



## Romax Technology's Bearing Consultancy Services Equip Cummins Generator Technologies with Knowledge and Confidence

### Client

Cummins Generator Technologies is part of Cummins Inc., a Fortune 500 corporation and a world-leader in the design, manufacture and distribution of engines and related technologies.

### Challenge

To review bearing condition for assessment of life and durability; to gather independent expert technical evidence; to assess new bearing designs.

### Solution

Romax consultants' expert bearing knowledge provides support for both the analysis of new design arrangements and detailed investigation of existing in-service components for condition review and investigation of failure root cause.

### Benefits

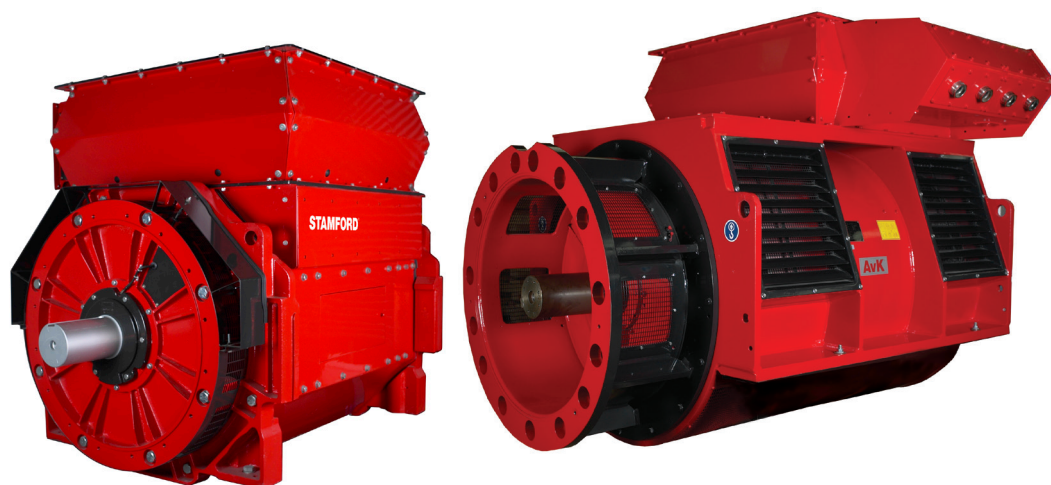
An impartial expert to assess new bearing designs and identify failure root cause within existing bearings, equips Cummins with confidence underpinned by specialist knowledge.

Cummins Generator Technologies (CGT) is part of Cummins Inc.'s Power Solutions Business Group (which accounts for approximately 20% of Cummins Inc.'s total revenue [\$17.3bn in 2016]). CGT manufacture alternators under the renowned brands of STAMFORD and AvK from 2 to 11,200 kVA. Setting the standard for alternators that are both reliable and versatile, CGT have an international reputation for quality and superior customer support, which makes them a world class leader in the power generation market.

Romax have partnered with CGT on numerous alternator bearing projects, including failure analysis and condition review of existing bearings, as well support on new bearing developments. Shaun Green, Global Mechanical Design Specialist at Cummins Generator Technologies, comments: "Romax have provided invaluable support on several projects covering a wide variety of bearing related activities, from failure investigation to supporting new bearing arrangement design initiatives. Their knowledge and experience in bearing design and manufacture, combined with their access to vendors of approved and certified bearing specific measurement systems, always ensures a high level of technical competency is achieved."

### A Comprehensive Bearing Consultancy Offering

Romax have provided CGT with an independent expert view and specific technical bearing expertise for many small projects including: visual inspections, geometrical measurement (to varying degrees of complexity), grease analysis and metallurgical analysis. Larger projects have included: performance testing of new bearing arrangements; measurement analysis to validate bearings against their manufacturing specifications (including dimensional and geometrical features, heat treatment condition, chemical and mechanical properties, etc.) and full condition review of in-service bearings, to evaluate bearing life condition. All of these projects have been initiated, driven and guided by CGT's Technical Specialists, and Romax have provided their technical support on a collaborative footing. This method of working ensures CGT get the most appropriate support from Romax.



