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Australian Standard®

Effects of current passing through the human body

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PREFACE

This Standard was prepared by the Standards Association Committee on Wiring Rules and supersedes MP 30—1976.

It is identical with and has been reproduced from IEC Publication 479, *Effects of current passing through the human body,* 479-1(1984) Part 1: *General aspects,* and 479-2 (1987) Part 2: *Special aspects.*

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This Standard provides basic guidance on the effects of shock currents on the human body for use in the establishment of electrical safety requirements. However, care should be exercised in the application of the information and due consideration should be given to the notes to each Table and Figure. Attention is drawn to Clause 4.6 of Chapter 2 which indicates that 50 V r.m.s. is a voltage below which no hazard has been proven to exist.

For the purpose of this Standard, the text of IEC 479-1, and 479-2 is modified as follows:

(i) *References:* Replace references to other publications by references to Australian Standards as follows.

Reference to IEC Standards		*Australian Standard*	
IEC		AS	
50	International Electrotechnical Vocabulary	1852	International Electrotechnical Vocabulary
50(551)	Chapter 551: Power Electronics	1852(551)	Power Electronics
50(801)	Chapter 801: Acoustics and Electro-acoustics	1852(551)	Acoustics and Electro-acoustics

(ii) An Australian note has been added to Clause 4.4 of Chapter 2.

(iii) An Australian Appendix B giving information on the physiology of electrocution has been added.

CONTENTS

CHAPTER 6: EFFECTS OF UNIDIRECTIONAL SINGLE IMPULSE CURRENTS OF SHORT DURATION

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Australian Standard
Effects of current passing through the human body

INTRODUCTION

In order to avoid errors in the interpretation of this report it must be emphasized that the data given herein are mainly based on experiments with animals as well as on information available from clinical observations. Only a few experiments with shock currents of short duration have been carried out on living human beings.

On the evidence available, mostly from animal research, the values are so conservative that the report applies to persons under normal physiological conditions, including children irrespective of age and weight.

This report is intended to provide basic guidance on the effects of shock currents on the human body for use in the establishment of electrical safety requirements.

There are, however, other aspects to be taken into account, such as probability of faults, probability of contact with live or faulty parts, ratio between touch voltage and fault voltage, experience gained, technical feasibilities and economics. These parameters have to be considered carefully when fixing safety requirements, for example operating characteristics of protective devices for electrical installations.

The form of report has been adopted, as it summarizes results so far achieved which are being used by Technical Committee No.64 as a basis for fixing requirements for protection against shock. These results are considered important enough to justify an IEC publication, which may serve also as a guide to other IEC Committees and countries having need of such information.

The first edition of Publication 479 was issued in 1974 and was based on an extensive search in literature and on the evaluation of replies received to a questionnaire. However since that date, new research work has been conducted on this subject. The study of this work and a more precise analysis of preceding publications have allowed a better understanding of the effects of electric current on living organisms and, in particular, on man.

This specifically applies to the limits of ventricular fibrillation which is the main cause of deaths by electric current, and the analysis of all results of recent research work on cardiac physiology and on the fibrillation threshold taken together, has made it possible to better appreciate the influence of the main physical parameters, and especially of the duration of the current flow.

Recent research work has also been conducted on the other physical accident parameters, especially the waveform and frequency of the current and the impedance of the human body. This revison of Publication 479 was therefore considered necessary and should be viewed as the logical development and evolution of the first edition.

CHAPTER 1: ELECTRICAL IMPEDANCE OF THE HUMAN BODY

1. General

For a given current path through the human body, the danger to persons depends mainly on the magnitude and duration of the current flow. However, the time/current zones specified in the following chapters are, in many cases, not directly applicable in practice for designing protection against electric shock, the necessary criterion being the admissible limit of touch voltage (i.e., the product of the current through the body and the body impedance) as a function of time. The relationship between current and voltage is not linear because the impedance of the human body varies with the touch voltage, and data on this relationship is accordingly required.

The different parts of the human body—such as the skin, blood, muscles, other tissues and joints—present to the electric current a certain impedance composed of resistive and capacitive components.

The values of these impedances depend on a certain number of factors and, in particular, on the current path, on the touch voltage, the duration of the current flow, the frequency, the degree of moisture of the skin, the surface area of contact, the pressure exerted and on the temperature.

The impedance values indicated in this report result from a close examination of the experimental results available from measurements carried out principally on corpses and on some living persons.

2. Scope

This chapter indicates values for the electrical impedance of the human body as a function of the touch voltage, the frequency, the degree of moisture of the skin and the current path.

Note. – The values given in Clause 5 refer to frequencies of 50/60 Hz; values for higher frequencies and for direct current are under consideration.

3. Definitions

3.1 *Internal impedance of the human body (Z_i)*

Impedance between two electrodes in contact with two parts of the human body, after removing the skin from under the electrodes.

3.2 *Impedance of the skin (Z_p)*

Impedance between an electrode on the skin and the conductive tissues underneath.

3.3 *Total impedance of the human body (Z_T)*

Vectorial sum of the internal impedance and the impedances of the skin (see Figure 1, page 14).

3.4 *Initial resistance of the human body (R_i)*

Resistance limiting the peak value of the current at the moment when the touch voltage occurs.