



Maintenance-free, high-strength mechanical fasteners for extreme applications through advanced HuckBolt® technology

Alcoa
Fastening
Systems & Rings



www.afsrhuck.net/us/

ABSTRACT

Alcoa Fastening Systems & Rings has for many years produced innovative mechanical fastening technologies. In the 1940s, Louis C. Huck, the founder of Huck Fasteners, developed the very first HuckBolt® system. The functionality of this system is based on cold forming/extrusion technology, where a collar is swaged during installation by a specialized tool called an anvil into locking grooves. The fastener is mechanically locked due to the annular locking grooves being filled with collar material. The result is a high-fatigue-life joint with unparalleled vibration resistance and clamp/pre-load consistency. This technology was improved with Alcoa Fastening Systems & Rings' introduction of the pintail-less HuckBolt®, which featured faster, low-swage technology that enables use of lighter, more ergonomic installation tools.

Now, Alcoa Fastening Systems & Rings' newest innovation in locking fasteners, the Huck 360®, dramatically improves upon the traditional HuckBolt® system, offering flexibility and ease of installation without sacrificing clamping strength and reliability in an extreme environment. The Huck 360® is a removable and reusable nut-and-bolt system with HuckBolt®-equivalent vibration resistance and high fatigue strength. It provides the installation flexibility of high-strength nut-and-bolt systems and does not require specialized installation tools. Available in both Imperial and Metric sizes, the Huck 360® offers the highest-strength fastening system available for connections requiring field service with standard tools.



Louis C. Huck
1896-1952

A graduate of Cornell University with a degree in engineering, Louis C. Huck invented the blind rivet, which was first used in the B-24 Bomber in 1943. He formed Huck Fasteners in 1940 and developed what became known as the Huck Bolt, an aluminum fastener that is still used today. Huck Fasteners became Huck Manufacturing Co., and sales had grown to \$175 million annually at the time of Huck's death.

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Alcoa Fastening Systems & Rings

OVERVIEW

The Huck 360° System is an engineered high-strength, vibration-resistant nut-and-bolt fastening system that offers quick installation and removal with conventional tools. With superior fatigue strength, it holds tightly and securely under extreme conditions such as high spike loads. Made of low-carbon steel and available in HuckGuard or Geomet finishes (depending upon size), it is engineered to be virtually maintenance-free.

The Huck 360° stays tight under severe vibration loading by eliminating the “gap” around the crest of the bolt (Figure 1). When tightened to a specific clamp force, the Huck 360° fills this gap, which prevents transverse motion between the 360’s nut and bolt, keeping the assembly in place. Since its thread flanks are locked, the nut cannot move relative to the bolt, unlike nut-and-bolt systems with conventional threads, where the thread flanks can slide and the nut can move relative to the bolt.

With conventional nut-and-bolt systems, clamp load quickly decays under vibration (Figure 2). This doesn’t occur with the Huck 360° system, which was designed with shallow, low-notch-factor bolt threads and unique swage-able nut material. This means that the grooves aren’t rolled as deep as a conventional bolt. The effective area of the fastener itself is widened by as much as 20%, increasing tensile and fatigue strength. Tests show that the Huck 360° thread delivers five times the fatigue life of a standard thread bolt.

Stress concentration is the primary contributing factor leading to fatigue failures. In terms of its improved fatigue performance, Finite Element Analysis (FEA) conducted by Alcoa Fastening Systems & Rings showed that the Huck 360’s shallow thread form results in 27% less axial stress in the root than conventional bolt threads (Figure 3).

