

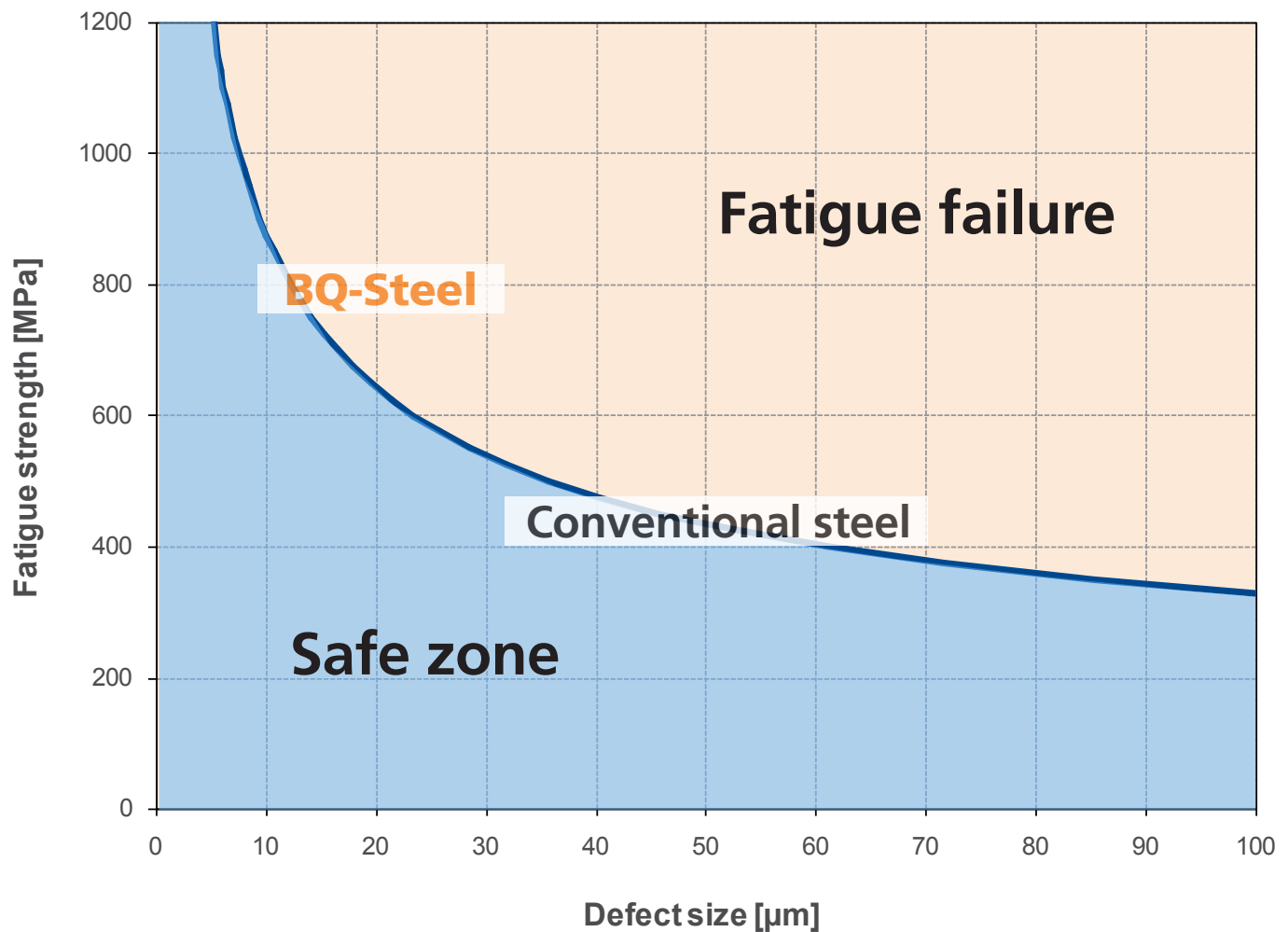


BQ-STEEL® – PURITY CREATES OPPORTUNITIES



Continuous improvements in the purity and consistency of our engineering steels are opening new design possibilities.

Ovako has gathered data from thousands of tests, including objective blind tests against more expensive re-melted steels and other grades, carried out over near a decade. The tests on our Bearing Quality steel (BQ-Steel®) and Isotropic Quality steel (IQ-Steel®) tell a clear story: purity creates opportunity.

