INTERNATIONAL STANDARD

ISO
3159

Second edition
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Timekeeping instruments — Wrist-chronometers with spring balance oscillator

Instruments horaires — Chronomètres-bracelet à oscillateur balancier-spiral

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Foreword

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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 3159 was prepared by Technical Committee ISO/TC 114, *Horology*.

This second edition cancels and replaces the first edition (ISO 3159:1976) which has been technically revised.

Timekeeping instruments — Wrist-chronometers with spring balance oscillator

1   Scope

This International Standard lays down the definition of the term "chronometer", describing the categories, the test programme and the acceptable minimum requirements for wrist-chronometers.

NOTE   Wristwatches using a tuning fork oscillator are subjected to these tests pending the availability of separate standards.

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 3158, *Timekeeping instruments — Symbolization of control positions*

3   Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
chronometer
precision wristwatch regulated for different positions and for various conditions of use

NOTE 1   Conformity to the definition of chronometer will be certified by a neutral official authority that checks the watch, or if necessary the movement, and issues an official certificate.

NOTE 2   A wristwatch described as a "chronometer" must satisfy the minimum requirements laid down in Clause 7.

4   Categories of wristwatch

Wristwatches are divided into two categories dependent on casing diameter or casing-up surface.

Category	Casing diameter mm	Casing-up surface mm^2
1	> 20	> 314
2	$\leqslant$ 20	$\leqslant$ 314

5 Definition of criteria

5.1 General

The condition of the watch designated by the letter E_i is obtained by subtracting the standard reference time from the time indicated by the watch. The time is observed to within limits of $\pm 0,5$ s.

The condition is rounded to the nearest full second.

The daily rate, M_i, is obtained by subtracting the condition observed 24 h earlier from the condition on the day of observation; it is expressed by the following formula:

$$M_i = \frac{1}{t_d}\left(E_i - E_{i-1}\right)$$

where

t_d = 1 (one day);

i = 1, 2, …, 15.

By convention, this daily rate, M_i, is expressed in seconds per days (s/d). It is positive if the watch gains and negative if the watch loses.

5.2 $\overline{M}$: mean daily rate

$\overline{M}$ is the arithmetic mean of daily rates during the first ten days of the tests.

$$\overline{M} = \frac{1}{10}\left(M_1 + M_2 + ... + M_{10}\right)$$

5.3 $\overline{V}$: mean variation in rates

$\overline{V}$ is the arithmetic mean of the five absolute values of variations in rates obtained for the five positions of the watch during the first ten days of the tests.

$$\overline{V} = \frac{1}{5}\left(\left|M_2 - M_1\right| + \left|M_4 - M_3\right| + ... + \left|M_{10} - M_9\right|\right)$$

NOTE   The variation in rate is the difference between two consecutive daily rates in identical environmental conditions.

5.4 V_{max}: greatest variation in rates

V_{max} is the absolute value of the greatest of the five variations in rates with regard to the five positions of the watch during the first ten days of the tests.

$$V_{max} = \left|M_{i+1} - M_i\right|_{max}$$

where i = 1, 3, 5, 7, 9.

5.5 D: difference between the rates in horizontal and vertical positions of the watch

D is obtained by subtracting the average of the rates observed in position CH (9th day and 10th day) from the average of the rates observed in position 6H (1st day and 2nd day).

$$D = \frac{1}{2}\left(M_1 + M_2\right) - \frac{1}{2}\left(M_9 + M_{10}\right)$$

5.6 P: greatest deviation in rates

P is the absolute value of the greatest of the ten differences between one of the first ten rates and the mean daily test rate.

$$P = \left|M_i - \overline{M}\right|_{\max}$$

where i = 1, 2, …, 10.

5.7 C: variation in rate as a function of temperature

C is obtained by subtracting the rate at 8 °C from the rate at 38 °C, the total being divided by the temperature difference, expressed in degrees Celsius.

$$C = \frac{M_{13} - M_{11}}{30}$$

5.8 R: resumption of the rate

R is obtained by subtracting the average of the first two rates from the last rate.

$$R = M_{15} - \frac{M_1 + M_2}{2}$$

6 Test programme[1]

Day	Position[a]	Nominal temperature[b] °C	E_i	M_i
0	6H	23	E_0	
1	6H	23	E_1	M_1
2	6H	23	E_2	M_2
3	3H	23	E_3	M_3
4	3H	23	E_4	M_4
5	9H	23	E_5	M_5
6	9H	23	E_6	M_6
7	FH	23	E_7	M_7
8	FH	23	E_8	M_8
9	CH	23	E_9	M_9
10[c]	CH	23	E_{10}	M_{10}
11	CH	8	E_{11}	M_{11}
12	CH	23	E_{12}	M_{12}
13	CH	38	E_{13}	M_{13}
14	6H	23	E_{14}	M_{14}
15	6H	23	E_{15}	M_{15}

a See ISO 3158.

b The tolerance on the temperature is ±1 °C.

c Auxiliary mechanisms, the functions of which can be interrupted, shall be made to function only on the 10th day.

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1) Normally, there shall be no interruption during the tests.

7   Minimum requirements

Criteria		Units	Minimum requirements Categories	
			1	**2**
$\overline{M}$	Mean daily rate	s/d	−4 +6	−5 +8
$\overline{V}$	Mean variation in rates	s/d	2	3,4
V_{max}	Greatest variation in rates	s/d	5	7
D	Difference between the rates in horizontal and vertical positions of the watch	s/d	−6 +8	−8 +10
P	Greatest deviation in rates	s/d	10	15
C	Variation in rate as a function of temperature	s/(d·°C)	±0,6	±0,7
R	Resumption of the rate	s/d	±5	±6
NOTE The minimum requirements are considered to be absolute limits and no calculation result shall be rounded off.				

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