Swinburne Test: DC Machine Losses and Efficiency

Constant losses of a DC shunt machine from its no-load (Swinburne) test, and its efficiency as a motor and as a generator at a chosen load current.

Method: Swinburne (no-load) test

Input parameters

Unit system: SI

Parameter	Value	Unit
Supply voltage	220.00	V
No-load line current	4.0000	A
Shunt field current	1.2000	A
Armature resistance (hot)	0.25000	Ω
Load line current	50.000	A

Calculated results

Parameter	Value	Unit
Constant losses (iron, friction, field)	878.04	W
Efficiency as a motor	86.605	%
Efficiency as a generator	87.765	%
Armature current for maximum efficiency	59.263	A

Notes for this case

• Run the machine light as a motor at rated voltage and speed: its input minus the small armature copper loss is the constant loss (iron, friction and windage, shunt field). At load, add the armature copper loss I_A²R_A: as a motor I_A = I_L − I_sh, as a generator I_A = I_L + I_sh. Efficiency peaks where copper loss equals constant loss. The test ignores the extra iron loss and armature reaction at load, so it slightly overestimates efficiency.

Formula and method

$$P_c = VI_0 - (I_0 - I_{sh})^2 R_A, \quad \eta_m = \frac{VI_L - P_c - I_A^2 R_A}{VI_L}, \quad \eta_g = \frac{VI_L}{VI_L + P_c + I_A^2 R_A}$$

Variables

V	Supply voltage	V
I_0	No-load line current	A
I_{sh}	Shunt field current	A
R_A	Armature resistance (hot)	Ω
I_L	Load line current	A
P_c	Constant losses (iron, friction, field)	W
η_m	Efficiency as a motor	-
η_g	Efficiency as a generator	-
$I_{A,\eta max}$	Armature current for maximum efficiency	A

Method and standards

Swinburne test.

Assumptions and limits

- Constant losses unchanged with load; brush drop neglected.

References

Swinburne (no-load) test

Report details

Report reference	FCC-K5MS-GR35 (the same inputs always give the same reference)
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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/swinburne-test-efficiency

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.