Bosch Starters and Alternators: The Comprehensive Range from a Single Supplier

- **Comprehensive Product Range**
  for passenger cars, commercial vehicles, agricultural and special machinery
  - Bosch new starters and alternators
  - Bosch spare parts for starters and alternators
  - Bosch eXchange – the exchange program for starters and alternators

- **Simple and Transparent Core Collection Process**
  New: CoremanNet as a service for external partners

- **Reliable Products**
  Solutions based on the high quality requirements of original equipment manufacturing

- **High Availability**
  - Products available throughout the vehicle’s life cycle
  - Starters, alternators and spare parts for vehicles of all ages

- **Comprehensive Sales Support**
  - Service hotline with expert knowledge
  - Extensive technical information and repair support on ESI[tronic]
  - Detailed application information available in Bosch electronic and paper catalogs as well as on TecDoc
  www.bosch-automotive-catalog.com

Your address for genuine Bosch quality:

For further information click onto:
www.bosch.com
The Quality Solution: Bosch eXchange
No Compromises on Quality: Bosch eXchange

Bosch applies the same high quality standards to remanufactured parts as it does to newly manufactured products. The dedicated and experienced engineering team constantly focuses on fulfilling the strictest standards. After disassembly, the components are cleaned in line with environmental legislation. Every component and part then passes an intensive testing process. They undergo a visual, dimensional and electrical test.

Bosch Remanufacturing - Top Quality
- 100% replacement of wearing parts, other parts are tested and remanufactured or replaced only as required, the body is mostly used again
- 100% replacement of critical components with new parts
- Exclusive use of genuine Bosch spare parts or Bosch-approved spare parts
- Same quality standards and functional tests as for new components
- Improvements made to original parts are carried over into the remanufacturing process
- The OE design of starters and alternators already considers the later remanufacturing of the products, so multiple lives can be given to one product
- Bosch remanufacturing plants are certified in accordance with the same quality standards as original equipment factories

Original Seal - Approved Quality
The quality seal is your assurance for Bosch eXchange quality. The seal proves that the product was tested by the Bosch remanufacturing team. Every part has gone through a long, intensive testing process. As Europe’s largest original equipment supplier of starters and alternators, Bosch offers more than 95 years of experience and expertise.

Same Warranty as for New Products
Every Bosch eXchange part is the product of ingenious engineering, accurate production and comprehensive testing. Therefore, a two-year guarantee is also offered on Bosch remanufactured parts.
**Reliable Starters and Alternators: Bosch eXchange**

With more than 2,000 different types Bosch offers an exceptionally wide exchange program of starters and alternators for passenger cars, commercial vehicles and agricultural and special machinery. Its high market share in original equipment is testament to the high level of confidence, which vehicle manufacturers have in Bosch.

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**Comprehensive Product Range**
- Extensive – 2,000 starters and alternators for passenger cars
- More than 200 starters and alternators for commercial vehicles
- Constant addition of new products guarantees an up-to-date range
- Superior market coverage – more than 90% in Europe

**Customer Benefits**
- Highly reliable and long-lasting due to professional remanufacturing and testing
- Comprehensive all-makes program
- Up to 30% cheaper than new products
- Same two-year warranty as for new products
- Comprehensive technical information through ESI[tronic], TecDoc and Bosch catalogues
- Skilled sales force and technical hotline
Comparable to New Products: Bosch eXchange

A defective product can be replaced by a new product or a remanufactured or repaired product. When the workshop wants to avoid the expenses of buying a new product, it will consider a repaired or a remanufactured product. At first glance both process will result in products which function again. Looking into the different processes and the characteristics of the final products it becomes obvious that there are significant differences concerning the quality and warranty of repaired and remanufactured products.

**Bosch Remanufacturing**
Remanufacturing brings a used product back to at least its original quality with a warranty that is equivalent to that of the newly manufactured product. Remanufacturing is a standardized industrial process.

- The product is disassembled, cleaned, components are repaired or replaced and the individual component as well as the whole product are tested to ensure that the original design specifications are met.
- The warranty of a remanufactured product is equal to that of a new product.
- The quality of a remanufactured product is comparable to that of a new product.

**Repair**
Repair returns an incorrect or defective product or component back to a usable state. This happens in the market i.e. in the workshop. Contrary to Remanufacturing, this is not a standardised industrial process.

- Only the specific fault is being repaired. Other components and parts are not revised.
- After repair, the product is expected to function again. Assurances of performance are in general only valid for the repaired component.
- The warranty of repaired products is usually less than that of new or remanufactured products. It mostly applies to the component which has been repaired.