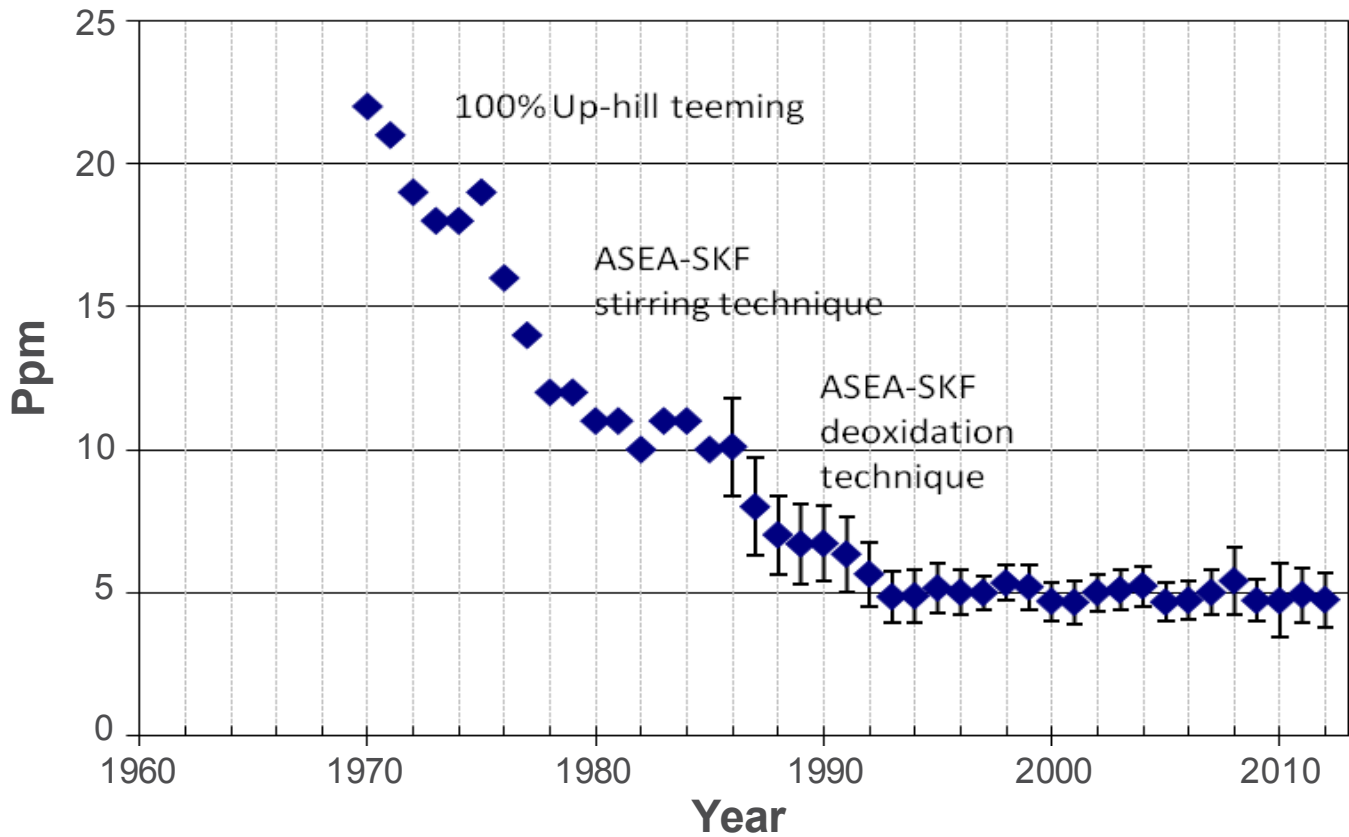


In previous presentation the fatigue strength versus defect size graph was presented and discussed. This graph shows that the fatigue strength of conventional steel is significantly affected by the presence of defects.

This presentation will aim to explain how the BQ-Steel is produced and monitored to ensure the quality.

The BQ-Steel has significantly smaller inclusion size distribution compared to conventional steel. At this part of the curve the slope is much steeper. This means that the gain in fatigue strength is increasing dramatically.

