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# INTERNATIONAL STANDARD

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**Superconductivity –  
Part 8: AC loss measurements – Total AC loss measurement of round  
superconducting wires exposed to a transverse alternating magnetic field  
at liquid helium temperature by a pickup coil method**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

### SUPERCONDUCTIVITY –

#### **Part 8: AC loss measurements – Total AC loss measurement of round superconducting wires exposed to a transverse alternating magnetic field at liquid helium temperature by a pickup coil method**

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International Standard IEC 61788-8 has been prepared by IEC technical committee 90: Superconductivity.

This second edition cancels and replaces the first edition published in 2003. This edition constitutes a technical revision.

The main changes with respect to the previous edition are listed below:

- extending the applications of the pickup coil method to the a.c. loss measurements in metallic and oxide superconducting wires with a round cross section at liquid helium temperature,
- u1 in accordance with the decision at the June 2006 IEC/TC90 meeting in Kyoto.

The text of this standard is based on the following documents:

FDIS	Report on voting
90/243/FDIS	90/249/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of the IEC 61788 series, under the general title: *Superconductivity*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

## INTRODUCTION

Magnetometer and pickup coil methods are proposed for measuring the AC losses of composite superconducting wires in transverse time-varying magnetic fields. These represent initial steps in standardization of methods for measuring the various contributions to AC loss in transverse fields, the most frequently encountered configuration.

It was decided to split the initial proposal mentioned above into two documents covering two standard methods. One of them describes the magnetometer method for hysteresis loss and low frequency (or sweep rate) total AC loss measurement, and the other describes the pickup coil method for total AC loss measurement in higher frequency (or sweep rate) magnetic fields. The frequency range is 0 Hz to 0,06 Hz for the magnetometer method and 0,005 Hz to 60 Hz for the pickup coil method. The overlap between 0,005 Hz and 0,06 Hz is a complementary frequency range for the two methods.

This standard covers the pickup coil method. The test method for standardization of AC loss covered in this standard is partly based on the Versailles Project on Advanced Materials and Standards (VAMAS) pre-standardization work on the AC loss of Nb-Ti composite superconductors [1]<sup>1)</sup>.

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1) Numbers in square brackets refer to the bibliography.

## **SUPERCONDUCTIVITY –**

### **Part 8: AC loss measurements – Total AC loss measurement of round superconducting wires exposed to a transverse alternating magnetic field at liquid helium temperature by a pickup coil method**

#### **1 Scope**

This part of IEC 61788 specifies the measurement method of total AC losses by the pickup coil method in composite superconducting wires exposed to a transverse alternating magnetic field. The losses may contain hysteresis, coupling and eddy current losses. The standard method to measure only the hysteresis loss in DC or low-sweep-rate magnetic field is specified in IEC 61788-13 [2].

In metallic and oxide round superconducting wires expected to be mainly used for pulsed coil and AC coil applications, AC loss is generated by the application of time-varying magnetic field and/or current. The contribution of the magnetic field to the AC loss is predominant in usual electromagnetic configurations of the coil applications. For the superconducting wires exposed to a transverse alternating magnetic field, the present method can be generally used in measurements of the total AC loss in a wide range of frequency up to the commercial level, 50/60 Hz, at liquid helium temperature. For the superconducting wires with fine filaments, the AC loss measured with the present method can be divided into the hysteresis loss in the individual filaments, the coupling loss among the filaments and the eddy current loss in the normal conducting parts. In cases where the wires do not have a thick outer normal conducting sheath, the main components are the hysteresis loss and the coupling loss by estimating the former part as an extrapolated level of the AC loss per cycle to zero frequency in the region of lower frequency, where the coupling loss per cycle is proportional to the frequency.

#### **2 Normative references**

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050-815:2000, *International Electrotechnical Vocabulary (IEV) – Part 815: Superconductivity*