



NAPOLEON

ENGINEERING SERVICES

A BRIEF GUIDE TO BEARING SOURCE QUALIFICATION

Napoleon Engineering Services (NES) utilizes specific bearing expertise and equipment to develop valuable technical information in order for customers to make informed decisions about bearing and supplier performance.

www.nesbearings.com



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Introduction

At **Napoleon Engineering Services (NES)**, we take tremendous pride in providing first-class bearing inspection and testing services, boasting an array of unparalleled programs that have helped countless original equipment manufacturers (OEMs) reduce risk, save money and more confidently qualify sources of supply.

NES has developed these services over nearly 29 years of real-world experience guiding OEMs through the bearing qualification process. These programs are rooted in our expertise in both the aerospace and industrial industries and in a personal desire to empower customers with technical information about bearings so that they can make informed decisions.

In the last three decades, NES has only solidified its place as an industry leader in bearing qualification; in fact, NES now houses the largest independent bearing inspection and testing facility in North America, located within its now-46,000-square-foot campus in Olean, N.Y. As part of that space, NES also features over 100 bearing testing platforms, an environmental testing channel, a state-of-the-art inspection lab and an environmentally controlled clean room that allows bearings to be inspected at cleanliness levels down to ISO Class 5.

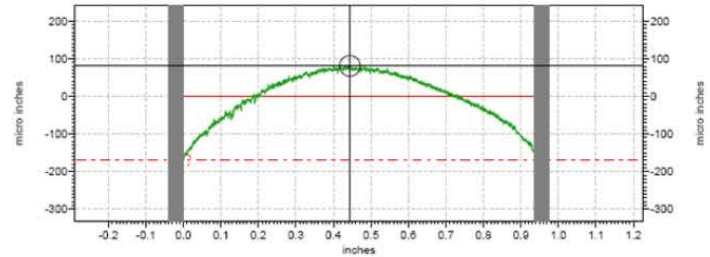
Bearing qualification begins with acknowledging the risk and responsibility associated with utilizing the global bearing market (and striving for the rewards that can be reaped from establishing new sources of credible supply). This means recognizing that bearings are NOT a commodity, accepting greater responsibility for understanding a bearing's design intentions and its impact on product life and allowing for the resources required to achieve a positive outcome.

From there, NES can help you create an optimal bearing inspection or testing plan. And at NES, those programs include our Source Qualification Inspection, bearing modeling, environmental testing, failure/condition analysis, lubricant life testing and life and efficiency testing.



Bearing Inspection

We talk to customers every day who ask essentially the same question: “Can you help us test a bearing?” After identifying their intentions for testing, nearly 100% of the time, we’ll suggest that we begin with a bearing inspection. NES firmly believes that the first step in the product assessment process is our **Source Qualification Inspection (SQI)**.



Source Qualification Inspection (SQI)

The **SQI** is a comprehensive reverse engineering program designed for the industrial sector which has three key objectives:

- Determine the design intentions of a manufacturer
- Assess how well the manufacturer carried out those intentions
- Evaluate the overall quality of workmanship

The SQI accomplishes these goals through a detailed evaluation of a sample population of bearings from applicable suppliers.*

(* When seeking to qualify a new supplier, the SQI should be performed on both the baseline supplier, one which typically performs well in the application, and any potentially new supplier for comparison purposes. A detailed evaluation of the characteristics described will identify areas of concern and significantly reduce risk and expense going forward.)



What does the SQI consist of?

The product undergoes a complete dimensional inspection, noise testing, visual inspection, seal evaluation (if applicable), material chemistry, microstructure and both a cleanliness and hardness inspection. It may also include non-destructive testing techniques for identification of material defects caused by abusive manufacturing practices.

