

# SVENSK STANDARD

## SS-EN ISO 16610-40:2015

Fastställt/Approved: 2015-06-07  
Publicerad/Published: 2015-06-15  
Utgåva/Edition: 1  
Språk/Language: engelska/English  
ICS: 17.020; 17.040.20; 17.040.30

---

### **Geometrisk produktspecifikation (GPS) – Filtrering – Del 40: Morfologiska profilfilter: Grundläggande begrepp (ISO 16610-40:2015)**

### **Geometrical product specifications (GPS) – Filtration – Part 40: Morphological profile filters: Basic concepts (ISO 16610-40:2015)**

This preview is downloaded from [www.sis.se](http://www.sis.se). Buy the entire standard via <https://www.sis.se/std-8014454>

# Standarder får världen att fungera

*SIS (Swedish Standards Institute) är en fristående ideell förening med medlemmar från både privat och offentlig sektor. Vi är en del av det europeiska och globala nätverk som utarbetar internationella standarder. Standarder är dokumenterad kunskap utvecklad av framstående aktörer inom industri, näringsliv och samhälle och befrämjar handel över gränser, bidrar till att processer och produkter blir säkrare samt effektiviserar din verksamhet.*

## Delta och påverka

Som medlem i SIS har du möjlighet att påverka framtida standarder inom ditt område på nationell, europeisk och global nivå. Du får samtidigt tillgång till tidig information om utvecklingen inom din bransch.

## Ta del av det färdiga arbetet

Vi erbjuder våra kunder allt som rör standarder och deras tillämpning. Hos oss kan du köpa alla publikationer du behöver – allt från enskilda standarder, tekniska rapporter och standardpaket till handböcker och onlinetjänster. Genom vår webbtjänst e-nav får du tillgång till ett lättnavigerat bibliotek där alla standarder som är aktuella för ditt företag finns tillgängliga. Standarder och handböcker är källor till kunskap. Vi säljer dem.

## Utveckla din kompetens och lyckas bättre i ditt arbete

Hos SIS kan du gå öppna eller företagsinterna utbildningar kring innehåll och tillämpning av standarder. Genom vår närhet till den internationella utvecklingen och ISO får du rätt kunskap i rätt tid, direkt från källan. Med vår kunskap om standarders möjligheter hjälper vi våra kunder att skapa verklig nytta och lönsamhet i sina verksamheter.

**Vill du veta mer om SIS eller hur standarder kan effektivisera din verksamhet är du välkommen in på [www.sis.se](http://www.sis.se) eller ta kontakt med oss på tel 08-555 523 00.**



# Standards make the world go round

*SIS (Swedish Standards Institute) is an independent non-profit organisation with members from both the private and public sectors. We are part of the European and global network that draws up international standards. Standards consist of documented knowledge developed by prominent actors within the industry, business world and society. They promote cross-border trade, they help to make processes and products safer and they streamline your organisation.*

## Take part and have influence

As a member of SIS you will have the possibility to participate in standardization activities on national, European and global level. The membership in SIS will give you the opportunity to influence future standards and gain access to early stage information about developments within your field.

## Get to know the finished work

We offer our customers everything in connection with standards and their application. You can purchase all the publications you need from us - everything from individual standards, technical reports and standard packages through to manuals and online services. Our web service e-nav gives you access to an easy-to-navigate library where all standards that are relevant to your company are available. Standards and manuals are sources of knowledge. We sell them.

## Increase understanding and improve perception

With SIS you can undergo either shared or in-house training in the content and application of standards. Thanks to our proximity to international development and ISO you receive the right knowledge at the right time, direct from the source. With our knowledge about the potential of standards, we assist our customers in creating tangible benefit and profitability in their organisations.

**If you want to know more about SIS, or how standards can streamline your organisation, please visit [www.sis.se](http://www.sis.se) or contact us on phone +46 (0)8-555 523 00**



Europastandarden EN ISO 16610-40:2015 gäller som svensk standard. Detta dokument innehåller den officiella engelska versionen av EN ISO 16610-40:2015.

Denna standard ersätter SIS-ISO/TS 16610-40:2008, utgåva 1.

