WHITEPAPER NEDSONIC® 2026

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1. Executive Summary

Nedsonic® is a fastener solution that enables the actual achieved preload (clamp load) in bolted joints to be measured directly, non-destructively, and reproducibly through ultrasonic bolt length measurement. The technology overcomes a fundamental limitation of conventional tightening methods, where torque and torque-angle are only indirect indicators of final clamp load and are strongly influenced by friction variations.

"The development of Nedsonic® originated from the long-term technical collaboration and practical experience with DAF, where the need for direct and reliable verification of preload in critical joints was the key driver."

The core idea behind Nedsonic is that the bolt itself is designed as a measurement object. By applying specific geometry at both the head and the tip of the bolt, ultrasonic measurement becomes practically feasible in production. The elongation of the bolt in the elastic range is measured and converted into preload through a predefined relationship. This creates, for the first time, a direct and objective quality parameter for bolted joints in series production.

Nedsonic® is not an alternative tightening method, but a verification and diagnostic instrument that complements conventional assembly processes. The technology has been proven over the long term and on a large scale in practice, particularly at DAF Trucks, where Nedsonic has been applied in series production for more than 25 years. The primary value of Nedsonic lies in increased process certainty, faster troubleshooting, and risk reduction in safety-critical joints.

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2. Problem Definition

2.1 Commercial and Operational Problem

n modern vehicles, bolted joints play a crucial role in safety, reliability, and functionality. Connections in areas such as chassis, suspension, drivetrain, and engines are subject to increasing loads, while tolerances become smaller and failure costs grow exponentially. OEMs and Tier-1 suppliers therefore require certainty: not only that a bolt has been tightened, but that it has actually achieved the correct preload.

Current practice is based on indirect control. Torque- and torque-angle-controlled processes are validated through sampling, statistical assumptions, and process stability. In the case of deviations—such as coating changes, lubricants, temperature effects, or tool wear—it is difficult to quickly and objectively determine the root cause. This leads to prolonged troubleshooting, additional inspections, possible production stops, and in the worst case, recalls.

2.2 Technical Problem

The core technical problem is physical in nature. Only a small portion of the applied tightening torque results in preload; the majority is absorbed by friction in the threads and under the bolt head. Because friction is inherently variable, the same torque can lead to widely different preload values. This problem cannot be solved by stricter process control or better tools, because the root cause is fundamental.

In yield-controlled tightening, this issue is partly bypassed by plastically loading the bolt, but this eliminates any possibility of post-assembly verification. Torque is no longer a relevant parameter. Without an additional measurement method, objective certainty about the achieved clamp load is missing.

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3. Nedsonic® Solution Overview

Nedsonic® approaches the problem from a different perspective. Instead of trying to control tightening torque more and more precisely, the outcome of the process is measured directly. The basis is the well-known linear relationship between bolt elongation and preload as long as the bolt remains within the elastic range.

By sending ultrasonic pulses through the bolt and measuring the travel time of these pulses, the bolt length can be determined with micrometer accuracy. The difference between the unloaded and loaded state is a direct measure of elongation and therefore of preload. Crucially, the bolt is designed so that this measurement can take place quickly, reproducibly, and without special preparation.

Nedsonic® is therefore primarily a measurement and verification system. It is intended to support existing tightening methods, not to replace them. It makes quality control objective, reproducible, and suitable for series production.

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4. Technical Architecture & Design

4.1 Functional System Structure

The technical architecture of Nedsonic® consists of an integrated combination of product design, measurement physics, and process integration. The system is explicitly not designed as a standalone measuring instrument, but as a production-ready combination of components that reinforce each other.

The core consists of three layers:

- The **Nedsonic® bolt** – designed to be ultrasonically measurable without additional machining
- The **measurement chain** – consisting of the transducer, measuring device, and interpretation of time-of-flight
- The **process layer** – where measurements are applied for verification, diagnostics, and quality assurance

The strength of Nedsonic lies in the fact that these three layers have been considered as one system from the beginning.

4.2 Bolt Design and Geometric Boundary Conditions

Bolt design forms the basis for reproducible ultrasonic measurement. The head of the Nedsonic® bolt is manufactured flat to enable stable and repeatable acoustic contact with the transducer. Deviations such as concave heads or irregular surfaces, common in standard bolts, would lead to variation in signal input and thus measurement inaccuracy.

