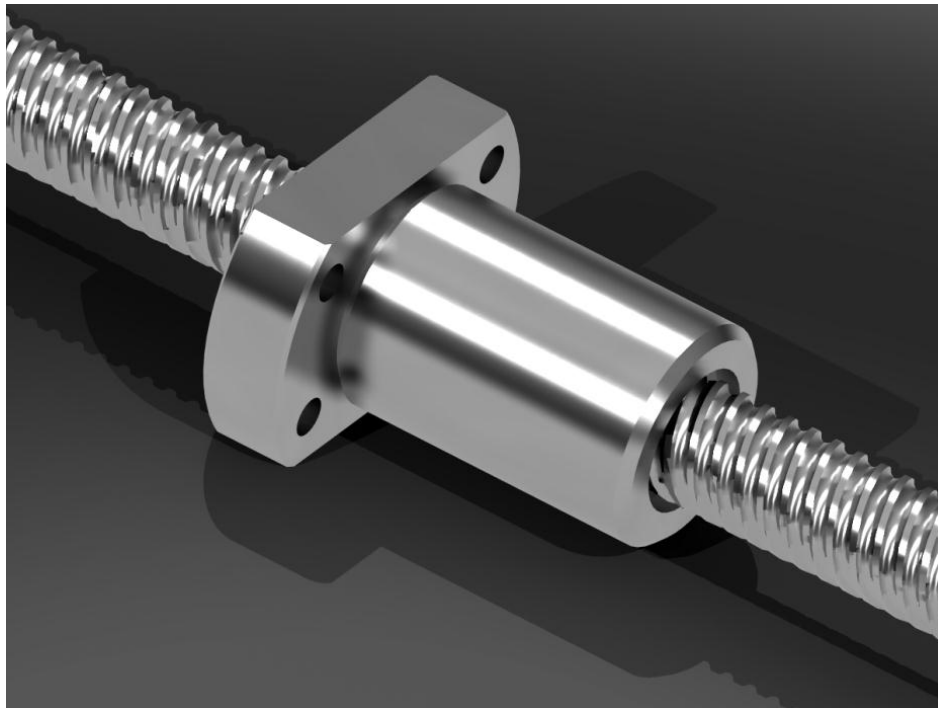


TRANSPORT BALL SCREW REPORT IPR 1001-2.0

Overview 1.7



PURPOSE:

To provide unbiased, objective commercial & product performance information allowing for better informed supplier decisions.

REPORT INCLUDES:

- Manufacturer & qualified supplier lists
- Price & delivery information from qualified suppliers
- Product performance testing of (4) lowest cost qualified suppliers
 - Load-Life
 - Accuracy
 - Efficiency
 - Stiffness & Deadband
 - Smoothness
- All individual product test results
- Side-by-side summary of test results by manufacturer, including catalog values for load-life, accuracy, & efficiency

TRANSPORT BALL SCREW REPORT IPR 1001-2.0

This report documents:

- Identification and qualification of transport ball screw manufacturers
- Price and delivery information from qualified manufacturers
- Testing of 6 key performance attributes of products from the 4 lowest cost qualified suppliers

Manufacturer Selection for Testing

The manufacturers whose products were tested were selected via the following process:

1. A list of manufacturers of transport ball screws was created.
2. A set of qualification criteria* was applied, whereby those who met the criteria formed a group to which a request for quote for a representative product was sent.
3. The responses from the request for quote were sorted by price. The four (4) lowest cost were purchased and tested.

* Manufacturer Qualification Criteria

In order to ensure specific commercial requirements are met by potential suppliers, the following qualification criteria were utilized:

1. Ball screws are a standard catalog product of their manufacture
2. Sales representation within the United States (either direct, distributor, or sales representative)
3. Operation to international standards
4. Minimum standard warranty

Representative Ball Screw Specification

- 16mm diameter
- 5mm lead
- C10 Accuracy class
- DIN standard nut
- Non-preloaded

Ball Screw Performance Testing

The following characteristics were tested for each ball screw:

