Morrison, chairman) will try to hold a meeting in 1974 to determine the extent of interest in this project.

Section D27.01.06 on Effects of Materials on Insulating Oils (J. H. Orum, chairman) has a method now being balloted by the committee for approval.

Materials Subcommittee D27.02 on Synthetics (R. M. Frey, chairman) has completed the new standard method for the compatibility of construction materials in askarels, D 3255. Changes have been voted in the conditions for obtaining the resistivity of askarels (for capacitors), D 2233 and (for transformers) D 2283.

A statement on environmental impact has been incorporated in D 901, D 2233, and D 2283.

Section D27.02.02 on Askarels (P. G. Benignus, chairman) after completing the work on the new method for compatibility of askarels, D 3255, is prepared to use this same procedure in testing new askarel mixtures which are being proposed and offered from time to time by the manufacturers. In this connection, every effort is being made to make minimum use of the higher boiling homologues of PCB's as they resist biodegradability.

Section D27.02.03 on Silicones (R. F. Burow, chairman) has a new chairman replacing Clayton Schultz, who has retired. A program for continuing the work on silicones is being developed.

Materials Subcommittee D27.03 on Gases (C. E. Welsh, chairman) has completed a Standard Method for Air as an Insulating Material, D 3283. This will apply to Type 1, "Gaseous Air," which is now packed in high-pressure metal containers. This may be

compressed atmospheric air or air synthesized by blending oxygen and nitrogen.

The Standard Specification for Nitrogen Gas as an Electrical Insulating Material, D 1933-73, has been reapproved as a standard.

Subcommittee D27.04.06 on Nomenclature and Definitions of Terms Relating to Electrical Insulating Liquids (T. G. Lipscomb, chairman) has obtained approval on an introductory statement for D 2864, which is the compendium for definitions prepared by the subcommittee. During the past year, eight new terms have been approved and five additional definitions are ready for letter ballot. Both Committee D-9 and Committee D-27 prepare definitions on insulating terms, with the former committee handling the terms on solid-type insulation in D 1711, and the latter group using D 2864 as its medium for terms on liquid and gaseous insulants. Where there is duplication, every effort is made to obtain identical wording.

Methods Subcommittee D27.05 on Electrical Tests (R. I. Lowe, chairman) has a new method, D 3300, now being balloted for approval for determining the breakdown voltage of electrical insulating oil under impulse conditions. Two methods have been reapproved as standards, D 924 on Power Factor and D 1169 on Resistivity. The joint jurisdiction with Committee D-9 over D 2413 on the electrical testing of oil impregnated paper insulation has been terminated in favor of Committee D-9. A note inserted in D 2477, on the breakdown voltage of insulating gases, indicates the indeterminant effect of irradiation of the gas sample during testing.

Section D27.05.01 on Power Factor and Resistivity (R. I. Lowe, chairman) is working to improve the accuracy of measurements by D 1169, after completing some round-robin testing.

Section D27.05.02 on Dielectric Strength of Insulating Liquids, (P. F. Ast, chairman) is undertaking round-robin tests on D 877 and D 1816, and will attempt to standardize the conditions of testing, in order to obtain a true comparison of results.

Section D27.05.06 on Dielectric Strength of Gases (H. G. Erdman, chairman) has

REPORT OF COMMITTEE D-27

revised D 2477, but data on irradiation effects will be investigated.

Section D27.05.08 on Impulse Testing (H. G. Erdman, chairman) will become inactive with the approval of the new standard method D 3300. It has been pointed out that this test procedure is becoming increasingly important with the use of extra-high-voltage and ultra-high-voltage equipment.

Methods Subcommittee D27.06 on Chemical Tests (V. R. Mulhall, chairman) has reapproved four of its methods as standards: D 1533, Test for Water in Insulating Liquids (Karl Fischer Method); D 1534, Test for Approximate Acidity of Used Electrical Insulating Liquids by Color-Indicator Titration; D 1701, Test for Sulfur Content in Asphalts; and D 1821, Test for Inorganic Chlorides in Asphalts. A note was added to D 1275 on Corrosive Sulfur to clarify the silica grit size. A revision of the procedure for catalyst preparation has been approved in D 2112, Oxidation by Rotating Bomb.

