

This is a preview - click here to buy the full publication



IEC/TR 62781

Edition 1.0 2012-09

# TECHNICAL REPORT



---

**Ultrasonics – Conditioning of water for ultrasonic measurements**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

PRICE CODE

**S**

---

ICS 17.140.50

ISBN 978-2-83220-376-7

**Warning! Make sure that you obtained this publication from an authorized distributor.**

## CONTENTS

|   |    |
|---|----|
| FOREWORD.....                                   | 4  |
| INTRODUCTION.....                               | 6  |
| 1 Scope.....                                    | 7  |
| 2 Normative references .....                    | 7  |
| 3 Dissolved gases .....                         | 7  |
| 3.1 General.....                                | 7  |
| 3.2 Chemical methods.....                       | 8  |
| 3.2.1 General .....                             | 8  |
| 3.2.2 Addition of sodium sulphite.....          | 8  |
| 3.3 Physical methods .....                      | 9  |
| 3.3.1 General .....                             | 9  |
| 3.3.2 Vacuum degassing .....                    | 9  |
| 3.3.3 Reduced pressure recirculation .....      | 9  |
| 3.3.4 Degassing contactors .....                | 11 |
| 3.3.5 Boiling.....                              | 11 |
| 3.4 Verification methods.....                   | 11 |
| 3.4.1 General .....                             | 11 |
| 3.4.2 Electrical verification methods .....     | 12 |
| 3.4.3 Optical verification methods.....         | 12 |
| 3.5 Re-gassing.....                             | 12 |
| 4 Dissolved ionic content.....                  | 13 |
| 4.1 General.....                                | 13 |
| 4.2 Chemical methods.....                       | 13 |
| 4.2.1 General .....                             | 13 |
| 4.2.2 Ion exchange devices.....                 | 13 |
| 4.3 Physical methods .....                      | 13 |
| 4.3.1 General .....                             | 13 |
| 4.3.2 Distillation .....                        | 14 |
| 4.3.3 Reverse osmosis .....                     | 14 |
| 4.4 Verification methods.....                   | 14 |
| 4.5 Reionization .....                          | 14 |
| 5 Biological content .....                      | 15 |
| 5.1 General.....                                | 15 |
| 5.2 Chemical methods.....                       | 15 |
| 5.2.1 General .....                             | 15 |
| 5.2.2 Addition of chlorine-based chemicals..... | 15 |
| 5.2.3 Addition of copper-based chemicals .....  | 15 |
| 5.2.4 Addition of silver-based chemicals.....   | 16 |
| 5.3 Physical methods .....                      | 16 |
| 5.3.1 General .....                             | 16 |
| 5.3.2 UV filtration .....                       | 16 |
| 5.3.3 Cavitation methods.....                   | 16 |
| 6 Suspended particulate content .....           | 16 |
| 6.1 General.....                                | 16 |

|     |   |    |
|-----|---|----|
| 6.2 | Physical methods .....                                  | 17 |
| 6.3 | Particulate re-contamination .....                      | 17 |
| 7   | Water temperature.....                                  | 17 |
| 7.1 | General .....   | 17 |
| 7.2 | Thermal sources in an ultrasonic measurement tank ..... | 18 |
| 8   | Examples of low-cost water treatment systems.....       | 18 |
| 8.1 | Hydrophone measurement water tank.....                  | 18 |
| 8.2 | RFB measurement vessel.....                             | 19 |
|     | Bibliography.....                                       | 21 |

|  |    |
|--|----|
| Figure 1 – Dissolved oxygen concentration as a function of time for 2, 4 and 6 g/l of sodium sulphite in de-mineralised water and for different surface areas and volumes of water ..... | 9  |
| Figure 2 – Dissolved oxygen concentration in water as a function of time during reduced pressure recirculation degassing .....   | 10 |
| Figure 3 – Re-gassing profile for a body of water following reduced pressure recirculation degassing .....   | 12 |
| Figure 4 – Example water treatment system for hydrophone measurements .....  | 19 |
| Figure 5 – Example water treatment system for RFB measurements .....   | 20 |
| Table 1 – Conditions for degassing by boiling .....  | 11 |

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

# ULTRASONICS – CONDITIONING OF WATER FOR ULTRASONIC MEASUREMENTS

## FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

The main task of IEC technical committees is to prepare International Standards. However, a technical committee may propose the publication of a technical report when it has collected data of a different kind from that which is normally published as an International Standard, for example "state of the art".

IEC 62781, which is a technical report, has been prepared by IEC technical committee 87: Ultrasonics.

The text of this technical report is based on the following documents:

|               |                  |
|---------------|------------------|
| Enquiry draft | Report on voting |
| 87/494A/DTR   | 87/507/RVC       |

Full information on the voting for the approval of this technical report 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.

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.

**IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.**

## INTRODUCTION

Many ultrasonic measurements are conducted in water, as it provides an inexpensive and readily available medium with characteristic acoustic impedance comparable to biological tissue. However, basic tap water is far from optimum for ultrasonic measurement as it contains many dissolved, absorbed and suspended contaminants. Measurements can be affected in many ways by these impurities. For example:

- dissolved gases readily dissociate from the water in the presence of high rarefactional pressures or heat giving rise to bubble formation. These bubbles not only are unwanted point reflectors but also increase the likelihood of cavitation.
- dissolved ionic components result in a raised conductivity of the water, which in turn can affect the measured output from some unshielded hydrophones. Furthermore experimental equipment left in an ionic solution for any period of time will gradually develop a layer of deposit (e.g. calcium carbonate) on its surface.
- biological activity within an untreated water tank will result in the creation of an unpleasant film on all available surfaces. If left long enough this biological activity will result in an undesirable environment for the operator and may also be a health hazard.

To minimize these effects it is necessary to undertake a water treatment process.

These problems are well known and many IEC standards have sought to address these issues, often by means of an informative annex. This technical report aims to provide a unified resource for operators wishing to establish a water treatment process for ultrasonic measurements. This technical report discusses each of the stages within a water treatment process and provides examples of suitable treatment methods.

## ULTRASONICS – CONDITIONING OF WATER FOR ULTRASONIC MEASUREMENTS

### 1 Scope

This Technical Report describes methods:

- for degassing water to be used in ultrasonic measurements,
- to decrease the ionic content of water to be used in ultrasonic measurements,
- to decrease the biological content of water to be used in ultrasonic measurements,
- to reduce the suspended particulate content of water to be used in ultrasonic measurements.

This technical report is applicable to all measurements of ultrasonic fields where water is the transmission medium. The quality and treatment methods for water used within a radiation force balance (RFB) may be different from that required for hydrophone based acoustic measurements. Chemical based methods of water treatment (e.g. algacides) may be appropriate for these applications. However, in this document, chemical means are noted but appropriately discouraged for acoustic pressure/intensity measurements.

### 2 Normative references

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

IEC 62127-1, *Ultrasonics – Hydrophones – Part 1: Measurement and characterization of medical ultrasonic fields up to 40 MHz*