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INTERNATIONAL STANDARD

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Guidance for installation procedures and tolerances of hydroelectric machines – Part 1: General aspects

Lignes directrices des procédures et tolérances d'installation des machines hydroélectriques – Partie 1: Aspects généraux

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Guidance for installation procedures and tolerances of hydroelectric machines – Part 1: General aspects

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

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Part 1: General aspects

FOREWORD

International Standard IEC 63132-1 has been prepared by IEC technical committee 4: Hydraulic turbines.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
4/380/FDIS	4/390/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 63132 series, published under the general title *Guidance for installation procedures and tolerances of hydroelectric machines*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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GUIDANCE FOR INSTALLATION PROCEDURES AND TOLERANCES OF HYDROELECTRIC MACHINES –

Part 1: General aspects

1 Scope

The purpose of this part of IEC 63132 is to establish, in a general way, suitable procedures and tolerances for the installation of hydroelectric turbines and generators. This document presents a typical assembly. There are many possible ways to assemble a unit. The size of the machines, design of the machines, layout of the powerhouse and delivery schedule of the components are some of the elements that could result in additional steps, the elimination of some steps and/or assembly sequences.

It is understood that a publication of this type will be binding only if, and to the extent that, both contracting parties have agreed upon it.

Installations for refurbishment projects or for small hydro projects are not in the scope of this document. An agreement between all parties is necessary.

This document excludes matters of purely commercial interest, except those inextricably bound up with the conduct of installation.

The tolerances in this document have been established upon best practices and experience, although it is recognized that other standards specify different tolerances.

Wherever this document specifies that documents, drawings or information is supplied by a manufacturer (or manufacturers), each individual manufacturer will furnish the appropriate information for their own supply only.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

4 Concept

4.1 General

For vertical units, reference axes are defined in relation to upstream, looking at the unit from the generator end (see Figure 1). Upstream corresponds to the Y+ axis, 0° and 12 h 00. The angles increase in the clockwise direction; therefore, the X+ axis corresponds to 90°, the right hand side and 3 h 00.

For horizontal units, upstream is replaced by vertical up and downstream replaced by vertical down.

