EV Motor Power for an Acceleration Time and Top Speed

Motor power an electric vehicle needs for a 0–v acceleration time with a traction limit and road load, the power for its top speed, and the launch motor torque.

Method: Constant-force then constant-power acceleration

Input parameters

Unit system: SI

Parameter	Value	Unit
Vehicle mass	1,800.0	kg
Rotating mass allowance	5.0000	%
Target speed	100.00	km/h
Target time	7.5000	s
Top speed	160.00	km/h
Rolling resistance coefficient	0.009000	
Drag area	0.60000	m²
Air density	1.2000	kg/m³
Traction limit (μ × driven-axle share)	0.60000	
Rolling radius	330.00	mm
Reduction gear ratio	9.0000	
Drivetrain efficiency	90.000	%

Calculated results

Parameter	Value	Unit
Motor power for the acceleration	131.86	kW
Motor power for top speed	42.962	kW
Motor power needed	131.86	kW
Motor torque for traction-limited launch	431.49	N·m
Shortest time with traction limit only	5.0778	s

Notes for this case

- Constant wheel force (traction-limited) up to the speed where power takes over, then constant power, against rolling and aerodynamic load. Peak (short-time) motor power is what this gives; continuous rating for top speed and hills is lower.

Formula and method

$$t = \int_0^{v_k} \frac{m_e\,du}{F_{max} - R(u)} + \int_{v_k}^{v_t} \frac{m_e\,du}{P/u - R(u)}, \quad P_v = \frac{R(v_{max})v_{max}}{\eta}$$

Variables

m	Vehicle mass	kg
δ	Rotating mass allowance	-
v_t	Target speed	m/s
t_t	Target time	s
v_{max}	Top speed	m/s
f_r	Rolling resistance coefficient	-

C_dA	Drag area	m²
ρ	Air density	kg/m³
μ	Traction limit (μ × driven-axle share)	-
r	Rolling radius	m
i	Reduction gear ratio	-
η	Drivetrain efficiency	-
P_a	Motor power for the acceleration	W
P_v	Motor power for top speed	W
P	Motor power needed	W
T_m	Motor torque for traction-limited launch	N·m
t_{min}	Shortest time with traction limit only	s

Method and standards

Acceleration power.

Assumptions and limits

- Level road; still air; ideal constant-power motor.

References

Constant-force then constant-power acceleration

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/automotive/electric-vehicles/ev-motor-power-for-acceleration

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Reopens the calculator with the inputs of this report.