Compared to conventional HuckBolt® systems, the Huck 360° installs faster (up to 300% faster) and more easily. Maintenance intervals can be extended. The Huck 360’s superior fatigue strength has proven to

Huck 360° Thread vs. Conventional Thread

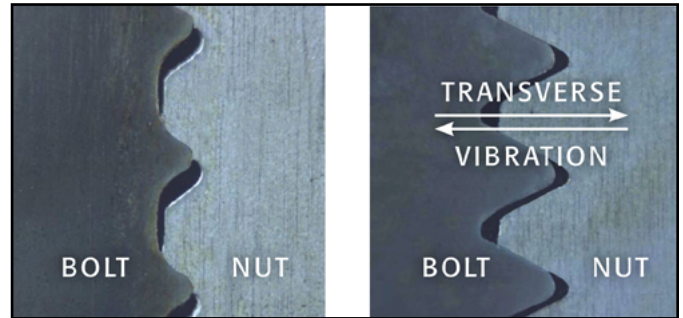


FIGURE 1: The Huck 360’s (left) thread flanks are locked, so the nut cannot move relative to the bolt. With a conventional thread (right), the thread flanks can slide under transverse vibration, and the nut can move relative to the bolt.

Transverse Vibration Comparison

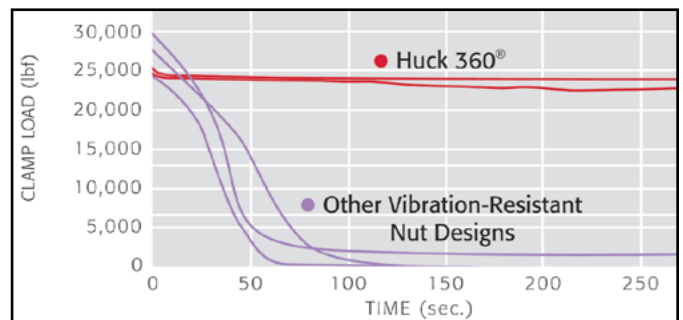


FIGURE 2: Once vibration begins, clamp load quickly decays with conventional nut-and-bolt systems. Clamp load with the Huck 360° holds constant.

Improved Fatigue Performance

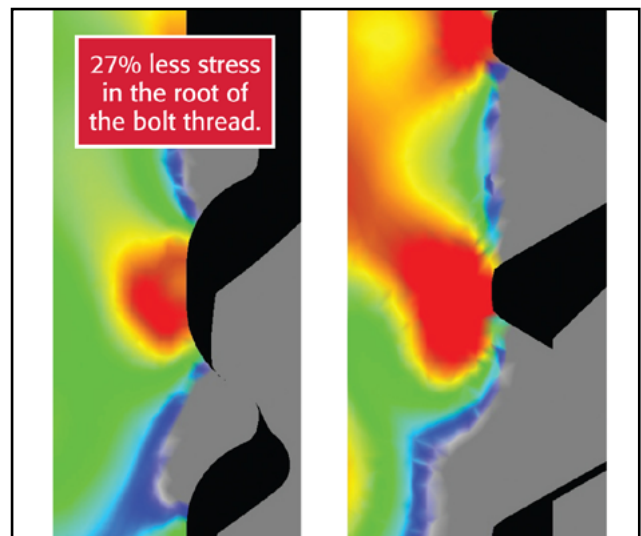


FIGURE 3: According to Finite Element Analysis (FEA), the shallow thread form of the Huck 360° (left) results in 27% less axial stress in the root than conventional bolt threads (right). Stress concentration is the primary contributing factor leading to fatigue failures.

OVERVIEW (continued)

increase equipment uptime and productivity. A Huck 360® nut and bolt is 100% reusable: It can be retightened, and can be reused, provided the nut and bolt set remains free-spinning after removal and reuse, with the same torque requirements as the initial installation.

The Huck 360® is available in eight Imperial sizes: 3/8-inch, 1/2-inch, 5/8-inch, 3/4-inch, 7/8-inch, 1-inch, 1-1/8-inch and 1-3/8-inch. Twelve Metric sizes are available: 10mm, 12mm, 14mm, 16mm, 18mm, 20mm, 22mm, 24mm, 27mm, 30mm, 36mm and 42mm. For all installations, hardened washers are recommended.



TEST RESULTS

Extensive tests have been conducted on the Huck 360® system by Dr.-Ing. Hans-Albert Staedler, Alcoa Fastening Systems & Rings Industrial Products Customer Engineering Director-Europe, Telford, UK. These tests concluded that the Huck 360®, with Grade 8 tensile strength and Class 10.9 shear strength, offers the highest-strength fastening system available for connections requiring field service with standard tools.

