INTERNATIONAL STANDARD

ISO 12085

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Geometrical Product Specification (GPS) — Surface texture: Profile method — Motif parameters

Spécification géométrique des produits (GPS) — État de surface: Méthode du profil — Paramètres liés aux motifs

Reference number
ISO 12085:1996(E)

Contents

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Annexes

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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 12085 was prepared jointly by Technical Committees ISO/TC 57, *Metrology and properties of surfaces,* Subcommittee SC 1, *Geometrical parameters — Instruments and procedures for measurement of surface roughness and waviness,* ISO/TC 3, *Limits and fits* and ISO/TC 10, *Technical drawings, product definition and related documentation,* Subcommittee SC 5, *Dimensioning and tolerancing.*

Annex A forms an integral part of this International Standard. Annexes B, C and D are for information only.

Introduction

This International Standard is a Geometrical Product Specification (GPS) standard and is to be regarded as a General GPS standard (see ISO/TR 14638). It influences links 2, 3 and 4 of the surface texture chain of standards on roughness profile and waviness profile.

For more detailed information of the relation of this International Standard to other GPS standards, see annex C.

The approach described in this International Standard facilitates the determining roughness and waviness parameters from the primary profile by finding those motifs which characterize the surface under consideration. This method is independent of any profile filter and results in parameters which are based on the depth and spacing of the motifs. These parameters, which are complementary to those defined in ISO 4287, can be used to describe the functional properties of workpieces as indicated in Annex B.

Geometrical Product Specification (GPS) — Surface texture: Profile method — Motif parameters

1 Scope

This International Standard defines terms and parameters used for determining surface texture by the motif method. It also describes the corresponding ideal operator and measuring conditions.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 1302:1992, *Technical drawings — Method of indicating surface texture.*

ISO 3274:1996, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Nominal characteristics of contact (stylus) instruments.*

ISO 4287:1996, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Terms, definitions and parameters of surface texture.*

ISO 4288:1996, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Rules and procedures for the assessment of surface texture.*

3 Definitions

For the purposes of this International Standard the following definitions apply.

3.1 General definitions

3.1.1 surface profile: (See ISO 4287.)

3.1.2 primary profile: (See ISO 3274.)

3.1.3 local peak of profile: A part of a profile between two adjacent minima of the profile (see figure 1).

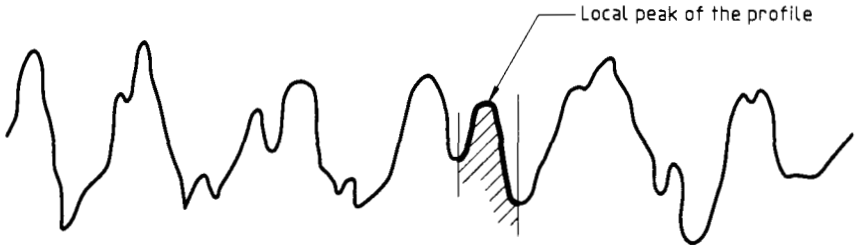


Figure 1 — Local peak of profile

3.1.4 local valley of profile: A part of a profile between two adjacent maxima of the profile (see figure 2).

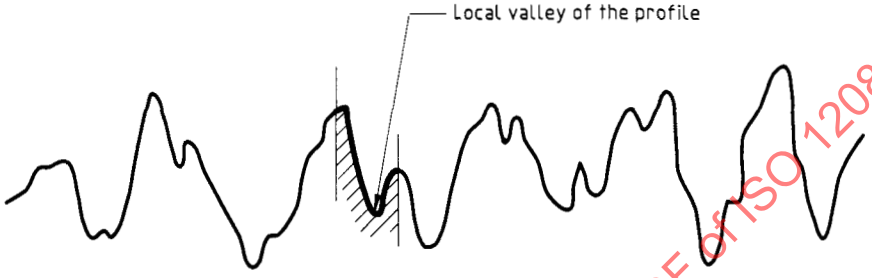


Figure 2 — Local valley of profile

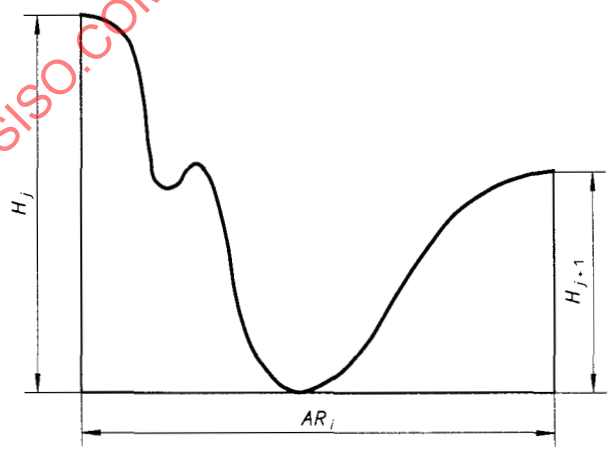
3.1.5 motif: A portion of the primary profile between the highest points of two local peaks of the profile, which are not necessarily adjacent.

