

White Paper

Precision Feeding for Medical Manufacturing -
RNA Innovations in Feed System Design



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white paper

Introduction

Precision feeding in medical and OEM manufacturing is a critical yet complex process, where the demands for accuracy, reliability, and compliance converge. Part feed systems must deliver components with pinpoint precision to ensure seamless production of medical devices, pharmaceuticals, and OEM assemblies. Components are often small, fragile, and geometrically complex, demanding feed systems that can orient and present them with exceptional consistency. Any variance in presentation directly impacts downstream processes such as assembly, testing, or packaging, making part feeding a potential bottleneck in high-value production lines.

These challenges are compounded by regulatory and environmental constraints. Medical device and pharmaceutical manufacturing are governed by rigorous standards including FDA regulations and Good Manufacturing Practice (GMP) guidelines. Feed systems must therefore be designed for cleanroom compatibility, using materials and finishes that minimise particle generation, prevent contamination, and allow high cleanability. Quiet operation is equally important, both for operator comfort and to support low-vibration environments where sensitive equipment is in use. Every element of the system must be engineered to withstand validation and compliance audits without compromising productivity.

To meet these requirements, manufacturers increasingly demand feed systems that combine robustness with ease of operation. Low-noise designs reduce workplace stress, while reliable maintenance-friendly designs minimise downtime and ensure sustained uptime in continuous operations. Automation must not only be precise but also predictable, with digital monitoring and smart control enabling proactive adjustments. This white paper explores RNA Automation's innovative approach to overcoming these challenges, detailing how our purpose-built feed systems deliver precision, reliability, and regulatory compliance to meet the evolving demands of medical and OEM manufacturing.

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Executive Summary

RNA Automation has a long-standing heritage as a leader in feeding technology, bringing decades of engineering excellence and innovation to industries where precision and reliability are paramount. As a trusted partner to global manufacturers and OEMs, RNA has built its reputation on delivering advanced feed systems that support the most demanding production environments.

In the medical manufacturing sector, the challenge is acute: feed systems must meet exceptionally high standards of cleanliness, reliability, and efficiency. Manufacturers and OEMs require solutions that are not only accurate and consistent but also quiet, low maintenance, and fully compliant with stringent regulatory expectations. Any deviation in performance can compromise quality, impact uptime, or put critical supply chains at risk.

RNA addresses these challenges with purpose-built, innovation-driven feed systems designed for optimal performance. Our solutions prioritise compliance with medical standards, delivering clean operation, minimal maintenance, and exceptional accuracy. By leveraging cutting-edge automation and engineering, RNA's feed systems ensure seamless integration, quiet performance, and maximum uptime, empowering manufacturers to meet stringent regulatory requirements without sacrificing productivity.

This white paper explores RNA's advancements in feed system design, highlighting how our tailored solutions lead the way for precision feeding for medical manufacturing, driving efficiency, reliability, and compliance in an evolving industry.

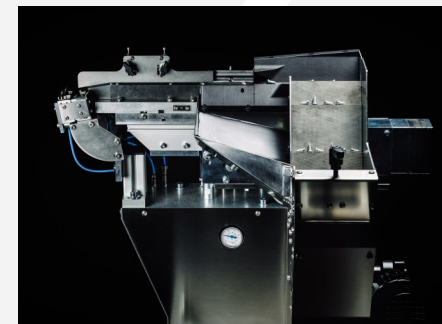
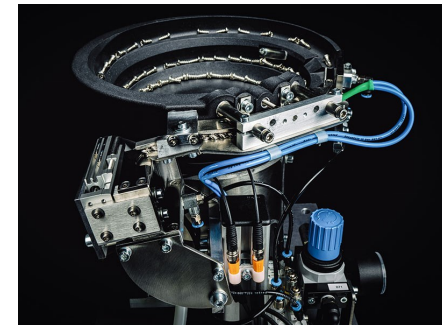
RNA's Expertise in Feeding Technology

RNA Automation, with over 120 years of combined expertise, stands as a global leader in automated feeding and orienting technology, delivering innovative solutions for industries demanding uncompromised quality. Since its inception, RNA has built a legacy of engineering excellence, pioneering advancements in automation that empower manufacturers to achieve efficiency and reliability. This rich heritage underpins RNA's ability to address the complex demands of medical and OEM manufacturing, where precision and compliance are non-negotiable.

