Motor Load from Measured Speed (Slip Method)

Estimated load of an induction motor from its measured speed, synchronous and rated full-load speeds and supply voltage, by the slip method used in energy audits.

Method: Slip method of motor load estimation; Bureau of Energy Efficiency; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Synchronous speed	1,500.0	rpm
Rated full-load speed (nameplate)	1,470.0	rpm
Measured speed	1,482.0	rpm
Measured voltage	415.00	V
Rated voltage	415.00	V
Rated output	30.000	kW

Calculated results

Parameter	Value	Unit
Measured slip	1.2000	%
Rated slip	2.0000	%
Estimated load	60.000	%
Estimated shaft output	18.000	kW

Notes for this case

• Below full load an induction motor's slip is nearly proportional to its torque, so the load is about (measured slip/rated slip) × (V/V_r)², the voltage term correcting for slip falling as the square of voltage. It needs only a tachometer, so it is safe and quick for audits, but nameplate rated speeds are often rounded and rewound motors differ: treat the result as ±10–15 %. The input-power method is more accurate where power can be measured.

Formula and method

$$s = \frac{N_s - N}{N_s}, \quad f_L \approx \frac{s}{s_r}\left(\frac{V}{V_r}\right)^2$$

Variables

N_s	Synchronous speed	rad/s
N_r	Rated full-load speed (nameplate)	rad/s
N	Measured speed	rad/s
V	Measured voltage	V
V_r	Rated voltage	V
P_r	Rated output	W
s	Measured slip	-
s_r	Rated slip	-
f_L	Estimated load	-
P	Estimated shaft output	W

Method and standards

Slip method.

Assumptions and limits

- Linear torque–slip region below full load.

References

Slip method of motor load estimation, Bureau of Energy Efficiency, Energy Efficiency in Electrical Utilities (Guide Book 3)

Report details

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Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/electrical/motors/motor-load-slip-method

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.