
Mechanical vibration and shock — Cold provocation tests for the assessment of peripheral vascular function —

**Part 1:
Measurement and evaluation of finger skin temperature**

iTeh STANDARD PREVIEW

Vibrations et chocs mécaniques — Essais de provocation à froid pour l'évaluation de la fonction vasculaire périphérique —

Partie 1: Mesurage et évaluation de la température de la peau des doigts

<https://standards.iteh.ai/catalog/standards/sist/6e1dd4a0-dd7b-4a54-bd71-b546a2db9c7d/iso-14835-1-2005>



PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[ISO 14835-1:2005](https://standards.iteh.ai/catalog/standards/sist/6e1dd4a0-dd7b-4a54-bd71-b546a2db9c7d/iso-14835-1-2005)

<https://standards.iteh.ai/catalog/standards/sist/6e1dd4a0-dd7b-4a54-bd71-b546a2db9c7d/iso-14835-1-2005>

© ISO 2005

All rights reserved. Unless otherwise specified, 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 either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword.....	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Measurement equipment	1
3.1 General.....	1
3.2 Thermometry	2
3.3 Thermography.....	2
4 Measurement procedure	3
4.1 Quantity to be measured.....	3
4.2 Conditions of examination.....	3
4.3 Cold provocation	4
4.4 Conduct of the test	5
5 Safety aspects.....	6
5.1 General.....	6
5.2 Electrical safety.....	7
5.3 Contraindications	7
5.4 Informed consent.....	7
5.5 Examiner and medical supervision.....	7
6 Data reporting	7
6.1 General.....	7
6.2 Examination conditions	7
6.3 Subject characteristics.....	8
6.4 Symptoms and signs during examination	8
6.5 Results	8
7 Assessment of normative values and limits	8
Bibliography	9

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 14835-1 was prepared by Technical Committee ISO/TC 108, *Mechanical vibration and shock*, Subcommittee SC 4, *Human exposure to mechanical vibration and shock*.

ISO 14835 consists of the following parts, under the general title *Mechanical vibration and shock — Cold provocation tests for the assessment of peripheral vascular function*:

- *Part 1: Measurement and evaluation of finger skin temperature*
<https://standards.iteh.ai/catalog/standards/sist/6e1dd4a0-dd7b-4a54-bd71-b546a2db9c7d/iso-14835-1-2005>
- *Part 2: Measurement and evaluation of finger systolic blood pressure*

Introduction

Finger skin temperature (FST) is related indirectly to finger blood flow and reflects the contribution of feed capillaries, nutritive capillaries and arteries. Mechanical, physiologic or pharmacologic effects at any of these levels may affect FST.

Assessing FST over a sufficient observation time can identify the presence and extent of finger vasoconstriction in response to cold provocation produced by appropriate hand cooling.

The changes in FST during hand cooling normally reflect the degree of vasoconstriction and resistance to blood flow caused by cold provocation, and possibly also alterations of this physiological process. The changes in FST after cold provocation reflect different neurovascular processes that control recovery from cold exposure and the return to steady-state circulatory conditions. The measurement of FST during cold provocation is carried out in a well-controlled environment.

FST indicates intra- and inter-individual variability to some extent. The test results of cold provocation are interpreted together with subjective symptoms, signs and history, including vibration exposure.

iTeh STANDARD PREVIEW (standards.iteh.ai)

[ISO 14835-1:2005](https://standards.iteh.ai/catalog/standards/sist/6e1dd4a0-dd7b-4a54-bd71-b546a2db9c7d/iso-14835-1-2005)

<https://standards.iteh.ai/catalog/standards/sist/6e1dd4a0-dd7b-4a54-bd71-b546a2db9c7d/iso-14835-1-2005>

iTeh STANDARD PREVIEW
(standards.iteh.ai)

ISO 14835-1:2005

<https://standards.iteh.ai/catalog/standards/sist/6e1dd4a0-dd7b-4a54-bd71-b546a2db9c7d/iso-14835-1-2005>

Mechanical vibration and shock — Cold provocation tests for the assessment of peripheral vascular function —

Part 1: Measurement and evaluation of finger skin temperature

1 Scope

This part of ISO 14835 specifies

- a) the methods for measuring the finger skin temperature (FST),
- b) the procedures for conducting the measurements (including the performance of cold provocation tests), and
- c) how to report the measurement results.

The methods specified in this part of ISO 14835 are designed to assist in the collection of basic data for a quantitative evaluation of vascular response to cold provocation, and to enable specification of normative figures.

ISO 14835-1:2005

This part of ISO 14835 is applicable to the measurement of FST in response to cold provocation for the assessment of various peripheral vascular disorders in persons exposed to hand-arm vibration, and is intended to be used together with a battery of tests for diagnosing hand-arm vibration syndrome.

2 Normative references

The following referenced documents are indispensable for the application 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.