A motif is characterized by (see figures 3 and 5):

— its length, AR_i or AW_i, measured parallel to the general direction of the profile;

— its two depths, H_j and H_{j+1}, or Hw_j and Hw_{j+1}, measured perpendicular to the general direction of the primary profile;

— its T characteristic, that is the smallest depth between the two depths.



$T = \text{MIN}\,[H_j ; H_{j+1}]$
here: $T = H_{j+1}$

Figure 3 — Roughness motif

3.1.6 roughness motif: Motif derived by using the ideal operator with limit value A (see figure 3).

NOTE 1 By this definition, a roughness motif has a length AR_i smaller than or equal to A.

3.1.7 upper envelope line of the primary profile (waviness profile): Straight lines joining the highest points of peaks of the primary profile, after conventional discrimination of peaks (see figure 4).

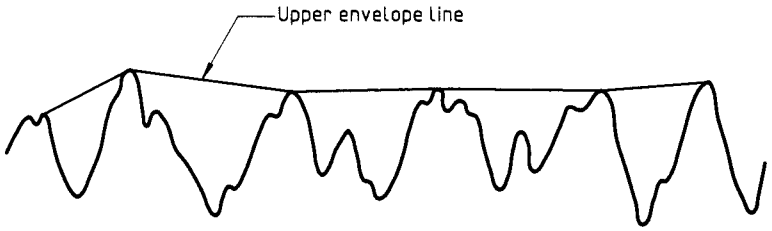


Figure 4 — Upper envelope line

3.1.8 waviness motif: Motif derived on the upper envelope line by using the ideal operator with limit value B (see figure 5).

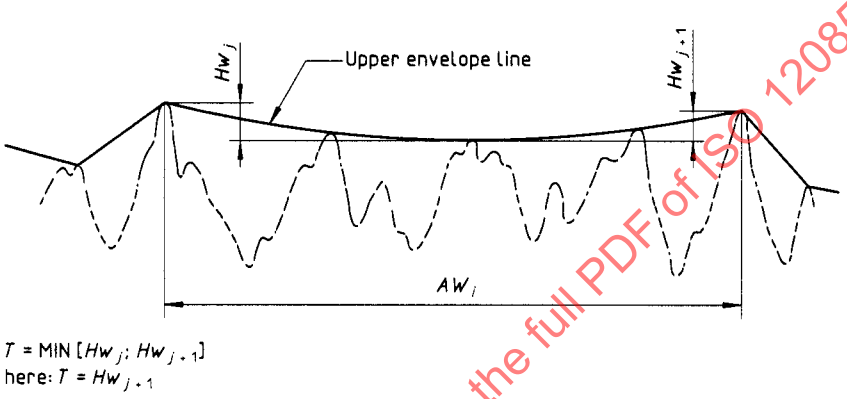


Figure 5 — Waviness motif

3.2 Parameter definitions

3.2.1 mean spacing of roughness motifs, AR: The arithmetical mean value of the lengths AR_i of roughness motifs, within the evaluation length (see figure 6), i.e.

$$AR = \frac{1}{n} \sum_{i=1}^{n} AR_i$$

where n is the number of roughness motifs (equal to the number of AR_i values).

3.2.2 mean depth of roughness motifs, R: The arithmetical mean value of the depths H_j of roughness motifs, within the evaluation length (see figure 6), i.e.

$$R = \frac{1}{m} \sum_{j=1}^{m} H_j$$

where m is the number of H_j values.

NOTE 2 The number of H_j values is twice the number of AR_i values ($m = 2n$).

3.2.3 maximum depth of profile irregularity, Rx: The largest depth, H_j, within the evaluation length.

EXAMPLE

On figure 6: $Rx = H_3$.

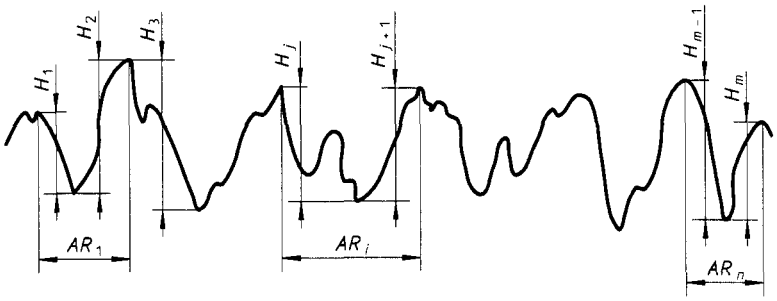


Figure 6 — Roughness parameters

3.2.4 mean spacing of waviness motifs, AW**:** The arithmetical mean value of the lengths AW_i of waviness motifs, within the evaluation length (see figure 7), i.e.

$$AW = \frac{1}{n} \sum_{i=1}^{n} AW_i$$

where n is the number of waviness motifs (equal to the number of AW_i values).

3.2.5 mean depth of waviness motifs, W**:** The arithmetical mean value of the depths Hw_j of waviness motifs, within the evaluation length (see figure 7), i.e.

$$W = \frac{1}{m} \sum_{j=1}^{m} Hw_j$$

where m is the number of Hw_j values.

NOTE 3 The number of Hw_j values is twice the number of AW_i values ($m = 2n$).

3.2.6 maximum depth of waviness, Wx**:** The largest depth Hw_j, within the evaluation length (see figure 7).

