INTERNATIONAL STANDARD

IEC 61685

First edition
2001-07

Ultrasonics – Flow measurement systems – Flow test object

Ultrasons –
Systèmes de mesure de débit –
Montage pour essai de débit

© IEC 2001 — Copyright - all rights reserved

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

International Electrotechnical Commission 3, rue de Varembé Geneva, Switzerland
Telefax: +41 22 919 0300 e-mail: inmail@iec.ch IEC web site http://www.iec.ch

Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

PRICE CODE W

For price, see current catalogue

CONTENTS

FOREWORD 4
INTRODUCTION 5

1 Scope 6
2 Normative references 6
3 Definitions 6
4 List of symbols 11
5 General outline of flow Doppler test object 12
6 Specification of the flow Doppler test object 12
6.1 General 12
6.2 Blood-mimicking fluid (BMF) 13
6.3 Tube 14
6.4 Tissue-mimicking material (TMM) 15
6.5 Geometry 15
7 Precautions to prevent changes in the composition of the blood-mimicking fluid (BMF) 15
8 Specifications for labelling 16

Annex A (informative) Rationale concerning the position of this standard 17
Annex B (normative) Formulae relating various quantities 20
Annex C (informative) Rationale for the numerical values chosen in this standard 21
Annex D (informative) Description of an example flow Doppler test object 23
Annex E (informative) Schematic diagram of a possible flow circuit 32
Annex F (informative) Measuring methods 33

Bibliography 34

Figure 1 – Three configurations for Doppler flow test objects 12
Figure D.1 – The main elements of a flow test object 24
Figure D.2 – Backscattering coefficient of BMF as a function of frequency 26
Figure D.3 – Attenuation of TMM (□) and BMF (○) as a function of frequency 26
Figure D.4 – Attenuation of ultrasound by material of tube wall, as a function of frequency 27
Figure D.5 – Deformation of velocity spectrum of parabolic flow by attenuation due to tube wall (wall thickness 1,5 mm) 28
Figure D.6 – Backscattering coefficient of two samples of TMM as a function of frequency 29
Figure D.7 – The quotient of attenuation by TMM (1-way passage) and frequency as a function of frequency 29
Figure D.8 – Testing for penetration depth 31
Figure E.1 – Schematic diagram of a possible flow circuit, showing the place of the flow Doppler test object 32

Table 1 – Typical ranges of parameters for blood at 37 °C, where *f* is the acoustic-working frequency in hertz 13
Table 2 – Specification of blood-mimicking fluid (BMF) 13
Table 3 – Parameters of tissue-mimicking material (TMM) 15
Table A.1 – Parameters concerning CW Doppler 18
Table A.2 – Additional parameters concerning pulsed Doppler and colour flow 19

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

ULTRASONICS – FLOW MEASUREMENT SYSTEMS – FLOW TEST OBJECT

FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. 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. The 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 the 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 National Committees.
3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical specifications, technical reports or guides and they are accepted by the National Committees in that sense.
4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.
5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.
6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61685 has been prepared by IEC Technical Committee 87: Ultrasonics.

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

FDIS	Report on voting
87/202/FDIS	87/208/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 3.

Annexes A, C, D, E and F are for information only.

Annex B forms an integral part of this standard.

The committee has decided that the contents of this publication will remain unchanged until 2006. At this date, the publication will be

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

INTRODUCTION

The purpose of this International Standard is to establish a **flow Doppler test object** for the acceptance testing, quality assurance testing and clinical calibration of Doppler systems, working at a frequency between 2 MHz and 10 MHz. As the response of Doppler systems depends on the signal level and on the spectral contents of the signal, it is desirable to test some aspects of a Doppler system with a test object that mimics the *in vivo* situation. A **flow Doppler test object** is particularly useful for

– testing the influence of the size and the depth of the blood vessel on the signal recorded by a Doppler system;

– testing the response of a Doppler system with a spectrum of blood velocities typical of the *in vivo* situation.

This **flow test object** is not intended as a phantom mimicking clinical conditions.

The basis of this International Standard is given by IEC Technical Report 61206:1993 *Ultrasonics – Continuous Wave Doppler systems – Test procedures*. In annex A the position of this standard in relation to IEC 61206 and IEC 61895 is described. This standard only declares parameters that can be measured with the test object. Measurement methods are given in IEC 61206 and IEC 61895.

This International Standard deals only with the **flow Doppler test object** in a restricted sense, i.e. the section in which the ultrasonic measurements are performed. Where the whole of the set-up is meant, the phrase 'flow rig' is used. The prescriptions of this International Standard define the ultrasonic properties and the flow pattern in the measurement section of the flow test object. For other aspects of the flow rig (i.e. generating and measuring flows) standard engineering practice has to be followed.

The flow conditions are simplified as much as possible: a steady flow through a straight **tube** with a circular cross-section. Generalisation of the flow conditions to other geometries and time dependent flows is required in order to test some instrument functions. This generalisation is not undertaken in this International Standard.

In annex D, an example **flow Doppler test object** is described which complies with the requirements of this International Standard. Compliance with this International Standard can also be fulfilled by measuring the properties of the materials to be used, and complying with the values given in this International Standard.

In literature [1], [2] the nomenclature about the primary measurand of Doppler systems is confused. 'Doppler frequency' and 'velocity' occur on equal footing. In 'velocity' often a correction for **Doppler angle** has been included. To avoid this ambiguity, in this International Standard the term 'Doppler frequency' is preferred. In case a Doppler system is declared to measure velocity, it is intended that measured values are converted to Doppler frequency, using **acoustic working frequency** and, if applicable, **Doppler angle**.

ULTRASONICS – FLOW MEASUREMENT SYSTEMS – FLOW TEST OBJECT

1 Scope

This International Standard specifies parameters for a **flow Doppler test object** representing a blood vessel of known diameter at a certain depth in human tissue, carrying a steady flow.

This International Standard establishes a **flow Doppler test object** which can be used to assess various aspects of the performance of Doppler diagnostic equipment.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 61206:1993, *Ultrasonics – Continuous-wave Doppler systems – Test procedures*

IEC 61102:1991, *Measurement and characterisation of ultrasonic fields using hydrophones in the frequency range 0,5 MHz to 15 MHz*

IEC 61895:1999, *Ultrasonics – Pulsed Doppler diagnostic systems – Test procedures to determine performance*