RNA specialises in handling **high-tolerance components**, including plastic moulded components, delicate parts, and parts ranging from small to very small geometries. These components require meticulous care to prevent damage, ensure consistent orientation, and maintain stringent hygiene standards. RNA leverages a broad technology portfolio - including **vibratory bowl feeders**, **linear feeders**, **step feeders**, and **vision-guided flexible feeding solutions** - to manage these challenges, offering gentle handling and precise delivery for even the most intricate parts. Careful consideration is given to material selection, surface treatment, and feed path design, enabling the secure handling of sensitive and complex geometries. This capability is critical in medical manufacturing, where components like syringe plungers or micro-connectors demand flawless accuracy.

Central to RNA's success is its **in-house engineering capability**, which allows every feed system to be tailored to the specific requirements of medical-grade production. From initial concept design to full system integration, RNA provides end-to-end expertise. Systems are developed with full consideration of cleanroom compatibility, validation protocols, and GMP/FDA expectations. RNA's engineering team tailors every aspect - material selection, vibration control, and noise reduction - to ensure seamless integration and long-term reliability.

By combining cutting-edge technology with custom solutions, RNA delivers feed systems that combine robustness, precision, and regulatory assurance. This engineering-led approach enables medical manufacturers and OEMs to achieve reliable, repeatable performance while maintaining compliance with the most stringent industry standards.



Core Innovations Across Feed Systems

RNA Automation's feed systems are engineered to meet the stringent demands of medical and OEM manufacturing. By integrating advanced technologies and purpose-built designs, RNA delivers solutions that ensure precision, compliance, and efficiency. This section explores key innovations driving RNA's leadership in feeding technology.

Simulation (Digital Feeder)

RNA's digital feeder technology leverages advanced simulation to accelerate design and validation. Using virtual modelling, RNA simulates part movement and orientation, predicting outcomes for complex components like autoinjector housings or syringe caps. By simulating different geometries, vibration profiles, and throughput conditions, engineers can identify bottlenecks and refine tooling without costly trial-and-error on the shop floor. This approach reduces development cycles, ensures first-time-right solutions, and allows for rapid adaptation when part designs change. In medical manufacturing, where validation is stringent, simulation provides confidence that performance metrics will be achieved before installation in regulated environments.

Digital Tooling and Plastic Milled Design

A notable advancement in feed system development is the integration of digitally designed tooling and precision-milled plastic bowls. Using advanced CAD and simulation software, feed tooling can now be customised with a higher degree of accuracy. Digital design ensures optimal part orientation and rapid prototyping, reducing lead times. Plastic milled feeder bowls, machined from medical-grade polymers, offer lightweight, durable, and cleanroom-compatible alternatives to traditional materials. These bowls are used to sort and orient parts, such as plastic components for medical devices, before they are released for further processing, with the design and machining process tailored to the specific needs of the parts being fed.

Clean-room Compatibility

Cleanroom compliance is a defining requirement in medical manufacturing. RNA feed systems are engineered with materials and finishes that minimise particle generation, including 304/316L stainless steel surfaces with fine polishing to prevent abrasion and dust. Enclosures are designed to reduce airflow turbulence and contain potential contaminants. Every system is accompanied by detailed documentation covering material traceability, assembly processes, and cleanroom qualification, ensuring regulatory alignment with ISO Class 7 or better environments.

High Speed Feeding

RNA excels in high-speed feeding solutions, delivering up to 1200 parts per minute for demanding medical applications. Vibratory bowl feeders and linear systems, optimised with multi-lane tracks and precision-tuned vibrations, ensure rapid, consistent component delivery without compromising accuracy. Custom tooling minimises jams, enabling seamless flow for components like plunger rods and cap removers. Designed for cleanroom compatibility, these systems maintain ISO 7/8 standards, delivering reliable, high-speed performance to meet the demanding production schedules of medical OEMs, enhancing efficiency and scalability.

Gentle Handling

Many medical components are small, lightweight, and fragile—syringe caps, autoinjector housings, or inhaler parts. RNA feed systems are designed with geometry-specific tooling, smooth surfaces, and controlled feed motion to eliminate damage or stress during handling. Custom tooling and soft-touch coatings, like FDA-approved polyurethane, prevent scratches or deformation. Step feeders employ elevator-based systems for smooth, low-impact delivery, ideal for fragile parts. Flexible feeding solutions ensure accurate robotic picking, reducing mechanical wear. By prioritising gentle handling, RNA ensures high yields, preserves component integrity, and supports manufacturers in maintaining strict quality standards and validation protocols across sensitive medical applications.

