

Tightening the Bolt or Nut Makes No Difference

by Joe Greenslade

Several times I have been asked, "Does it make any difference in joint tightness if the tightening torque is applied to the bolt or the nut?"

Over the years I have heard a variety of opinions on this subject, but when I researched the question I did not find any written information. I reviewed several documents that refer to the torque calculation $T=DPK$ and none of them mentioned that this formula, or any other, was applicable only when the torque was applied to just the bolt or just the nut.

Not finding a documented answer, I decided to conduct a simple test to see for myself whether applying torque to the bolt provided any different tension in the joint than did applying the torque to the nut.

THE HYPOTHESIS

Being a fan of the scientific method, I first formed a hypothesis. I hypothesized that whether the torque is applied to the bolt or to the nut the tension would be virtually the same.

THE TESTS

I then conducted some simple torque-tension tests to obtain my observations upon which I could test my hypothesis.

I tested six 1/4-20 Grade 5 zinc plated bolts and nuts using a calibrated hydraulic tension tester and a calibrated

Below are the results obtained from this series of tests:

Tension values obtained when applying 10 foot-pounds of torque to the nut:	Tension values obtained when applying 10 foot-pounds of torque to the bolt head:
1. 3250 pounds force	1. 3300 pounds force
2. 3200 pounds force	2. 3100 pounds force
3. 2800 pounds force	3. 2900 pounds force
Average: 3083 pounds force	Average: 3100 pounds force

Note: The difference between 3100 and 3083 is only .5%.

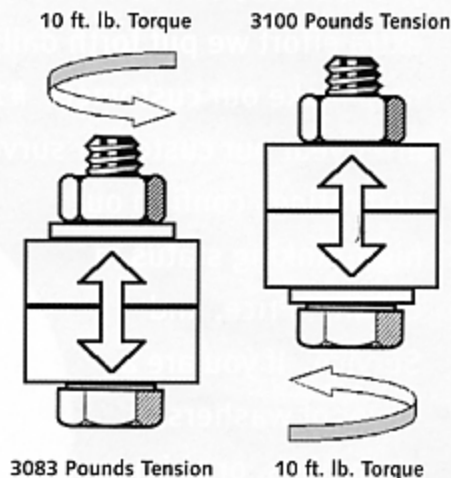
torque wrench. I referred to a recommended tightening torque chart based on the formula $T=DPK$ and found that the recommended tightening value for the bolts and nuts of this size, grade, and finish is 10 foot-pounds.

I then conducted three tests in which I applied the 10 foot-pounds of torque to the nut and three additional tests in which I applied the torque to the bolt head.

When applying the torque to the nut I place a hardened flat washer under the nut for its bearing surface to rotate on and when applying the torque to the bolt head I placed a hardened washer under the bolt head for its bearing surface to rotate on. I used new bolts, nuts, and washers for each test.

TEST CONCLUSION

Based on these tests it is my opinion that my hypothesis is correct.



The tension created in a particular joint is the same whether the tightening torque is applied to the nut or the bolt, provided the element that is driven (nut or bolt) is seated on a similar surface. ■



Joe Greenslade has been active in the fastener industry since 1970. He has held positions with major fastener producers in sales engineering, marketing, product design, manufacturing management, and research and development management.

Mr. Greenslade holds twelve U.S. patents on various fastener related products. He has authored over 136 trade journal articles on fastener applications, manufacturing and quality issues. He is one of the fastener industry's most frequent speakers at trade association meetings and conferences. He is the youngest person ever inducted to the Fastener Industry Hall of Fame.

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In addition to guiding the activities of Greenslade & Company, Mr. Greenslade works as a consultant with fastener suppliers and end users on product design, applications engineering, and quality issues. In this capacity he works to resolve fastener applications problems, to help select the best fastening approaches in new product designs, to assist in the standardization of fasteners used within an organization, and to provide training on various aspects of fastening technology and fastener quality assurance. He also serves as Expert Witness in litigation involving fastener related issues.