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# Analogue quartz clocks — Timing accuracy

*Horloges analogiques à quartz — Précision du temps*



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# Foreword

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The committee responsible for this document is ISO/TC 114, *Horology*, Subcommittee SC 14, *Table and wall clocks.*



 

# Introduction

Each year, there is a large number of analogue quartz clocks produced and this International Standard aims to provide quality information for consumers and producers. This International Standard will help producers by giving them quality control methods and customers by informing them about expectations they could have on those products.

# Analogue quartz clocks — Timing accuracy

## 1 Scope

This International Standard specifies the basic parameters, requirements, and testing methods of timing accuracy for analogue quartz clocks, hereinafter referred to as "the quartz clock".

This International Standard applies to analogue quartz table and wall clocks which the oscillator frequency is 32 768 Hz and the nominal voltage is DC 1,5 V. Analogue quartz clock movements can refer to it.

This International Standard does not apply to the following quartz clocks:

— clocks for particular applications such as clocks used in aircraft, ship, vehicle, and facilities;

— clocks incorporated into other products;

— clocks in which time is radio-synchronized.

## 2 Terms and definitions



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



**2.1**
**mean instantaneous rate**
$\overline{m}$



arithmetic mean value of three instantaneous rates of the quartz clock separately measured on three successive days, in "s/d" or "s/m"

**2.2**
**voltage coefficient**
$C_U$
variation rate of instantaneous rate of the quartz clock caused by the variation of source voltage

**2.3**
**temperature coefficient**
$C_t$
variation rate of instantaneous rate of the quartz clock caused by the variation of temperature

**2.4**
**nominal voltage**
$U_n$
voltage for which the movement is destined

## 3 Basic parameters and requirements of timing accuracy

### 3.1 Mean instantaneous rate, $\overline{m}$

After the quartz clock has been continuously running for 3 d, the mean instantaneous rate shall be within –1,0 s/d to +1,0 s/d.

### 3.2 Voltage coefficient, $C_U$

The voltage coefficient, $C_U$, shall be within –1,0 s/(d·V) to +1,0 s/(d·V).

### 3.3 Temperature coefficient, $C_t$

The temperature coefficient, $C_{t1}$, shall be within 0 s/(d·°C) to +0,1 s/(d·°C) and $C_{t2}$ shall be within −0,1 s/(d·°C) to 0 s/(d·°C).

## 4 Test methods

### 4.1 Test conditions

#### 4.1.1 Test environment

The test ambient temperature shall be 18 °C to 25 °C, the temperature variation shall be within ±2 °C during the whole test and the relative humidity shall be between 50 % and 70 %.

#### 4.1.2 Power supply

Unless otherwise specified, the test power supply during the test shall be the nominal voltage of the quartz clock of DC 1,5 V.

#### 4.1.3 Pre-running

Before the test, the quartz clock shall run for at least 2 h in the test environment specified in 4.1.1.

### 4.2 Test apparatus



The resolution and maximum permissible error of the test apparatus can refer to Table 1.

**Table 1 — Test apparatus**



| Test apparatus | Resolution | Maximum permissible error |
|---|---|---|
| Instantaneous rate test instrument | 0,01 s/d | ±0,03 s/d |
| Temperature and humidity cabinet | 1 °C, RH 1 % | ±1 °C, RH ± 5 % |
| Constant voltage power supply | 0,01 V | ±0,5 % |

### 4.3 Testing

#### 4.3.1 Mean instantaneous rate, $\bar{m}$

The quartz clock shall be placed at a temperature of (23 ± 1) °C for at least 2 h. Then the instantaneous rates $m_1$, $m_2$, $m_3$ for the first, second and third day shall be measured respectively and the mean instantaneous rate $\bar{m}$ calculated in accordance with Formula (1):

$$\bar{m} = \frac{m_1 + m_2 + m_3}{3} \tag{1}$$

where

$\bar{m}$ is the mean instantaneous rate for 3 d;

$m_1$ is the instantaneous rate of the first day;

$m_2$ is the instantaneous rate of the second day;

$m_3$ is the instantaneous rate of the third day.

### 4.3.2 Voltage coefficient, $C_U$

The instantaneous rate variation of the quartz clock caused by 1 V voltage variation is called the voltage coefficient, $C_U$, when the supply voltage of the quartz clock is reduced from 100 % $U_n$ to 90 % $U_n$.

The instantaneous rates of the quartz clock $m_{1,50}$ and $m_{1,35}$ shall be measured respectively under the supply voltage of DC 1,50 V and DC 1,35 V, when $U_n$ is 1,50 V, and $C_U$ is calculated in accordance with Formula (2):

$$C_U = \frac{m_{1,50} - m_{1,35}}{1,50 - 1,35} \tag{2}$$

where

$C_U$ is the voltage coefficient, in s/(d·V);

$m_{1,50}$ is the instantaneous rate under the voltage of DC 1,50 V (100 %), in s/d;

$m_{1,35}$ is the instantaneous rate under the voltage of DC 1,35 V (90 % $U_n$), in s/d.



### 4.3.3 Temperature coefficient, $C_t$

The variation of instantaneous rate caused by 1 °C temperature variation is called temperature coefficient, $C_{t1}$, when the temperature is decreased from 23 °C to 8 °C. The variation of instantaneous rate caused by 1 °C temperature variation is called temperature coefficient, $C_{t2}$, when the temperature is increased from 23 °C to 38 °C.



The quartz clock shall be placed at a temperature of 23 °C ± 1 °C for at least 2 h, then the instantaneous rate, $m_{23}$, shall be measured. Afterwards, it shall be placed at a temperature of 8 °C ± 1 °C for at least 2 h, then the instantaneous rate, $m_8$, shall be measured. After the test, it shall be placed for 1 h in the environment described in 4.1.1 and then placed at a temperature of 38 °C ± 1 °C for at least 2 h. Afterwards, the instantaneous rate, $m_{38}$, shall be measured. $C_{t1}$ and $C_{t2}$ are calculated in accordance with Formula (3) and Formula (4), respectively:

$$C_{t1} = \frac{m_{23} - m_8}{23 - 8} \tag{3}$$

where

$C_{t1}$ is the temperature coefficient when the temperature is decreased from 23 °C to 8 °C, in s/(d·°C);

$m_{23}$ is the instantaneous rate at 23 °C, in s/d;

$m_8$ is the instantaneous rate at 8 °C, in s/d.

$$C_{t2} = \frac{m_{38} - m_{23}}{38 - 23} \tag{4}$$

where

$C_{t2}$ is the temperature coefficient when the temperature is increased from 23 °C to 38 °C, in s/(d·°C);