3.2.7 total depth of waviness, Wte**:** The distance, measured in a direction perpendicular to the general direction of the primary profile, between the highest point and the lowest point of the upper envelope line of the primary profile (see figure 7).

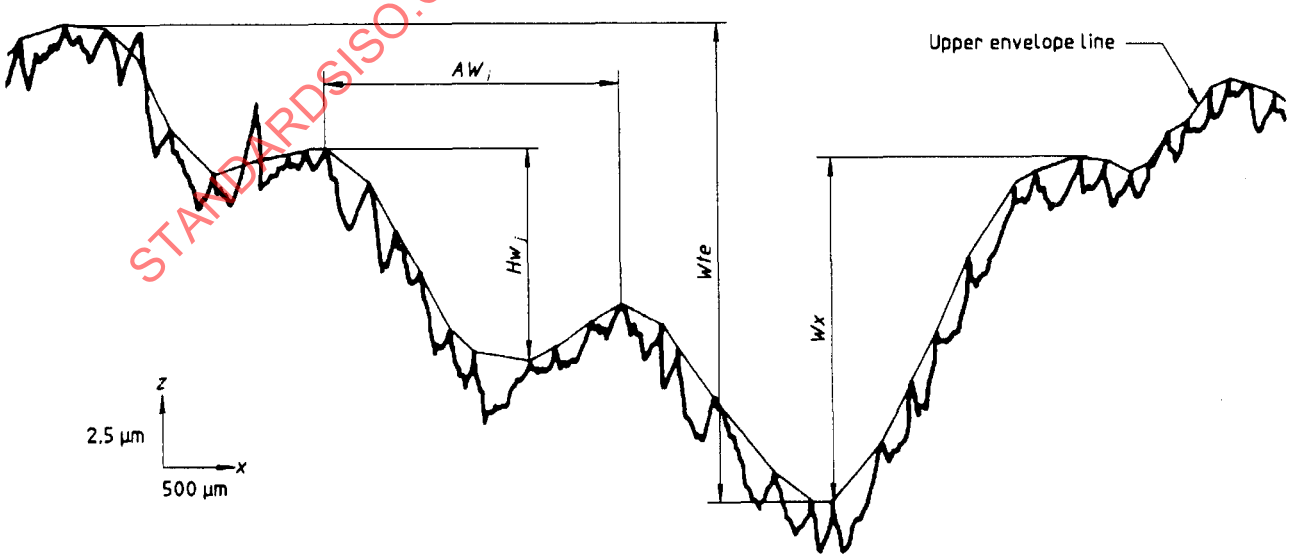


Figure 7 — Waviness parameters

4 Theoretically exact operator of the motif method

4.1 General

This clause describes the identification conditions of motifs (length and depth discrimination) and presents the process for calculating roughness and waviness parameters.

4.2 Conventional limits of motifs

The recommended values for limits A and B as described in figure 8 are given under clause 5.

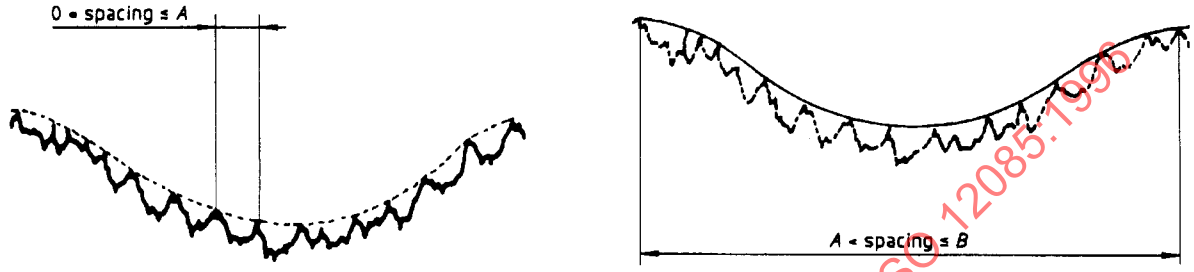


Figure 8 — Conventional limits of motifs

4.3 Depth discrimination

The depth discrimination applies to the primary profile for the assessment of surface roughness.

4.3.1 Discrimination based on minimum depth

Divide the primary profile into sections of width $A/2$, and take the height of each rectangle.

The local peaks taken into account are those whose depth is larger than 5 % of the mean height of these rectangles (see figure 9).