- Load-Life**
- Accuracy**
- Efficiency
- Stiffness & Deadband
- Smoothness

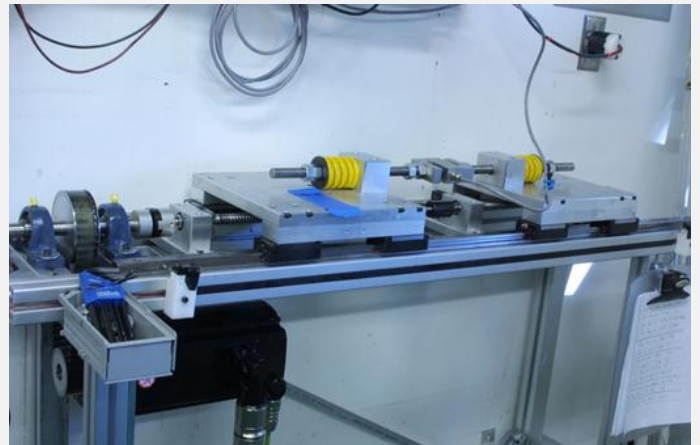
** Manufacturers catalog values for Load-Life, Accuracy, and Efficiency are provided for comparison to test values .

Common test equipment via the same test protocol was used for all testing.

A population of six (6) specimens from each manufacturer was used for each test.

Load-Life

Ball screw life is measured by means of running all ball screws under the same constant load until fatigue failure.



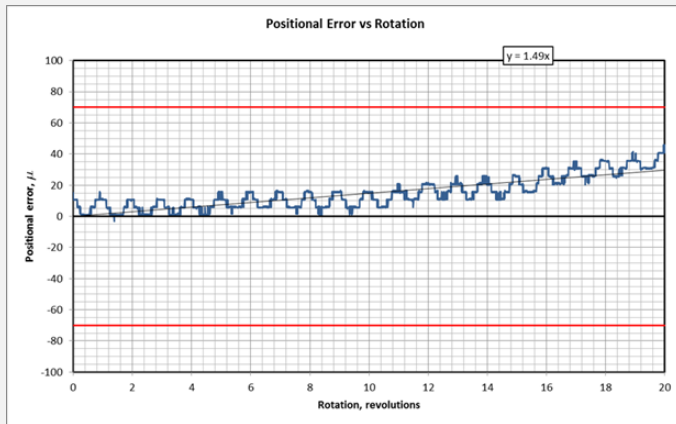
Results are compared against the calculated L10 life based utilizing the dynamic load rating from within each manufacturers' catalog:

	Manufacturer			
	1	2	3	4
Dynamic load rating (kN)	x	x	x	x
Calculated life* (revs x 10 ⁶)	x	x	x	x
Empirical Travel Life				
Screw 1	x	x	x	x
Screw 2	x	x	x	x
Screw 3	x	x	x	x
Screw 4	x	x	x	x
Screw 5	x	x	x	x
Screw 6	x	x	x	x
Achieved Calculated				
Catastrophically Failed				
Suspended				

Accuracy

Ball screw accuracy is determined by measuring the linear position of the ball screw driven table as a function of the commanded rotation of the ball screw.

Accuracy Graph Sample



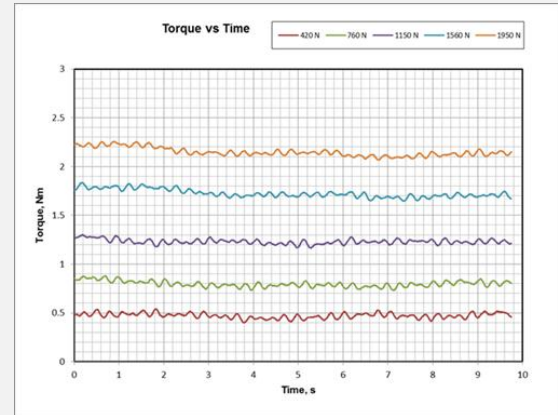
Accuracy results are provided along side the catalog accuracy published by each manufacturers comparison:

	Manufacturer			
	1	2	3	4
Average	x	x	x	x
Maximum	x	x	x	x
Std Deviation	x	x	x	x

Efficiency

Ball screw efficiency is determined by measuring the required drive torque as a function of applied axial load.

Efficiency Graph Sample



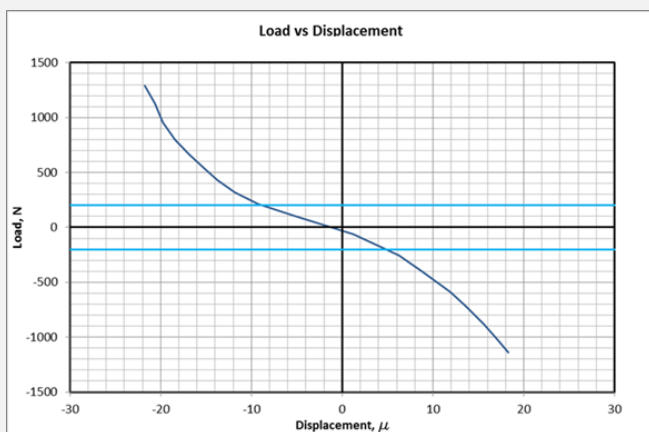
Efficiency results are provided and ranked:

