IEC 62792

Edition 2.0 2026-04

INTERNATIONAL STANDARD

COMMENTED VERSION

Measurement method for the output of electroshock weapons

ICS 17.220.20; 95.020

ISBN 978-2-8327-1210-8

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FOREWORD

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This commented version (CMV) of the official standard IEC 62792:2026 edition 2.0 allows the user to identify the changes made to the previous IEC 62792:2015 edition 1.0. Furthermore, comments from IEC TC 85 experts are provided to explain the reasons of the most relevant changes, or to clarify any part of the content.

A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text. Experts' comments are identified by a blue-background number. Mouse over a number to display a pop-up note with the comment.

This publication contains the CMV and the official standard. The full list of comments is available at the end of the CMV.

IEC 62792 has been prepared by IEC technical committee 85: Measuring equipment for electrical and electromagnetic quantities. It is an International Standard.

This second edition cancels and replaces the first edition published in 2015. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) addition of a new clause describing a method for measuring the high voltage arcing charge delivery distance; and
b) an annex describing an impedance matching network that is necessary to calibrate the measurement system.

The text of this International Standard is based on the following documents:

Draft	Report on voting
85/988/FDIS	85/995/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

Words in *italics* in the text are defined in Clause 3.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

– reconfirmed,
– withdrawn, or
– revised.

INTRODUCTION

Manufacturers, medical researchers, policy makers, users, and other interested parties involved with different aspects of *electroshock weapons* (*ESW*s) use a variety of different measurement methods, different terminologies, and different *parameters* to measure and describe the performance of an *ESW*. These differences generate confusion and misunderstanding within this stakeholder community, and this impacts the ability to perform accurate, reliable, and reproducible measurement comparisons. By developing a generally-accepted terminology, set of performance *parameters*, and test methods, this document will facilitate accurate and precise communication for the *parameters* that describe the electrical outputs, current and *high voltage*, of *ESW*s. This improved communication will aid this stakeholder community in collectively developing uniform methods for describing the *ESW* output and its effect on human physiology consistently and accurately, thereby enabling the development of safe use performance standards~~/~~ or regulations by the appropriate standardization body. **1**

1 Scope

This document specifies a method for measuring the electrical outputs, current and *high voltage*, from *electroshock weapons* (*ESW*s) that deliver an electrical stimulus to humans. This document is applicable to any and all *ESW*s. This document describes *ESW* measurement systems to help guide the user of this document in developing their own *ESW* measurement system. It includes methods for measuring or computing a variety of *parameters* that can be used to characterize the electrical output of the *ESW*. The user of this document will select those *parameters* that are appropriate for their applications and stakeholders.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60469:2013, *Transitions, pulses and related waveforms - Terms, definitions and algorithms*

~~IEEE Std. 1057-2007, *IEEE Standard for digitizing waveform recorders*~~

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

BIPM, *The International System of Units (SI)*, ~~8th~~9th Edition, ~~2006~~2019

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[1] P. Daponte, L. De Vito, F. Picariello, S. Rapuano, I. Tudosa, "*A review of measurement methods for traceable calibration of waveform recorders used in ElectroShock Weapons (ESWs) testing*", in Proc. of 1st IEEE International Workshop on Technologies for Defense and Security (TechDefense), Rome, Italy, 2023, pp. 22-27. https://doi.org/10.1109/TechDefense59795.2023.10380858

[2] N. Paulter, Jr., "*Method for measuring the phase spectrum of the output of a frequency source used in the calibration of an electroshock weapon characterization system*," Journal of research of the National Institute of Standards and Technology, vol. 122, no. 35, pp. 1–14, 2017. https://doi.org/10.6028/jres.122.035

[3] S. Rapuano, P. Daponte, L. De Vito, F. Picariello, I. Tudosa, N. Paulter, "*A phase measurement method to guarantee the traceability of the calibration systems*," in Proc. of Conference on Precision Electromagnetic Measurements (CPEM), Denver, Colorado, USA, 2020, pp. 1–2. https://doi.org/10.1109/CPEM49742.2020.9191708

