

THE THEORY OF ELECTRIC CABLES AND NETWORKS

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By

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PREFACE

THERE is nothing more conducive to the satisfactory working of an electric supply station than having a thoroughly trustworthy and economical network of cables connecting the dynamos with the lamps and motors of the consumer. It is necessary therefore that the engineer have a thorough knowledge of the phenomena connected with the flow of current along conductors and across dielectrics. He must also have a working knowledge of the dielectric strengths of insulating materials and the electric stresses to which they are subjected under working conditions. In addition, the thermal conductivity of the dielectric has to be considered and its effect on the temperature of the conductor.

The author gives some information on these points in this book. His experience in practical testing, and with the difficulties which sometimes arise in interpreting "specifications" and "rules and regulations" has convinced him that the solutions of these problems are of practical use and ought to be more widely known. In fact many of the problems discussed were originally suggested by these difficulties.

Questions in connexion with the electrostatic capacity and the inductance of cables have not been considered, as the author has discussed these points fully in his *Treatise on the Theory of Alternating Currents*. He has also omitted many elementary theoretical considerations as the

reader is supposed to know the elements of the theory of electricity and electrical engineering.

In Chapter I, the fundamental electrical principles are stated and a description is given of the various gauges in use for specifying wires. Conductivity is discussed in Chapter II, and special attention is devoted to the effect of the "lay" on the weight and conductivity of stranded cables. In Chapter III, the standard methods of measuring insulativity are described.

The design of distributing networks is explained in Chapter IV, particular stress being laid on "feeding centres" and on the importance of calculating their positions. The theorems given in this Chapter can easily be expanded so as to enable satisfactory solutions to be obtained for the very complex problems which sometimes arise in practice.

In Chapters V, VI, and VII methods of measuring the insulation resistance of house wiring and distributing networks are given. The author only gives those methods which he has found useful in practice. The problem of the calculation of a suitable resistance to put in the earth connexion with the middle wire was suggested to him by Mr. A. P. Trotter.

The dielectric strength of materials is discussed in Chapter VIII. Unfortunately very few accurate data are yet obtainable, but the author hopes that by applying the methods he suggests, engineers will be able to obtain satisfactory physical "constants" for dielectric strengths. An examination of many published results will show that the experimenters have neglected elementary theoretical considerations which must be taken into account if the results obtained are to be of any value.

In Chapter IX, the grading, and in Chapter X, the heating, of cables is considered. It is only of recent years

that the former of these subjects has been recognized to be of practical importance. In Chapter XI, the very interesting subject of electrical safety valves is considered, but only a few types are discussed, as it is probable that the standard safety device has not yet been evolved.

The author has added a Chapter on lightning conductors, in which he has made extensive use of the classical paper on the subject read to the Institution of Electrical Engineers by Sir Oliver Lodge in 1889.

He has to thank several friends for the kind help they have given him by making suggestions or revising proofs. In particular he has to thank Dr. Chree, F.R.S., for much information about atmospheric electricity and Mr. G. F. C. Searle, F.R.S., for his helpful criticisms of Chapters I and II. He has also to thank Mr. J. N. Alty, A.I.E.E., for his able assistance in drawing the diagrams and reading proofs and his old pupil, the Hon. E. Fulke French, for checking most of the mathematical formulæ given.

A. R.

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1. The first part of the document discusses the importance of maintaining accurate records of all transactions and activities. It emphasizes that proper record-keeping is essential for transparency and accountability, particularly in the context of public administration and financial management.

2. The second part of the document outlines the various methods and tools used to collect, analyze, and report data. It highlights the need for standardized procedures and the use of modern technology to ensure the reliability and accuracy of the information gathered.

3. The third part of the document focuses on the role of the audit committee and the internal control system. It discusses how these mechanisms are designed to identify and address potential risks and weaknesses in the organization's operations and financial reporting.

4. The fourth part of the document addresses the challenges and opportunities associated with implementing effective internal control systems. It notes that while there are many obstacles, such as limited resources and resistance to change, there are also significant opportunities to improve efficiency and reduce the risk of fraud and error.

5. The fifth part of the document provides a summary of the key findings and recommendations. It stresses the importance of ongoing monitoring and evaluation of the internal control system to ensure it remains effective and relevant in a constantly changing environment.

6. The sixth part of the document discusses the role of the external auditor and the impact of their findings on the organization's reputation and financial performance. It emphasizes the need for a strong working relationship between the internal and external audit functions.

7. The seventh part of the document concludes with a call to action, urging the organization to take immediate steps to address the identified issues and to commit to a culture of continuous improvement and high standards of integrity and transparency.