Gear Materials

THE QUESTION

We know the values for fatigue strength tooth root tension, σFlim and Hertzian stress, σHlim for the steel 18CrNiMo7-6 according to DIN and others. But there is a new material — Ferrium (I found it searching in web) — and this is a high-performance material compared to traditional materials. I would like to know the values for σFlim and σHlim for this material."

(Ed.'s Note: Newly developed ferrium *C64 (AMS 6509) is a high-strength, high-surface-hardness, good fracture toughness carburizable steel — steel that also has high temperature resistance, corrosion resistance and hardenability. C64 steel is a higher performance upgrade from 9310, X53 (AMS 6308), EN36A, EN36B, EN36C and 8620. It can achieve a surface hardness of 62-64 Rockwell C (HRC) via vacuum carburization. C64 steel is double-vacuum melted, i.e. — vacuum-induction -melted and then vacuum-arc-re-melted (or "VIM/VAR") for high purity, leading to much greater fatigue strength. Applications include: demanding Bell Helicopter and Sikorsky transmission gearboxes Source:* Questek.com.)

EXPERT RESPONSE PROVIDED BY CHUCK SCHULTZ PE: AGMA allowable stress values for tooth bending stress do not vary with the alloy selected. The allowables were negotiated based upon the committee members' experience. Relatively recently the standards were revised to provide a range of allowables for various levels of heat treat and metallurgical quality but these revisions still do not reference specific alloys. Only core hardness is considered and as each alloy has a unique hardenability profile, this could be considered "linkage" to a specific alloy. Put more directly, in the AGMA system there is no change in the allowable bending stress due only to an "upgrade" in the alloy.

Perhaps future research will provide a way to calculate a specific allowable bending stress for a specific material based upon traditional physical tests on samples. This would provide guidance to those seeking to develop better gear materials. At this time we simply do not have the "science" to provide such a formula.

ISO, DIN, and AGMA all allow designers to establish their own allowable stress levels based upon their experience and test results. It would be helpful if those with experience from making gears of unique materials would share their knowledge with the standards committees so the science can be nurtured.

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