[4] P. Daponte, L. De Vito, F. Picariello, S. Rapuano, I. Tudosa, "*Sensitivity assessment of a phase measurement method used in a waveform recorder traceable testing for ElectroShock Weapons (ESW)*", in Prof. of 1st IEEE International Workshop on Technologies for Defense and Security (TechDefense), Rome, Italy, 2023, pp. 245-250. http://dx.doi.org/10.1109/TechDefense59795.2023.10380852

[5] I. Tudosa, F. Picariello, P. Daponte, L. De Vito, S. Rapuano, N. Paulter, Jr., "*Prototype of high accuracy single input phase measurement instrument*", Measurement, vol. 201, 2022, pp.1-17. https://doi.org/10.1016/j.measurement.2022.111595

[6] IEC 60050 (all parts), International Electrotechnical Vocabulary (available at http://www.electropedia.org)

[7] IEC 60359:2001, *Electrical and electronic measurement equipment - Expression of performance*

[8] IEC 60469:2013, *Transitions, pulses and related waveforms - Terms, definitions and algorithms*

[9] IEC 60479-2*:2019, Effects Of Current On Human Beings And Livestock - Part 2: Special Aspects*

[10] IEEE Std. 4-1995, *IEEE Standard techniques for high-voltage testing*

[11] IEEE Std. 1057-2017, *IEEE Standard for digitizing waveform recorders*

[12] ISO/IEC Guide 98-3:2008, *Uncertainty of measurement - Part 3: Guide to the expression of uncertainty in measurement (GUM: 1995)*

[13] ISO/IEC Guide 99:2007, *International vocabulary of metrology - Basic and general concepts and associated terms (VIM)*

List of comments

1 Clarification is added to the scope due to user feedback, adding that the standard is intended to be a guide for the user to select parameters relevant to their specific applications, and methods to measure or compute those parameters.

2 Aggregate current is added to the standard due to the measurement's relevance to electrical safety and effectiveness of ESWs.

3 Pulse rate is added due to the measurement's relevance to an ESWs ability to stimulate muscle for a period of time.

4 The overview is edited to provide clarification to the reason that standard test methods and calculations are needed for ESWs.

5 Clarification is added describing the waveform recording system. In addition, information is added regarding the battery of the ESW requiring enough charge to operate, to prevent the false failure of an ESW due to insufficient battery capacity.

6 Environmental conditions that could affect measurement are moved from Section 4.3 to earlier in the standard.

7 Feedback received during review of the initial version expressed confusion regarding the different levels of performance requirements for the measurement equipment, so clarification of each system is added.

8 The minimum bandwidth of the waveform recorder is reduced based on the expected frequency band contained within an ESW waveform.

9 Rather than specify the load resistance, a range is given within the physiological impedance range expected for ESWs to discharge into, allowing the user to customize the test to their specific needs.

10 Clarification is added regarding the use of an accredited third-party laboratory rather than the user being required to perform the calibration of the instruments.

11 The minimum bandwidth requirement for the current probe is reduced due to the expected band of frequencies contained within an ESW waveform, however guidance is provided for any circumstance which higher bandwidth may be necessary.

12 The calculation of voltage based on the current waveform and load impedance is added as an alternate method to voltage measurement, potentially reducing the equipment requirements and cost to the user.

13 The minimum bandwidth requirement for the voltage probe is reduced due to the expected band of frequencies contained within an ESW waveform, however guidance is provided for any circumstance which higher bandwidth may be necessary.

14 Due to the importance of an ESW to be able to perform even with a poor connection, for example if a probe fails to puncture through clothing, a test method is developed to measure the output of an ESW while arcing to a load.

15 Clarification is added to specify that this measurement average is for the specific sub-epoch.

16 Clarification is added to specify that this measurement absolute average is for the specific sub-epoch.

17 A formula showing how voltage values can be converted to current values is added.

18 Aggregate current/how much charge is delivered per second into a load; is added because it is an important factor to describing the electrical safety and the waveform's muscle stimulation effectiveness.

19 Instead of using Fourier transforms to calculate energy, this section is changed to use time domain samples (i.e. oscilloscope), which makes the measurements more accurate and easier to accomplish.

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