Delimitation Remanufacturing vs. Recycling, Repair, Re-use

Source: Boston University
Bosch Remanufacturing: Planned Quality

At Bosch we leave nothing to chance. At Bosch Remanufacturing all critical components are replaced 100% with tested spare parts of Bosch quality. Technical specialists completely dismantle the product, clean it and replace any severely worn out and safety-relevant parts prior to reassembly. Small parts like screws are 100% replaced with new parts and the complete unit is reassembled with a torque according to OE-specifications.

The genuine Bosch Remanufacturing procedure for starters
Quality that Protects the Environment: Bosch Remanufacturing

The remanufacturing system of used automotive products not only saves materials and energy, it also helps Bosch in its efforts to protect the environment. In comparison with the process of producing new products, CO₂ emissions are reduced by 25,000* tons every year. In other words, you would need about 1.923 hectares of the average European forest to convert this much CO₂.

Bosch Remanufacturing Protects the Environment
- Material savings of almost 90% thanks to re-use
- Energy and CO₂ savings of more than 50%
- Reduced CO₂ emissions by 25,000 tons per year
- This equates to the CO₂ savings of 1.923 hectares of forest

CO₂ Balance of Bosch Remanufacturing
In collaboration with the Fraunhofer Institute and the University of Bayreuth, Bosch has traced the entire manufacturing and logistics processes in a concrete example (starter) and identified the ecological balance between new production and remanufacturing. As a GWP (Global Warming Potential) of the IPCC (Intergovernmental Panel on Climate Change) was used.

The remanufacturing savings, as far as materials, CO₂ and energy are concerned, amount to more than 50% compared to new productions.

* Savings depend on product mix, minimal changes are possible
What Makes the Difference: Remanufacturing Performance Levels

Quality Indicators
The quality of a remanufactured product is determined by two major factors: The production process and the spare parts quality. Depending on these factors, products in the remanufacturing market can be separated into a high, medium and low performance level. Low- and medium-performance products will last for significantly lower mileage and show different behaviour (e.g. higher noise levels, reduced robustness, malfunctions under rough conditions) than the original equipment unit. The high-performance remanufactured product will almost certainly last the remaining lifetime of the vehicle, even for professional use, and will have similar comfort functions as the original equipment product.

High Performance (HP)
With a high-performance product, the customer will feel no difference compared to the original equipment product. Sometimes performance and durability are even better, since weak areas in the design of the original equipment product are often improved when the reman unit is reengineered for remanufacturing. With a high-performance product the customer can forget about it ever failing during the remaining lifetime of the vehicle.

Medium Performance (MP)
Medium-performance products are suitable for older cars or where the car owner accepts multiple exchanges of the units. These products are not recommended for professional use.

Low Performance (LP)
Customers only wishing to keep their cars for a limited period of time or preparing them for sale are the target group for low-performance products. Although usually cheap, these products do not have a good price-performance ratio.

A high-performance remanufactured product will have a lifetime of approx. 80% compared to the original equipment product. A product at a medium-performance level will give a mileage of rd. 30%-60% compared to the original equipment unit, whereas a low-performance product will be less. The claim rate of a low- and medium-performance product is higher compared to a high-performance one.
## Perfection in Each Discipline:
Bosch eXchange

### Component Test

**Highest Process Capability**
All components are carefully tested before being released for reassembly. In the test plan for each remanufactured component, individually designed test procedures are implemented. All quality gates are included in the total quality approach of the remanufacturing process. New components are sourced from certified plants.

### Production Process

**Automotive Standard**
The production facilities for the remanufacturing of high-performance products are similar to the small-batch production of original equipment. For each step in the remanufacturing process, the procedures are proven and documented. Failure Mode and Effect Analysis (FMEA) is performed in order to predict critical situations and avoid failures. The quality assurance system complies with the TS 16949 standards of the automotive industry.

### End-of-line Test

**Permanent Process Assurance**
The tests are set at such low tolerances, so that deviations in the manufacturing process can be detected immediately. Causes of errors are systematically investigated and eliminated. The detailed testing of several product parameters ensures that no product outside the tolerances is shipped.
**Medium Performance**

**Focus on Main Components**
The main components are carefully tested. Special test devices are used to assure functionality. Systematically introduced quality gates do not exist. The testers are not calibrated according to the overall manufacturing concept. Therefore risks still remain.

**Industrial Standard**
Remanufacturing on a medium performance level complies with industrial standards for small production sizes. The processes are organized and documented according to ISO 9000. Possible failures and their effects on customers (Failure Mode and Effect Analysis) are usually not described. Production failures cannot be systematically avoided prior to delivery to customers. Quality management is based on field claims.