The European Standard EN ISO 16610-40:2015 has the status of a Swedish Standard. This document contains the official English version of EN ISO 16610-40:2015.

This standard supersedes the Swedish Standard SIS-ISO/TS 16610-40:2008, edition 1.

**Förhållandet till övriga delar under samma huvudtitel - Utdrag ur Förord i ISO 16610-49:2015/  
Relations to other parts under the same general title - Extract from the Foreword of ISO 16610-49:2015**

ISO 16610 consists of the following parts, under the general title *Geometrical product specifications (GPS) — Filtration*:

- Part 1: Overview and basic concepts
- Part 20: Linear profile filters: Basic concepts
- Part 21: Linear profile filters: Gaussian filters
- Part 22: Linear profile filters: Spline filters
- Part 28: Profile filters: End effects
- Part 29: Linear profile filters: Spline wavelets
- Part 30: Robust profile filters: Basic concepts
- Part 31: Robust profile filters: Gaussian regression filters
- Part 32: Robust profile filters: Spline filters
- Part 40: Morphological profile filters: Basic concepts
- Part 41: Morphological profile filters: Disk and horizontal line-segment filters
- Part 49: Morphological profile filters: Scale space techniques
- Part 60: Linear areal filters: Basic concepts
- Part 61: Linear areal filters: Gaussian filters
- Part 71: Robust areal filters: Gaussian regression filters
- Part 85: Morphological areal filters: Segmentation

The following parts are planned:

- Part 26: Linear profile filters: Filtration on nominally orthogonal grid planar data sets
- Part 27: Linear profile filters: Filtration on nominally orthogonal grid cylindrical data sets
- Part 45: Morphological profile filters: Segmentation
- Part 62: Linear areal filters: Spline filters
- Part 69: Linear areal filters: Spline wavelets
- Part 70: Robust areal filters: Basic concepts
- Part 72: Robust areal filters: Spline filters
- Part 80: Morphological areal filters: Basic concepts
- Part 81: Morphological areal filters: Sphere and horizontal planar segment filters
- Part 89: Morphological areal filters: Scale space techniques

© Copyright/Upphovsrätten till denna produkt tillhör SIS, Swedish Standards Institute, Stockholm, Sverige.

Användningen av denna produkt regleras av slutanvändarlicensen som återfinns i denna produkt, se standardens sista sidor.

© Copyright SIS, Swedish Standards Institute, Stockholm, Sweden. All rights reserved. The use of this product is governed by the end-user licence for this product. You will find the licence in the end of this document.

*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.*

*Information about the content of the standard is available from the Swedish Standards Institute (SIS), telephone +46 8 555 520 00. Standards may be ordered from SIS Förlag AB, who can also provide general information about Swedish and foreign standards.*

Denna standard är framtagen av kommittén för Mätteknik GPS och Ytstruktur, SIS/TK 507/AG 6.

Har du synpunkter på innehållet i den här standarden, vill du delta i ett kommande revideringsarbete eller vara med och ta fram andra standarder inom området? Gå in på [www.sis.se](http://www.sis.se) - där hittar du mer information.



EUROPEAN STANDARD

**EN ISO 16610-40**

NORME EUROPÉENNE

EUROPÄISCHE NORM

June 2015

---

ICS 17.040.20

English Version

**Geometrical product specifications (GPS) - Filtration - Part 40:  
Morphological profile filters: Basic concepts (ISO 16610-  
40:2015)**

Spécification géométrique des produits (GPS) - Filtrage -  
Partie 40: Filtres de profil morphologiques: Concepts de  
base (ISO 16610-40:2015)

Geometrische Produktspezifikation (GPS) - Filterung - Teil  
40: Morphologische Profilfilter: Grundlegende Konzepte  
(ISO 16610-40:2015)

This European Standard was approved by CEN on 21 February 2015.