SQIs can be performed on the following types of bearings:

- Deep Groove Ball Bearings
- Angular Contact Ball Bearings
- Tapered Roller Bearings
- Cylindrical Roller Bearings
- Needle Roller Bearings
- Thrust Ball and Roller Bearings



The Power of Inspection

The SQI allows OEMs to:

- Eliminate costly physical test programs using known deficient product
- Openly communicate design issues with a bearing manufacturer
- Determine why suppliers might perform differently
- Accurately model bearing performance characteristics through commercially available bearing software programs
- Control bearing design to ensure success in the global supply chain.



How is SQI data useful?

For no other reason but the first bullet point, we should be performing an SQI.

Dynamic testing of bearings without knowing the design, manufacturing ability and overall quality characteristics of the two (or more) suppliers limits one's ability to make decisions and learn from endurance testing results AND costs additional money in the future.

Neither the customer nor NES prefers to waste time and money testing a product that possesses design or manufacturing defects, most of which can be addressed and corrected easily and relatively quickly. Without an SQI, this can happen too often.

The knowledge gained through the technical information resulting from the inspection enables you to communicate issues with the manufacturer,

affecting change at a faster rate. Through inspection, we can begin to understand why a supplier might perform differently. Furthermore, once physical testing commences, we can assign cause for performance differences. Without the inspection data, we only know that a supplier performed better or worse, but without an assignable cause.

And we believe this to be a waste of available and valuable information.



***** An SQI typically requires about 4-6 weeks for completion and comes with a detailed report on our findings.***

With an array of uncertainties that may affect your application, let NES provide the stability and peace of mind that only its experienced bearing engineers can offer.



Source Qualification Inspection (SQI)

