

# Fatigue Considerations of High Strength Rolling Bearing Steels

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*Abstract: Since the 1946 issuance of the ASTM bearing steel specification, A295, the research and development of bearing steels has resulted in substantially improved fatigue and wear performance of rolling bearings across the entire industry. This is not only the case with higher-end “advanced” materials and processes such as ceramic based technologies, but also with the more economic material selection of bearing quality steels.*

*The bearing quality steels are characterized primarily, though not exclusively, by high hardness, very high static strength, fine grained microstructures, and low non-metallic inclusion content. Although developed to perform under cyclic rolling contact and slippage loads, these steels are also at times considered for usage in structural applications, such as shafting. When used in a structural manner, the design engineers are advised to consider unique fatigue related attributes of rolling bearing steels, such as the concept of “volume stressed”.*

*The main point presented is that bearing grade steels in structural applications are expected to realize a wide range of cycles to failure in a group of seemingly identical parts. Also discussed are some related experiences with Virtual Product Development activities at INA (Schaeffler) USA with bearing/structural components using a combination of FE analysis with ABAQUS, fatigue assessment and validation testing.*

*Keywords: Fatigue, Steel, High Strength Steel, Bearings, Rolling Bearings, Bearing Steel*

## 1. ROLLING BEARING STEEL FATIGUE BASICS

### 1.1 INTRODUCTION

In making fatigue endurance considerations with high strength rolling bearing steels for use as a potential material for structural applications, it is worth examining the wealth of experience found from the theory and practice of using these steels in their native application. Thus, a short background regarding the mechanics of bearing fatigue, the materials used, and some common key effects on the fatigue life of rolling bearings is provided.

For the purpose of this paper, a “structural” type loading application is defined as one where a mechanical member, such as a shaft, supports cyclic bending and/or shear loads. This is important to note since we are drawing connections to the fatigue life of rolling bearings, which see mainly only compressive load cycles, to the fatigue life of those same steels when used under tensile and shearing conditions. For the balance of the paper, “bearing” and “bearing steels” will be used interchangeably with “rolling bearing” and “rolling bearing steels”, respectively.