

REACTION THE WASHER  
COMPANY

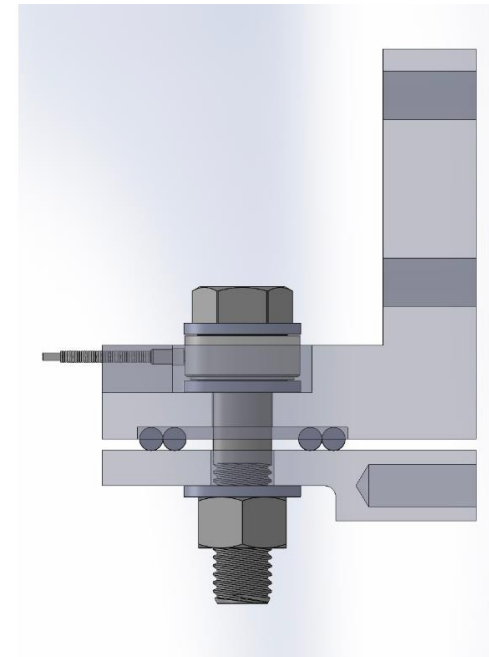
JUNKERS TEST REPORT  
(DIN25201-4)



## JUNKER TEST REPORT - 28 June 2024



<b>PRODUCT BRAND TESTED:</b>	SerraLoc™ - The Reaction Washer Company
<b>BOTTOM GEOMETRY:</b>	SerraLoc™ <i>Patented</i> Dual Row Bi-Directional Helical Serrations
<b>TOP GEOMETRY:</b>	SerraLoc+V™ Uni-Directional Fastener Lock Serrations
<b>TESTING SPECIFICATIONS:</b>	DIN 25201-4: LTI-057 (Undated from DIN 65151)
<b>TESTING AGENCY:</b>	(ITS) Innovative Test Solutions, Inc. 551 Kings Road Schenectady, NY 12304
<b>SCOPE OF ACCREDITATION:</b>	To ISO/IEC 17025:2017
<b>FIELDING OF TESTING:</b>	Mechanical Testing
<b>CERTIFICATION NUMBER:</b>	2631.01



## **BACKGROUND**

A Junker test is a mechanical test to determine the point at which a bolted joint loses its preload when subjected to shear loading caused by transverse vibration. Design engineers apply the Junker test to determine the point at which fastener securing elements – such as lock nuts, wedges and lock washers – fail when subjected to vibration. The data collected by the test enables design engineers to specify fasteners that will perform under a wide range of conditions without loosening.

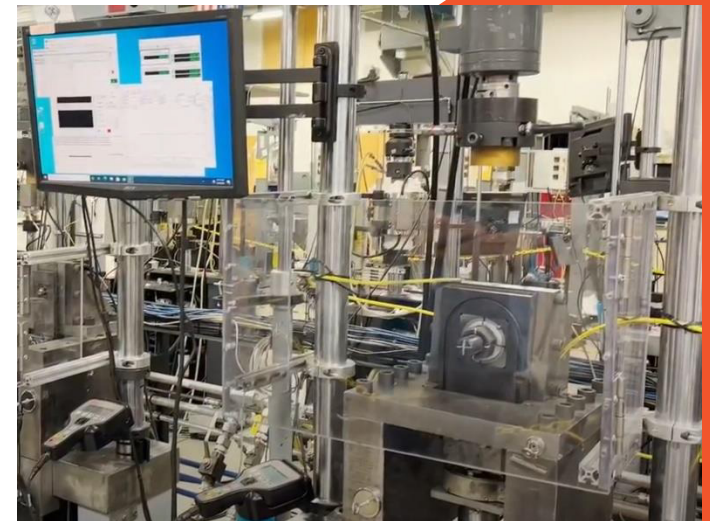
Research into the causes of vibration-induced self-loosening of threaded fasteners spans six decades and the causes of self-loosening are now well understood. It was pioneering experimental research into the behavior of bolted joints under transverse loads, conducted by German engineer Gerhard Junker in the late 1960's which underpins modern theories on self-loosening behavior.