SUPPLIER A

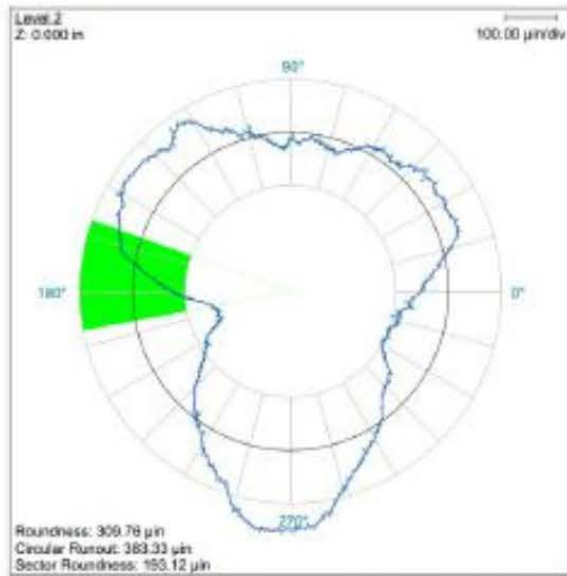


Figure 1: Cup Raceway #2 - 310 μm

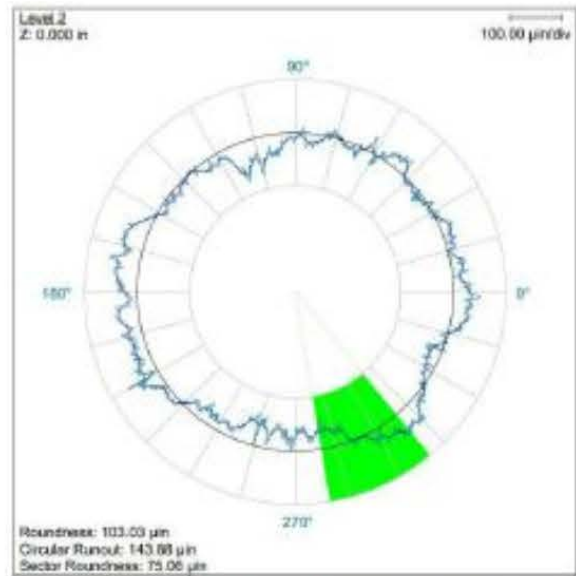


Figure 2: Cone Raceway #6 - 103 μm

SUPPLIER B

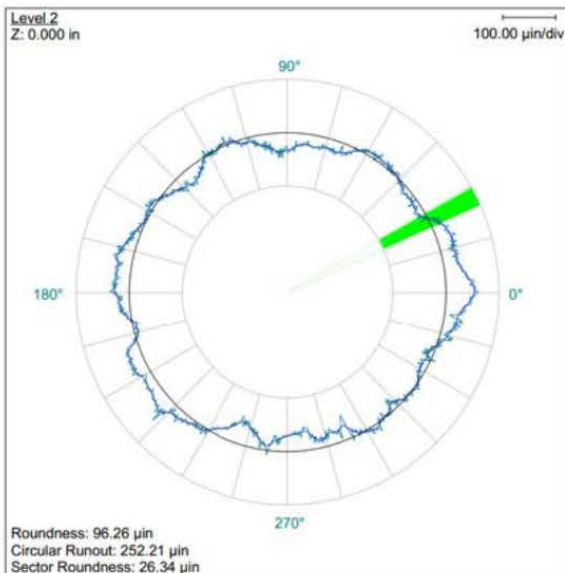


Figure 3: Cup Raceway #2 - 96 μm

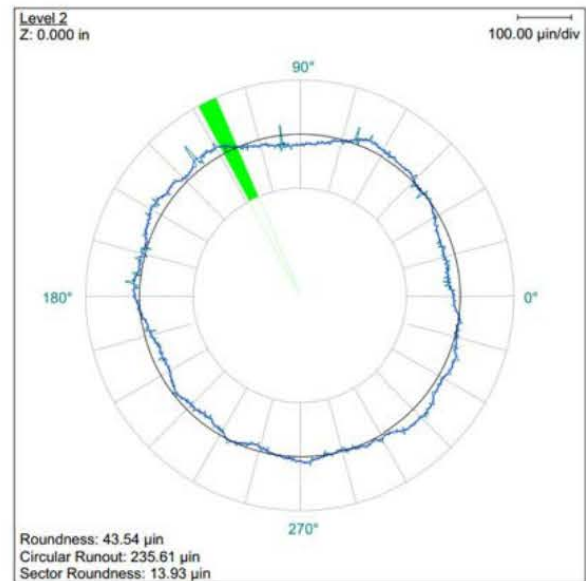


Figure 4: Cone Raceway #8 - 44 μm



Source Qualification Inspection (SQI) Digital Stitching

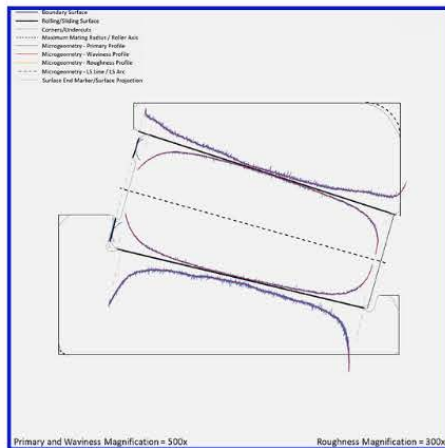
NES, in recent years, has incorporated a new feature as part of its Source Qualification Inspection program: **Digital Stitching**.

NES' bearing inspection engineers work closely with the inspection technician team to develop enhanced technical information about the interaction between contacting surfaces within a tapered roller bearing.

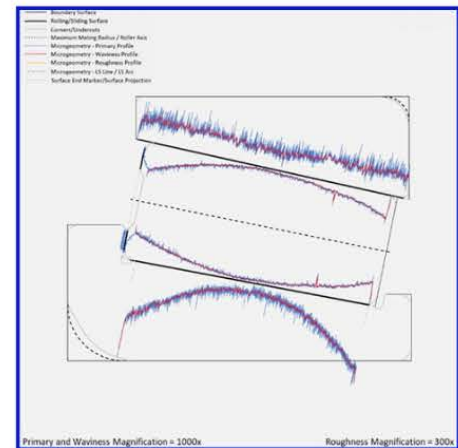
Our inspection technicians provide the data that's produced by various high-quality measuring machines. Our engineers then "digitally stitch" that information together to create an accurate image of the exact location and form of all contacting surfaces of the cone, cup and rolling element.