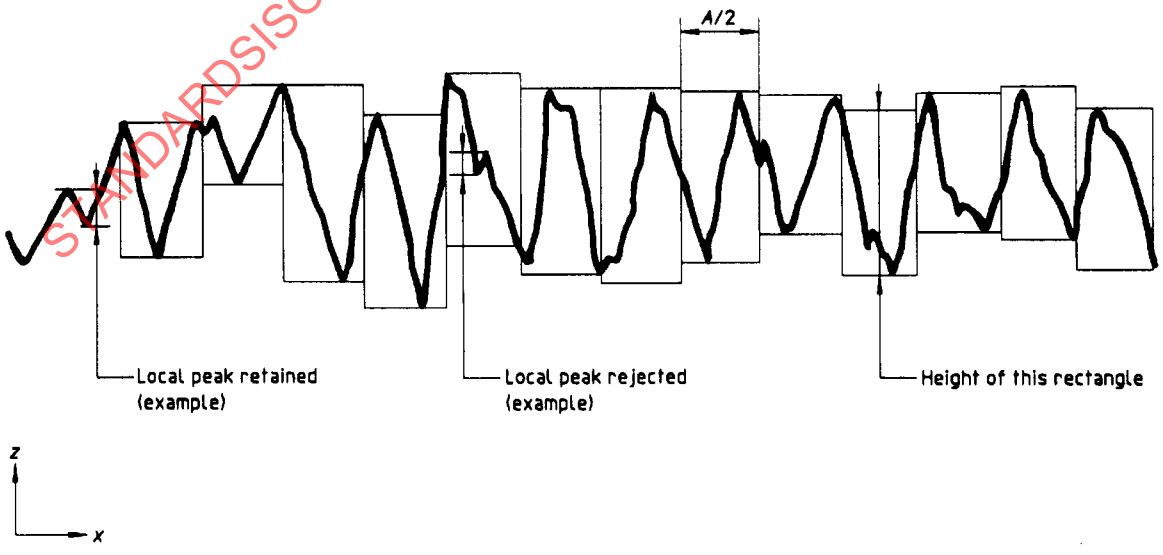


Figure 9 — Depth discrimination

4.3.2 Discrimination based on maximum depth

For the roughness motifs the depths of which are H_j, the value $\overline{H_j}$ (mean value of H_j) and σH_j (standard deviation) are calculated. Any depth of local peak or valley the value of which is larger than $H = \overline{H_j} + 1{,}65\ \sigma H_j$, is levelled equal to the H value (see figure 10).

NOTE 4 If the distribution of H_j is Gaussian, this condition concerns 5 % of the peaks and valleys. This discrimination obviates the risk of high isolated peaks interfering with the envelope line.

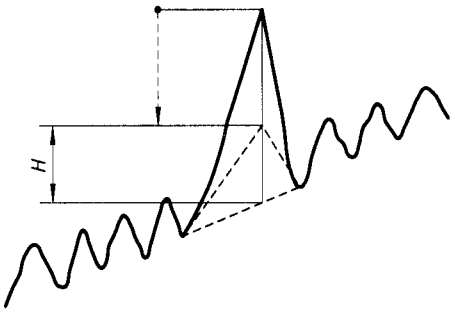


Figure 10 — Discrimination based on maximum depth

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4.4 Identification of roughness and waviness motifs through the combination of motifs

(These four conditions are related to figure 11.) In figure 11, R stands for roughness and W for waviness.

I Envelope condition

The first condition retains peaks, which are higher than one of the adjacent peaks.

II Length condition

The second condition limits the length of motif to the A value (conventional limit between roughness and waviness) or the B value (conventional limit between waviness and residual form), as defined in 4.2 and 5.2.

III Enlargement condition

The third condition eliminates the smallest peaks, by trying to find the largest motif possible.

It does not allow the combining of two motifs into one motif, longer than the two original ones, if it results in a motif the T characteristic of which is smaller than one of the two original motifs.
(It eliminates small peaks which are inserted between large peaks.)

IV Similar depth condition

The fourth condition limits combination of motifs with similar depths, particularly for periodical surfaces.
(It avoids eliminating peaks the depth of which is similar to adjacent peaks.)

The combination algorithm shall be applied until no further combination can be accomplished.