STAMFORD and AvK Alternators - courtesy of Cummins Generator Technologies (CGT)

### Three Projects: General and Specific Condition Investigation and Supplier Selection

First Project:- Romax were tasked with investigating the general condition of bearing components which had been removed from an "in service" alternator. Dimensional and geometrical features were measured and visual observations of general condition were made. The resulting data was combined with CGT's observational and service data, then technically reviewed by CGT in collaboration with Romax - this review provided CGT with opportunities for product improvement and establishing supplier best practices.

Second Project:- Romax were asked to provide an independent, expert comparative assessment of bearings from two different suppliers. CGT created a specific programme of work tasks to follow, which was reviewed and agreed upon by Romax. Romax's measurements of the bearing components revealed general adherence to industry standard tolerances, although some features were found to deviate slightly between suppliers. The resulting data was combined with CGT's measurement and test data, then technically reviewed by CGT in collaboration with Romax.

Shaun Green, Global Mechanical Design Specialist at Cummins Generator Technologies, comments: "The measurement work carried out by both Romax and ourselves, in conjunction with our comprehensive bearing testing programme, enabled us to better assess the risks associated with moving to a new bearing supplier."

Third Project:- A third project tasked Romax with investigating a ceramic coating applied to bearing outer race external surfaces. CGT created a specific programme of work tasks to follow, which was reviewed and agreed upon by Romax. Analysis revealed that all dimensional and geometric tolerances were within typical bearing limits. The steel-ceramic interfaces were investigated and their nature was noted. Other features such as hardness and surface roughness were also measured and noted. The resulting data was combined with CGT's measurement and test data, then technically reviewed by CGT in collaboration with Romax. Results of the review were then used to establish best practice for bearing arrangement designs that incorporate this type of bearing.

Shaun Green, Global Mechanical Design Specialist at Cummins Generator Technologies, comments: "The observations made during Romax's investigation, when combined with our measurement and test data, assisted us in better understanding the nature of ceramic coated bearings. This in turn led to our development of bearing arrangements that took full advantage of the ceramic coating's operational characteristics and manufacturing features."

### Avoiding Future Failures: Knowledge and Confidence

As well as investigations into the condition of specific bearings and analysis of bearing failure modes, Romax worked on a collaborative project with CGT to assist with their physical testing of bearing arrangements. CGT created a very detailed programme of testing which was reviewed and agreed upon by both Romax and CGT. Then, in collaboration with CGT, Romax constructed and assembled a bearing test rig and carried out the testing programme. The tests were aimed at providing a better understanding of bearing arrangement behaviour under typical loading and re-lubrication cycles. Some of the tests were also designed to accelerate known typical failure modes so that their behaviour could be better understood. The test rig data was combined with CGT's design and performance data, to create best practice design guidelines and validation guidelines.

Romax have provided CGT with a wide range of bearing consultancy projects, to offer an impartial, expert view of the condition of existing bearings and assessment of future designs. Assisting CGT with such specialist technical knowledge contributes to their ability to talk to their suppliers and customers with confidence when improvement opportunities arise or challenges are encountered.

Shaun Green, Global Mechanical Design Specialist at Cummins Generator Technologies, concludes: "We will continue to work with Romax on similar future bearing projects, as we continually strive to improve our understanding of bearing behaviour in our customer's ever-more demanding applications. The expert knowledge, experience and capabilities encompassed in Romax, when combined with their impartial third party position, provide the type of support that some of CGT's future bearing activities will require."

- **Specialist, technical knowledge for informed supplier discussions**
- **Impartial investigation into bearing failures and root cause analysis**
- **Expert evaluation of new bearing designs**

### Condition review/ failure analysis:

- Identification of bearing failure root cause
- Creep investigation
- Inspection and measurement of bearings after "in service" operation (comparison with brand new bearings)
- Investigation into damage features associated with bearing failure
- Condition review to establish re-lubrication interval

### Supplier comparison:

- Assessment of bearings from different suppliers

### New design review:

- Support with design review
- Comparison to industry standards and drawing standards
- Condition evaluation of bearing components

### To find out more

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