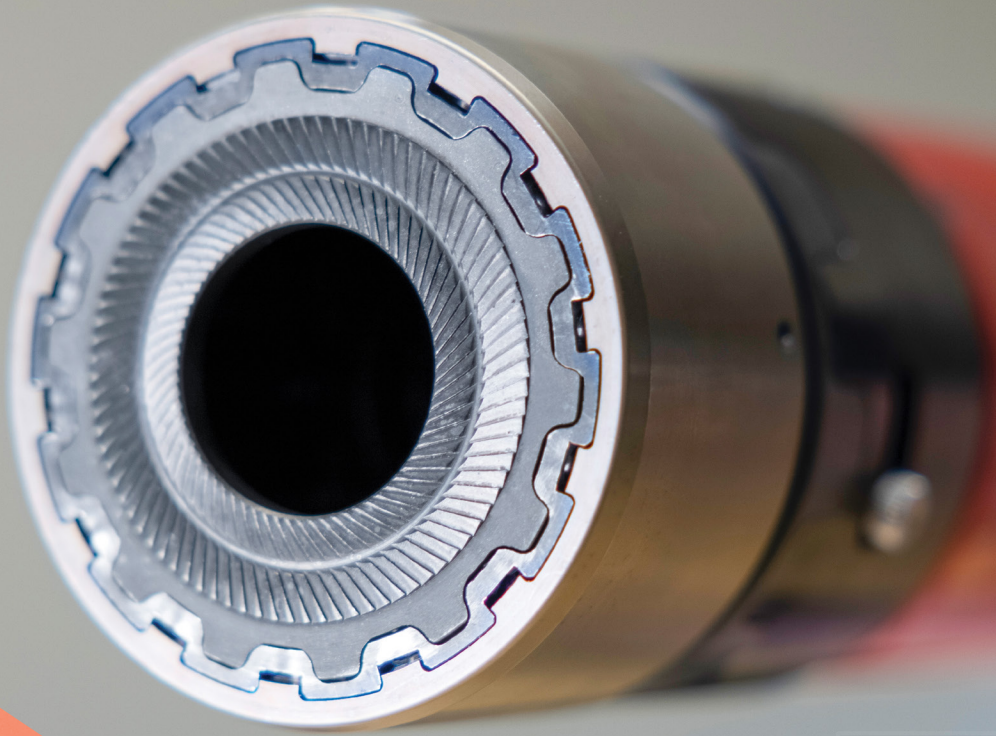
Junker's test methodology and apparatus described in his 1969 paper has since become known as the Junker test and has been adopted into international fastener standards such as DIN 65151. The Junker test, now revised and published under standard DIN 25201-4, is the latest established method used for analyzing the self-loosening behavior of secured and unsecured threaded fasteners under transverse loading conditions by vibration testing.

## **THE PROCESS**

The Junker test to DIN 25201-4 involves more stringent reference testing, verification testing and reporting requirements than the original DIN 65151.

1. Reference testing is conducted to determine the effective displacement at which the bolt starts to self-loosen, so that the performance of the securing element of locking mechanism can be effectively tested.
2. Three subsequent reference tests are performed to ensure the effective displacement value is correct.
3. Twelve verification tests for each set of measurements are recorded from the Reference test. Data recorded includes the pre-stressing force, transverse displacement under load and the number of load cycles.
4. The securing effect of the locking mechanism is considered adequate if a minimum of 80% preload remains *from and initial 50% preload applied at the beginning of the test*. The preload must be maintained for 2000 load cycles.
5. The new DIN 25201 requirements provide customers with data about products they are purchasing and also allows researchers and test engineers to exchange data about locking device performance with much greater confidence.





