

Our Certifications

ISO 9001 + AS9100

ITAR Registered

DFARS Compliant

RoHS & R.E.A.C.H. Compliant

NIST SP 800-171 Compliant

**Case Study: Aerospace Actuation System —
Reducing Risk Through Integrated Manufacturing Partnership**



Aerospace programs demand an uncompromising balance of precision, reliability, and speed to qualification. Yet even highly engineered systems can falter when design and manufacturing evolve in isolation. This case study follows an aerospace OEM developing a compact electromechanical actuation system, an effort that initially struggled under the weight of design-for-manufacturing gaps but ultimately succeeded through partnership with SDP/SI and a system-level approach to design and production.

Production challenges encountered before engaging a manufacturing partner.

The program's early phases appeared promising, but as prototypes emerged, a pattern of issues began to surface. Excessive backlash degraded positional accuracy, thermal expansion introduced misalignment under load, and vibration testing exposed unexpected failures. What seemed like discrete technical problems quickly compounded into systemic challenges. Engineering change orders multiplied as tolerance conflicts surfaced, and qualification timelines began to slip. The team found itself caught in a familiar loop: design, test, correct, repeat, while costs and risk continued to climb.

A deeper investigation revealed that these issues were not rooted in any single design decision, but in the way the system had been conceived and executed. Components were sourced from a fragmented supply chain, each vendor operating within different process capabilities. Tolerances had been optimized at the part

level, without sufficient consideration for how variations would accumulate across the system. Assembly conditions, inevitably variable in practice, had not been fully accounted for in the design intent. Most critically, no single organization owned system-level integration, leaving performance gaps to emerge only during late-stage validation.

Recognizing the need for a different approach, the OEM engaged SDP/SI early in the redesign phase, bringing manufacturing expertise directly into the engineering process.

Rather than treating production as a downstream constraint, the team adopted a System Design for Production and System Integration methodology, effectively treating design and manufacturing as a single, interdependent system.

This shift immediately reframed the problem. A comprehensive tolerance stack-up analysis was performed at the system level, exposing how cumulative variation, not individual component error, was driving backlash and misalignment. With this insight, the team could rebalance tolerances to align precision requirements with achievable manufacturing capability.



ENGINEERED SOLUTIONS FOR A WORLD IN MOTION

Designatronics inc.



The gear train was redesigned with optimized geometry to improve load distribution and reduce sensitivity to variation, resulting in greater durability under real operating conditions. Assembly processes were also redefined, introducing controlled, repeatable procedures and critical alignment checkpoints that reduced build-to-build variability.

At the interface level, bearing preload and fits were carefully tuned to increase stiffness, minimize play, and account for both thermal expansion and applied loads.

Equally important, testing was no longer deferred to the end of the process. Functional validation was embedded directly into the build cycle, enabling early detection of deviations and preventing issues from propagating downstream. This continuous feedback loop ensured that performance was not only designed but consistently achieved.

The results were significant. Backlash was reduced by 40%, positional accuracy and repeatability improved, and the system successfully passed vibration and environmental testing. Engineering change orders declined sharply, and the qualification timeline accelerated. What had once been a reactive development cycle became a controlled, predictable progression toward production.

Beyond the technical improvements, the program delivered meaningful strategic gains. Early validation reduced engineering rework and eliminated costly late-stage corrections. Fewer design iterations enabled a smoother transition from prototype to manufacturing, while upstream issue resolution lowered overall system risk. Perhaps most importantly, the consistency of performance increased confidence across stakeholders, reinforcing mission readiness.

This transformation also highlighted a broader shift in development philosophy. Traditional sequential models, where manufacturing constraints are discovered late, inevitably

drive cost and delay. In contrast, a concurrent model, where design and manufacturing co-evolve, enables teams to address real-world constraints early and converge more rapidly on an optimal solution. The lesson is clear: system performance cannot be assured by component-level optimization alone; it must be engineered holistically, with full consideration of variation, assembly, and operating conditions.

In the end, the program underscored a fundamental principle of aerospace engineering: when failure is not an option, integration is everything. By aligning engineering intent with manufacturing execution from the outset, and by establishing clear ownership of system-level performance, the team was able to anticipate risks, design for reality, and deliver a robust, flight-ready system on an accelerated schedule. What began as a cycle of iteration and correction evolved into a disciplined, integrated process, demonstrating that early manufacturing partnership is not simply advantageous, but essential to modern aerospace development.

Early validation reduced engineering rework and eliminated costly late-stage corrections.

Partner with SDP/SI from concept to production. Our team brings early-stage engineering collaboration, deep expertise in precision gearing and machining, and an uncompromising focus on process

optimization to ensure efficiency at every step. With scalable production capabilities and a proven track record in demanding aerospace and defense applications, we're built to support your growth.

We don't just supply components; we invest in your success. Connect with us today to get started.