At the tip side of the bolt, a specially designed reflection surface is integrated. This surface has a sharp geometric transition so that the ultrasonic pulse reflects unambiguously. This prevents secondary reflections or noise from influencing the measurement result. The geometry is designed so that it can be realized within existing bolt manufacturing processes.

Important boundary conditions include:

- sufficient bolt length relative to diameter
- a thread length of at least approximately 50% of total bolt length
- preferably an external drive to ensure adequate bottom thickness

These conditions somewhat limit the application range but ensure high measurement reliability.

4.3 Ultrasonic Measurement Principle and Physical Basis

The Nedsonic® measurement is based on the time-of-flight principle. An ultrasonic pulse is introduced into the bolt via the transducer, propagates through the material, and reflects at the specially integrated reflection surface at the tip. The travel time of this pulse is directly related to the bolt length.

Because the speed of sound in steel is known and relatively constant, the measured travel time can be converted into length with high accuracy. By determining the difference between the unloaded and loaded state of the bolt, elongation is established. As long as the bolt is loaded within the elastic range, this elongation is linearly related to preload.

Temperature effects and material influences affect the absolute speed of sound, but not the fundamental measurability. These effects are addressed through calibration and, where necessary, temperature correction.

4.4 Calibration and Stability

For each Nedsonic® bolt variant, a calibration is performed in which the relationship between elongation and preload is empirically established. This relationship is recorded as ultrasonic stiffness (k_US). Calibration is carried out on representative samples and linked to specific geometric and material parameters.

In practice, this relationship proves very stable, provided that:

- the bolt is used within the elastic range
- no plastic deformation occurs
- geometry and material remain consistent

“Calibration is performed per application, where the installation location of the bolt is decisive. Relevant parameters are the clamping length and the specific bolt. As a result, the same bolt may require a different calibration in different applications.”

5. Technical Differentiation & Validation

5.1 Accuracy and Repeatability

The technical differentiation of Nedsonic® lies primarily in the fact that the system enables direct measurement of preload under production conditions.

“The measurement accuracy of the **length measurement** is on the order of ±1–2%. For preload determination, where bolt stiffness and temperature influences also play a role, the total variation is typically on the order of **3–5%**.”

This accuracy is based on comparison of ultrasonic measurements with reference measurement methods and has been repeatedly confirmed over large quantities and long periods.

An essential differentiating aspect is that this accuracy is independent of friction variations in the threads and under the head. Factors such as coating, lubrication, surface roughness, or minor process deviations influence tightening torque, but do not directly affect measured bolt elongation as long as the bolt remains elastically loaded. This eliminates a fundamental uncertainty of conventional tightening methods.

5.2 Comparison with Alternative Approaches

Compared to torque- and torque-angle-controlled tightening processes, Nedsonic® stands out because it evaluates not the process input, but the actual outcome: the achieved preload. This makes the system particularly suitable as a verification and diagnostic instrument.

Compared with classical ultrasonic measurement methods, Nedsonic® provides the same physical measurement accuracy but with significantly less effort. Because the reflection surface and measurement conditions are integrated into the bolt, time-consuming preparation steps and frequent recalibration are eliminated. This makes ultrasonic measurement practically applicable in production and service environments.

Alternatives such as load washers, strain-gauge bolts, or sensor bolts require additional components, electrical connections, or modifications to the joint design. These solutions are often more expensive, more vulnerable in production environments, and less scalable. Nedsonic® offers a simpler and more robust alternative, precisely because it requires no permanent sensors or additional parts.

5.3 Validation in Industrial Practice

Validation of Nedsonic® is largely practice-driven. At customers such as DAF Trucks, the technology has been applied in series production for several years. In this context, Nedsonic® serves as a reference instrument for process deviations and quality analyses.

Long-term application has shown that the measurement relationship remains stable as long as the defined boundary conditions are respected. In addition, the use of Nedsonic® has led to faster troubleshooting and a better understanding of process influences, such as changes in coating, lubrication, or tool behavior. This combination of technical stability and practical applicability forms the core of the validation.