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## **BENEFITS OF THE JUNKERS TEST**

The Junker test is used to determine which fasteners maintain clamp load when under the influence of vibration and which do not. Having this information helps engineers design safe joints with a long service life when such applications are subjected to intense vibratory conditions.

## **TEST SAMPLES**

**Fifteen** (15) Test samples of Grade 8 1"-14 3.0" length yellow Chromate Plated Hex Head Bolts were provided by ITS along with fifteen (15) Grade 8 1"-14 3.0" length yellow Chromate Plated Hex Head Nuts.



**Twelve** (12) Test samples of the SerraLoc Washer with SerraLoc+V top serration geometry were provided to innovative Test Solutions for testing per DIN 25210-4.

**Three** (3) of the Grade 8 1"-14 3.0" length yellow Chromate Plated Hex Head Bolts along with three (3) Grade 8 1"-14 3.0" length yellow Chromate Plated Hex Head Nuts were used to create a baseline test result. Twelve of the Grade 8 Hex Head Bolts, Hex Head Nuts and SerraLoc Washers were used for comparison for DIN 25201 (Junkers) test. The results were indicated.

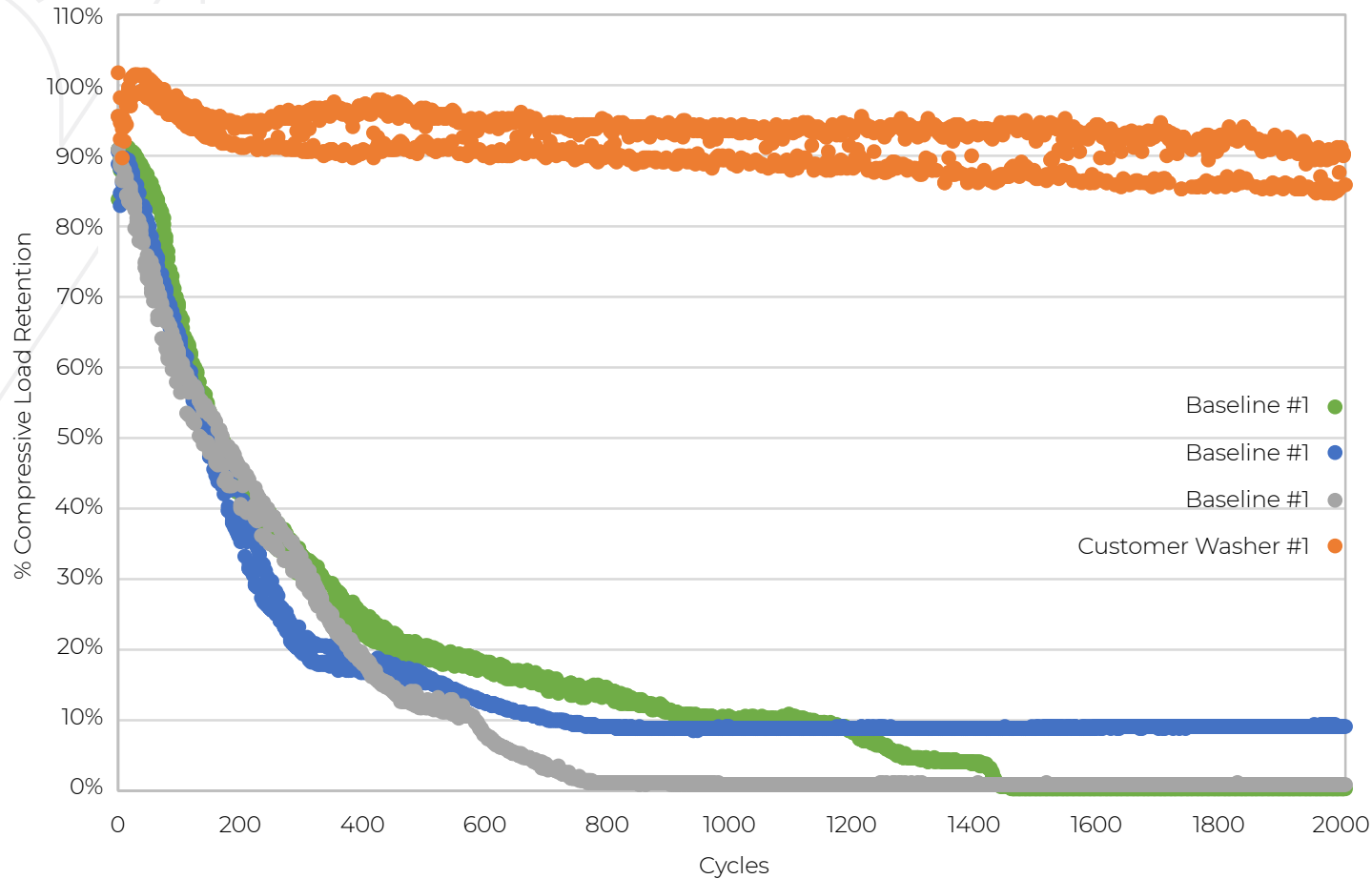


## BASELINE TEST

### Innovative Test Solutions, In. (24175)

1"-14 Zinc-Yellow Chromate plated Grade 8 Bolt, Grade 8 Hex Nut  
Baseline vs. Customer Washer Compressive Load vs. Cycles  
450 Ft-lbf, +/- 0.06" Displacement, 125 Hz, 75F

Customer: John Davis - Company: The Reaction Washer Company





# BASELINE RESULTS



## CERTIFICATE OF TEST

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551 Kings Road  
