



## White Paper - Torque vs Clamp

### What It Means For Joint Integrity and Vibration Resistance

For most heavy equipment applications, design engineers have focused on a stable, consistently tight joint for long-term durability and vibration resistance. For years, torque has been the standard by which the tightness, and maybe even the overall integrity, of a joint were measured. This conventional thinking was based on the idea that the more power applied to a nut and bolt assembly in the form of torque,

the tighter, more secure, and vibration resistant the joint. And as it turns out, like much conventional thinking, the belief that higher torque resulted in a more secure and durable joint was wrong.

### Clamp – The Real Measure of Joint Integrity

Clamp, defined as the load on the joint brought about by the drawing together of the fastener components, is virtually unrelated to torque. In fact, ongoing studies of clamp using sophisticated Skidmore-Wilhelm pre-load test equipment have clearly established that even when torque between two or more nuts and bolts is absolutely the same, the clamp value of these fasteners can vary more than 30% (Chart 1). By comparison, a HuckBolt® lock bolt will vary 2% or less. This is an important point, given the fact that clamp is the critical element in joint integrity and durability.

Chart 1

**TORQUE**  
**@226FT-LB**

GRADE 8 FASTENER	CLAMP LBF TEST 1	CLAMP LBF TEST 2	CLAMP LBF TEST 3	CLAMP LBF TEST 4	% VARIATION
Free Running Nut	15,000	20,000	21,000	18,000	40%
Nylon Lock Nut	21,500	18,000	18,000	24,000	33%
Stoverized Lock Nut	26,000	21,000	28,500	23,000	36%



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### Clamp – The Real Measure of Joint Integrity *continued*

Not only is clamp the true measurement of joint quality, it is critical to its long-term durability. If there is low or inconsistent clamp, a bolt can experience the very same service load as the joint. With a loose bolt, the cyclical loading is put on the bolt, which will subject it to fatigue. This pattern of failure usually occurs when there is high frequency loading, and often only several cycles are required to slowly propagate a crack across the cross-section of a bolt. The nut and bolt will either loosen or fail when the diminished cross-sectional area of the bolt is low enough to where it can no longer support the load.

Similarly, if there are several bolts in a joint and there exists inconsistent clamp between them – some bolts having more than others – the outcome is going to be problematic. The bolts having more clamp will carry more of the service load. The bolts that are less clamped actually contribute little or nothing to the strength of the joint as compared to those exhibiting proper clamp. For instance, in an application where only three bolts out of six exhibit proper clamp, those three fasteners are forced to carry most of the load. Since the design of the joint calls for the use of six bolts, the joint is actually being supported

by only three of the six bolts originally envisioned in the design. Because those three bolts are carrying most of the load designed for six bolts, they are highly prone to failure.

### Direct Tension Fastening – The Surest Method for Achieving Consistent Clamp

Today, many product engineers are moving away from conventional nuts and bolts fastening, with even various locking washers and nuts being seen as inadequate to provide the consistent clamp and secure locking needed for high-vibration applications. Direct tensioned HuckBolts, offered by Howmet Fastening Systems and Rings, are more often being utilized to provide both the reliability of consistent clamp, along with vibration resistance.

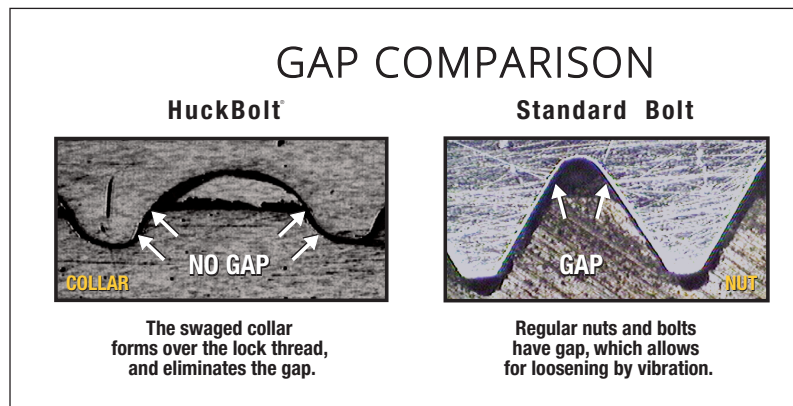
Structural HuckBolts, offered in a wide range of sizes (up to 1-3/8") and materials, have been proven in some of the most challenging equipment applications including heavy transportation, agriculture, and mining. Consisting of a pin and collar, these fasteners are installed via a direct tension technique, in which the pin is pulled and the collar is simultaneously swaged into the locking grooves of the pin. Based on their design and unique direct tension installation, HuckBolts deliver ultimately consistent clamp for a strong, long-term stable joint.

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### HuckBolt® Fastening Technology – Eliminating the Effects of Vibration

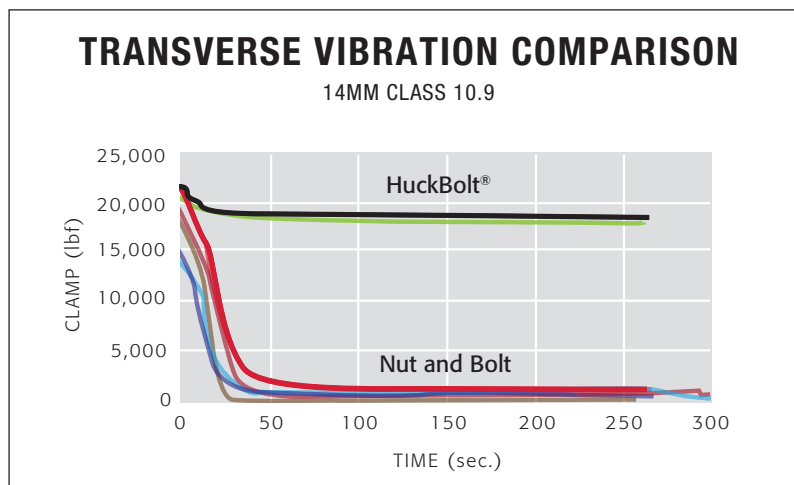
In addition to providing for the most reliable clamp performance, there are several design elements of HuckBolts that also ensure their ultimate resistance to the effects of vibration. In conventional nut and bolt installations, gaps between the nut and bolt threads are universally encountered, providing the opportunity for loosening in high-vibration environments. By contrast, the Huck design, featuring the collar fully swaged into the locking grooves of the pin, creates no such problematic gap (Chart 2).

Chart 2



Instead of the deep threads required to achieve a tolerance fit between conventional nuts and bolts, the HuckBolt pin requires only shallow locking grooves into which the collar is swaged. The shallow design of the locking grooves allows for a much larger root radius, which contributes significantly to the fatigue strength – up to 5 times that of a conventional nut and bolt. Overall, a HuckBolt lockbolt provides superior vibration resistance as indicated by the study charted below (Chart 3).

Chart 3





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