Noise Reduction

RNA prioritises low-noise operation for cleanroom environments. Anti-vibration mounts absorb mechanical oscillations, reducing operational noise in vibratory bowl and linear feeders. Precision-tuned mechanical damping systems minimise vibration transfer, ensuring quiet performance. Acoustic covers and enclosure options further suppress airborne noise while also enhancing cleanliness. Together, these advancements create a quieter workspace, enhancing operator comfort and meeting stringent regulatory requirements for medical manufacturing environments.

Low Maintenance Design

RNA's feed systems are engineered for minimal maintenance, maximising uptime. Tool-less changeovers enable rapid part switches, reducing downtime during production shifts. Modular builds, with accessible hoppers and tracks, simplify cleaning and servicing, crucial for cleanroom compliance. Lubrication-free or dry-run components eliminate contamination risks from oils or greases. Routine

servicing can often be completed without halting entire lines, thanks to segmented design strategies. This maintenance-friendly architecture extends operating intervals, lowers total cost of ownership, and ensures feed systems contribute to sustained productivity and reliability.

Durability Enhancements

Durability is a cornerstone of RNA's feed systems, built to withstand rigorous medical manufacturing demands. Reinforced materials, such as stainless steel and high-grade polymers, ensure longevity under continuous operation. Design strategies accommodate medical-grade polymers and metals, resisting corrosion and wear. For example, bowl feeders for autoinjector housings use FDA-approved coatings to enhance durability while maintaining hygiene. Precision engineering minimises stress points, extending system lifespan. These enhancements ensure RNA's systems deliver consistent performance, reducing replacement costs and supporting high-volume production in demanding medical manufacturing environments.

Compact Footprint

Medical manufacturing facilities often face space constraints, with cleanroom square footage representing significant capital cost. RNA addresses this challenge by designing feed systems with compact footprints, optimised layouts, and multi-lane capability to maximise throughput per unit area. Vertical stacking, integrated enclosures, and efficient bowl-to-linear transfer paths allow systems to deliver high performance without consuming excessive floor space. Modular construction ensures that feeders can be adapted or expanded within tight environments. The result is equipment that integrates smoothly into complex, high-density production cells, supporting lean manufacturing principles while preserving the accessibility and ergonomics required for regulated medical operations.



Product-Specific Innovations

Comparison of Feeding Technologies

Feeder Type	Suitable Component Parts	Feed Rate	Noise Level	Durability	Footprint	Compliance (Cleanroom / GMP / FDA)
Bowl Feeders	Small to medium-sized parts with defined geometries; robust plastics, metal components, moulded items.	Moderate to high (100–600 parts/min). Effective for high-volume, single-part production but less adaptable for frequent changeovers.	Moderate; vibratory action generates noise, though enclosures and dampers can reduce levels.	Highly durable for high-volume runs. Stainless steel or coated materials (e.g., polyurethane) enhance longevity; proven over decades, long service life with minimal wear.	Compact; integrates well into standard production lines.	Can be adapted for cleanroom use with covers and stainless-steel finishes; moderate suitability for GMP/FDA applications.
Linear Feeders	Ideal for complex, multi-variant parts. Handles small to medium components with modular designs for flexibility.	High throughput (up to 1200 parts/min). Multi-lane setups enhance speed for complex components.	Low noise, smooth operation with no referred vibration.	Robust, with modular designs reducing wear.	Compact, especially for multi-lane systems. Modular design optimises floor space.	High compliance with medical standards. Modular materials support cleanroom requirements.
Step Feeders	Small, delicate, or irregularly shaped components; especially plastics, lightweight moulded parts, and components sensitive to vibration.	Medium; slower than bowl feeders but steady and highly controlled; controlled delivery suits precise batch processing.	Very low; step action is mechanically quiet compared to vibratory systems.	High durability with low maintenance; less wear from vibration, longer service intervals.	Compact. Integrated hopper and elevator minimize footprint, ideal for tight spaces.	Excellent for medical compliance. Clean, low-maintenance design aligns with FDA/GMP standards.
Vision-Guided Flexible Feeders	Wide variety of parts including complex, small, or frequently changing geometries; ideal for high-mix, low-volume production.	Low; feed rate depends on vision system speed and robot pick cycle.	Very low; typically non-vibratory with minimal acoustic output.	Durable, though dependent on camera/lighting system maintenance.	Moderate. Requires space for robotic arms and vision systems, but flexible layouts optimise usage.	High compliance potential; smooth, clean operation and easy reconfiguration align well with GMP/FDA and medical requirements.