Schenectady, NY 12304  
Ph.: (518) 688-2851  
Fax: (518) 688-2855  
www.its-inc.com

Customer Name:	John Davis	Certificate Date:	6/6/2024						
Company Name:	Prime Source Consulting LLC	ITS Project:	24175.01						
Test Type:	Junker	Certificate No:	1						
Test Spec:	DIN 25201	P.O. No:	Signed Acknowledgment						
		Specimen Material:	Baseline Flat Washer						
<small>The recording of false, fictious, or fraudulent statements or entries on this document may be punished as a felony under federal law.</small>									
Test Number	Bolt Size	Test Date	Cycles Completed	Initial Torque (ft*lbs)	Initial Compressive Load (lbf)	Final Compressive Load (lbf)	% Compressive Load Retained after 400 Cycles	% Compressive Load Retained after 2000 Cycles	Did Fastener Retain 80% or more of Initial Compressive Load at Cycle 2000?
Baseline #1	Grade 8 1"-14 3.0" length yellow Chromate Plated Hex Head Bolt	5/23/2024	2,000	450	22,598	20	47	0	No
Baseline #2	Grade 8 1"-14 3.0" length yellow Chromate Plated Hex Head Bolt	5/23/2024	2,000	450	23,013	0	19	0	No
Baseline #3	Grade 8 1"-14 3.0" length yellow Chromate Plated Hex Head Bolt	5/24/2024	2,000	450	23,588	0	34	0	No


\* Any cell marked with a hyphen ( - ) denotes a value that is not applicable.

### Test Information

Washer Used: Flat Washer	Test Frame: 0010
Nut Type: Grade 8 1"-14 3.0" length yellow Chromate Plated Hex Head Nut	Test Temperature (°F): 75
Lubricant Used: W30 oil	Test Frequency (Hz): 12.5
Clamp Length to Bolt Diameter Ratio: 1.93:1	Test Displacement (± in): 0.0600

