Self-Locking Fasteners: Vibration-Resistant Designs & Applications

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July 21, 2026 ·Nigen

Key Takeaways

108 - All-Metal Prevailing Torque Hex Lock Nut (Type 1) — GB□T 6184 □ ISO 7042 (Series 047) — GB□T 6184 □ ISO 7042

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- Self-locking fasteners maintain joint integrity under vibration by using prevailing torque, mechanical wedging, or adhesive bonding to resist loosening.
- Nylon insert lock nuts are economical and reusable up to 120°C, while all-metal prevailing torque nuts withstand temperatures beyond 300°C.
- International standards such as ISO 7040, ISO 7042, and DIN 985 define the dimensional and performance requirements for locking fasteners.
- Surface finishes like zinc-flake coatings enhance corrosion resistance without affecting the locking element's integrity.
- Proper selection requires evaluating the operating environment, reusability needs, and compatibility with base materials and lubricants.

Self-Locking Fasteners: Engineered for Vibration Resistance

All-Metal Lock Nuts — ISO 7042 □ DIN 980

All-Metal Lock Nuts — ISO 7042 □ DIN 980

Self-locking fasteners provide a reliable solution for bolted joints exposed to vibration, shock, thermal cycling, and dynamic loading. Unlike standard threaded fasteners that may loosen over time, these components incorporate a locking feature—mechanical, chemical, or geometric—that maintains clamp load without the need for additional locking devices. They are widely specified in automotive, aerospace, heavy equipment, and industrial machinery where joint failure is not acceptable.

► Watch video: https://www.youtube.com/watch?v=KIIr-e8zJqY

Simple DIY: Make Self Locking Nuts — by Camaro Rick on YouTubeNormal nut turned Self Locking. Just add Hammer Simple interference fit.

Specification Overview

- **Diameters / Thread Sizes:** Available in metric (M3 to M36) and imperial (#4 to 1-1/2”) as standard; larger diameters upon request.
- **Thread Pitch:** Coarse (standard) and fine thread series per ISO 724, ASME B1.1, DIN 13.
- **Lengths:** Standard lengths from 6 mm to 300 mm; custom lengths engineered to order.
- **Head / Drive Types:** Hex head, hex flange, socket cap, button head, countersunk flat head, and custom head configurations.
- **Material Grades:** Carbon steel (Grade 5, 8, Class 8.8, 10.9, 12.9), stainless steel (A2/A4 or 304/316), and alloy steels for high-strength needs.
- **Property Class:** Metric classes 8.8, 10.9, 12.9; inch grades 5 and 8; stainless up to A4-80.
- **Surface Finish:** Zinc plating (clear, yellow, black), zinc-nickel, hot-dip galvanized, Geomet®, PTFE, and other coatings for corrosion resistance and lubricity.

Variants and Locking Mechanisms

Self-locking fasteners are differentiated by their locking principles. The most common variants include:

- **Prevailing Torque Nuts:** Nylon insert nuts (e.g., ISO 7040) and all-metal lock nuts (e.g., ISO 7042) rely on a deformed thread or insert to create friction during tightening, resisting rotation.
- **Chemical Locking:** Pre-applied microencapsulated adhesives (patch or pellet) that activate during installation, providing strong resistance to loosening and the ability to seal against leakage.

- **Wedge-Locking Washers:** Paired washers with radial serrations and cams that use tension instead of friction to prevent self-rotation under vibration.
- **Serrated Flange Fasteners:** Flange heads or nuts with integrated serrations that bite into the mating surface, increasing breakaway torque.
- **Deformed Thread Fasteners:** Threads intentionally distorted (e.g., ovalized or trilobular) to create interference with the mating part.

Differences in thread engagement (full vs. partial), pitch (coarse for faster assembly, fine for vibration-prone joints), and head style allow engineers to optimize for specific load and access conditions.

Typical Applications and Buyer Scenarios

Self-locking fasteners are critical in assemblies where maintenance is difficult or where failure could lead to safety risks. Common industry uses include:

- **Automotive & Transportation:** Engine mounts, suspension systems, drivetrain components, and brake assemblies.
- **Aerospace:** Airframe panels, engine nacelles, and interior fixtures subject to high vibration and thermal cycles.
- **Industrial Machinery:** Heavy presses, conveyor systems, pumps, and compressors.
- **Renewable Energy:** Wind turbine towers and solar tracking systems exposed to constant wind-induced vibration.
- **Railway & Heavy Equipment:** Track fastening systems, undercarriage joints, and structural bolting.