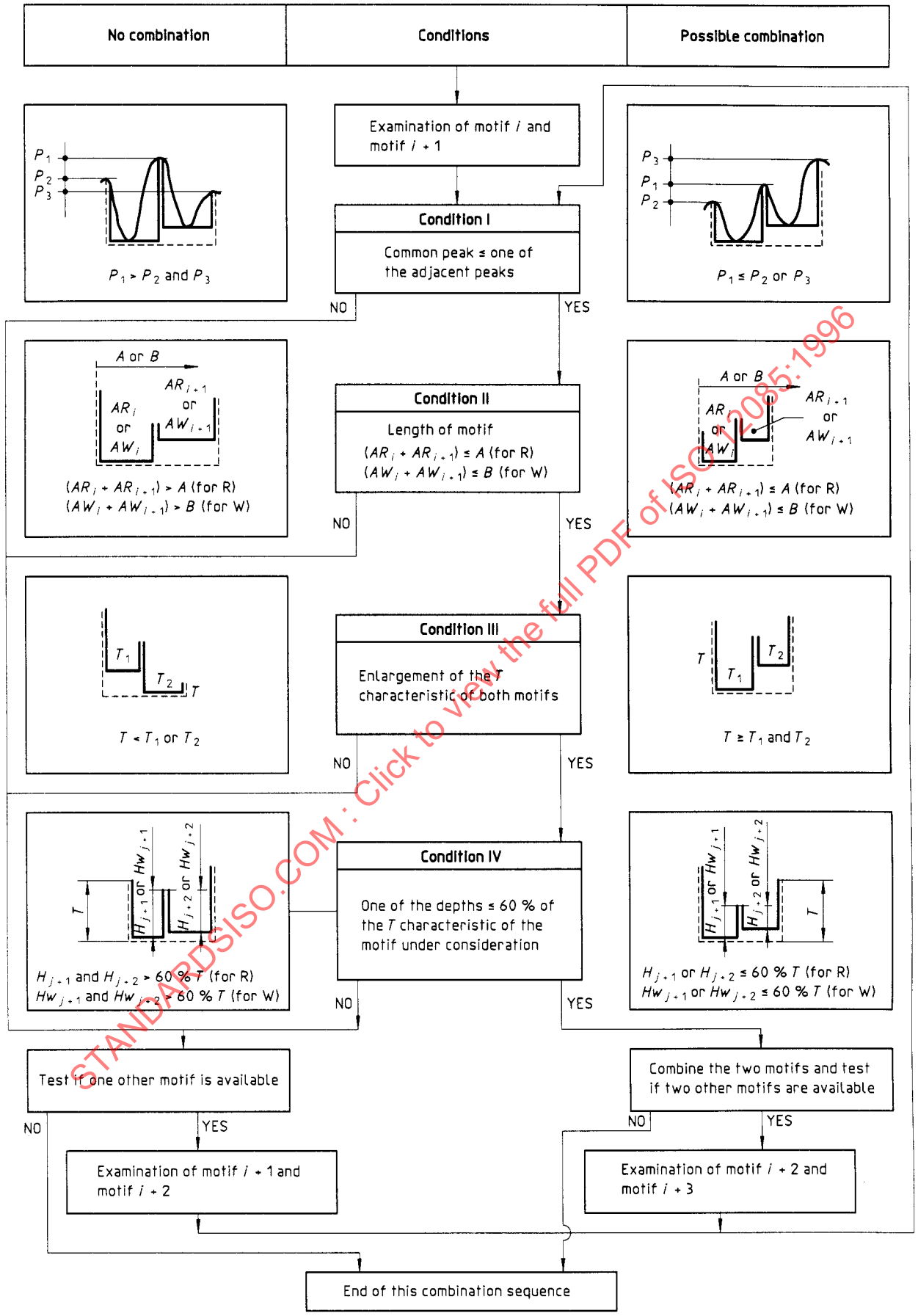
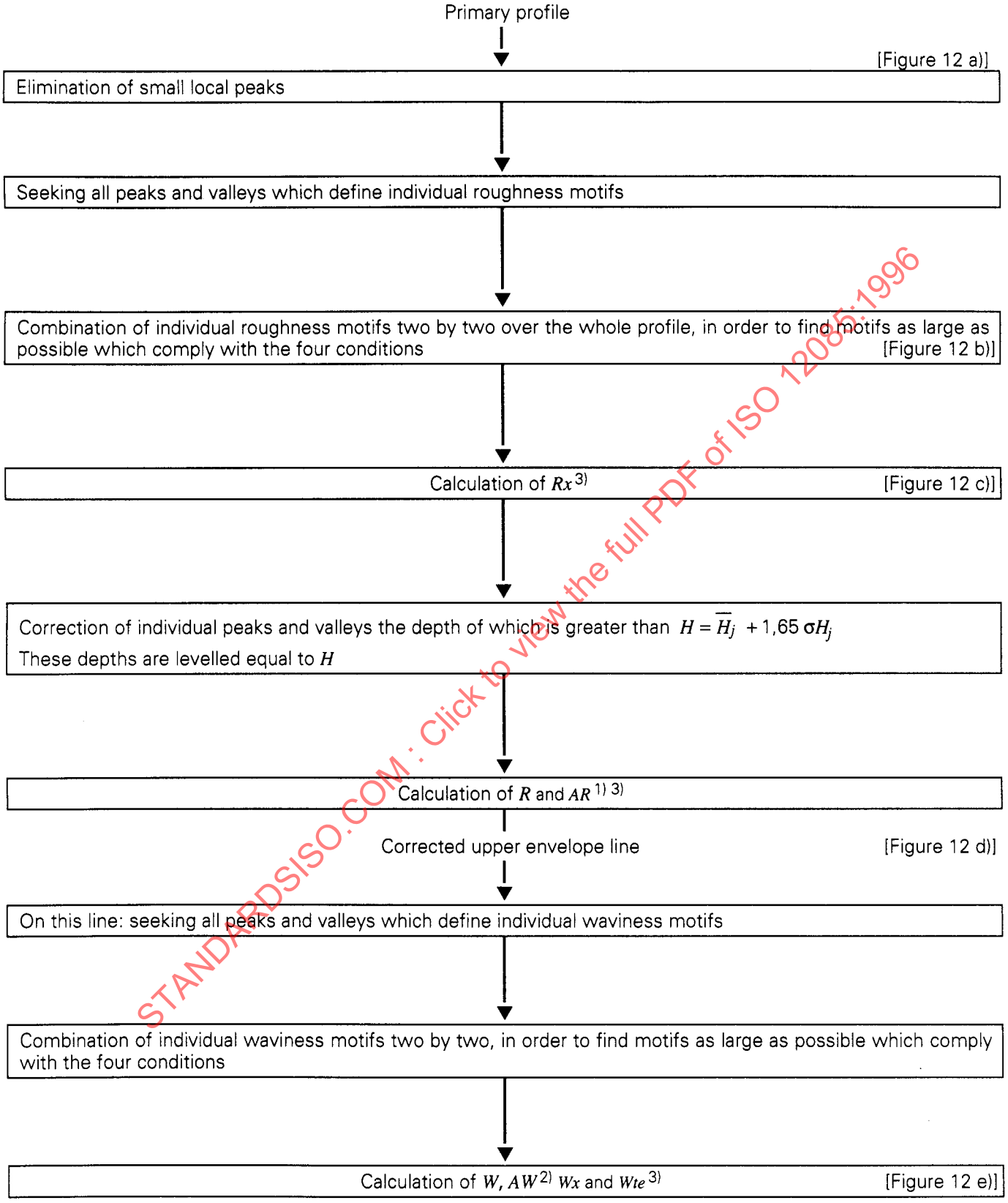