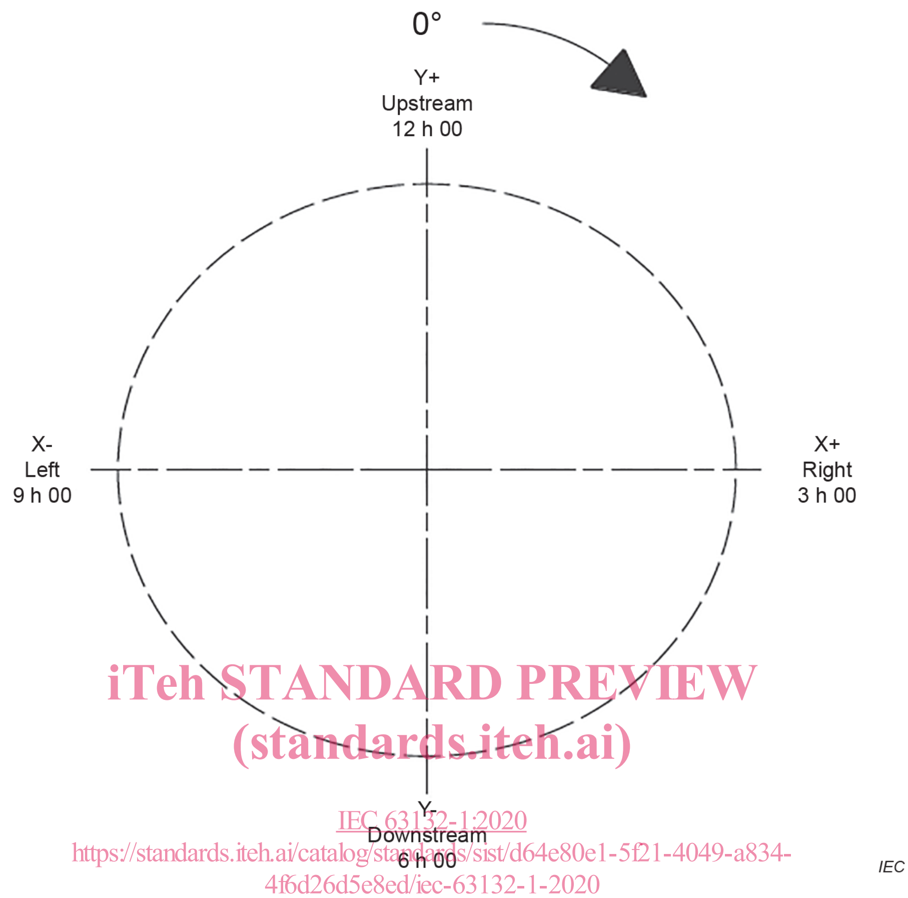

Figure 1 – Axes definition for vertical units

4.2 Reference centre

The reference centre is the best centre of the designated (or specific) component that all other components should be aligned to.

4.3 Best centre

The best centre of a circular shape component corresponds to the point for which the circularity has the minimal deviation. Its location is calculated from a set of radii at equal angles and measured from the reference centre.

Determination:

The components x and y of the best centre from the reference centre can be calculated with the following two formulae, where 0° is located upstream and the angle increases clockwise:

$$x = \frac{2}{n} \sum_{i=1}^{n} R_i \sin(\theta_i)$$

$$y = \frac{2}{n} \sum_{i=1}^{n} R_i \cos(\theta_i)$$

where

n is the number of readings;

R_i is the measured radius;

θ_i is the angular position of each measurement.

Table 1 shows a sample calculation.

Table 1 – Sample calculation

Reading #	Angle	Component	X	Y	Calulated X	Calculated Y	Component centered with reference center
1	0°	99,65	0,00	99,65	-0,11	99,98	99,98
2	45°	99,95	70,68	70,68	70,57	71,01	100,11
3	90°	100,05	100,05	0,00	99,94	0,33	99,94
4	135°	100,25	70,89	-70,89	70,78	-70,55	99,94
5	180°	100,45	0,00	-100,45	-0,11	-100,12	100,12
6	225°	100,05	-70,75	-70,75	-70,86	-70,41	99,89
7	270°	100,00	-100,00	0,00	-100,11	0,33	100,11
8	315°	99,60	-70,43	70,43	-70,54	70,76	99,91
		Best centre (X,Y)	0,11	-0,33		Circularity	0,22
		Concentricity	0,35				
		Angle	162°				

The explanation of how to calculate the best centre is given below (see Figure 2):

X(#4) = 100,25 × sin135° = 70,89

Y(#4) = 100,25 × cos135° = –70,89

bcX = {0,00 + 70,68 + 100,05 + 70,89 + 0,00 + (–70,75) + (–100,00) + (–70,43)} × 2/8 = 0,11

bcY = {99,65 + 70,68 + 0,00 + (–70,89) + (–100,45) + (–70,75) + 0,00 + 70,43} × 2/8 = –0,33

Concentricity: $\sqrt{(0{,}11)^2 + (-0{,}33)^2} = 0{,}35$

Thus the best centre of the component is located 0,11 units upstream (Y+) and 0,33 units to the left (X–) of the reference centre. Calculated radii based on the Best Centre as the new reference can be calculated in order to calculate circularity.