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, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, 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: Avenue Marnix 17, B-1000 Brussels**

<b>Contents</b>		Page
<b>Foreword</b> .....		<b>iv</b>
<b>Introduction</b> .....		<b>vi</b>
<b>1 Scope</b> .....		<b>1</b>
<b>2 Normative references</b> .....		<b>1</b>
<b>3 Terms and definitions</b> .....		<b>1</b>
<b>4 Basic concepts</b> .....		<b>3</b>
4.1 Minkowski sums .....		3
4.1.1 General .....		3
4.1.2 Minkowski addition .....		3
4.1.3 Minkowski subtraction .....		4
4.2 Morphological operations .....		4
4.2.1 General .....		4
4.2.2 Dilation .....		4
4.2.3 Erosion .....		5
4.2.4 Opening .....		5
4.2.5 Closing .....		6
4.2.6 Higher order morphological operations .....		6
4.2.7 Properties of morphological operations .....		7
<b>5 Morphological filters</b> .....		<b>7</b>
5.1 General .....		7
5.2 Fill transform .....		7
5.3 Discrete morphological filters .....		8
5.4 Envelope filters .....		8
5.5 Sampling and reconstruction .....		8
<b>Annex A (informative) Concept diagram</b> .....		<b>13</b>
<b>Annex B (informative) Relationship to the filtration matrix model</b> .....		<b>14</b>
<b>Annex C (informative) Relationship to the GPS matrix model</b> .....		<b>15</b>
<b>Bibliography</b> .....		<b>16</b>

## **Foreword**

This document (EN ISO 16610-40:2015) has been prepared by Technical Committee ISO/TC 213 “Dimensional and geometrical product specifications and verification” in collaboration with Technical Committee CEN/TC 290 “Dimensional and geometrical product specification and verification” the secretariat of which is held by AFNOR.

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 December 2015, and conflicting national standards shall be withdrawn at the latest by December 2015.

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

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, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

### **Endorsement notice**

The text of ISO 16610-40:2015 has been approved by CEN as EN ISO 16610-40:2015 without any modification.

## Introduction

This part of ISO 16610 is a geometrical product specification (GPS) standard and is to be regarded as a general GPS standard (see ISO/TR 14638). It influences the chain links 3 and 5 of all chains of standards.

The ISO/GPS Masterplan given in ISO 14638 gives an overview of the ISO/GPS system of which this part of ISO 16610 is a part. The fundamental rules of ISO/GPS given in ISO 8015 apply to this part of ISO 16610 and the default decision rules given in ISO 14253-1 apply to specifications made in accordance with this part of ISO 16610, unless otherwise indicated.

For more detailed information about the relation of this part of ISO 16610 to the GPS matrix model, see [Annex C](#).

This part of ISO 16610 develops the terminology and concepts for morphological operations and filters, including envelope filters.



# Geometrical product specifications (GPS) — Filtration —

## Part 40:

# Morphological profile filters: Basic concepts

## 1 Scope

This part of ISO 16610 sets out the basic concepts and terminology for morphological operations and filters, including envelope filters.

## 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 17450-1:2011, *Geometrical product specifications (GPS) — Geometrical concepts — Part 1: Model for geometrical specification and verification*

ISO 16610-1:2015, *Geometrical product specifications (GPS) — Filtration — Part 1: Overview and basic concepts*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 16610-1, ISO 17450-1, and the following apply.

### 3.1

#### **morphological operation**

binary operation involving two geometrical objects as sets, resulting in another geometrical object

Note 1 to entry: Dilation and erosion are two primary morphological operations, and closing and opening are two secondary morphological operations.

Note 2 to entry: Geometrical objects are point sets, i.e. set of points.

### 3.2

#### **morphological filter**

*morphological operation* (3.1) that is both *monotonically increasing* (3.11) and *idempotent* (3.12)

### 3.3

#### **envelope filter**

*closing* (3.10) or *opening* (3.9) filter, whose output envelops the input profile or surface

Note 1 to entry: A closing filter generates the upper envelope; an opening filter generates the lower envelope.

### 3.4

#### **Minkowski addition**

vector sum of points in two given geometrical sets

### 3.5

#### **Minkowski subtraction**

binary operation defined using *Minkowski addition* (3.4) of two sets

Note 1 to entry: It is the complement of the Minkowski addition of the complement of the first set with the second set.

**3.6**  
**structuring element**

⟨morphological filters⟩ second geometrical object used in morphological operations

**3.7**  
**dilation**

⟨morphological⟩ morphological operation that expands one input set by another

Note 1 to entry: Dilation is not a morphological filter because it is not idempotent.