Figure 11 — Combination of motifs

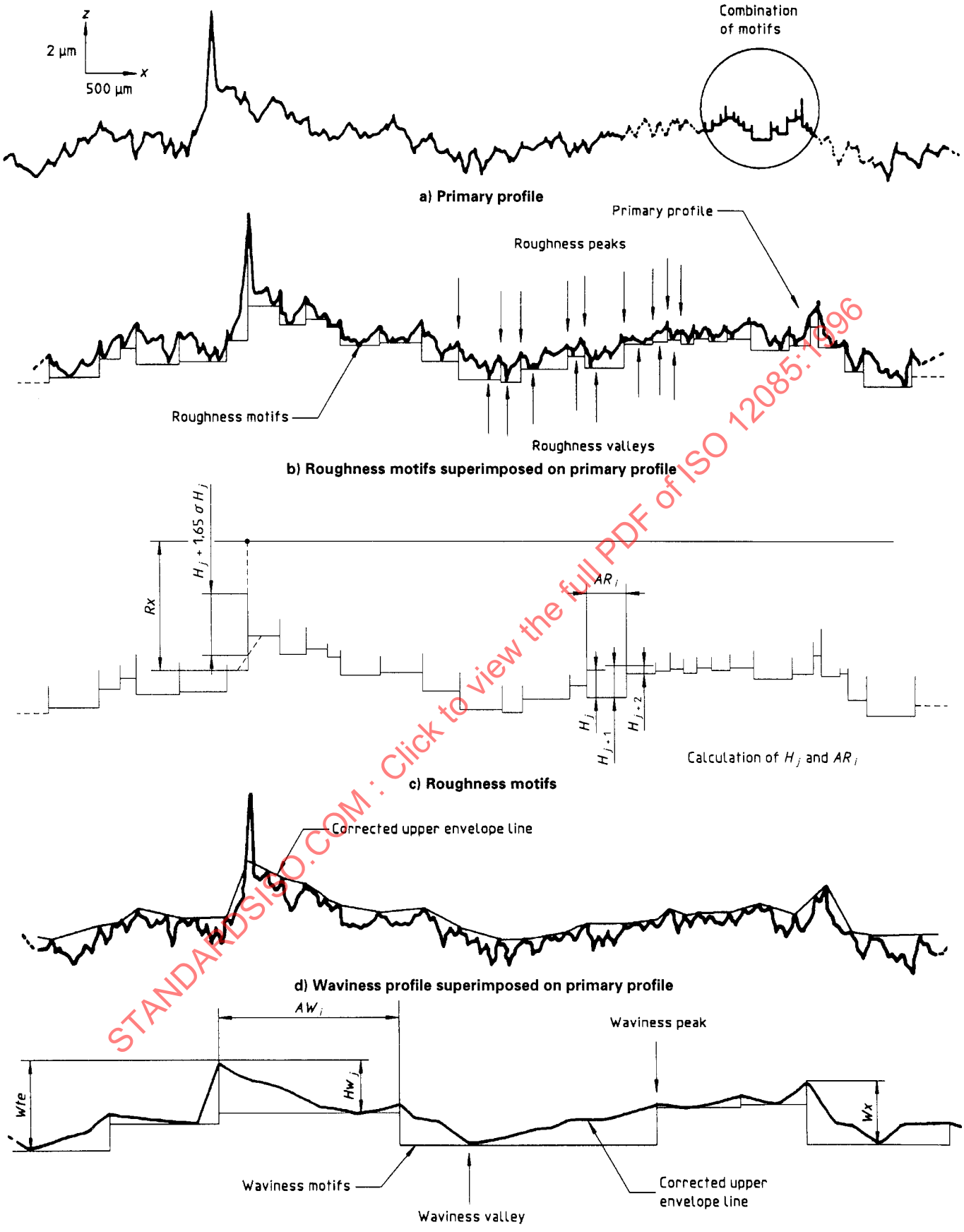
4.5 Procedure for parameter calculation



1) *R* and *AR* parameters are calculated for at least three motifs.

2) *W* and *AW* parameters are calculated for at least three motifs.

3) If there are less than three motifs, *Rx*, or *Wx*, is calculated.



a) Primary profile

b) Roughness motifs superimposed on primary profile

c) Roughness motifs

d) Waviness profile superimposed on primary profile

e) Waviness motifs superimposed on waviness profile

Figure 12 — Illustration of procedure for parameter calculation

5 Measuring conditions of parameters

5.1 Convention concerning traversing the primary profile

In order to calculate waviness parameters, the primary profile shall be measured relative to a reference guide (see ISO 3274).

