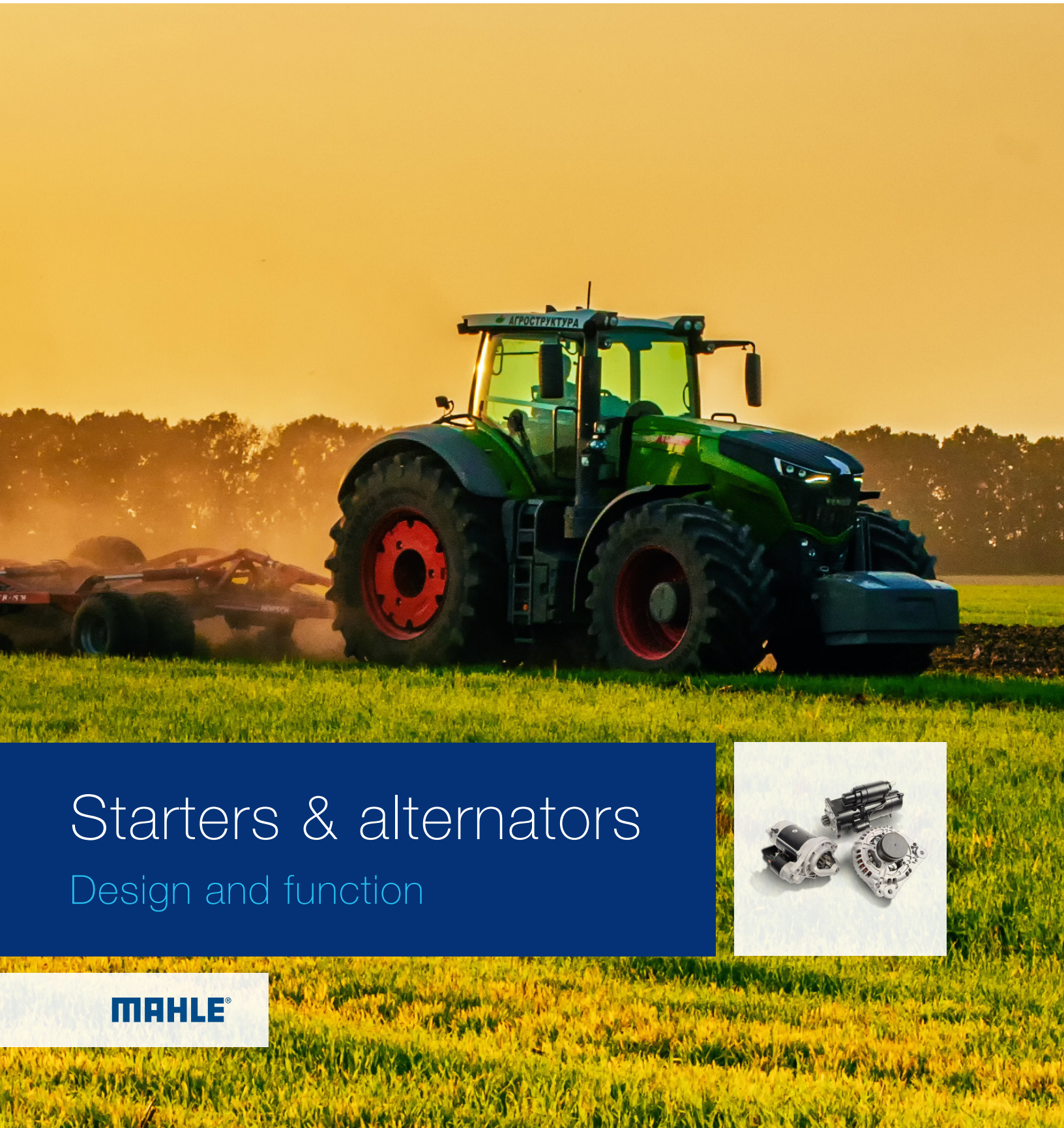
MAHLE



Starters & alternators

Design and function

MAHLE®

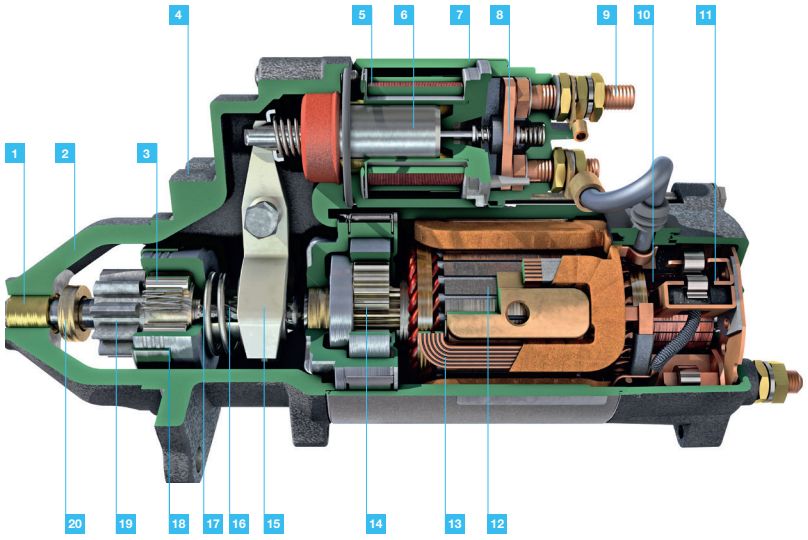
Starter motors

The starter motor is responsible for turning the combustion engine over so it can begin running. When the ignition switch is activated, it sends current to the solenoid. The solenoid then pulls in an iron core (the plunger), which—through a release fork—pushes the starter pinion gear into mesh with the ring gear on the engine's flywheel. As the plunger reaches the end of its travel, it also closes a set of electrical contacts that supply power to the starter motor itself.

In most modern starter designs, the motor drives the engine through a reduction gear, allowing the motor to crank the engine efficiently. The starting phase ends once the combustion engine reaches sufficient cranking speed and begins running on its own. At that point, the ignition switch stops supplying current to the solenoid. A return spring then pulls the iron core back to its rest position, opening the electrical contacts and cutting power to the starter motor. The pinion gear also retracts from the flywheel.

Because the engine speed rises quickly to idle while the pinion may still be engaged momentarily, a freewheel (overrunning) clutch between the pinion and the starter shaft prevents the starter motor from being driven faster than it is designed to rotate.

Technical data	
Speed required in the combustion engine to reach the point of self-sustained operation	approx. 70–120 rpm
Speed of the starter armature at the starting speed of the combustion engine	approx. 3,000–6,000 rpm
Idle-running speed of the combustion engine	approx. 700–1,200 rpm
Current consumption of the solenoid	approx. 50–250 A
Current consumption of the solenoid holding coil	approx. 20–80 A
Current consumption of the starter motor	approx. 200–2,500 A
Starter motor output	0.8–9.0 kW



1 Location of pinion shaft
2 Flange
3 Rolling element of freewheel clutch
4 Mounting flange
5 Solenoid coil
6 Plunger
7 Solenoid
8 Contact bridge
9 T30 battery connection
10 Commutator
11 Carbon brush
12 Armature
13 Pole winding
14 Reduction gear
15 Engaging fork
16 Helix
17 Meshing spring
18 Freewheel clutch
19 Pinion
20 Stop ring