ROLLER TO RACEWAY

GOOD QUALITY BEARING

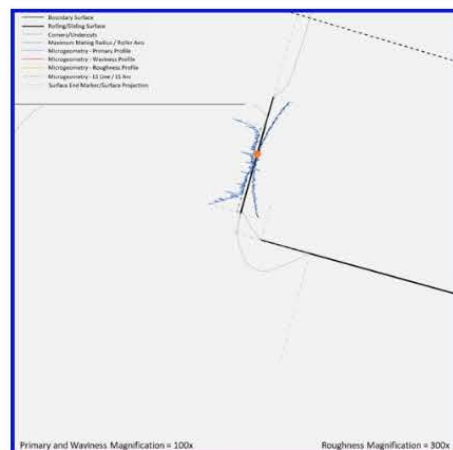


POOR QUALITY BEARING



ROLLER END TO CONE RIB

GOOD QUALITY BEARING



POOR QUALITY BEARING



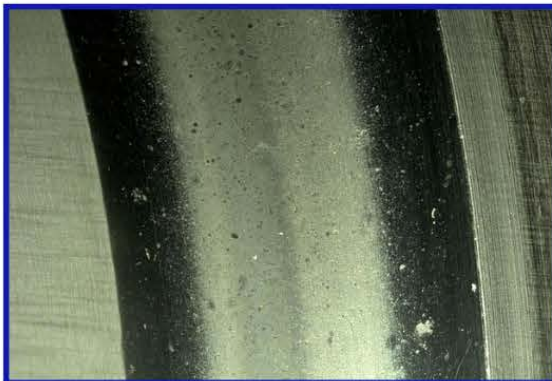


Bearing Condition Analysis



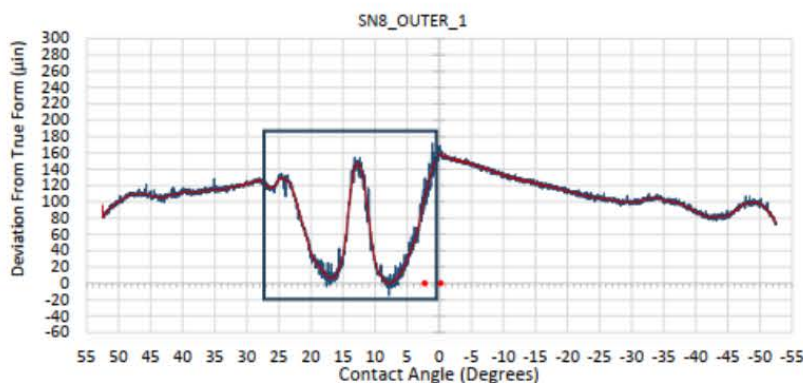
Another area of inspection that could be valuable to you, particularly if you become engaged in your own application or field testing is NES' bearing condition/failure analysis program.

Bearing condition analysis defines the wear and performance characteristics of a bearing during new product development. It can highlight issues associated with system design, provides a qualitative assessment of bearing life expectancy and also allows for direct comparison of suppliers or different designs. Additionally, it can help define the failure mode of the bearing within the application. This is important since understanding the failure mode allows one to perform specific standard bearing tests, which allow for more cost-effective testing programs for future development.



Standard Examination Plan

NES can pinpoint the cause of bearing fatigue, whether surface- or sub-surface-initiated, by performing a thorough examination of the bearing components, including material composition and microstructure, and identifying wear characteristics impacting its condition.