**Testing According to Specifications**
In this market segment, the 100% end-of-line testing ensures that the remanufactured units fulfill the performance values given in the sales prospect. Products having failed the end-of-line test are reworked. A document with the test results is usually enclosed in the delivery to prove that the unit has successfully passed the final test.

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**Low Performance**

**Minimum Testing of Components**
Some components are tested in production. The test equipment does not fulfill professional requirements.

**Semi-Professional Standard**
The remanufacturing processes at the low performance level are not organized. The workers on the production line lack work descriptions. They are occasionally guided by their supervisors. This results in a chaotic workflow, where process steps can be unintentionally missed. No quality assurance systems are in place, hence product quality fluctuates heavily.

**Test of Basic Functions**
With this tester, just the basic function of the unit is ensured (e.g. alternator generates current). The test does not cover different operating conditions and output profiles. The test result is sometimes not even documented.
The Quality Proof:
Starter Performance Test

Once installed in the car, the driver expects the car to start under any condition. If that is the case, the driver will be satisfied and perhaps not even think about starting. If the vehicle does not start due to a failed starter, the drivers’ trust is lost. Bosch does not compromise on quality, and creates trust, as shown in the following test comparing Bosch eXchange starters with competitor starters.

Bosch eXchange:
Higher Reliability and Longer Lifetime
The results of the durability test clearly show the quality differences of starters. The Bosch starter passed the test with minimal wear and showed perfect performance within the specifications. The competitor’s starter failed after a short time and the components suffered unusually strong wear.

Bosch eXchange Starters: Longer lifetime and reliable starting

The Bosch eXchange starter performed 30,000 cycles before the coal brushes were worn. All other components still worked perfectly. The competitor starters failed early due to short circuits of the armature and/or melted carbon brushes. More conspicuous heavy wear damages as well as construction inaccurateness were detected. Examples are shown on the opposite page.

High Performance
The high quality of the Bosch eXchange starter’s components pays off. They have a much longer lifetime than the competitor products and are extremely reliable.

The Test Set-up and Results
An independent laboratory conducted a durability test using a test set-up also having been used to test OE starters. The durability test was performed by mounting the starters on a mechanical simulator imitating the load cycle of an engine during the start-up process. The total cycle consisted of 1 s crank, 1 s overrun, and 28 s rest. The cycle was performed until the starters malfunctioned and could not start anymore.

High Performance - Bosch eXchange
- OE know-how - The technical specifications of the original spare parts are known
- Long-term and reliable partnerships to component suppliers exist. In the context of supplier development programs, the quality is constantly tested and improved.
- Professional tests during the entire remanufacturing process, ensure a long-term excellent quality and durability.

Medium Performance - Competitors
- The components of a medium-performance product lower specified. Normally there is no access to OE know-how
- The end-of-line testing ensures that the remanufactured units fulfil the specifications
- This results in good product quality and medium durability
One Selection of Many:
Comparison of Components

After the test, the starters were disassembled and inspected for defects. The condition of the components reflect the test result clearly.

<table>
<thead>
<tr>
<th>Component Test</th>
<th>Bosch eXchange</th>
<th>Competitors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Armature</td>
<td>Still worked after 30,000 cycles</td>
<td>Armature is short-circuited after 7,500 cycles</td>
</tr>
<tr>
<td>Reason</td>
<td>Armature has already been short-circuited once. Nevertheless, it has been remanufactured and used again</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Production Process</th>
<th>Field Coil</th>
<th>Good finishing and isolation</th>
<th>Problem</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Short circuit due to contact of wires</td>
<td>Reason</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Poor painting quality</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mounting of Rubber Seal</th>
<th>Excellent sealing of the housing</th>
<th>Problem</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Water and dust in the housing could lead to a short-circuit</td>
<td>Reason</td>
</tr>
<tr>
<td></td>
<td>Poor assembly</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Not fully sealed</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Component Quality</th>
<th>Tab</th>
<th>Correct mounting and size</th>
<th>Problem</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Risk that the pinion gear is discharged diagonally or too far out</td>
<td>Reason</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tabs and lever are not mounted straight</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Low-quality suppliers</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Insufficient goods income control</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Low-skilled employees</td>
<td></td>
</tr>
</tbody>
</table>

|                   | Lever | Correct mounting |
|                   |       | |

|                   | Pinion | Still works |
|                   |        | Problem |
|                   |        | Pinion on the drive has hit the toothed flywheel ring |
|                   |        | Wrong engagement |
|                   |        | Poor quality of material |