Calculated X(#4) = X(#4) – bcX = 70,89 – 0,11 = 70,78

Calculated Y(#4) = Y(#4) – bcY = –70,89 – (–0,33) = –70,55

Calculated radius (#4) = $\sqrt{(70{,}78)^2 + (-70{,}55)^2} = 99{,}94$

Circularity: max. – min. = 100,12 – 99,89 = 0,22

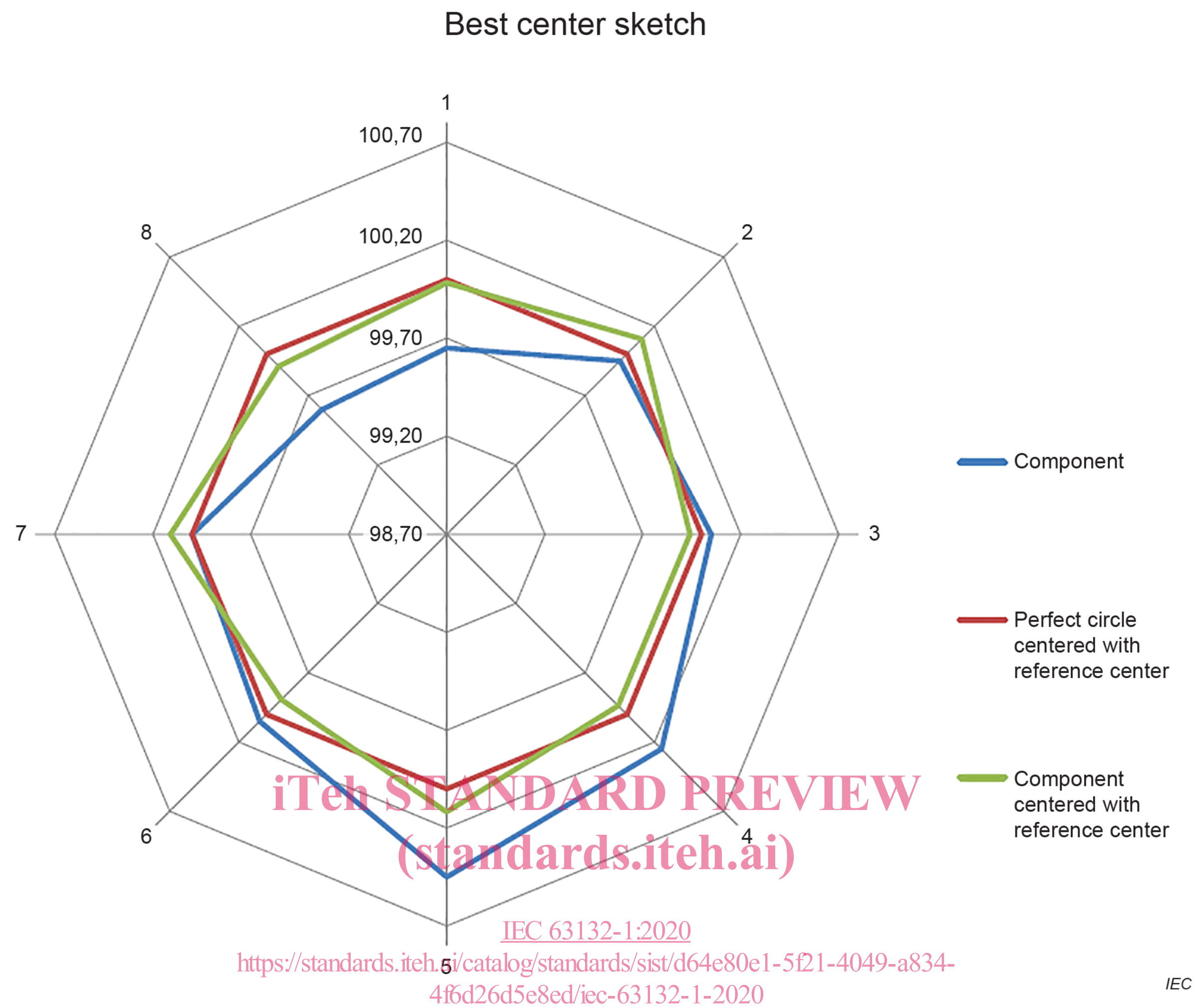

Figure 2 – Best centre sample calculation

4.4 Concentricity

The concentricity is the radial distance, d, from the reference centre to the best centre of the component (see Figure 3).