NES' typical condition/failure analysis processes include:

- Thorough cleaning of bearing
- High-level visual assessment of condition
- Measurement of internal radial clearance
- Bearing disassembly (destructive)
- Profile measurements

- Visual inspection of rolling elements, cages and raceways for presence of damage
- Magnetic Particle Inspection (MPI)
- Surface Temper Etch
- Microstructure analysis
- Basic electronic report with accept/reject determination



Bearing Testing

It's a line you might have heard associated with us before ...

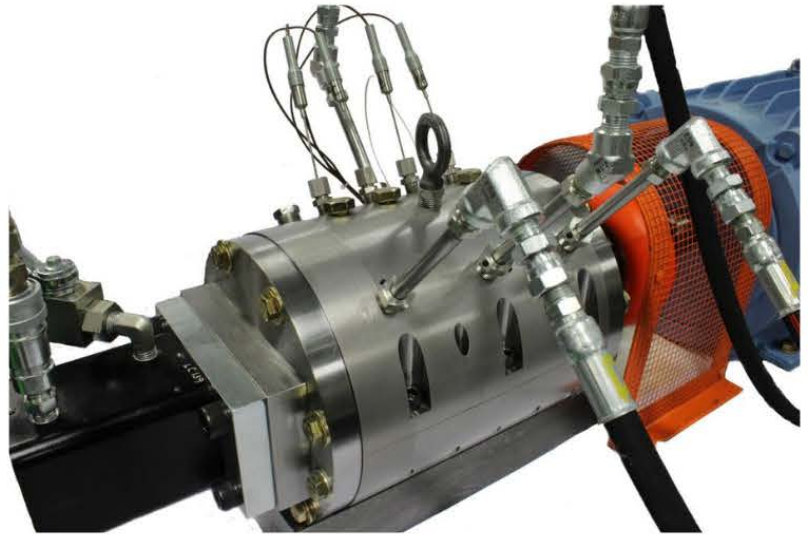
"Napoleon Engineering Services houses the largest independent bearing testing and inspection facility in North America."

It's a factual statement. But what does it mean? It means NES has the capacity to perform **Standard Bearing Testing** (SBT) to support your supplier qualification needs.

NES' objective is to utilize lab testing programs related to application failure modes because they are typically faster, lower cost and provide a greater number of data points for assessment. The three main types of lab tests include:

- Endurance/Life/Fatigue/Efficiency
- Environmental
- Impact/Static Load

NES' **Standard Bearing Testing** programs (primarily Endurance/Life/Fatigue) compare how bearing life, efficiency and overall running characteristics are influenced by material properties, heat variations, design, manufacturing quality and lubrication. Customers can then use that knowledge gained from these tests to make more informed supplier qualification decisions. Our **Environmental Testing**, meanwhile, evaluates seal effectiveness for those applications in which the failure mode results from contamination intrusion and surface-initiated failure. These applications include agricultural equipment and heavy machinery, off-road motorsport vehicles, commercial and consumer outdoor power equipment and turf maintenance systems.



NES President and Chief Engineer Chris Napoleon:

"By performing standard bearing testing, NES can inform customers about the design and manufacturing quality of bearings, resulting in reduced risk of utilizing new or alternative suppliers. Standard bearing testing provides customers with detailed results that supply the information needed to make sound decisions."



Bearing Testing



Endurance Testing

When developing an endurance test program, there are a few basic steps performed by the test engineer.

NES tasks itself early in the overall qualification process to gather application data. The more imperative component, however, is to define the intentions of the test. We ask this question of our own test engineers and customers every day: What do you want to learn from the test? More specifically, what is the failure mode inside that application, which will then allow us to pinpoint what we're going to do?

If the failure mode is fatigue, then we likely should be carrying out a Standard Bearing Test.

Standard Bearing Testing is the most common of our programs and provides the best bang for your buck. An NES test engineer is then able to choose the best test rig

concept to carry out those intentions. Knowing product capacity, rig capability, the testing conditions are formulated, bearing life is estimated and sample size defined based on rig characteristics, availability of product and budget constraints.