**3.8**  
**erosion**

⟨morphological⟩ morphological operation that shrinks one input set by another

Note 1 to entry: Erosion is not a morphological filter because it is not idempotent.

**3.9**  
**opening**

⟨morphological filters⟩ morphological operation obtained by applying the *erosion* (3.8) followed by the *dilation* (3.7)

Note 1 to entry: An opening is both a morphological filter and one of the two basic building blocks for other morphological filters.

**3.10**  
**closing**

⟨morphological filters⟩ morphological operation obtained by applying the *dilation* (3.7) followed by the *erosion* (3.8)

Note 1 to entry: A closing is both a morphological filter and one of the two basic building blocks for other morphological filters.

**3.11**  
**monotonically increasing**

⟨morphological filters⟩ property of an operation that preserves the set containment condition on its operands

**3.12**  
**idempotent**

property of an operation such that applying the operation more than once does not change the outcome

**3.13**  
**extensive**

⟨morphological filters⟩ property of an operation that the output of the operation contains the input

**3.14**  
**anti-extensive**

⟨morphological filters⟩ property of an operation that the output of an operation is contained in the input

**3.15**  
**fill transform**

operation that converts a profile into a two-dimensional object and a surface into a three-dimensional object

**3.16**  
**umbra transform**

*fill transform* (3.15) applicable to open profiles and open surfaces

**3.17**  
**rigid body transformation**

operation on a geometric object involving translations and rotations that do not change the distance between any two points in the object

### 3.18

#### rigid motion invariant

property of an operation that does not change under *rigid body transformation* (3.17)

## 4 Basic concepts

### 4.1 Minkowski sums

#### 4.1.1 General

Minkowski sums refer to Minkowski additions and Minkowski subtractions involving sets of geometric objects in any dimension. Geometric objects are represented by sets of points.

NOTE A concept diagram for the concepts for morphological filters is given in [Annex A](#). The relationship to the filtration matrix model is given in [Annex B](#).

#### 4.1.2 Minkowski addition

Minkowski addition of two sets,  $A$  and  $B$ , is denoted  $A \oplus B$ , and is defined as the vector addition

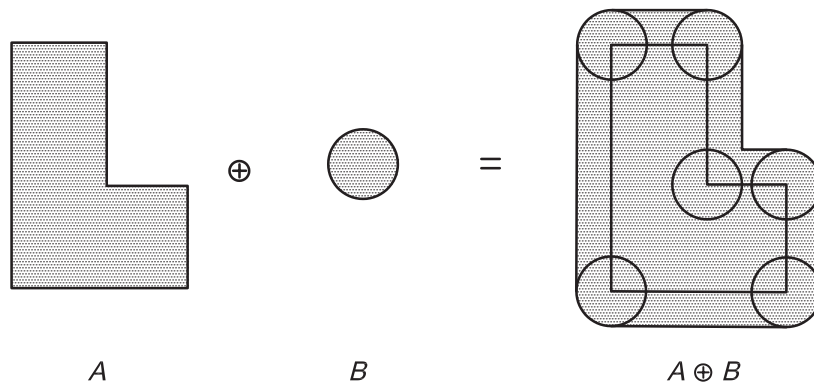
$$A \oplus B = \{a + b : a \in A, b \in B\} \quad (1)$$

[Figure 1](#) illustrates the Minkowski addition of two sets,  $A$  and  $B$ , in two dimensions.

NOTE 1 Sets  $A$  and  $B$  can be of any dimensionality. They can also be of mixed dimensionality, e.g.  $A$  can be three-dimensional and  $B$  can be two-dimensional. Sets in one, two, and three dimensions are of interest.

NOTE 2 Minkowski addition can be viewed as the sweep of one set over the other set. This can be seen in the construction of  $A \oplus B$  in [Figure 1](#). Minkowski addition leads to an enlargement of the sets that are added.

NOTE 3 Minkowski addition is commutative, i.e.  $A \oplus B = B \oplus A$ , as can be verified from the definition of Minkowski addition.



NOTE Shaded areas are the sets.

**Figure 1 — Minkowski addition of two sets**