



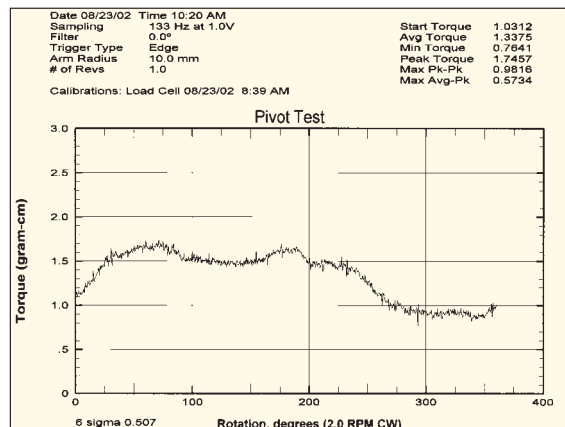
PRINCIPLES OF MicroTorque™ TESTING

By Simon Harrison, Ph.D., President, Dynaroll Corp.



MicroTorque testing is a deceptively simple method to accurately determine the “quality” of a rotating part. A source of accurate, slow, vibration-free rotation is applied to one component of a rotating part while measuring the force exerted by the opposite component. The essence of the test is that it is performed at very low speeds, typically 2 RPM, but in some cases as low as 0.001 RPM. At these very low speeds, there is no vibration to mask the very small changes in transmitted force that are caused by microscopic internal inconsistencies during rotation. When such a rotation system is coupled to a sensitive force-measuring load cell, the system can detect the smallest variations caused by bearing brinelling, contamination, raceway misalignment, lobing and many other issues. Results are graphically displayed on an easy-to-read trace.

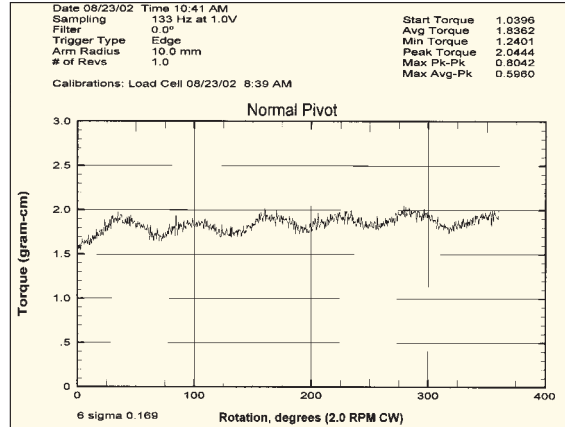
The purpose of this article is to introduce the reader to the concept of MicroTorque testing and to present some analytical results from tests on parts with different rotational problems. All measurements were taken using an M15W MicroTorque™ tester from Measurement Research, Inc.





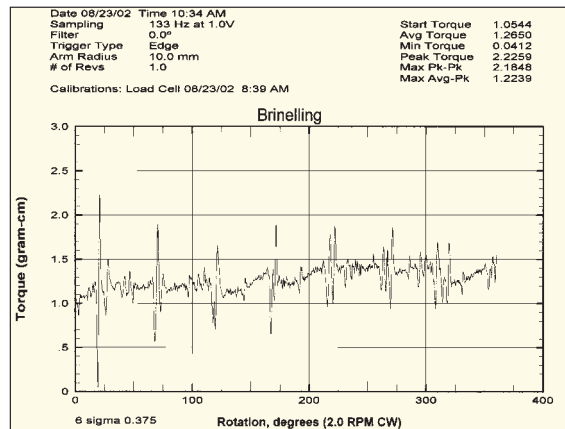
Normal Test Trace

Normal test – A “normal” test, like beauty, is in the eye of the beholder. The M15 is a very sensitive device and a perfectly made part may show many small variations during rotation. The important thing is to decide what is important to the application. The test shown here is typical of a disk drive pivot, showing even rotation over 360°. Small irregularities and the grease hash do not indicate any problems. In a typical ball bearing the inner race must rotate 3-4 complete revolutions relative to the outer race before the balls have moved around the raceways once. This means that consecutive 360° tests of the same part actually have different starting positions for the balls, causing apparent torque variation.