Total oxygen content

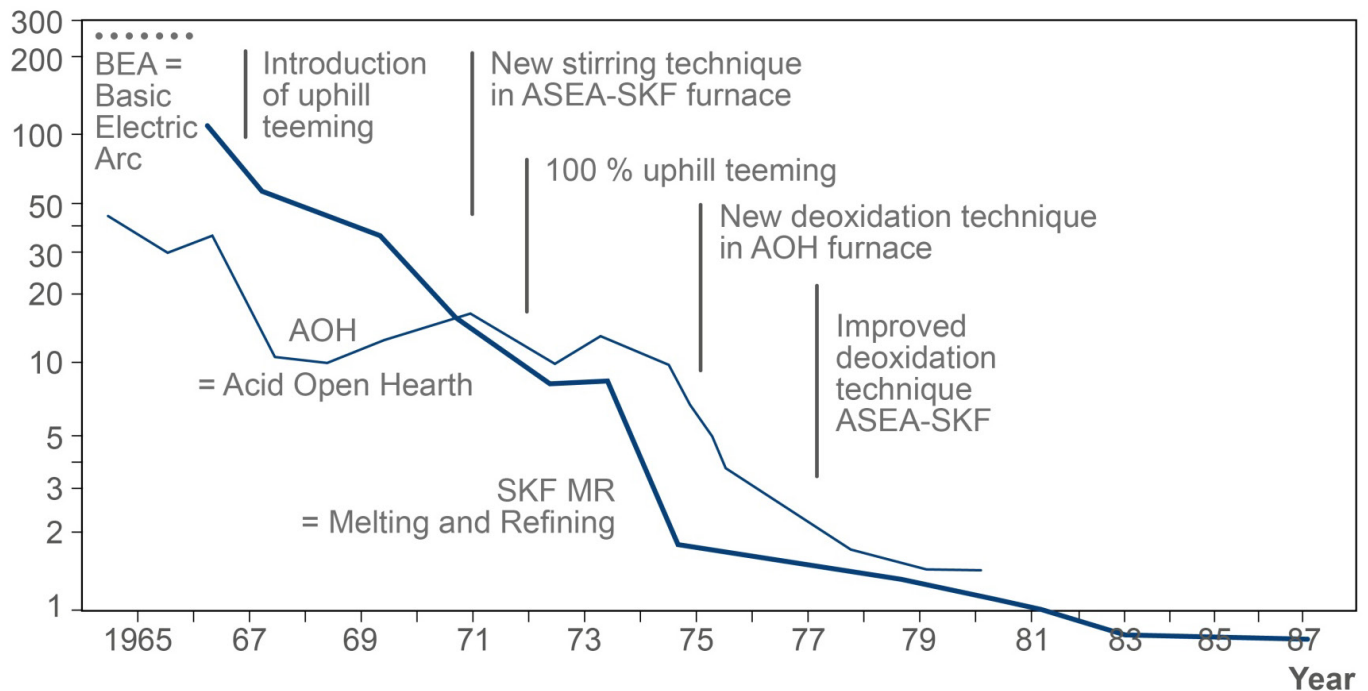


Ovako has 100 years of experience of producing steel for the bearing industry's demanding applications. There has been continuous work to improve the process.

One example is the oxygen content in through hardened bearing steel that today average around 4 to 5 ppm, 40 years ago it was three times this value.

Quantification inclusions

Macro inclusions [mm/m²]

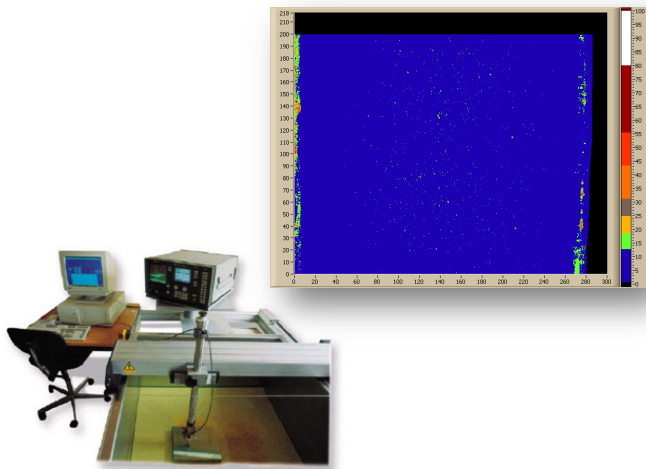


Even more important is the work started in the mid 1980s of quantifying inclusions with immersed ultrasonic testing.

The immersed ultrasonic's gave new opportunities to develop the process.

This figure shows that all the work with teeming protection, stirring technology and de-oxidation practice made the step-down test method used obsolete. This test, or similar, is still used to quantify macroscopic cleanliness today.