Buyers typically seek these fasteners to eliminate the need for double nuts, lock washers, or threadlockers, simplifying assembly and reducing part count.

Customization and Branding Options

We offer extensive customization to meet specific application requirements:

- **Special Dimensions:** Non-standard lengths, diameters, and thread combinations per drawing.
- **Coatings & Platings:** Custom corrosion protection including zinc-nickel alloys, PTFE, Xylan®, and passivation for stainless grades.
- **Head Marking:** Company logos, grade identifiers, traceability codes according to ISO 898 or SAE J429.
- **Packaging:** Individually sealed packs, custom box quantities, barcoded labels, and export-compliant palletization.

Ordering Parameters

Standard minimum order quantities (MOQ) vary by part type and material, typically starting from a few thousand pieces for standard catalog items and higher for specials. Lead times for stock items are generally short, while made-to-order components are quoted upon specification review. Packaging is available in bulk, small bag quantities, or custom-labeled containers to suit supply chain requirements. All shipments comply with international trade and packaging standards.

Request a Tailored Quote

To receive a detailed quotation, please submit your drawings, specifications, and target quantities. Our engineering team will evaluate your requirements and propose the optimal self-locking fastener solution, including material grade, locking method, and finish. Contact us to discuss your next project.

How Self-Locking Fasteners Prevent Vibration Loosening

Self-locking fasteners maintain clamp load under dynamic conditions by introducing a controlled prevailing torque or mechanical interference that resists rotation. Unlike standard threaded joints that can relax when exposed to cyclic loading, these designs add friction, elasticity, or deformation elements that continually oppose loosening forces. This principle is applied across multiple fastener types including lock nuts, thread-locking screws, and specialized washers, each tailored to specific vibration profiles and operating environments.

The most widely adopted configurations rely on a deformable element that creates friction between mating threads. Nylon insert lock nuts, covered under ISO 7040 and DIN 985, contain a polymer ring that deforms elastically during tightening, generating a prevailing torque that persists even if the nut backs off slightly. All-metal prevailing torque nuts, such as those conforming to ISO 7042 or DIN 980, achieve a similar effect through deformed threads, elliptical collars, or crimped segments—options that provide higher temperature resistance and better reusability in demanding industrial settings. For joints subject to extreme vibration, wedge-locking washers employ paired cams with a rise angle greater than the thread pitch, effectively converting vibration into increased preload rather than loosening. Additionally, adhesive patch or pellet treatments applied to male threads (e.g., on Hex Bolts or studs) cure into a thermoset plastic that fills thread clearance, providing both locking and sealing.

Design Variants and Selection Guide

Selecting the correct self-locking solution requires evaluating mechanical demands, reuse cycles, and environmental exposure. The table below summarizes key design classes and their primary attributes.

- **Nylon Insert Lock Nuts**: An internal polymer ring provides consistent prevailing torque across multiple reuses. Temperature limits (typically -50°C to +120°C) and chemical compatibility must be considered. These are ideal for general machinery, automotive subassemblies, and equipment with moderate thermal cycling. See Nyloc Lock Nuts for dimensional standards.
- **All-Metal Prevailing Torque Nuts**: Effective up to 300°C and beyond, these nuts are preferred in engines, exhaust systems, and heavy equipment. Variants include deformed thread, elliptical, and serrated flange types. They are less affected by oil and solvents. All-Metal Lock Nuts are available in ISO 7042 and other international standards.
- **Serrated Lock Washers**: External teeth bite into mating surfaces to resist loosening under shear loads. Best used with through-bolts and softer substrates. Refer to Serrated Lock Washers for standard dimensions.
- **Chemical (Adhesive) Locking**: Pre-applied micro-encapsulated adhesives or threadlockers cure anaerobically, providing sealing and locking. Suitable for assemblies that require automated application and minimal inventory of special fasteners.
- **Mechanical Locking (Castellated/Slotted Nuts with Cotter Pins)**: A positive lock method for critical joints, often used in steering linkages and rotating shafts. Requires accurate hole drilling.