The MAHLE Quality promise

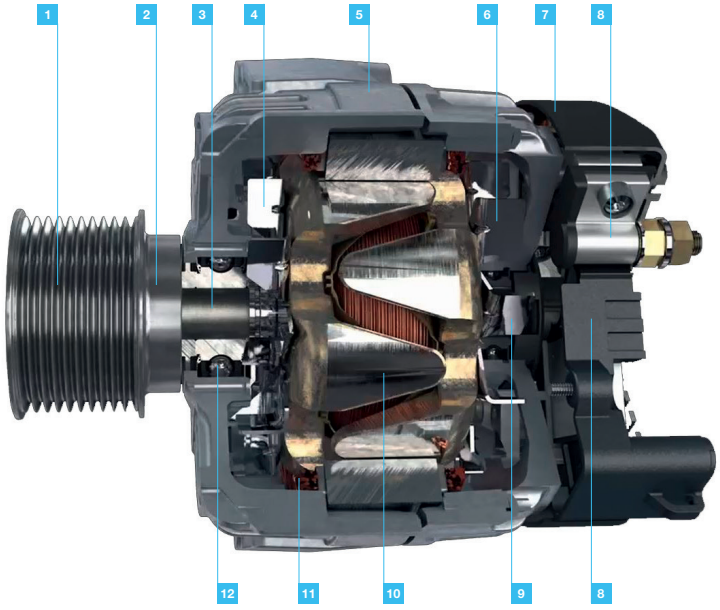
MAHLE delivers reliability you can trust—built on carefully selected suppliers, rigorous 100% final product inspections, and strict adherence to global safety and quality standards. With robust traceability and a commitment to continuous improvement, MAHLE ensures every component meets the highest expectations for performance and dependability.

Alternators

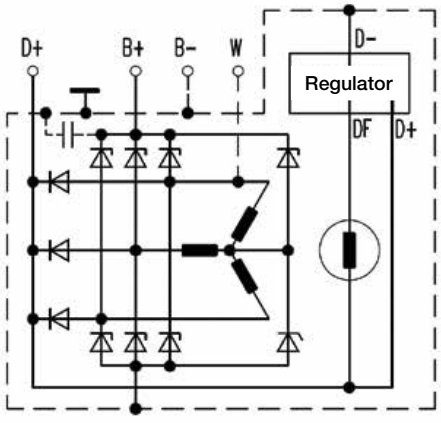
The electrical systems in a vehicle rely on a steady supply of power. When the combustion engine is running, that power is produced by the alternator, while the battery functions as an energy reserve and stabilizer. The alternator must be engineered to deliver enough output for all electrical consumers that operate continuously, and its design has to account for the engine's typical operating speeds.

The alternator is normally driven by the engine through a belt. As the rotor spins inside the stationary stator, it induces electrical current. Most modern alternators generate three-phase alternating current. A bridge rectifier made up of high-capacity diodes then converts this alternating current into direct current for the vehicle's electrical system. The rotor's exciter coil receives power from a voltage regulator, which adjusts the excitation level based on the vehicle's current electrical demand. The regulator supplies this current to the rotor through carbon brushes that maintain contact with the slip rings.

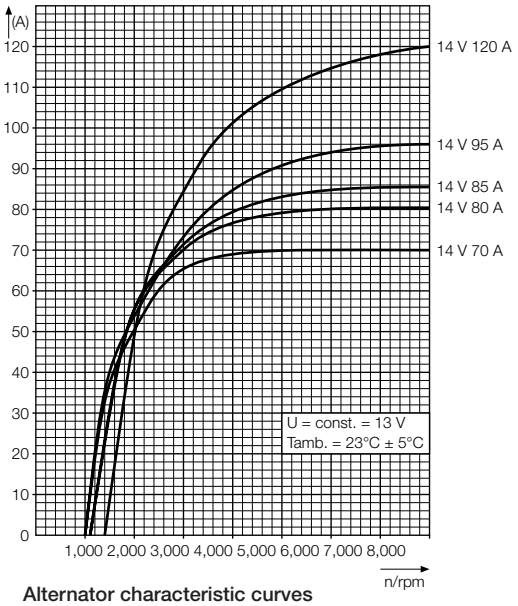
Because electromagnetic losses and electrical resistance generate heat during operation, alternators also require cooling. Depending on the design, one or two fans are mounted on the rotor shaft to move air through the housing and dissipate excess heat.



1 Belt pulley
2 Distance washer
3 Shaft
4 Fan
5 Housing
6 Protective cover
7 Rectifier/excitation diodes
8 Regulator/carbon brushes/slip rings
9 Rear bearing
10 Rotor
11 Stator
12 Front bearing



Example connection diagram



Alternator characteristic curves

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