Section D27.06.02 on Oxidation (C. E. Trautman, chairman) is reviewing D 2440, Oxidation Stability of Mineral Insulating Oil. In order to make it interchangeable with the IEC method. The use of the IEC method for inhibited oil is being examined with perhaps testing at higher temperatures or for longer periods of time.

Section D27.06.07 on Water Content (T. K. Slout, chairman) is considering a second procedure using a patented apparatus which is more accurate for testing oils of low moisture content.

Methods Subcommittee D27.07 on Physical Tests (H. G. Erdman, chairman) has reapproved eight standard methods, D 831, D 1315, D 1698, D 1807, D 1808, D 1810, D 1903, and D 2129. Five new standard methods have been approved and accepted by the Society. These were the standard Method D 3277, Determination of Moisture Content in Oil-Impregnated Cellulose Insulation; Method D 3284, Test for Combustible Gases in Electrical Apparatus in the Field; Method D 3303, Rapid Gas Chromatographic Estimation of Higher Boiling Homologues of Chlorinated Biphenyls for Capacitor Asphalts; Method

D 3304, Analysis of Environmental Materials for Polychlorinated Biphenyls; and Method D 3305, Sampling Gas from a Transformer.

A revision of the standard method for sampling, D 923, was approved with the addition of a syringe technique for sampling where gas is present in oil.

Section D27.07.01 on Sampling (R. I. Lowe, chairman) will try to reduce the complexity of methods in D 923 on sampling. Two new procedures for sampling gas in oil may be added to D 923 rather than to become two more separate methods.

Section D27.07.04 on Water by Extraction (J. H. Orum, chairman) has reapproved Standard Method D 1315.

Section D27.07.09 on Infrared Absorption (R. H. Kershaw, chairman) has remained in active status, but no new material on the detection of other additives than 2,6-di-tert-butyl para-cresol has become available.

Section D27.07.12 on Gas Chromatography (E. L. Morrison, chairman) which was reactivated to cooperate on the method for estimation of PCB's has become inactive with the approval of the new method, D 3303.

Section D27.07.16 on Combustible Gases Over Oil (E. L. Morrison, chairman) has obtained approval on the new method, D 3284, after obtaining a waiver on certain patent rights on this technique.

Section D27.07.18 on Analysis of Gases (V. R. Mulhall, chairman) has had numerous trial methods in an endeavor to reconcile all objections and may have a standard ready for ballot in 1974.

Section D27.07.19 on Detection of Polychlorinated Biphenyls (PCB's), (P. G. Benignus, chairman) has completed work on the two methods which have recently received Society approval, D 3303 and D 3304. Both methods were urgently required and were brought to standard status by a gratifying cooperative effort.

Subcommittee D27.91 on Symposia and Research (R. L. Peeler, chairman) held two panel discussions during the year. At the March 1973 meeting in Houston, Tx., the panel members were J. E. Morgan of the Morgan Schaffer Corp., E. L. Morrison of Los

REPORT OF COMMITTEE D-27

Angeles Department of Power and Water, and T. K. Sloat of Westinghouse Electric Corp. They explained the "Interpretation of Transformer Gas Analyses."

The second panel consisting of R. L. Lowe, F. W. Heinrichs, J. R. Hastings, R. T. Kern, Jr., and H. W. McCulloch, Jr., met at the Fall meeting in Boston, Mass. This was a well-attended meeting and they discussed the new types of insulating oils to be expected from the changes in refining processes.

The discussion planned for the March 1974 meeting in Phoenix, Ariz., will be of utmost interest to the industry. Topics will be the re-refining of used transformer oils and experience in mixing different types of oils from different processes.

Subcommittee D27.92 on Bylaws (H. W.

McCulloch, Jr., chairman) has received revised regulations for technical committees to be incorporated in the bylaws. These changes will appear in a new section to be sent to each member for his membership book.

The selection of an IEC representative or a group to carry on the participation of the Committee in the IEC will be described in the bylaws, as this function has now been transferred to Committee D-27.

Respectfully submitted on behalf of the committee,

T. K. Sloat,
Chairman

C. A. Johnson,
Membership Secretary