



# Mechanical Tolerance Guidelines for Hydroelectric Generators

VibroSystM guidelines are based on 15 years experience with dynamic air gap measurement and data interpretation, as well as on the guidelines established by the Canadian Electrical Association (CEA) and Hydro-Québec. VibroSystM guidelines apply to dynamic measurements obtained with its monitoring equipment.

The values are conservative<sup>†</sup> by design and for reference only; further results analysis and other considerations are recommended before initiating an intervention on the machine. With the Results Interpretation Service (RIS), VibroSystM offers its expertise in data analysis of hydroelectric machine condition and behavior.

Parameters	Deviation <sup>◇</sup>		
	Assembly	Acceptable	Critical
<b>Rotor-Stator Mechanical Tolerances</b>			
Maximum Air Gap Variation	< 13% <sup>†</sup>	13 — 30%	> 30%
Stator Roundness	< 7%	7 — 20%	> 20%
Stator Concentricity	< 5%	5 — 10%	> 10%
Rotor Roundness	< 6%	6 — 10%	> 10%
Rotor Concentricity	< 1.2%	1.2 — 4%	> 4%
Minimum Air Gap	> 85%	85 — 50%	< 50%
<b>Vibration</b>			
Shaft (0—300 rpm)	< 102 / 4.0 <sup>*</sup>	102 — 305 / 4.0 — 12.0	> 305 / 12.0
Shaft (300—1200 rpm)	< 51 / 2.0	51 — 152 / 2.0 — 6.0	> 152 / 6.0
Stator Core	< 25 / 1.0	25 — 51 / 1.0 — 2.0	> 51 / 2.0
Stator Frame	< 25 / 1.0	25 — 127 / 1.0 — 5.0	> 127 / 5.0

<sup>◇</sup> Table for dynamic measurements obtained with VibroSystM monitoring equipment

<sup>†</sup> Air Gap expressed in percentage (%) of nominal air gap at Static—Cold

<sup>\*</sup> Vibration expressed in µm / mils Peak-Peak

**References** Guide for Erection Tolerances and Shaft System Alignment, Canadian Electrical Association (CEA)  
Guide technique – Division Études et Normalisation, VP Ingénierie, Hydro-Québec  
Latest revision by Genexpert for VibroSystM in January 2005

Definitions on back of page



## Definitions:

<b>Tolerance</b>	<i>Permissible zone</i> within which a point, axis or plane of a component must be located. Unless otherwise indicated, this tolerance zone is centered on the reference point, line or plane. This reference point, line or plane is assumed accurate with no tolerance.
<b>Deviation</b>	<i>Measured or measured and calculated distance</i> of a point, line or plane on a component being verified from the reference point, line or plane.
<b>Assembly</b>	At commissioning of a new or refurbished generator and up to five years in operation.
<b>Acceptable</b>	For generator in service for five to fifteen years.
<b>Critical</b>	For which immediate actions are required.
<b>Nominal Air Gap</b>	Designed air gap value at static–cold (as indicated on manufacturer drawings).
<b>Air Gap Variation</b>	Difference between maximum inside radius of the stator and minimum outside radius of the rotor (maximum gap) measured on a single plane from the rotor rotation axis <sup>3</sup> .
<b>Average Air Gap</b>	Average of all measured and calculated air gaps for all rotor poles.
<b>Stator Concentricity (Center Offset)</b>	Difference between best stator center (geometric center) and rotor rotation axis (reference) measured on the same plane and calculated from the rotor reference pole <sup>3</sup> .
<b>Stator Roundness</b>	Difference between maximum inside radius and minimum inside radius measured from the rotor rotation axis.
<b>Rotor Concentricity (Center Offset)</b>	Difference between best rotor center (geometric center) and rotor rotation axis (reference) calculated from the outside radius of each pole on the same plane facing sensor #1.
<b>Rotor Roundness</b>	Difference between maximum outside radius and minimum outside radius along the same horizontal plane facing sensor #1.
<b>Stator Core Vibration</b>	Measured between the core and the frame.
<b>Stator Frame Vibration</b>	Measured between the frame and the sole plate.
<b>Acceptable Air Gap Runout</b>	Acceptable variation in air gap readings of 0.13 mm / 5 mils attributed to shaft vibration (75%), and stator vibration (25%).
<b>Static–Cold</b>	Machine stopped and cooled down to ambient temperature.
<b>Full Load–Hot</b>	Machine in normal operating condition at full load and temperature stabilized after a minimum of 3 hours in operation.

<sup>1</sup> Two reasons for conservative values:

- 1) air gap sensor may not be installed at true minimum gap location,
- 2) unknown manufacturers safety factor margins

<sup>2</sup> 1 mm ≈ 39.4 mils / 1 mil ≈ 0.0254 mm or 25.4 μm

<sup>3</sup> VibroSystM default references:

- rotor pole #1,
- 0° axis at upstream location (top of polar graph),
- virtual rotational axis for pole #1 facing sensor #1 (usually near upstream)

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