6. Use Cases & Scenarios

he most mature and extensive application of Nedsonic® is found at **DAF Trucks**. Here, the technology has been used for many years for verification of critical bolted joints in series production. Nedsonic® is applied in all engine bolts and in all chassis joints at DAF. Within this environment, Nedsonic® serves as the first diagnostic instrument when deviations occur in the tightening process, allowing root causes to be identified quickly and objectively.

In addition to DAF, several other OEM and Tier-1 applications have been realized, each with its own technical context and motivation:

- **Schmitz Cargobull** applies Nedsonic® to shock absorber bolts and kingpin joints. In the kingpin application, this specifically concerns the kingpin wear plate, which is fastened with a Nedsonic® M14×1.5 bolt.
- **BMW** uses Nedsonic® in yield-controlled applications where conventional verification of preload is not possible.
- **Mercedes** applies Nedsonic® in both truck and passenger car applications. Examples include mounting the bumper to the chassis of a truck and securing the rear axle of the Mercedes A-Class.
- **Scania** applies Nedsonic® to the injector bolt, where direct and reliable verification of preload is essential.
- In addition, recent pilots are ongoing at **Brose**, focused on safety-critical joints.

Outside of series production, Nedsonic® is also used for field analyses and audits. In these situations, the ability to perform non-destructive measurement is decisive, for example in troubleshooting, service cases, or quality reviews.

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7. Business Model & Commercial Logic

The economic value of Nedsonic® lies primarily in risk reduction and quality improvement. The bolt itself carries only a limited premium compared to a standard bolt. The customer's main investment lies in measurement equipment and process implementation.

The business case is strongest in safety-critical applications and high volumes, where failure costs, recalls, and production downtime have major impact. In this context, Nedsonic serves as insurance against rare but extremely costly failures.

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8. Competitive Landscape

Nedsonic® does not primarily compete with specific products, but with established practices. Alternatives such as improved torque-angle strategies, load washers, or strain-gauge bolts all have limitations in terms of cost, integration, or reliability.

The unique position of Nedsonic lies in enabling direct measurement without fundamental changes to the assembly process or joint design. However, the technology is less suitable for applications with internal drives or very small diameters.

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9. Risks, Assumptions & Open Questions

Although the technology is technically proven, strategic and commercial questions remain open. Market adoption is slow, partly due to conservatism in the industry and limited visibility of reference cases. In addition, assumptions regarding scalability and future markets (such as EV and megacasting) require further substantiation.

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10. Roadmap & Next Steps

In the short term, the focus is on further standardization, documentation, and making the business case explicit. This includes structuring existing practical experience and improving accessibility of technical knowledge for internal and external stakeholders.

Mid-term developments focus on expanding application areas and exploring combinations with other Nedschroef solutions, including Nedtite®.

In the long term, a strategic positioning is required: will Nedsonic® remain a specialized solution for critical joints, or become part of a broader quality and process platform?

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11. Nedtite® × Nedsonic® – Strategic combination

11.1 Rationale for Combination

Nedtite® bolts introduce additional variation in the tightening process because they are thread-forming and therefore locally deform material. In such applications, the relationship between tightening torque and preload is difficult to predict and verify.

The combination of Nedtite® with Nedsonic® is conceptually logical: where Nedtite® simplifies assembly and provides process robustness in thread forming, Nedsonic® can provide objective certainty about the actually achieved preload.

11.2 Technical Coherence

Technically, both solutions share a focus on robust production processes. The combination requires careful consideration of geometry, material behavior, and calibration, because thread-forming behavior affects stress build-up in the bolt.

Based on the available information, the combination appears feasible in specific applications, but it has not yet been generically developed or validated.

11.3 Strategic Meaning

As a strategic option, Nedtite® × Nedsonic® can be seen as a possible next step in offering integrated fastener solutions. At this moment, it is not a mature product, but a direction that requires further technical and commercial substantiation.

This positioning fits within a master whitepaper as an explicitly stated development direction, without presenting it as an already proven solution.

Although both variants offer technically comparable functionality, they differ in application range. This provides the opportunity for a distinctive market approach, where both product names can be used alongside each other as a surprising element in marketing and positioning, depending on diameter and application."

Appendix A – Content Reuse Matrix

This document forms the basis for future technical presentations, commercial positioning, animations, and internal decision-making.