ISO 5349-1, *Mechanical vibration — Measurement and evaluation of human exposure to hand-transmitted vibration — Part 1: General requirements*

IEC 60601-1, *Medical electrical equipment — Part 1: General requirements for safety*

3 Measurement equipment

3.1 General

Several types of transducers are available for the measurement of FST. Thermocouples and thermistors (point transducers) are often used. They are simple to use and practical for following up. Thermal imaging devices have also been used, sometimes with infrared sensors. These devices, however, tend to be expensive and difficult to calibrate accurately compared to point transducers.

It is recommended that all equipment be checked for correct operation before and after use.

3.2 Thermometry

3.2.1 General

The advantage of contact thermometry and non-contact point thermometry using infrared in the field of vascular assessment methods is that the apparatus is less expensive and easier to maintain than thermography. Although FST is usually measured at one fixed point for each finger, depending on how many hands are being measured at once, an alternative is to measure on the distal phalanx of all fingers and the middle and proximal phalanges when measuring just one hand.

3.2.2 Sensors

It is important that sensors do not influence temperature changes at the measurement location and do not provide thermal insulation from the exterior environment or cold provocation. The sensors should be highly sensitive and accurate, with a maximum thermal discrimination of 0,1 °C within the physiological temperature range (5 °C to 40 °C).

3.2.3 Recorders

All FST data obtained during the test shall be recorded, and data storage on a computer may be performed. The time interval between temperature measurements of each finger shall not exceed 1 min. During recording, the temperatures may be displayed in real time. The recorded data, as numerically stored in the recorder, may be transferred to a computer for further processing, either manually after printing on paper, or directly through an electronic interface. A recorder with an integrated keyboard may permit control and digital display of the recording parameters.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

3.2.4 Calibration

Calibration of the temperature sensors should be carried out by inserting a calibrated reference thermometer and all sensors into the cold water bath. The sensors should be within $\pm 0,2$ °C of the reference thermometer. The range of temperatures registered using the sensors should not exceed 0,1 °C.

3.3 Thermography

3.3.1 General

The advantage of non-contact thermography in the field of vascular assessment methods is that, during the cold provocation test, the skin temperature of more than one point on a single finger may be measured and registered. Non-contact thermography methods show thermal images of whole hands. In this way, peripheral blood circulation disturbances in local parts of the hands and fingers may be detected and may indicate the severity of impairment to health.

3.3.2 Remote-sensing techniques

Remote-sensing systems involve infrared radiation. They usually consist of a high-resolution sensor unit (i.e. plane array sensor with at least 250 pixels per line and 250 lines per image), cooling system, operating unit, digital image recorder, digital computer, colour monitor and colour printer for reproduction of the thermogram. The maximum range of temperature to be measured shall be at least from 5 °C to 40 °C, but shall be variable within different steps. The maximum thermal discrimination shall be 0,1 °C within the mentioned temperature range.

3.3.3 Data processing

Data are recorded as an image of the hand with the FST coded as a colour map. Images should be recorded at possible maximum intervals not exceeding 1 min. The times at which cold provocation begins and ends should be recorded with the image. The relationship between colour and FST should be recorded for quantitative interpretation of results.

3.3.4 Calibration

Calibration may be accomplished in different ways. A cavity radiator as a black body may be used for calibration. Internal reference data for automatic comparison during measurement interruption may serve for testing the stability of measurements.

4 Measurement procedure

4.1 Quantity to be measured

FST is the quantity to be measured. It is expressed in degrees Celsius (°C).

4.2 Conditions of examination

4.2.1 General

To obtain precise data, the test conditions and procedures shall be sufficiently controlled. Measurement of FST should be carried out in a well-controlled environment.

4.2.2 Examination room

FST is strongly affected by room temperature. The room temperature should be maintained at (21 ± 1) °C over the whole length of the body, for the duration of the test. Any deviations outside this range should be reported.

The environment shall be controlled to prevent extraneous conditions that might influence examination results.

Atmospheric temperature during the test should be strictly controlled. It is necessary to control room temperature at different vertical levels to prevent temperature differences at different parts of the body. The atmospheric temperature around the entire body should be maintained within the allowable range by mild air circulation. Stronger air circulation can increase skin cooling and alter the effective ambient room temperature.

4.2.3 Time

4.2.3.1 Time of year

Because the season can affect the measurement, it is desirable to make measurements in the cold season. If periodic examination at two or more times per year is required for follow-up in addition to the examination in the cold season, a test may be conducted in the autumn or summer.

4.2.3.2 Time of day

With respect to circadian biorhythm, examination between 9:00 and 18:00 is recommended.

NOTE It has been reported that the time of day has an influence on FSTs, but it is unknown whether these daily variations have a significant effect on the FST response to cold provocation.

4.2.3.3 Time lag between previous test(s)/examination(s)

A delay of 3 h between cold provocation tests, including test described in ISO 14835-2, and FST measurements is recommended so as to avoid the effects of prior cold exposure. This includes a cold provocation that has been aborted after cold provocation has begun.