AS/NZS 60479.1:2002
IEC 60479-1:1994

Australian/New Zealand Standard™

Effects of current on human beings and livestock

Part 1: General aspects

Standards Australia

STANDARDS NEW ZEALAND
Paerewa Aotearoa

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee EL-001, Wiring Rules. It was approved on behalf of the Council of Standards Australia on 10 September 2002 and on behalf of the Council of Standards New Zealand on 3 September 2002. It was published on 3 October 2002.

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We also welcome suggestions for improvement in our Standards, and especially encourage readers to notify us immediately of any apparent inaccuracies or ambiguities. Please address your comments to the Chief Executive of either Standards Australia International or Standards New Zealand at the address shown on the back cover.

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee EL-001, Wiring Rules to supersede AS 3859—1991 Chapters 1, 2 and 3.

AS 3859—1991 was produced from IEC 60479, *Effects of current passing through the human body*, 60479-1:1984 *Part 1: General aspects*, and 60479-2:1987 *Part 2: Special aspects*. Subsequently IEC 60479-1 was revised and issued as IEC 60479-1:1994 (third edition). IEC 60479-2 was reconfirmed without change and a new IEC 60479-3:1998 published. AS 3859—1991 has been revised and issued as AS/NZS 60479.1, 60479.2 and 60479.3.

The objective of this Standard is to provide basic guidance on the effects of electrical currents on persons and livestock for the establishment of electrical safety requirements.

This Standard has been reproduced from IEC 60479-1:1994, *Effects of current on human beings and livestock—Part 1: General aspects*.

Variations to IEC 60479-1:1994 are indicated at the appropriate places throughout this Standard. Strikethrough (~~example~~) identifies IEC tables, figures and passages of text which, for the purposes of this Australian/New Zealand Standard, are deleted. Where Australian/New Zealand tables, figures or passages of text are added, each is set in its proper place and identified by shading (example). Added figures are not themselves shaded, but are identified by a shaded border.

This Standard is Part One of a series that includes the following:

AS/NZS	
60479	Effects of current on human beings and livestock
60479.1	Part 1: General aspects (this Standard)
60479.2	Part 2: Special aspects
60479.3	Part 3: Effects of currents passing through the body of livestock

In January 1997, the IEC commenced numbering its Standards from 60000 by adding 60000 to the number of each existing Standard. This coordinates IEC numbering with ISO numbering. During the transition period an IEC Standard might be identified by its new number or its old number (for example, IEC 60050 or IEC 50).

As this Standard is reproduced from an International Standard, the following applies:

(a) Its number does not appear on each page of text and its identity is shown only on the cover and title page.

(b) In the source text ‘this technical report’ should read ‘this Australian/New Zealand Standard’.

(c) A full point should be substituted for a comma when referring to a decimal marker.

In this Standard, the following print types are used:

– requirements proper: in arial type;

– *test specifications: in italic type;*

– explanatory matter: in smaller arial type.

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the annex to which they apply. A ‘normative’ annex is an integral part of a Standard, whereas an ‘informative’ annex is only for information and guidance.

CONTENTS

INTRODUCTION

This Technical Report is intended to provide basic guidance on the effects of shock currents on human beings and livestock, for use in the establishment of electrical safety requirements.

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.

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Any IEC table, figure or passage of text that is struck-through is not part of this Standard. Any Australian/New Zealand table, figure or passage of text that is added (and identified by shading) is part of this Standard.

1 General

1.1 Scope and object

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 clauses are, in many cases, not directly applicable in practice for designing protection against electrical 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 therefore 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 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 Technical Report result from a close examination of the experimental results available from measurements carried out principally on corpses and on some living persons.

Clause 3 is primarily based on the findings related to the effects of current at frequencies of 50 Hz or 60 Hz which are the most common in electrical installations. The values given are, however, deemed applicable over the frequency range from 15 Hz to 100 Hz, threshold values at the limits of this range being higher than those at 50 Hz or 60 Hz. It is considered principally the risk of ventricular fibrillation which is the main cause of fatal accidents in that range of frequencies.

Accidents with direct current are much less frequent than would be expected from the number of d.c. applications, and fatal accidents occur only under very unfavourable conditions, for example, in mines. This is partly due to the fact that with direct current, the let-go of parts gripped is less difficult and that for shock durations longer than the period of the cardiac cycle, the threshold of ventricular fibrillation remains considerably higher than for alternating current.