5.2 Recommended measurement conditions

The recommended measurement conditions (see ISO 3274) are stated in table 1.

Table 1

A[1] mm	B[1] mm	**Traversing length** mm	**Evaluation length** mm	λs µm	**Maximum stylus tip radius** µm
0,02	0,1	0,64	0,64	2,5	2 ± 0,5
0,1	0,5	3,2	3,2	2,5	2 ± 0,5
0,5	2,5	16	16	8	5 ± 1
2,5	12,5	80	80	25	10 ± 2

1) If not otherwise specified, the default values shall be A = 0,5 mm and B = 2,5 mm, respectively.

5.3 Profile quantization step

The parameters covered by this standard are only valid if the primary profile contains a minimum of 150 vertical quantization steps.

5.4 Rule for acceptance

The 16 % rule given in ISO 4288 applies for motif parameters.

5.5 Use of motifs method for analysis of multiprocess surfaces

The corrected upper envelope line can be used as an alternative to the filter defined in ISO 13565-1, for the assessment of parameters *Rk*, *Rpk* and *Rvk* defined in ISO 13565-2. In this case, these parameters are named *Rke*, *Rpke* and *Rvke*.

5.6 Indications on the drawings

The motif parameters are specified on the drawings according to ISO 1302.

Annex A
(normative)

Calculation method for combination of motifs

In order to have reproducible results with existing apparatus, the method of calculation given in A.1 to A.3 shall be applied in the software (see figure A.1).

A.1 Profile decomposition in "segments", the length of which is smaller than or equal to "A" for roughness and "B" for waviness ("A" and "B" values in 5.2)

Find two peaks P_i, P_{i+1} satisfying the following conditions:

— the horizontal distance between these two peaks is maximum;

— this horizontal distance is smaller than or equal to A or B (see table 1);

— there is no peak between them, higher than either of them.

The part of the profile comprised between these two peaks is called "segment".

A.2 Motif combination inside each segment

Inside each segment, the three conditions I, III, IV of 4.4 are successively tested on each pair of motifs. The combination of two individual motifs is only possible if these three conditions are fulfilled.

For condition IV, the minimum (H_{j+1}, H_{j+2}) is compared to 60 % of the vertical reference T of the segment (T = minimum of the two heights h_1, h_2 of the segment) and not to that of the possible combined motif.

When all individual motifs inside the segment have been successively tested, the combination operation is performed again from the beginning of the segment until no combination is possible inside this segment.

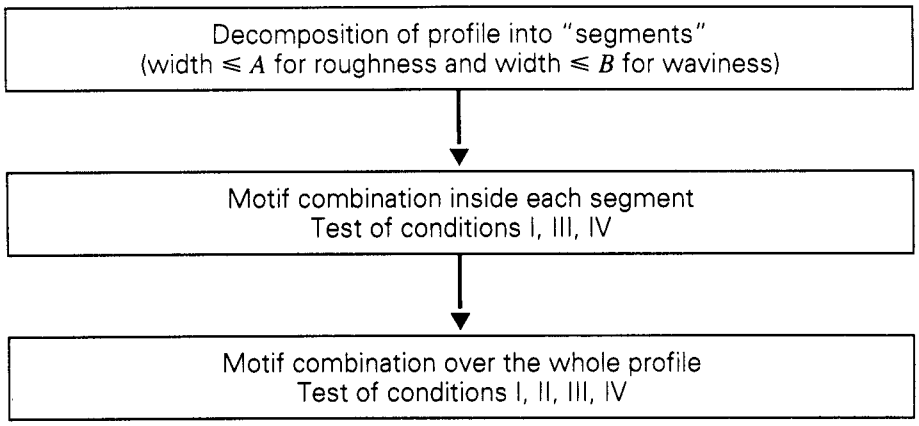
The following segments are then examined in the same manner.

A.3 Combination over the whole profile

All motifs resulting from the previous step are combined two by two over the whole profile. For each pair of motifs, the conditions I, II, III, IV are successively tested. The two considered motifs are combined only if these four conditions are fulfilled. For condition IV, the vertical characteristic T is the minimum of the two heights of the possible combined motif considered.

When all motifs of the profile are successively tested, the combination operation is performed again from the beginning of the profile until no combination is possible.

