Induction Motor Torque-Speed Curve by the Kloss Formula

Synchronous speed, rated and breakdown torque, breakdown slip and the torque at any speed of an induction motor from its rating plate data by the Kloss formula.

Method: Kloss approximation of the induction motor torque curve

Input parameters

Unit system: SI

Parameter	Value	Unit
Rated output	37.000	kW
Supply frequency	50.000	Hz
Number of poles	4.0000	
Rated speed	1,475.0	rpm
Breakdown torque / rated torque	2.6000	
Speed of interest	1,000.0	rpm

Calculated results

Parameter	Value	Unit
Synchronous speed	1,500.0	rpm
Rated slip	1.6667	%
Rated torque	239.54	N·m
Breakdown slip	8.3333	%
Breakdown speed	1,375.0	rpm
Torque at the speed of interest	293.09	N·m
Starting torque by Kloss (s = 1)	103.09	N·m

Notes for this case

• Kloss: T = 2T_k/(s/s_k + s_k/s), with s_k = s_n(λ + √(λ² − 1)) fitted to the rated point. It describes the running region well; deep-bar and double-cage rotors give much more starting torque than Kloss predicts, so use the maker's locked-rotor torque for starting.

Formula and method

$$T = \frac{2T_k}{s/s_k + s_k/s}, \quad s_k = s_n\left(\lambda + \sqrt{\lambda^2 - 1}\right)$$

Variables

P	Rated output	W
f	Supply frequency	1/s
p	Number of poles	-
n_r	Rated speed	1/s
λ	Breakdown torque / rated torque	-
n	Speed of interest	1/s
n_s	Synchronous speed	1/s
s_n	Rated slip	-
T_n	Rated torque	N·m
s_k	Breakdown slip	-
n_k	Breakdown speed	1/s
T	Torque at the speed of interest	N·m

T_{st}	Starting torque by Kloss (s = 1)	N·m

Method and standards

Kloss formula.

Assumptions and limits

- Constant voltage and frequency; stator resistance neglected.

References

Kloss approximation of the induction motor torque curve

Report details

Report reference	FCC-0H4C-DEMB (the same inputs always give the same reference)
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Calculator	Induction Motor Torque-Speed Curve by the Kloss Formula
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Release checks	3 reference cases of this calculator, computed independently, are checked on every release

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/induction-motor-kloss-torque-speed

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Reopens the calculator with the inputs of this report.