Load	Manufacturer			
	1	2	3	4
420	x (4)	x (3)	x (1)	x (2)
780	x (4)	x (2)	x (1)	x (2)
1170	x (4)	x (2)	x (1)	x (3)
1560	x (4)	x (2)	x (1)	x (3)
1970	x (4)	x (2)	x (1)	x (3)
Avg Rank	2.8	3.2	1.2	1

Stiffness & Deadband

Ball screw stiffness and deadband are determined by measuring the generated linear force as a function of commanded rotation of the ball screw.

Stiffness & Deadband Graph Sample



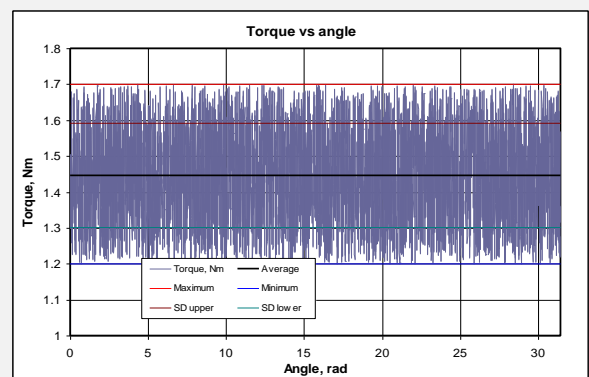
A summary of Stiffness & Deadband results are provided:

	Manufacturer			
	1	2	3	4
Stiffness	x	x	x	x
Reversing Band	x	x	x	x

Smoothness & Vibration

Ball screw smoothness & vibration are determined by measuring the variation in torque required to drive the ball nut at varying load values.

Smoothness & Vibration Graph Sample



Smoothness & Vibration results are provided:

Load	Manufacturer			
	1	2	3	4
420	x (4)	x (3)	x (1)	x (2)
780	x (4)	x (2)	x (1)	x (2)
1170	x (4)	x (2)	x (1)	x (3)
1560	x (4)	x (2)	x (1)	x (3)
1970	x (4)	x (2)	x (1)	x (3)
Avg Rank	4	2.2	1	2.6

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Appendix A: Accuracy Data

Appendix B: Efficiency & Smoothness Data

Appendix C: Stiffness Data

Download a sample copy of the report at:

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Industrial Product Reports

Independent • Objective • Complete

Founded by two engineers with 50+ years of industrial product experience, Industrial Product Reports is an independent source for unbiased, objective commercial and product performance information.

Independent – Industrial Product Reports is completely independent. We are not affiliated with, nor accept advertising from, any manufacturer or seller of industrial products. Income is generated by means of selling reports to, and for the benefit of, our customers.

Objective – All information reported is based upon our direct experience and testing. Information reported from our commercial experience, i.e. purchasing process, is unaltered data as provided directly by the manufacturers. Objective criteria are used for selection of manufacturers whose products are to be tested. Product performance data is generated by a common test protocol with results derived by identical means. Products are purchased without the knowledge that they will be tested.

Complete – Our reports contain the complete vendor screening process, consisting of identifying and documenting all vendors, narrowing the list by means of meeting specific criteria, and side-by-side performance test results. All selection criteria, test protocols, and equations used are contained within the reports.

Summary of Commercial and Component Testing Results

Attribute	Units	Manufacturer			
		1	2	3	4
Price - Cut-To-Length	\$	x	x	x	x
Quoted Leadtime	Days	x	x	x	x
Price - Machined	\$	x	x	x	x
Quoted Leadtime	Days	x	x	x	x
PO Stated Ship Time	Days	x	x	x	x
Actual Ship Time	Days	x	x	x	x
Load-Life					
Dynamic Load Rating	kN	x	x	x	x
Catalog L10 Life	x 10 ⁶ rev	x	x	x	x
Achieved Catalog Life	qty	x	x	x	x
Failed	qty	x	x	x	x
Suspended	qty	x	x	x	x
Accuracy	error(μ)/rev	x	x	x	x
Efficiency	%	x	x	x	x
Stiffness	N/μ	x	x	x	x
Reversing Band	μ	x	x	x	x
Smoothness	torque SD	x	x	x	x

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