Material and Surface Finish Specifications

Self-locking fasteners are produced from carbon steel (Property Classes 8, 10, and 12 per ISO 898-1), austenitic stainless steel (A2-70, A4-80 per ISO 3506), and specialized alloys for corrosive or high-temperature service. Surface finishes include zinc plating (Cr3+ passivation), zinc-flake coatings (Geomet, Dacromet) for extended corrosion protection, and plain/oiled for non-critical environments. For nylon insert nuts, the ring material is typically polyamide 6.6, offering good resilience at moderate temperatures.

Key Facts at a Glance

- Self-locking fasteners prevent vibrational loosening through mechanisms such as prevailing torque (deformable elements), mechanical wedging, or adhesive bonding.
- Nylon insert lock nuts are limited to applications below 120°C, while all-metal variants can withstand temperatures exceeding 300°C.
- International standards like ISO 7040, ISO 7042, and DIN 985 govern dimensions and performance of prevailing torque type nuts.
- Reusability varies: nylon insert nuts typically retain adequate locking torque for multiple cycles; some all-metal designs are rated for fewer reuses.
- Chemical locking patches can be applied to custom thread lengths and are compatible with standard nuts and tapped holes.

Consolidated Overview: Self-Locking Fastener Specifications

Aspect	Typical Options / Values
Locking Mechanism	Nylon insert (prevailing torque), all-metal deformed thread/elliptical/serrated, chemical adhesive, wedge-locking washers, mechanical (castle nut + cotter pin)
Common Standards	ISO 7040, ISO 7042, DIN 985, DIN 980, ASME B18.16.6, ISO 2320
Thread Sizes	M3 to M36 (metric); UNC/UNF #4 to 1-1/2″ (imperial); custom sizes available
Material Grades	Carbon steel: Property Class 8, 10, 12; Stainless steel: A2-70, A4-80; Alloy steel; Brass
Surface Finishes	Zinc plating (Cr3+), zinc-flake (Geomet, Dacromet), plain/oiled, galvanized; nylon insert unaffected by many platings
Temperature Range	Nylon insert: -50°C to +120°C; All-metal: up to +300°C or higher; Wedge-locking: up to +500°C depending on material
Reusability	Nylon insert: 5–10 times (specification-dependent); All-metal deformed thread: 3–5 times; Chemical locking: one-time use
Typical Applications	Automotive powertrain, industrial machinery, railway, HVAC, renewable energy, off-road equipment

Request Engineering Support

Choosing the optimal self-locking fastener depends on your specific joint geometry, load spectrum, and environmental conditions. Send your assembly requirements, including thread size, material preference, and target torque, to our application engineers for a tailored recommendation. We supply hardened, plated, and certified components to international standards from stock and custom production. Contact us to initiate a technical review or request samples for validation.

Frequently Asked Questions

What are self-locking fasteners?

Self-locking fasteners are threaded components designed to resist vibrational loosening without the need for additional locking devices. They achieve this through features such as a nylon insert, deformed threads, serrated bearing surfaces, or pre-applied adhesives that create a prevailing torque or mechanical interference during tightening.

How do self-locking nuts work?

Self-locking nuts work by introducing a controlled frictional force that opposes rotation. Nylon insert lock nuts rely on a polymer ring that engages the mating thread, while all-metal lock nuts use distorted thread forms or crimped collars. This prevailing torque prevents the nut from backing off under cyclic loading.

What is the difference between self-locking and non-self-locking nuts?

Self-locking nuts have an integral feature that resists loosening; they maintain clamp load without external locking elements. Non-self-locking nuts, such as standard hex nuts, require separate locking devices (lock washers, threadlocker, jam nuts) to prevent vibration-induced loosening.

When should I use an all-metal lock nut instead of a nylon insert nut?

All-metal lock nuts are preferred in applications involving high temperatures (above 120°C), chemical exposure, or where the polymer of a nylon insert could degrade. They are commonly used in engine compartments, exhaust systems, and industrial ovens where thermal stability is critical.

Can self-locking fasteners be reused?

Reusability depends on the locking mechanism. Nylon insert lock nuts typically retain sufficient prevailing torque for multiple installations, as specified in standards like ISO 2320. All-metal designs may lose effectiveness after several cycles and are often rated for fewer reuses. Chemical locking patches are generally single-use.

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