nexen Tech.Doc

Roller Pinion vs Involute Gear Systems:

PERFORMANCE COMPARISON OF STIFFNESS, BACKLASH AND HYSTERESIS

Stiffness in a mechanical gear system is defined as the extent to which the gears deform when one member is locked and a torque is applied to the other.

Nexen Group, Inc. performed extensive tests and studies to calculate, understand, and compare the stiffness values of a roller pinion system vs. an AGMA 12 involute gear system. The test results found that the stiffness of the two systems is similar.

TEST DETAILS

The roller pinion selected for the test is a Nexen RPS size 16. The gear selected is a class AGMA 12, ground, module 4 involute gear. The specifications are in the table below.

Gear Type		Roller Pinion	Involute Spur Gear
Pinion Teeth	qty	10	12
Gear Teeth	qty	60	101
Gear Ratio	qty	6.00	8.42
Tooth Width	mm	11.50	11.50
Module	mm	n/a	4.00
Center Distance	mm	171.00	228.00

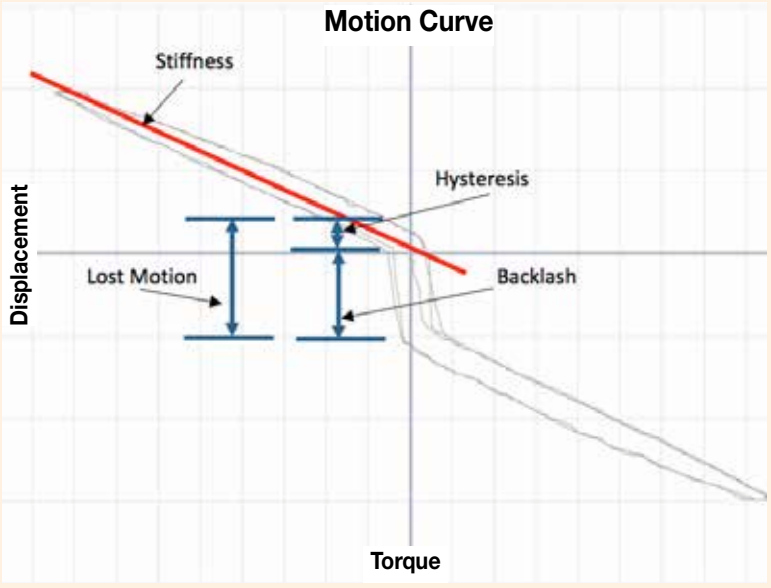
DEFINITIONS:

Stiffness: The rate of change when comparing applied torque to displacement. Typically any non-linear motion around 0 is ignored as it is accounted for in other terms.

Blacklash: Motion where the input moves and the output does not. Typically, due to clearance between gears.

Hysteresis: The difference in position when an axis is loaded vs unloaded.

Lost Motion: The combination of hysteresis and backlash.



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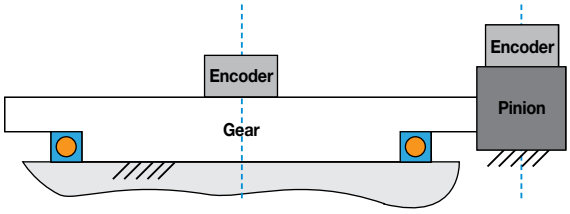
Test Details continued...

The two systems were chosen because they represent approximate head to head configurations having a similar size, ratio, and center distance. In addition, they also have equal face widths.

The pinion is locked to ground preventing rotation. A torque is applied to the gear and the rotational displacement is measured via an encoder attached the both the gear center and the non-locked end of the pinion. Below is a representation of the test.

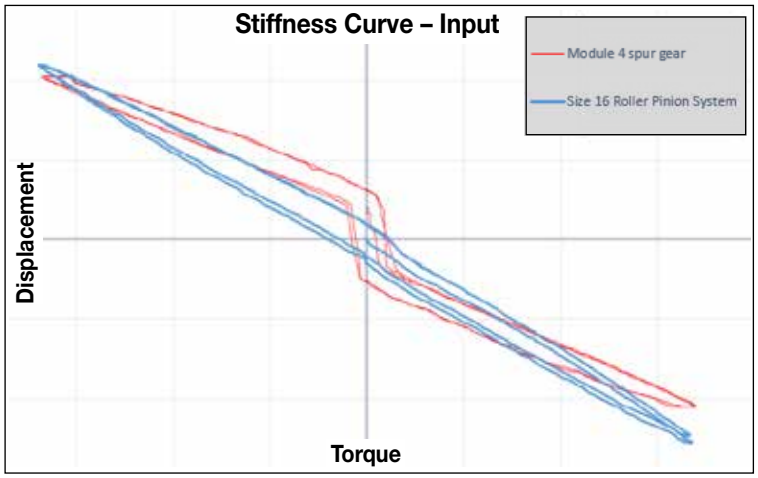


EVALUATION:

Rotational stiffness can be evaluated on both the input and the output gears. This test evaluated on the input because it normalizes the effect of gear ratio.

TEST RESULTS:

The graph below shows the normalized results of the roller pinion and involute gear products.



Key differences between the two systems:

Stiffness: The roller pinion system is comprised of multiple parts including the pinion body, pins, rollers, bearings and the gear. The common assumption is that more parts yield significantly lower stiffness than an involute made of 2 components (pinion and gear). The test data shows that the involute gear and the Roller Pinion System have similar stiffness.

Backlash: The data shows that the involute gear has backlash around the 0 torque point where the applied load changed direction.An involute gear's center distance can be adjusted to reduce or increase the backlash, although to avoid jamming some backlash is necessary. The Roller Pinion System shows no measurable backlash, which is a key performance difference.

Hysteresis: Both products show a similar hysteresis in this test.

SUMMARY:

When comparing the stiffness, backlash and hysteresis features of an involute gear vs the Roller Pinion System the two product are similar. The key performance advantage is the zero backlash feature on the Roller Pinion System.

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