



BSI Standards Publication

Ergonomics of human-system interaction

Part 940: Evaluation of tactile and haptic interactions

This is a preview of "BS EN ISO 9241-940:2...". [Click here to purchase the full version from the ANSI store.](#)

National foreword

This British Standard is the UK implementation of EN ISO 9241-940:2022. It is identical to ISO 9241-940:2017. It supersedes BS ISO 9241-940:2017, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PH/9, Applied ergonomics.

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

Contractual and legal considerations

This publication has been prepared in good faith, however no representation, warranty, assurance or undertaking (express or implied) is or will be made, and no responsibility or liability is or will be accepted by BSI in relation to the adequacy, accuracy, completeness or reasonableness of this publication. All and any such responsibility and liability is expressly disclaimed to the full extent permitted by the law.

This publication is provided as is, and is to be used at the recipient's own risk.

The recipient is advised to consider seeking professional guidance with respect to its use of this publication.

This publication is not intended to constitute a contract. Users are responsible for its correct application.

© The British Standards Institution 2022
Published by BSI Standards Limited 2022

ISBN 978 0 539 18935 3

ICS 13.180; 35.180

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

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 November 2017.

Amendments/corrigenda issued since publication

Date	Text affected
30 June 2022	This corrigendum renumbers BS ISO 9241-940:2017 as BS EN ISO 9241-940:2022. The supersession details in the national foreword have also been updated.

EUROPÄISCHE NORM

March 2022

ICS 35.180; 13.180

English Version

Ergonomics of human-system interaction - Part 940: Evaluation of tactile and haptic interactions (ISO 9241-940:2017)

Ergonomie de l'interaction homme-système
- Partie 940: Évaluation des interactions
tactiles et haptiques (ISO 9241-940:2017)

Ergonomie der Mensch-System-Interaktion -
Teil 940: Evaluation taktiler und haptischer
Interaktionen (ISO 9241-940:2017)

This European Standard was approved by CEN on 13 March 2022.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

This is a preview of "BS EN ISO 9241-940:2...". [Click here to purchase the full version from the ANSI store.](#)

European foreword

The text of ISO 9241-940:2017 has been prepared by Technical Committee ISO/TC 159 "Ergonomics" of the International Organization for Standardization (ISO) and has been taken over as EN ISO 9241-940:2022 by Technical Committee CEN/TC 122 "Ergonomics" the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by September 2022, and conflicting national standards shall be withdrawn at the latest by September 2022.

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

Any feedback and questions on this document should be directed to the users' national standards body. A complete listing of these bodies can be found on the CEN website.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Endorsement notice

The text of ISO 9241-940:2017 has been approved by CEN as EN ISO 9241-940:2022 without any modification.

This is a preview of "BS EN ISO 9241-940:2...". Click here to purchase the full version from the ANSI store.

Contents

	Page
Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	2
4 Conformance	4
5 How to use ISO 9241-940	4
5.1 Structure.....	4
5.2 Uses of this document.....	5
5.3 Evaluation in the design and development lifecycle.....	5
5.4 Planning activities.....	6
5.5 Initial assessment.....	6
5.6 Unique aspects of haptic interaction.....	7
6 Types of evaluation methods	8
6.1 General.....	8
6.2 Physical measurements against requirements.....	8
6.3 Inspection by an expert.....	8
6.4 Usability test.....	8
6.4.1 General.....	8
6.4.2 Measurement context.....	8
6.4.3 Evaluation data.....	9
7 Quality of haptic interaction	10
7.1 Quality model.....	10
7.2 Haptic system attributes.....	11
7.2.1 Quality attributes.....	11
7.2.2 Haptic device attributes (see Annex A).....	11
7.2.3 Haptic user interface attributes.....	12
7.3 Usability attributes.....	12
7.3.1 Context of use (see Annex D).....	12
7.3.2 Specific usage qualities (see Annex E).....	13
7.3.3 Human-centred quality (see Annex F).....	14
7.4 Evaluation matrix.....	14
7.4.1 Types of attributes.....	14
7.4.2 Measures of haptic quality.....	14
8 Guide to the annexes	17
Annex A (informative) Haptic device attributes	18
Annex B (informative) Haptic effect design principles	27
Annex C (informative) Haptic effect task elements	34
Annex D (informative) Context of use	40
Annex E (informative) Specific usage qualities	43
Annex F (informative) Human-centred quality	50
Annex G (informative) Gesture attributes	61
Annex H (informative) Examples of evaluation of device attributes	72
Annex I (informative) Unique aspects of haptic interaction	86
Annex J (normative) Evaluation by usability walkthrough or usability task test	88
Bibliography	108

This is a preview of "BS EN ISO 9241-940:2...". Click here to purchase the full version from the ANSI store.