Eng/Tech:   
Jim Roselle

Data Check:   
Kevin McEvoy

Quality Manager:   
Sam Acevedo

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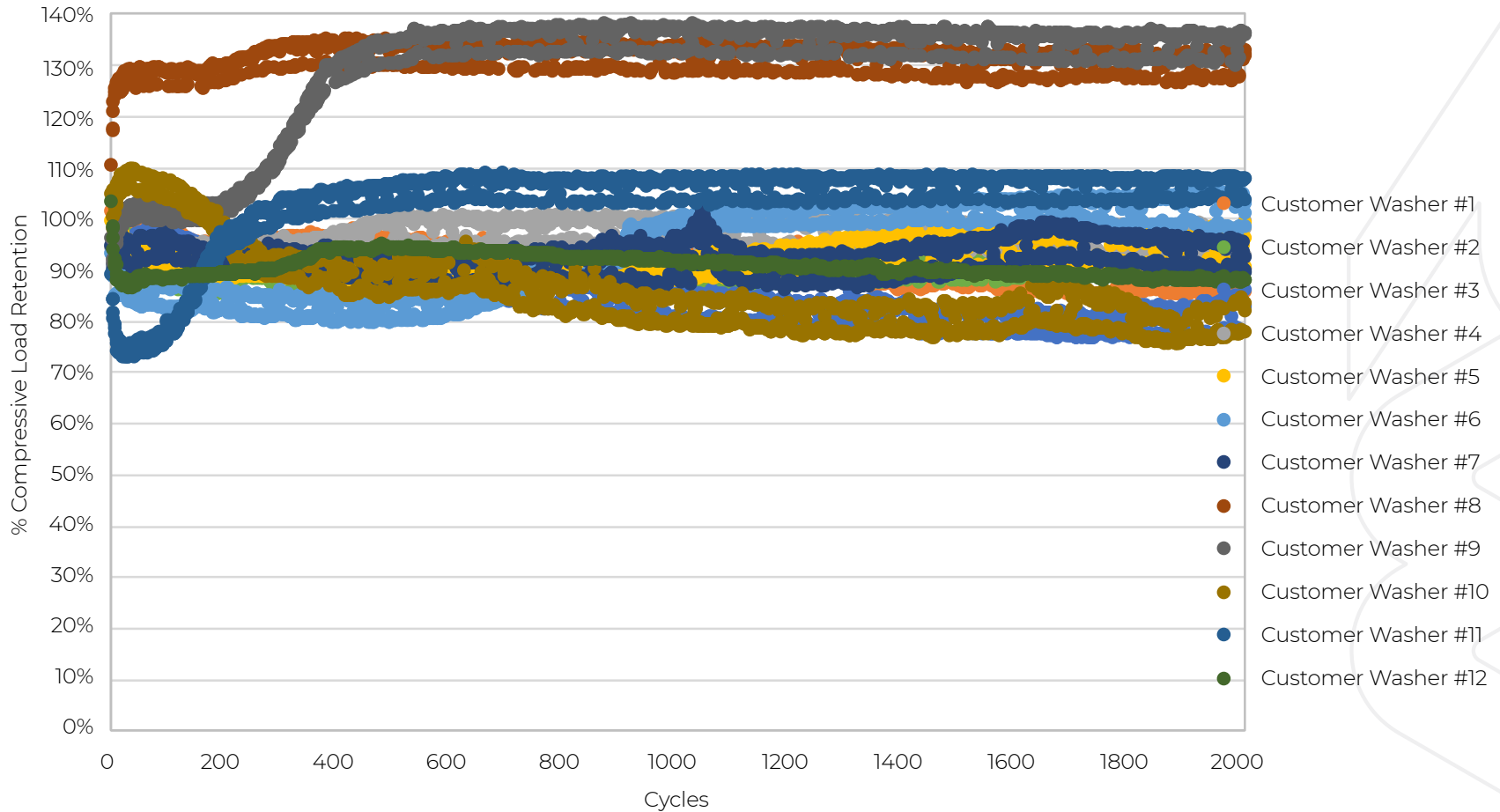