Staedler's tests determined that the Huck 360's free-running nut thread quickly spins down and tightens while minimizing damage to coatings. The Huck 360® stays tight under severe vibration loading, and its superior fatigue strength holds up against high repetitive service loads. The pre-loaded Huck 360® bolt thread is similar to that of a HuckBolt® system, but has mild contours and zero stress concentration areas (Figure 4). Thus, it delivers to the bolt a larger cross-sectional area than a conventional bolt thread. The nut thread and specialized material is designed to deform during the tightening process, providing enough material for the locking mechanism. However, the

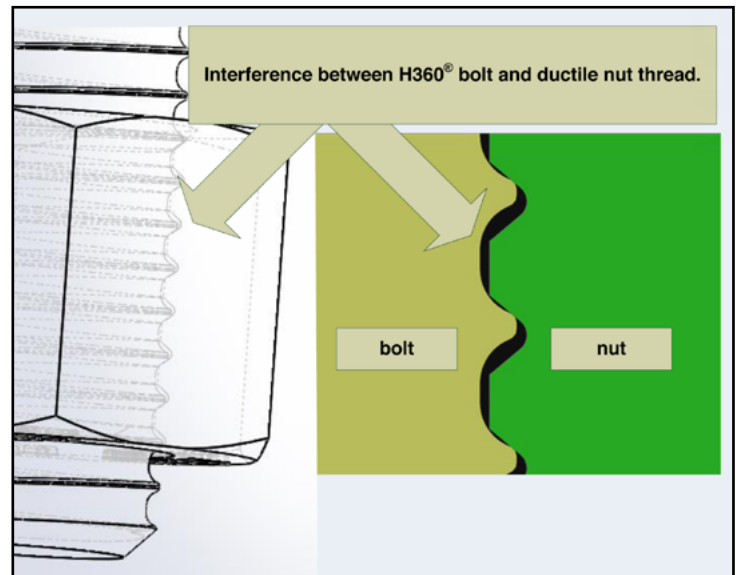






FIGURE 4: Minimal interference between the Huck 360® system's bolt and ductile nut thread allows for rapid spin-down and tightening, and minimizes damage to coatings. The bolt thread features mild contours and zero stress concentration areas.

nut thread has specialized ductility hardness that allows removability and reusability. Therefore, the Huck 360® system is suitable for fastening applications with surface imperfections and/or screw installation strategies.

Evolution of the HuckBolt® System

	High Strength Bolt & Nut	Traditional Lock Bolt	Advanced Lock Bolt	Huck 360® System
				
Features				
Clamp Load	High	High	High	High
Clamp Variation	±30%	±6%	±6%	±20%
Removability	Yes	Semi-permanent	Semi-permanent	Yes
16mm Tool Weight	< 10 lbs.	20 lbs.	< 10 lbs.	< 10 lbs
Vibration Resistance	Low	High	High	High

MULTIPLE APPLICATIONS

The Huck 360® system is designed for numerous applications where high-strength, vibration-resistant and low-maintenance is required. These include rail (i.e., special trackwork and rail joints) and railcars, steel construction, trucks and trailers, agricultural harvest machinery, motor vehicles, mining, construction machines and excavators, and the repair market, where conventional fastening systems have failed. **BNSF Railway began evaluating the new Huck 360® HuckBolt® for track applications in June 2013 at the Opal Diamond in Temple, Texas (Figure 5). As of July 2015, 90% of the HuckBolts are still in use.**



FIGURE 5: The Huck 360® lock bolt system installed on BNSF Railway's Opal Diamond at Temple, Texas.

For Additional Information

Website Link: <http://afsrhuck.net/Huck360>

YouTube Videos:

Informational:

<https://www.youtube.com/watch?v=FSQp6Xx3Sbc&list=PLW7MbMxNtPZPNG1sUCJ7YP4jgIPZPvYYw>

Speed comparison vs. prevailing torque bolt/nut:

https://www.youtube.com/watch?v=c_LsrEnmdvc&list=PLW7MbMxNtPZPNG1sUCJ7YP4jgIPZPvYYw&index=2