PD ISO/TS 18684:2015

BSI Standards Publication

Timekeeping instruments — Watch external parts made of hard materials — General requirements and test methods

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee STI/53, Specifications and test methods for jewellery and horology.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Published by BSI Standards Limited 2015

ISBN 978 0 580 83506 3
ICS 39.040.10

Compliance with a British Standard cannot confer immunity from legal obligations.

This Published Document was published under the authority of the Standards Policy and Strategy Committee on 31 October 2015.

Amendments/corrigenda issued since publication

Date	Text affected

PD ISO/TS 18684:2015

TECHNICAL SPECIFICATION

ISO/TS 18684

First edition
2015-09-01

Timekeeping instruments — Watch external parts made of hard materials — General requirements and test methods

Instruments horaires — Habillages de montre en matériaux durs — Exigences générales et méthodes d'essais

Reference number
ISO/TS 18684:2015(E)

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Foreword

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The committee responsible for this document is ISO/TC 114, *Horology*.

Introduction

In recent years, hard materials such as tungsten carbide, ceramics, etc., have found several applications in the horological industry, particularly for the external parts of watches, and more particularly in watchcases and some of their accessories such as bezels, crowns, wristbands and clasps.

Their properties in terms of hardness, of wear resistance or of finish quality (brightness) bring many undeniable advantages for this type of application.

This Technical Specification deals with constitutive components of external parts of watches. Given the variety of possibilities in the mounting of these elements, it is not possible to define and to specify “a complete watch made of hard material”.

Manufacturers of hard materials have developed know-how with the aim of satisfying the legal requirements and the criteria of horological standardization, without standards nor specifications that can serve as references. The aim of this Technical Specification is to clarify the general requirements and the test methods for the horological external parts made of hard material.

Timekeeping instruments — Watch external parts made of hard materials — General requirements and test methods

1 Scope

This Technical Specification concerns whole watches, in which all or some of the components of the external parts are made of hard material, with the exception of watch glasses.

It applies to all elements made in massive material whose hardness is greater than or equal to 1 200 Vickers.

It describes the performance in terms of resistance to mechanical and thermal shocks, to corrosion, to scratches, to sunlight exposure and also to the wear of its components.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 1413:—[1)], *Horology — Shock-resistant watches*

ISO 9227, *Corrosion tests in artificial atmospheres — Salt spray tests*

ISO 23160:2011, *Watch cases and accessories — Tests of the resistance to wear, scratching and impacts*

SN 289 120:2013, *Definition of linear types shocks for the wristwatches components*

SN 289 650:2013, *Process to estimate the resistance to chemical and climatic agents of a horological external part*

3 Terms and definitions

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

3.1
external part
<horological context> the watchcase, the bezel, the crown, the push buttons, the wristband and the clasp

3.2
hard material
material whose Vickers hardness is equal to or higher than 1 200 HV1

3.3
massive
<component> having a composition that is macroscopically homogeneous across its entire section

3.4
brittleness
<material or component> susceptibility to breaking, under the effect of a static or dynamic stress, without being significantly plastically deformed

1) To be published. Revises ISO 1413:1984.

4 Requirements, method of control and acceptance criteria

4.1 General

The requirements of this Technical Specification apply to the elements of external parts of watches made in hard and massive material, according to the definitions of Clause 3.

It shall be noted that these materials may contain allergens or toxic materials such as Nickel or Cobalt. Their amounts and effects must imperatively stay within the specified limits of standards and regulations relative to consumers' protection.

The watch external parts made of hard material shall not present any shape which may be harmful for the user.

The control method and the acceptance criteria of these materials, constituting the prerequisites, are reported in Annex A.

In the case of tests involving mechanical solicitations (see 4.2, 4.7 and 4.8), the number of samples to be tested shall be sufficient to include the usually large dispersion of measurement inherent to this type of brittle materials. A statistical approach should be adopted.

It is possible to apply all the tests or a selection of them to assemblies or to certain individual components. The definition of which components are to be tested and the test conditions to be achieved shall be given special attention in advance in order to highlight those parts that are typically sensitive under conditions of ordinary use.

In the case of hard materials that are additionally coated, the surface-related tests should be interpreted differently (wear, scratches, hardness, etc.).

The existence of porosity is admitted as long as the requirements below are fulfilled.

4.2 Mechanical shock resistance

4.2.1 Requirements and control method

The purpose of this test is to verify the mechanical behaviour of the tested elements or assemblies.

