

When the Spec Outlives the Technology

Legacy qualification, modern manufacturing and the defense industrial base's scaling problem



Delevan has designed and built magnetic components for aerospace and defense programs for more than 75 years with most of that work looking forward: custom magnetics for new platforms, new power architectures, and requirements that did not exist a few years ago. Throughout our history, we also have supported designs that have been in continuous service for decades. Both approaches have given us a direct view of what happens when a qualification written in one era meets the manufacturing capability of another.

The defense industrial base is now being asked to raise output across munitions, missiles and radar programs at rates that many of these qualification frameworks were not originally designed to accommodate. In most cases, the designs are sound, and the requirements remain valid. The strain falls on the manufacturing and qualification system around them, which was built for stability rather than scale. This white paper traces that pattern from the program level down to the component level and closes with practical steps engineers can take now within existing frameworks.

WHY THIS MATTERS NOW: WHAT RECENT PRODUCTION RAMPS REVEAL

In our experience, many recent production ramps share a common thread: the constraint is rarely the design. Rather,

it is how quickly a qualified manufacturing process can change without putting reliability at risk.

Patriot: Sustaining a Proven System at a New Rate

Patriot has been in U.S. service since the 1980s and has remained relevant through continuous upgrades rather than replacement. In January 2026, the Department of War announced a framework agreement to raise annual PAC-3 MSE interceptor production from about 600 to about 2,000.¹ Lockheed Martin has noted that ramps like this depend on growing production capability across the supply chain – not only inside its own factories.²

For suppliers, a threefold increase on a qualified program is less a design challenge than a manufacturing challenge: more throughput, more capacity and more sources – all within a qualification baseline set when the program ran at a fraction of today's volume.

Stinger: When the Industrial Base Goes Quiet

Stinger experienced the alternate production challenge. After roughly two decades without new production, demand surged in 2022. Raytheon brought back retired employees to train new workers, used drawings dating back to the Carter administration and pulled test equipment out of storage. Obsolete electronics meant circuit cards and components had to be redesigned before

¹ U.S. Department of War, "Department of War Establishes New Acquisition Model to More than Triple PAC-3 MSE Production in Partnership With Lockheed Martin," January 6, 2026.

² Lockheed Martin, "Lockheed Martin's PAC-3 MSE Achieves Record Production Year," March 24, 2025.

production could restart, and first deliveries were expected about 30 months after the order.³

The most telling detail concerns automation. Raytheon’s leadership explained that modern methods simply could not be applied, because doing so would mean redesigning the weapon and going through a lengthy certification process. The missile had to be built largely as it was four decades earlier, including hand installation of the nose cone.³

Better manufacturing methods existed, but the qualification framework made them slower to adopt than repeating the original process.

Modernization is Not Risk-Free Either

The Army’s 155mm artillery ramp targeted 100,000 rounds per month, but output was limited by projectile metal parts and reached only about 36,000. A new automated facility built to close that gap had not produced any parts meeting specifications, a Department of War Inspector General report found, in part because equipment built for an older projectile was adapted before being proven against the new drawing.⁴ Freezing legacy processes limits growth; modernizing without rigor puts delivery at risk. The industry needs a disciplined path between the two.

WHERE QUALIFICATION BASELINES FALL BEHIND

Specifications exist for good reason. They define what “qualified” means and keep mission-critical hardware working where failure is not an option. However, every specification reflects what the industry knew and could



build at the time it was written. Since many legacy programs were qualified, electromagnetic and thermal modeling, in-line process monitoring and modern failure analysis have changed how reliability is engineered. Materials have moved furthest: high-temperature polymers, improved conductor insulation, and better encapsulants

offer real gains in dielectric strength, thermal margin and environmental resistance.

Meanwhile, hardware has shrunk. Higher switching frequencies and power densities mean designers now ask for magnetics that are smaller, run cooler and carry more current than the parts they replace. At the system level, a transformer is judged by its electrical output, and its mechanical envelope is usually the first thing given up to make room elsewhere. The electrical requirement doesn’t change often, but the space it has to fit into does. When qualification is anchored to the original materials and construction, the modern tools and materials that could close that gap are far easier to apply to new designs than to the established programs that would benefit most.

FOUR FORMS OF PROCESS LOCK-IN

Process lock-in describes methods, materials or inspection criteria that stay fixed even when better options exist, because the cost and risk of requalifying outweigh the perceived benefit. Each instance usually starts as a defensible engineering decision. Together they produce a system that is difficult to improve, and the cost stays hidden until demand rises. In magnetics, it tends to appear in four ways (Table 1):

Form of Lock-In	How it Shows Up	What Engineers Can Do
Material Callouts	Legacy material named on the drawing	Specify required properties, not materials
Acceptance Criteria	Fixed limits applied to shrinking construction	Agree on construction-appropriate criteria during design
Qualification by Similarity	Heritage materials and construction inherited	Evaluate the reference part before committing
Single Source or Manual Process	Can’t scale without requalification	Build requalification into the sustainment plan

Table 1. Common forms of process lock-in in high-reliability magnetics and practical responses.