**SERRALOC™ TEST**

**Innovative Test Solutions, In. (24175)**

1"-14 Zinc-Yellow Chromate plated Grade 8 Bolt, Grade 8 Hex Nut  
Customer Washer Compressive Loads vs. Cycles  
450 Ft-lbf, +/- 0.06" Displacement, 125 Hz, 75F

Customer: John Davis - Company: The Reaction Washer Company







# SERRALOC+V™ RESULTS



## CERTIFICATE OF TEST

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551 Kings Road  
Schenectady, NY 12304  
Ph.: (518) 688-2851  
Fax: (518) 688-2855  
www.its-inc.com

Customer Name:	John Davis	Certificate Date:	6/6/2024
Company Name:	Prime Source Consulting LLC	ITS Project:	24175.01
Test Type:	Junker	Certificate No:	1
Test Spec:	DIN 25201	P.O. No:	Signed Acknowledgment
		Specimen Material:	Baseline Flat Washer


The recording of false, fictious, or fraudulent statements or entries on this document may be punished as a felony under federal law.

Test Number	Bolt Size	Test Date	Cycles Completed	Initial Torque (ft*lbs)	Initial Compressive Load (lbf)	Final Compressive Load (lbf)	% Compressive Load Retained after 400 Cycles	% Compressive Load Retained after 2000 Cycles	Did Fastener Retain 80% or more of Initial Compressive Load at Cycle 2000?
Baseline #1	Grade 8 1"-14 3.0" length yellow Chromate Plated Hex Head Bolt	5/23/2024	2,000	450	22,598	20	47	0	No
Baseline #2	Grade 8 1"-14 3.0" length yellow Chromate Plated Hex Head Bolt	5/23/2024	2,000	450	23,013	0	19	0	No
Baseline #3	Grade 8 1"-14 3.0" length yellow Chromate Plated Hex Head Bolt	5/24/2024	2,000	450	23,588	0	34	0	No