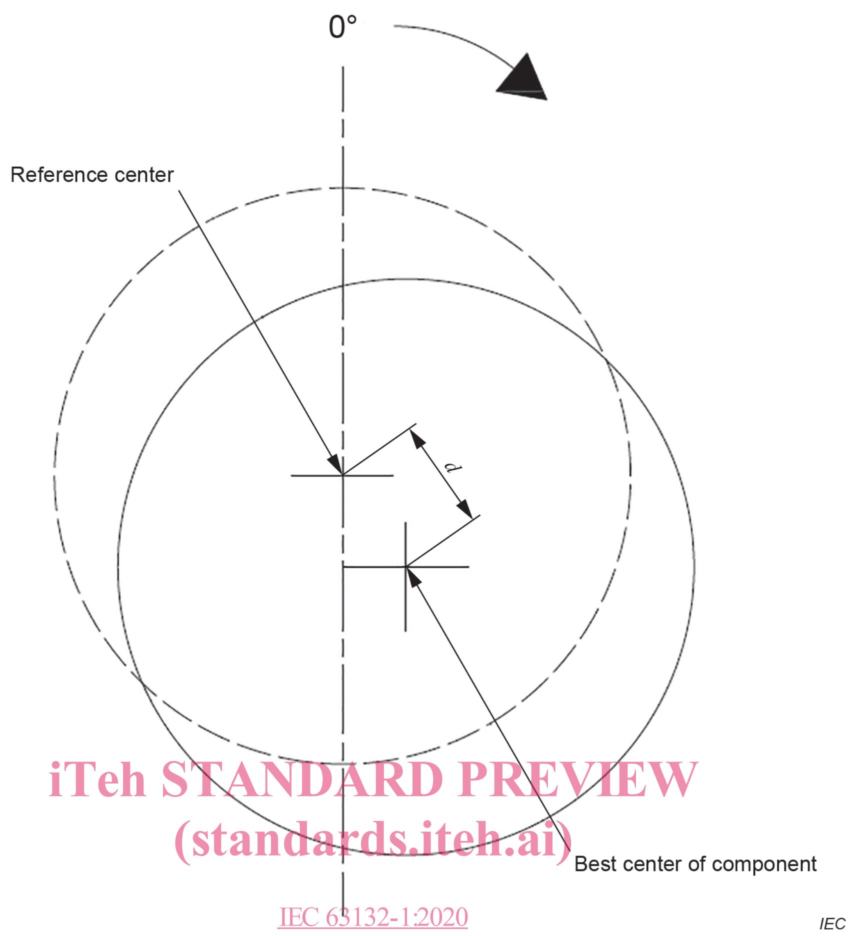

Figure 3 – Concentricity

4.5 Circularity

Circularity is the difference between the maximum and minimum radii, measured from the component best centre (see Figure 4).