The external elements of watches made of hard material shall comply with the specific requirements of the following standards:

— ISO 1413:—, 5.3. However, the height to be used shall be 0,75 m because of the lower shock resistance of hard materials, of which the consumer should be made aware;

— SN 289 120:2013, Chapters 7 and 8. It is up to the producer to define the minimum requirements in terms of degree of severity, according to the table in Chapter 5 which refers exclusively to the complete product.

4.2.2 Acceptance criteria

The examination of the elements made of hard material shall not reveal any permanent deterioration affecting its functions, its performance or its appearance (flaws or broken components).

The examination of the wristband shall not reveal any failure and not present any loss of components.

The assembly of the watch head, the wristband and its functional elements (clasp, loop, etc.) shall stay functional.

4.3 Thermal shock resistance

4.3.1 Requirements and control method

The purpose of this test is to evaluate the behaviour of assemblies containing at least one element made of hard material.

The elements of external parts of watches made of hard material shall meet the specific requirements according to the methods described in SN 289 650:2013, Chapter 6.6

4.3.2 Acceptance criteria

No visible degradation shall be observed on the components or assembly tested.

4.4 Corrosion resistance

4.4.1 Requirements and control method

The purpose of this test is to evaluate hard material elements or assemblies against corrosive agents.

The elements of external parts of watches made of hard material shall meet the specific requirements of ISO 9227 and SN 289 650:2013, particularly concerning the following tests:

— ISO 9227, (*Neutral salt spray test*);

— SN 289 650:2013, Chapter 6.2, (*Synthetic sweat test*).

4.4.2 Acceptance criteria

No visible degradation shall be observed on the components or assembly tested.

4.5 Wear resistance

4.5.1 Requirements and control method

The purpose of this test is to evaluate the potential degradation of the element made of hard material due to random wear.

The elements of external parts of watches made of hard material shall meet the specific requirements of ISO 23160:2011, 4.1 (*Wear resistance*).

4.5.2 Acceptance criteria

According to ISO 23160:2011, 4.1.6 *(Evaluation of results).*

NOTE The wear resistance shall be high due to customer's expectations.

4.6 Scratch resistance

4.6.1 Requirements and control method

The purpose of this test is to evaluate the potential degradation of the element made of hard material. Due to customers' expectations, the abrasive load shall be adapted in order to provide more discriminating tests than those described in ISO 23160:2011, 5.3).

The elements of external parts of watches made of hard material shall meet the specific requirements of the ISO 23160:2011, 5.2, 5.3 and 5.4 *(Scratch resistance),* using sharp edge alumina abrasive (Corundum F70), see Table 1.

Table 1 — Characteristics of the Corundum F70

Particle size	Indicative density	Hardness	Composition
$Dv_{0,5}$ 210 µm	3,96 g/cm^3	1900 HV ± 100 HV	Al_2O_3

4.6.2 Acceptance criteria

According to ISO 23160:2011, 5.6 *(Evaluation of results).*

NOTE The scratch resistance shall be high due to customers' expectations.

4.7 Impact resistance

4.7.1 Requirements and control method

The purpose of this test is to evaluate the impact resistance of a watch head and its bracelet when exposed to accidental friction against rough, hard and abrasive surfaces.

The elements of external parts of watches made of hard material shall meet the specific requirements of ISO 23160:2011, 6.2, 6.3 and 6.4 *(Impact resistance)*, particularly regarding impacts, accidental falls, and shocks in luggage/handbags.

4.7.2 Acceptance criteria

According to ISO 23160:2011, 6.6 *(Evaluation of results).*

4.8 Sunlight resistance

4.8.1 Requirements and control method

The purpose of this test is to verify the colour stability of elements made of hard material when exposed to sunlight.

The elements of external parts of watches made of hard material shall meet the specific requirements of SN 289 650:2013, Chapter 6.3 (*Artificial sunlight test*) and more specifically concerning the following tests:

Exposure of horological external parts to a light whose spectrum is close to the sun's spectrum, with a controlled energetic illumination, a temperature higher than the normal wear conditions and in an atmosphere of controlled and determinate humidity.

The control is made by comparison of the visual colour variation based on a reference sample.

4.8.2 Acceptance criteria

No colour variation shall be visible at 30 cm with the naked eye.

4.9 Mechanical behaviour of assembled elements

4.9.1 Requirements and control method

The purpose of these tests is to ensure the consumers are made aware that it is in normal use that the expectations in term of durability and resistance to external stresses are fulfilled.

When they are assembled together or with other materials, the external parts of watches made of hard material shall meet the requirements described in 4.9.2.