Standard Bearing Testing is:

- Performed on the subject bearing only
- Typically exclusive of any application components
- Typically performed with operating conditions unassociated with the application (load type, speed, temperature and lubricant selected can be influenced by application)
- Intended for comparison of products at accelerated conditions
- Intended to create fatigue-related failures (Bearing life is the measurable characteristic for Weibull distribution)

Standard Bearing Testing allows for:

- Correlation of new supplier to application condition when baseline supplier is also tested
- Maximum efficiency of test equipment availability
- Greater sample size for statistical analysis
- Testing in both classical and sudden death test methodologies
- Determination of L10 life confidence bands for the population based on samples tested



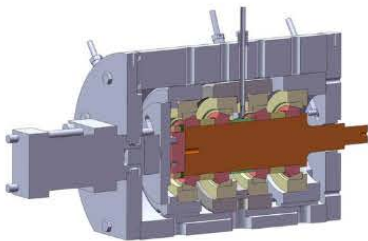
Particulars of Standard Bearing Testing

Standard Bearing Tests are performed on the subject bearing only; testing is exclusive of any additional application components. Test loads and conditions are typically irrespective of the application duty cycle conditions; however, load type, speed, temperature and lubricant can be influenced by the application.

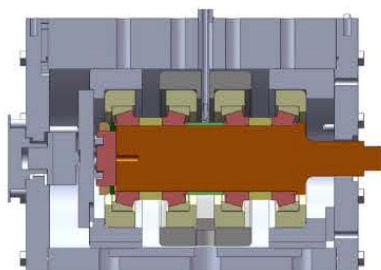
Standard Bearing Testing is intended for the evaluation of product performance at accelerated conditions. This is one of the greatest benefits of SBT over those tests utilizing application duty cycles. SBT typically creates fatigue-related failures. Bearing failure over time is the measurable characteristic enabling Weibull distribution analysis and estimation of the probability of failure occurrence by the supplier based on actual product design and manufacturing capabilities.

SBT does allow for correlation of a new supplier to application conditions when the baseline supplier is also tested. SBT allows for maximum efficiency of test equipment availability, resulting in a greater sample size for statistical analysis. Finally, it enables both classical and sudden death methodologies.

Standard Bearing Test Rigs

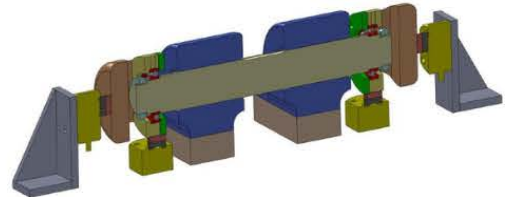


FOUR BEARING HOUSE



FOUR BEARING HOUSE SBT

- Radial and Axial Load Capabilities
- Flexible Lubrication Types
- Convenient Sudden Death Testing



OVERHUNG LOAD



OVERHUNG LOAD SBT

- Axial, Radial and Moment Load Capabilities
- Individual Test Bearing Positions
- Convenient Visual Monitoring of Test Bearings
- Convenient for Classical Test Methods

Contact us

Meet our team



Chris Napoleon
President/Chief Engineer



Tom Jaskolka
Sr. Testing Engineer



David Steere
Inspection Engineer



Gus Napoleon
Inspection Engineer



Wesley Senn
Materials Engineer

About NES

NES is regarded as the premier independent, single-point resource for bearing design, inspection, testing and manufacturing of custom bearings. Our intimate knowledge of bearing applications plus expertise in bearing technologies enables NES to be a key technical resource to bearing manufacturers, distributors and equipment manufacturers serving aerospace, military, transportation, off-road, oil and gas and other industrial applications.

NES is an ISO-9001:2008 and AS 9100:2009 REVC-certified company. Our participation in the Society of Tribology and Lubrication Engineers and other industry associations enables NES to stay ahead of the curve on trends in new materials such as ceramic and hybrid bearings, surface treatments and on evolving trends in handling application challenges such as higher loads, higher speeds and greater environmental extremes.



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