



Evaluating Relative Thermal Expansion of Stator Using Air Gap Measurements

Air gap measurements can provide a good assessment of the relative thermal expansion of the stator. If abnormal results are observed, it is recommended to implement stator frame displacement instrumentation for further investigation of the core/frame attachments and lamination clamping system.

The first step is to ensure stability of the rotor axis (displacement) and shape (loose rim, rim vibration), as one rotor pole is used as a point of reference. This is done using the technique described in *Application Note AN004*¹. In all our evaluations, a small air gap variation is tolerated for “Acceptable Air Gap Runout” (AAGR)².

Once rotor stability is confirmed, air gap readings are compiled for a reference rotor pole facing each sensor for at least two operating temperature conditions: SNL–Excited and Full Load–Hot (at least 3 hours generating).

Air gap between both conditions are compared for each sensor. The expansion is said uniform (Table 1) if the maximum difference between each sensor is small – less than 0.19 mm / 7.5 mils – and said irregular (Table 2) if one or many values are abnormally great – larger than 0.25 mm / 10 mils – or scattered. This technique provides a relative value, i.e. with respect to rotor axis of rotation.

If a problem or irregularity is detected, the addition of non-contact displacement sensors installed at the stator sole plate locations or directly behind air gap sensors is recommended for further investigation. The ZOOM system can then correlate the absolute radial displacement of the stator frame with the air gap to monitor the rate of change over time.

Tests	Air gap at Pole 28 (mm)			
	Sensor 1	Sensor 2	Sensor 3	Sensor 4
SNL–Excited 42 °C	26.82	22.88	28.72	23.35
100% Load 71 °C	27.04	23.20	29.02	23.76
Max. Rel. Expansion	0.22	0.32	0.30	0.41
Difference	0	+0.10	+0.08	+0.19

TABLE 1: Example of uniform thermal expansion of the stator.

Tests	Air gap at Pole 41 (mm)							
	S#1	S#2	S#3	S#4	S#5	S#6	S#7	S#8
SNL–Excited 23 °C	17.71	17.83	17.45	17.24	17.57	18.96	18.91	18.67
100% Load 82 °C	18.92	19.21	18.62	18.31	18.65	19.17	20.11	19.94
Max. Rel. Exp.	1.33	1.22	1.08	0.91	0.95	1.14	1.14	1.19
Difference	+0.42	+0.31	+0.17	0	0.04	+0.23	+0.23	+0.28

TABLE 2: Example of irregular expansion. Out-of-range values are highlighted.

¹ See Application Note AN004: “Technique to Verify Rotor Stability Using Air Gap Measurements”.

² Acceptable Air Gap Runout: small variation of 0.13 mm / 5 mils tolerated in air gap readings for shaft and stator core vibration; see Application Note AN001.

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