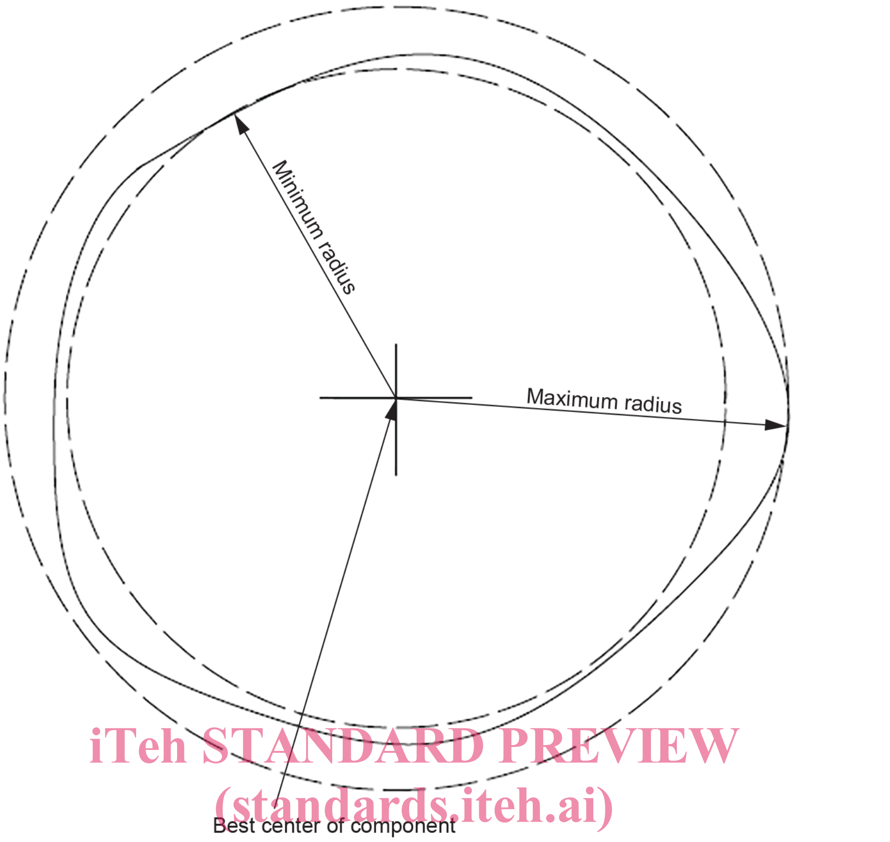

Figure 4 – Circularity

4.6 Reference horizontal plane

The reference horizontal plane is a horizontal plane located at the average elevation of a feature on the component that the other component should be aligned to.

4.7 Reference vertical plane

The reference vertical plane is a vertical plane located at the average distance of a feature on the component that the other component should be aligned to.

4.8 Best fit plane

The best fit plane is a calculated plane which represents a surface. The best fit plane minimizes the sum of perpendicular distances from each measurement point to the plane.

4.9 Axis of rotation

The axis of rotation is the axis that all points on the rotating components rotate about.

4.10 Junction

A step s, where two components meet, or where the projection of one component meets the other component (in cases where they are not in direct contact). See Figure 5.

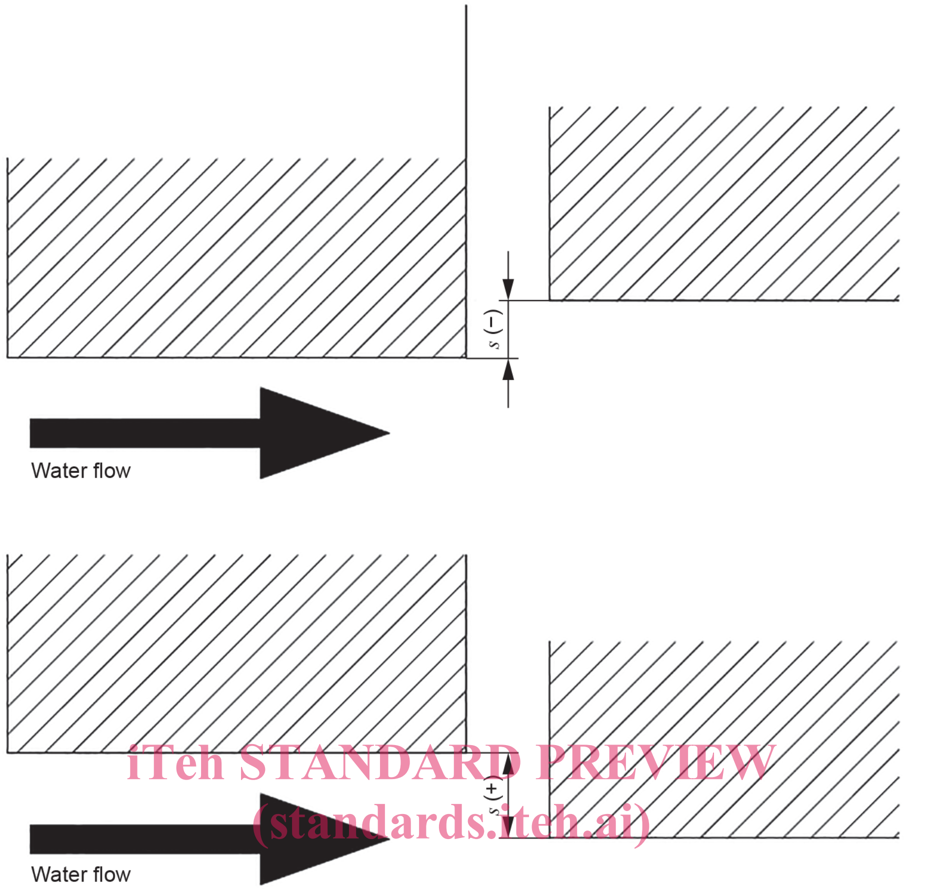

Figure 5 – Junction

4.11 Elevation

The vertical distance to a horizontal plane located at the average elevation of a feature on the component from the reference horizontal plane (see Figure 6).