The applicable control methods shall be determined according to the nature of the components to be tested, for example:

— Random movements, applicable in the case of assembled wristband elements.

— Tensile/torsion tests, applicable to the terminal links that attach the wristband to the watch head.

— Tensile tests according to ISO 6425:1996, 6.7.1 and 7.3.1, applicable to complete wristwatches.

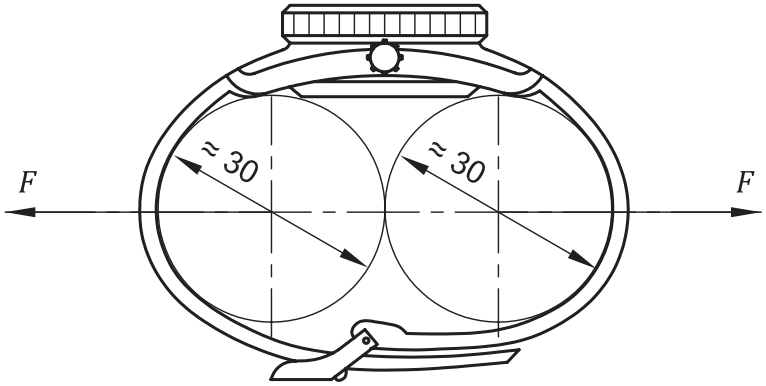

Figure 1 — Representation of the test for resistance of attachments

The levels of solicitation, intensities and the duration of the tests are to be determined between the stakeholders.

4.9.2 Acceptance criteria

No watch part shall break away, move or exhibit mechanical failure when the watch or the different components are submitted to the indicated tests in 4.9.1.

Annex A
(informative)

Hard materials

A.1 Hard material

A.1.1 Massive material

A.1.1.1 Control method

Prepare a metallographic section of a representative sample.

Check the massive character and measure the hardness into the bulk according to the ISO 3878.

In the case of composite material, make sure that the size of the indentation footprint is significantly higher than the characteristic size of the microstructure.

A.1.1.2 Acceptance criteria

The massive character is verified by the homogeneity of the microstructure across its whole section.

The hardness is checked on an average of five hardness measurements, made through the entire cross section of the specimen, and shall be higher than or equal to 1200 HV1. The test force can be adapted to satisfy the point A.1.1.

A.1.2 Mechanical properties (Flexural strength and Elastic modulus)

The Table 2 gives some non-exhaustive examples of minimum mechanical values for some generic forms of hard material.

Table 2 — Mechanical properties (Flexural strength and Elastic modulus)

Material	Flexural strength MPa	Elastic modulus GPa
Oxide ceramic	≥ 675	≥ 198
Tungsten carbide cermet	≥ 1 400	≥ 500
Titanium carbide cermet	≥ 900	≥ 320

Annex B
(informative)

Inspection rules

B.1 Inspection rules

Acceptance inspections shall be performed as specified in ISO 2859-1.

Single sampling plan for normal inspection shall be applied.

Bibliography

[1] ISO 2859-1, *Sampling procedures for inspection by attributes — Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

[2] ISO 3158, *Timekeeping instruments — Symbolization of control positions*

[3] ISO 3160-2, *Watch-cases and accessories — Gold alloy coverings — Part 2: Determination of fineness, thickness, corrosion resistance and adhesion*

[4] ISO 3327, *Hardmetals — Determination of transverse rupture strength*

[5] ISO 3878, *Hardmetals — Vickers hardness test*

[6] ISO 4505, *Hardmetals — Metallographic determination of porosity and uncombined carbon*

[7] ISO 12687, *Metallic coatings — Porosity tests — Humid sulfur (flowers of sulfur) test*

[8] ISO 14704, *Fine ceramics (advanced ceramics, advanced technical ceramics) — Test method for flexural strength of monolithic ceramics at room temperature*

[9] ISO 15732, *Fine ceramics (advanced ceramics, advanced technical ceramics) — Test method for fracture toughness of monolithic ceramics at room temperature by single edge precracked beam (SEPB) method*

[10] ISO 18754, *Fine ceramics (advanced ceramics, advanced technical ceramics)Determination of density and apparent porosity*

[11] ISO 23146, *Fine ceramics (advanced ceramics, advanced technical ceramics) — Test methods for fracture toughness of monolithic ceramics — Single-edge V-notch beam (SEVNB) method*

[12] EN 1811, *Reference test method for release of nickel from all post assemblies which are inserted into pierced parts of the human body and articles intended to come into direct and prolonged contact with the skin*

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