Brinelling test trace

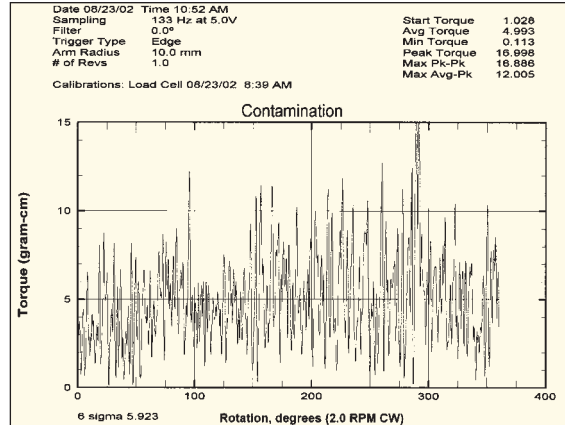
Brinelling – Dented raceways (brinelling) are shown as a series of evenly-spaced spikes with the leading edge falling (the ball falls into the hole in the raceway before climbing out). Very severe brinelling may cause a rippling of the raceway, seen as multiple spikes. At this point, the damage can usually be felt by hand.





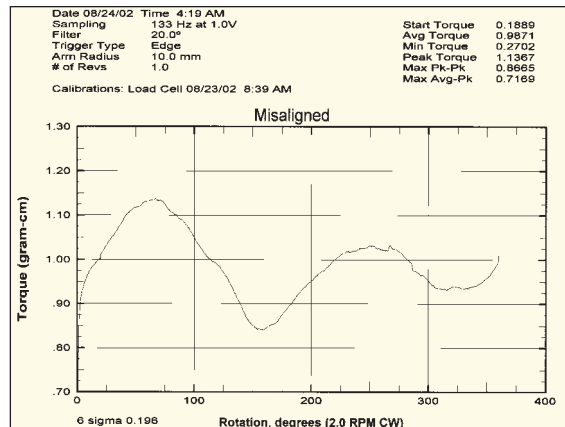
Contamination test trace

Contamination – Shown as irregular spikes with the leading edge rising (the ball must climb the contaminating speck before falling off the back side).



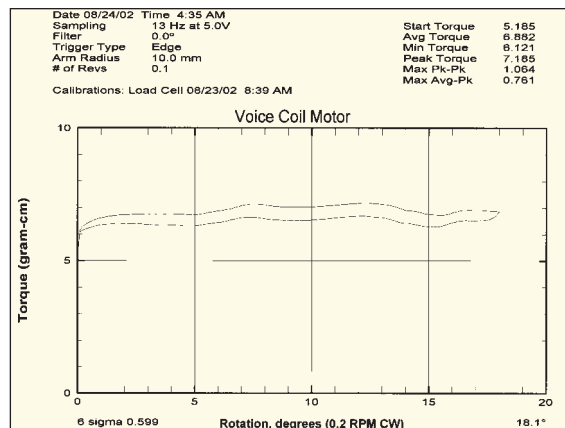
Misalignment test trace

Raceway misalignment – Sinusoidal torque variation over 360° is indicative of slight raceway misalignment.



VCM test trace

Voice coil motor (VCM) – This is an automatic test of the motor efficiency over the entire length of stroke of the motor. The test automatically reverses when the hard stop is encountered and the reverse stroke is overlaid as a reversed trace so that features will align correctly. Built-in current measurement allows display of Kt (gm-cm per amp).





Lobing test trace

Lobing – Two different sinusoidal variations with periods much shorter and much longer than 360° are typical. This example is plotted in MS Excel using direct test export feature.



Conclusion

The MicroTorque tester is a versatile and powerful tool that can be used to pinpoint a number of rotational faults. The traces shown in this article show simple effects, but further analysis of test data, including frequency domain, can expose great detail of the internal structure of any rotating part.



551 FIFTH STREET
SAN FERNANDO, CALIFORNIA 91340
TEL: (818) 898-1036
FAX: (818) 837-3466
WEB: www.measurement-research.com