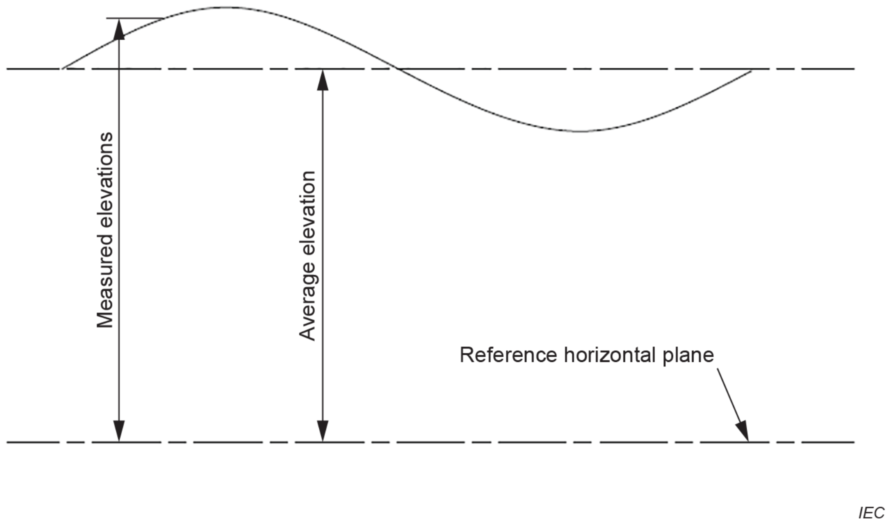

Figure 6 – Elevation

4.12 Level

The level, as used in this document, is the deviation of the best fit plane, calculated from a series of equally spaced elevation measurements, from a reference horizontal plane (see Figure 7).

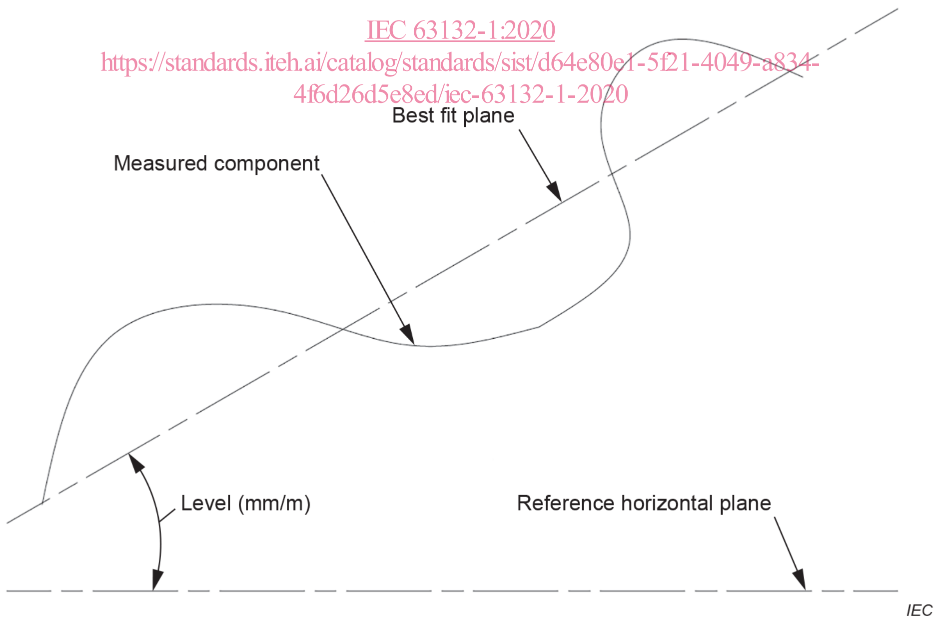

Figure 7 – Level

4.13 Inclination

Inclination is the slope of a best fit plane of a vertical surface with respect to a vertical reference plane(s) (see Figure 8).