A.4 Summary of the calculation method for combination of motifs



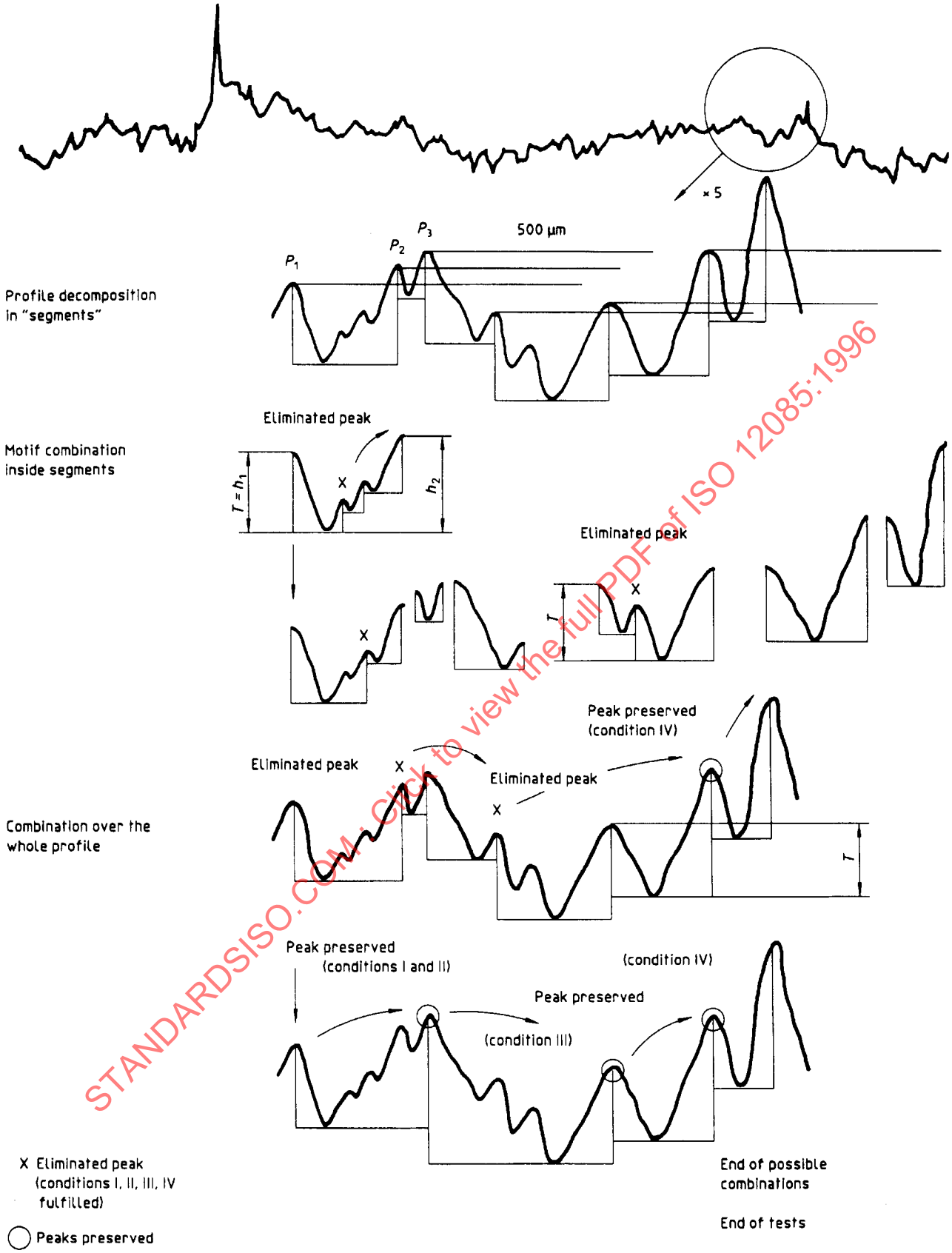


Figure A.1 — Combination of motifs

Annex B
(informative)

Relation between motif parameters and function of surfaces

Table B.1 gives, for information, the motif parameters which can be specified according to the function of surfaces.

Table B.1

Surface		Functions applied to the surface		Parameters								
				Roughness profile			Waviness profile				Primary profile	
		Designations	Symbol*)	*R*	*Rx*	*AR*	*W*	*Wx*	*Wte*	*AW*	*Pt*	*P&c*
two parts in contact	with relative displacement	Slipping (lubricated)	FG	●			≤ 0,8*R*			○		●
		Dry friction	FS	●		○		●		○		
		Rolling	FR	●			≤ 0,3*R*	●		○		○
		Resistance to hammering	RM	○		○	○			○		●
		Fluid friction	FF	●		○				○		
		Dynamic sealing with gasket	ED	●	○	○	≤ 0,6*R*	●		○		
		Dynamic sealing without gasket	ED	○	●		≤ 0,6*R*					●
	without displacement	Static sealing with gasket	ES	○	●		≤ *R*		○	○		
		Static sealing without gasket	ES	○	●		≤ *R*		●			
		Adjustment without displacement with stress	AC	○								●
		Adherence (bonding)	AD	●							○	
Independent surface	with stress	Tools (cutting surface)	OC	○		○	●			●		
		Fatigue strengths	EA	○	●	○						○
	without stress	Corrosion resistance	RC	●	●							
		Paint coating	RE			○				○		
		Electrolytic coating	DE	●	≤ 2*R*	●						
		Measures	ME	●			≤ *R*					
		Appearance (aspect)	AS	●		○	○			○		

● Most important parameters: specify at least one of them.
○ Secondary parameters: to be specified if necessary according to the part functions.
The indication ≤ 0,8*R*, for example, means that, if the symbol FG is indicated on the drawing, and *W* not otherwise specified, the upper tolerance on *W* is equal to the upper tolerance on *R* multiplied by 0,8.

*) The symbols (FG, etc.) are acronyms of French designations.