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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 159, *Ergonomics*, Subcommittee SC 4, *Ergonomics of human-system interaction*.

A list of all parts in the ISO 9241 series can be found on the ISO website.

This is a preview of "BS EN ISO 9241-940:2...". [Click here to purchase the full version from the ANSI store.](#)

Introduction

Tactile and haptic interactions are becoming increasingly important as interaction modalities in special purpose computing environments and assistive technologies. This document explains how to evaluate attributes of the haptic device and the user interface, and the outcomes of interaction with a haptic device, along with an assessment of human-centred quality and other and more specific usage qualities.

This document can be used to identify the measures to be used when establishing requirements for haptic interaction, and to evaluate haptic interactions to identify problems, to establish benchmarks or to evaluate whether a haptic system meets requirements.

A haptic interaction involves sensory or motor activity in the skin, muscles, joints and tendons; a tactile interaction refers specifically to touch (sensory activity in the skin).

In a haptic interaction, a user typically employs a device to manipulate objects in the virtual world of the computer and also to feel the result of the manipulation through sensors in the skin and joints. This is the bidirectional sense of haptics. Haptics is important in the design of switches in traditional keyboards and mice, but here, we consider computer interaction by means other than keyboard, mouse and passive joysticks.

Haptic interactions can also work in a passive unidirectional sense, conveying information to the skin without active motion or exploration on the part of the user. A cell phone on vibration mode is one such unidirectional tactile device. They can also work in an active unidirectional sense, as the user makes gestures that send commands or data to a device.

Tactile and kinaesthetic haptic interactions are being developed in university and industrial laboratories in many countries, and a variety of commercial products exist that incorporate tactile and kinaesthetic interactions. Both the developer and the prospective purchaser of such interactions and their associated devices and software need a means of making comparisons between competing choices.

Other International Standards are cross-referenced in order to understand and point out the specific differences in evaluating haptic interactions. The nature of these interactions, whether bidirectional, unidirectional from the device to the skin or body of the user, or unidirectional as gestures from the body of the user to the device, sets them apart as a group of interactions that needs special consideration in relation to the forms of evaluation which are appropriate.

ISO 9241-910 provides a common set of terms, definitions, and descriptions of the various concepts involved in designing and using haptic interactions. It provides an overview of the range of haptic applications, objects, attributes, and interactions.

ISO 9241-920 provides basic guidance in the design of haptic interactions.

ISO 9241-960 provides guidance for the definition of gestures in human-machine interactions. It explains how to describe their features and what factors to take into account when defining gestures.

This document provides evaluation processes specific to haptic interactions and the devices that enable them. It shows how requirements set out in ISO 9241-910, ISO 9241-920 and other International Standards can be applied to actual haptic systems and specific interactions. In a parallel way, it shows how the usability of a haptic system can be evaluated, taking into account quality attributes such as effectiveness, efficiency, user satisfaction and avoidance of harm from use.

This is a preview of "BS EN ISO 9241-940:2...". [Click here to purchase the full version from the ANSI store.](#)

This is a preview of "BS EN ISO 9241-940:2...". Click here to purchase the full version from the ANSI store.

Ergonomics of human-system interaction —

Part 940: Evaluation of tactile and haptic interactions

1 Scope

This document

- describes the types of methods that can be used for the evaluation of haptic devices and of systems that include haptic devices,
- specifies a procedure for the evaluation of haptic interactions by a usability walkthrough or usability test (see [Annex J](#)), and
- provides guidance on the types of methods that are appropriate for the evaluation of specific attributes of haptic systems, cross-referenced to the guidance in the relevant clauses of other International Standards (see [Annexes A, B, C, D, E, F and G](#)).

It applies to the following types of interaction:

- augmented reality — information overlaid on a real scene, e.g. vibrating belt indicating distance;
- gesture control of a device or a virtual scenario;
- unidirectional interaction such as a vibrating phone or a vibrating belt;
- virtual environment — virtual space with which a user can interact with the aid of a haptic device.

This document applies to the following types of devices:

- gesture sensor, e.g. video that discerns 3D hand movements, touch screens that sense 2D touches;
- kinaesthetic haptic device, e.g. desktop haptic interface;
- tactile display, e.g. vibrating phone.

This document is not applicable to standard input devices such as keyboards, mice or track balls.

NOTE ISO 9241-400 covers standard input devices, and ISO 9241-411 applies to the evaluation of input devices such as keyboards and mice.

This document can be used to identify the types of methods and measures for

- establishing benchmarks,
- establishing requirements for haptic interaction,
- identifying problems with haptic interaction (formative evaluation), and
- use of the criteria to establish whether a haptic system meets requirements (summative evaluation).

2 Normative references

There are no normative references in this document.