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### Test Information

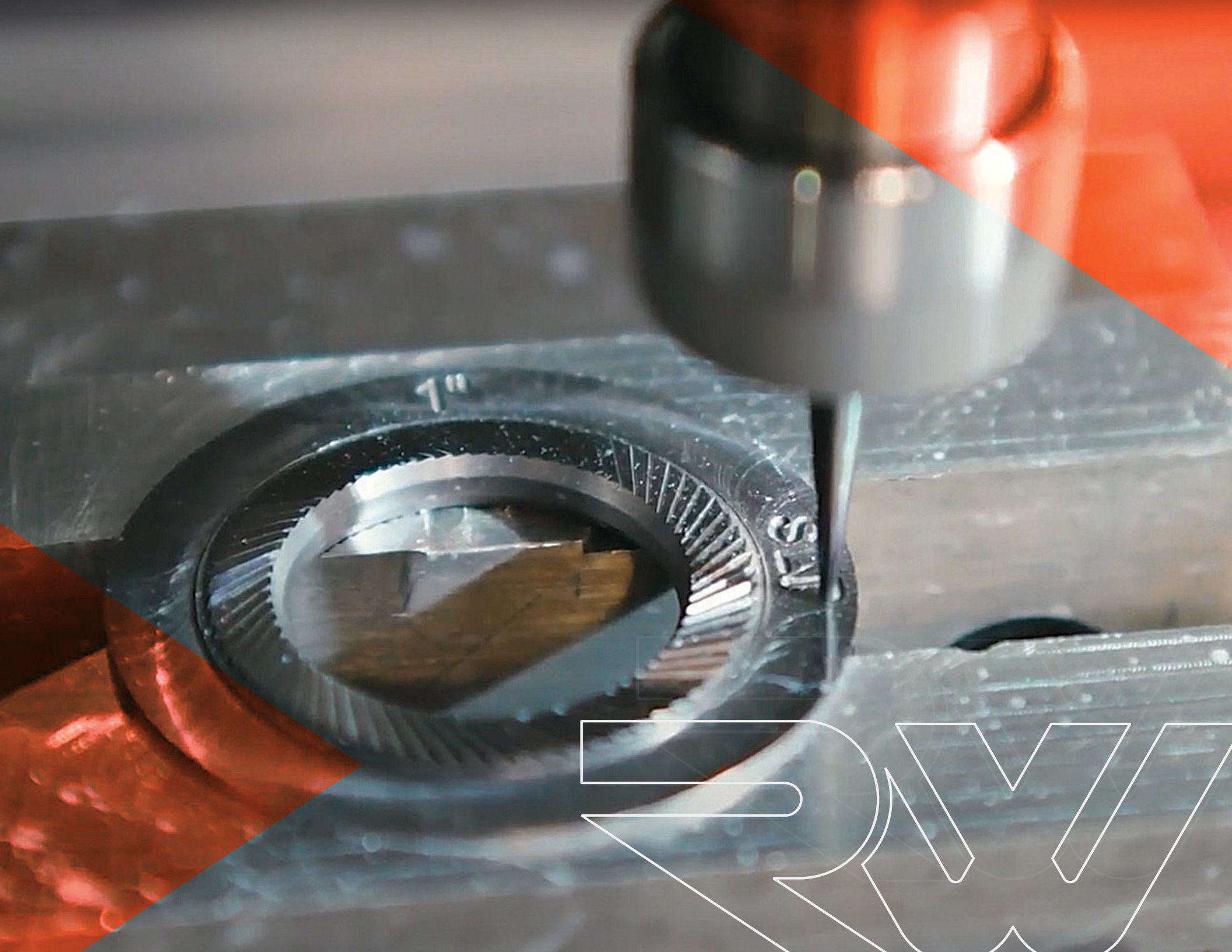
Washer Used: Flat Washer	Test Frame: 0010
Nut Type: Grade 8 1"-14 3.0" length yellow Chromate Plated Hex Head Nut	Test Temperature (°F): 75
Lubricant Used: W30 oil	Test Frequency (Hz): 12.5
Clamp Length to Bolt Diameter Ratio: 1.93:1	Test Displacement (± in): 0.0600

Eng/Tech:   
Jim Roselle

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## **COMPLETED TEST RESULTS**

### **1"-14 TPI Grade 8 Hex Nut**

The test results summary of the three (3) baseline samples is as indicated below:

Nominal Bolt Size:	1"
Coating:	Yellow Chromate Plated
Lubricant:	W30 Oil
Number of Test Samples:	3
Initial Torque:	450 ft/lbs.
Average Initial Compression Load:	23,066 lbs.
Average Load at Cycles 2,000:	6 ft./lbs.
Average Percentage Load at Cycles 2,000:	<b><u>0%</u></b>

### **SerraLoc Washer with SerraLoc+V Top Serration with 1"-14 TPI Grade 8 Hex Nut**

The test results summary of the twelve (12) SerraLoc test samples is as indicated below.

Nominal Bolt Size:	1"
Washer Coating:	Black Oxide
Lubricant:	W30 Oil
Number of Test Samples:	12
Initial Torque:	450 ft/lbs.
Average Initial Compression Load:	16,627 lbs.
Average Load at Cycles 2,000:	18,110 lbs.
Average Percentage Load at Cycles 2,000:	<b><u>109%</u></b>

The SerraLoc Washer with SerraLoc+V top serration geometry had an average bolt load retention **increase** over the 2,000-cycle loading test. When monitored during the cycles, not only did the clamping force not fall below the required 80% load retention rate to pass the DIN 25201 requirements, but in reality it increased its clamping load to reduce the bolt shear sliding effect induced by the Junker test machine.

Unlike other "load loss" locking washers with acceptable load retentions recorded at 86%, 92% and 96%, the SerraLoc+V Washer improved the integrity of the bolted joint at the conclusion of the 2,000-cycle test.



THE  
**REACTION WASHER**  
COMPANY