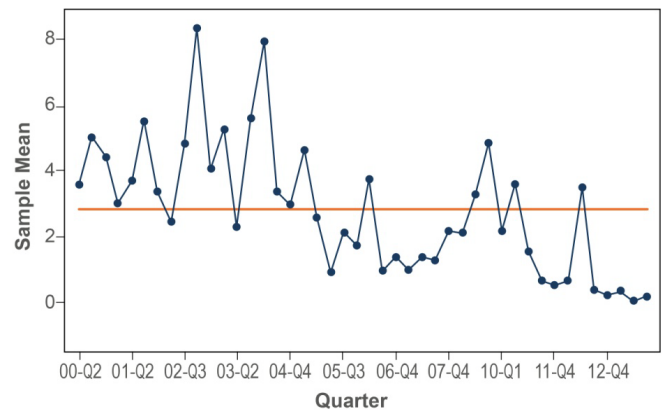
Immersed ultrasonic testing



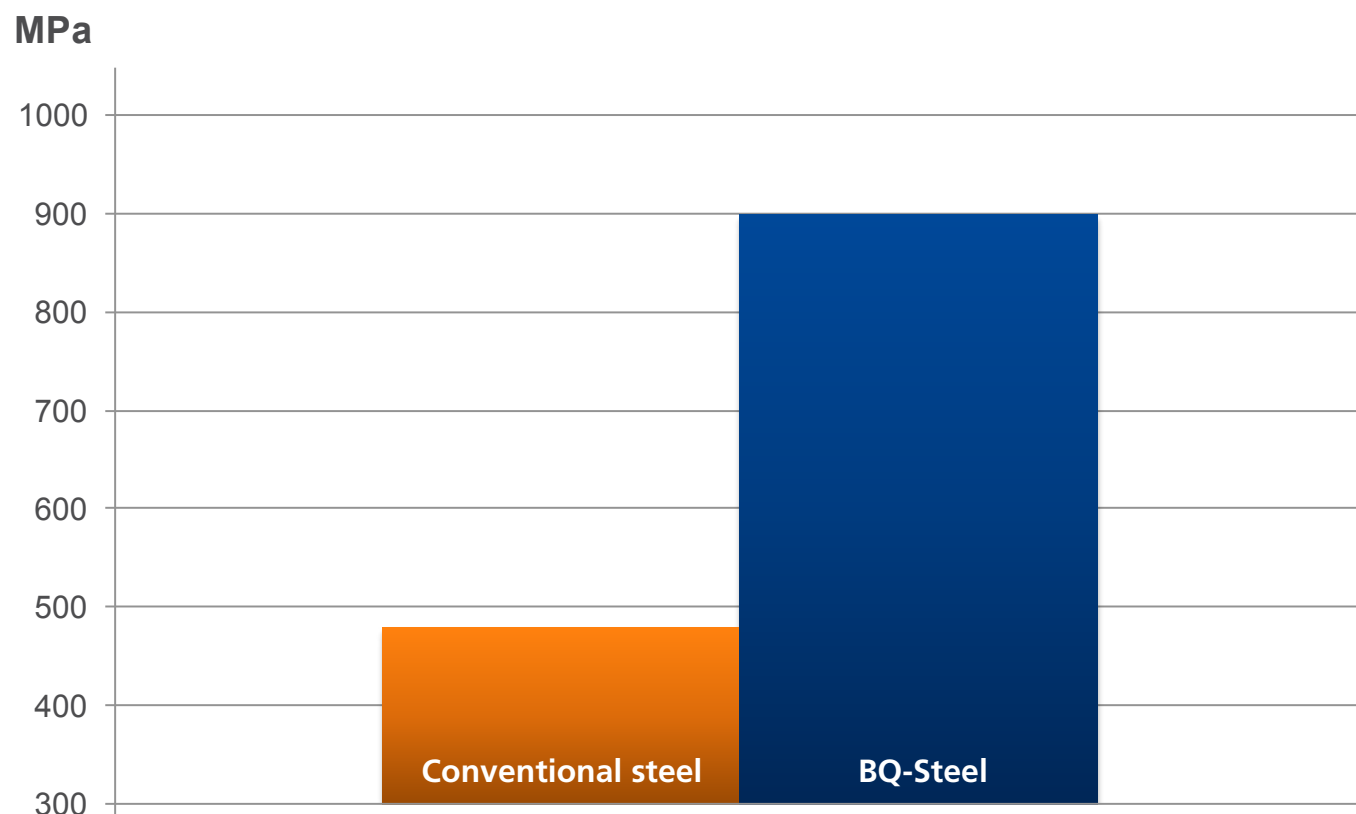
10 MHz testing allows detection of defects down to 120 μm

This picture show immersed ultrasonic testing that has been used to develop the cleanliness. For BQ-Steel this technique is applied on a statistical basis to ensure that the high product quality is maintained.

Xbar Chart of 0.2 mm/dm³



Rotating bending fatigue



For the end customer it is most important how the properties are affected. Fatigue testing is often used for process development and benchmarking.

Ovako BQ-Steel will for the standard test we use obtain around 900 MPa in fatigue limit. The expected fatigue limit for a conventional steel with larger inclusion distribution could obtain under 500 MPa.

This means that if you for instance produce a 30 mm axle in conventional steel that is loaded with a tensile cyclic loading, the diameter could be reduced to 22 mm for BQ-Steel. The weight will then reduce from 5 to 3 kg per meter.