³ M. Weisgerber, “Raytheon Calls in Retirees to Help Restart Stinger Missile Production,” Defense One, June 28, 2023.

⁴ M. Peck, “Manufacturing woes hamper US 155-mm ammo production,” Military Times, July 14, 2026.

1. Material Callouts

Many legacy drawings name a specific insulation, encapsulant or wire coating rather than the properties the application needs. That callout carries forward even as the material ages or its supply base shrinks. Replacing it, even with a material that meets or exceeds every requirement, generally triggers a qualification effort that program schedules weren't built to absorb.

2. Acceptance Criteria

High-reliability inspection flows often apply fixed dimensional limits to internal clearance and conductor-to-conductor spacing. Radiographic inspection is a common example, required at higher product levels under MIL-PRF-27 and for Class S space devices under MIL-STD-981.^{5,6} Many of those limits were set when parts had far more internal volume, and standards are revised less often than the hardware they govern.

As packages shrink, pin-to-pin clearance and the distance between adjacent solder terminations shrink with them. In some applications, a part built exactly to its drawing, with sound joints and proven performance, can still show internal clearances below a limit set for a larger part. The result is a disposition cycle rather than a reliability finding: deviations, engineering justification, customer concurrence and lost schedule. Many frameworks already allow construction-specific criteria with customer or qualifying-activity approval, but that option is underused.

3. Qualification by Smilarity

When a new platform needs a transformer or inductor, the fastest approved route is often to qualify by similarity to a device first qualified decades earlier. MIL-PRF-27, for example, permits similarity where products use the same or similar materials and are made in the same facility with the same processes.⁵ Those limits are sensible safeguards, but they also define what the new part cannot change. A new program can inherit a core, insulation system and encapsulant chosen decades ago, not because anyone preferred them but because the similarity argument depends on them. Each program added to the lineage makes it more attractive for the next similarity argument and more difficult to reopen.

4. Single Sources and Manual Processes

Many qualified parts depend on one approved source or on operations still performed by hand. At steady rates, that works. During a ramp, it can become a significant constraint: adding a second source or automating a manual step usually counts as a change to the qualified configuration, and both require requalification before they can add capacity. As Stinger showed, the method that limits output can be the hardest one to replace.

WHAT ENGINEERS CAN DO TODAY

Changing standards takes years. These steps work within current frameworks, and each lowers the risk of lock-in on the programs an engineer supports.

- Specify performance, not materials, where the program allows. Much of today's lock-in started as a material name on a drawing. Defining required properties instead, such as dielectric withstand, thermal class, moisture resistance and outgassing limits, keeps better options open for the engineers who support the design later.
- Settle inspection criteria during design, not at disposition. If pin-to-pin clearance or internal conductor spacing is likely to land near standard inspection limits, raise it while the drawing is still open. Agreeing on construction-appropriate criteria upfront costs far less than dispositioning every lot afterward.
- Evaluate a similarity argument before accepting it. Similarity carries forward every material and construction decision of the reference part. Confirm those are choices you would make today, not just ones that happen to be qualified.
- Involve the magnetics supplier before the drawing is released. Pin layout, internal clearance, winding method and second-source strategy are all easier to settle during design, while concerns are still inexpensive to address.
- Plan requalification into sustainment. If a program will run for decades or increase in volume, assume materials, processes or sources will need to change. This approach to budgeting makes requalification a scheduled event rather than an emergency during a ramp. Stinger shows what it costs when that planning doesn't happen.
- None of these steps require changing a standard. They use flexibility already provided by current frameworks, but applied early.

LOOKING AHEAD

Configuration control exists because lives depend on these systems working, and nothing in this paper advocates reducing reliability requirements, weakening qualification standards or relaxing configuration control. However, preserving a qualification and preserving the intent behind it are not the same thing. Where modern process data and analysis can show that intent is met, the industry would benefit from pathways that recognize that evidence, including risk-proportional requalification and periodic review of dimensional acceptance limits.

Seventy-five years of designing magnetics for both new development and long-running platforms has

⁵ MIL-PRF-27G, Transformers and Inductors (Audio, Power, and High-Power Pulse), General Specification for, Amendment 1, June 2020.

⁶ MIL-STD-981C, Design, Manufacturing and Quality Standards for Custom Electromagnetic Devices for Space Applications, Change 2, August 2015.

shown us that the most difficult engineering problem is rarely the part itself. Rather, it is keeping a proven part manufacturable, sourceable and scalable over a service life measured in decades, while remaining free to engineer the next one well. How the industry handles that challenge will shape how quickly it can respond when asked.

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This article reflects engineering and manufacturing observations across multiple generations of military programs, and is intended to contribute to industry discussion. The views expressed are based on Delevan's experience and do not represent guidance regarding any specific military specification, qualification requirement, government program, product, customer, or supplier relationship.



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