

**Vibration och stöt – Provningar med köld-  
provocering för att uppskatta yttre kärlfunktion –  
Del 1: Mätning och bedömning av temperaturen på  
fingertopparna (ISO 14835-1:2005, IDT)**

**Mechanical vibration and shock – Cold  
provocation tests for the assessment of  
peripheral vascular function –  
Part 1: Measurement and evaluation of finger  
skin temperature (ISO 14835-1:2005, IDT)**

Den internationella standarden ISO 14835-1:2005 gäller som svensk standard. Detta dokument innehåller den officiella engelska versionen av ISO 14835-1:2005.

The International Standard ISO 14835-1:2005 has the status of a Swedish Standard. This document contains the official English version of ISO 14835-1:2005.

---

Upplysningar om **sakinnehållet** i standarden lämnas av SIS, Swedish Standards Institute, telefon 08 - 555 520 00.

Standarder kan beställas hos SIS Förlag AB som även lämnar **allmänna upplysningar** om svensk och utländsk standard.

*Postadress:* SIS Förlag AB, 118 80 STOCKHOLM  
*Telefon:* 08 - 555 523 10. *Telefax:* 08 - 555 523 11  
*E-post:* [sis.sales@sis.se](mailto:sis.sales@sis.se). *Internet:* [www.sis.se](http://www.sis.se)

# 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

**SS-ISO 14835-1:2005****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*
- *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.



# 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.

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.

## SS-ISO 14835-1:2005

### 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.

#### 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.