Explanatory Notes

Bowl Feeders remain the industry workhorse, offering high throughput and proven robustness. They excel with consistent, robust components where orientation rules are well-defined. Due to their reliance on vibration introducing possibility of noise and particle generation, they may require covers, noise attenuation, and special coatings, depending on application.

Linear Feeders are designed for precise selection and orientation of components along multi-lane tracks, providing controlled vibration without the circular motion of bowl feed systems. Multi-lane linear feeders transport and sort complex parts, and are especially effective for high-throughput applications, achieving feed rates up to 1200 parts per minute. Their smoother motion reduces both noise and part damage, while their modular design makes them space-efficient. With the right material choices, linear feeders can readily support medical-grade manufacturing.

Step Feeders represent a significant advance for delicate and vibration-sensitive applications. Operating through a lifting and stepping motion, they handle small plastic mouldings and irregular parts with minimal noise and almost no particulate generation. The tabletop design inherently supports GMP/FDA compliance and cleanroom integration, with a small footprint.

Vision-Guided Flexible Feeders are the most versatile option, particularly suited to modern medical manufacturing where product designs and geometries change frequently. Using cameras and robots, they allow rapid reprogramming and orientation flexibility without the need for mechanical tooling. While their footprint and system complexity are greater, they offer the highest potential for compliance, quiet operation, and adaptability. Feed rate is dependent on robot and vision system performance rather than purely mechanical throughput.

Application Examples

CASE STUDY #1

Autoinjector Feeding Systems for a Global Medical OEM

A global medical OEM faced challenges with misfed fragile autoinjector components, such as pen needles and syringes, in their existing feeding system, leading to production delays and quality issues.

RNA Automation delivered a tailored solution with vibratory bowl feeders featuring custom tooling, FDA-approved polyurethane coatings, and noise-dampening technology.

The system ensured precise orientation and gentle handling at 300 parts per minute across multiple lanes.

Validated for ISO 8 cleanroom compliance, RNA's solution enhanced uptime, reduced manual handling, and met stringent FDA/GMP standards, optimising the OEM's production efficiency.



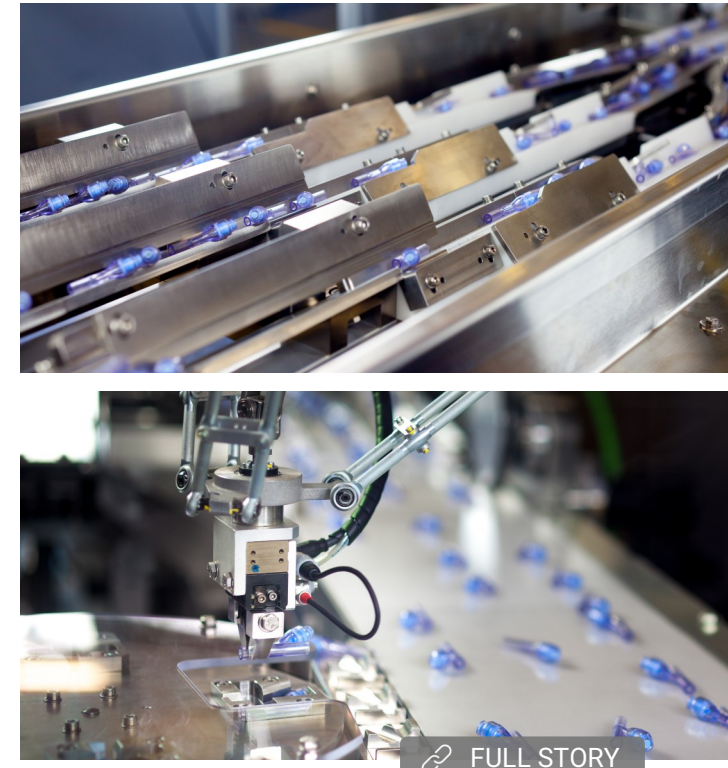
CASE STUDY #3

Valves Sorting with RNA FlexType™ R

A leading medical OEM faced disruptions in Valve Assembly due to frequent part design updates, which rendered traditional feeding systems obsolete and caused inconsistent component sorting.

RNA Automation's FlexType™ R provided a solution with its vision-based flexible feeder, integrating a pre-sorting bowl feeding system and a vision system. The system is particularly suitable for complex part geometries and adapts to geometry changes.

Bulk parts are orientated, sorted, and inspected; vision identifies validly presented parts for robotic pick-and-place. The adaptable solution accommodates design shifts with minimal physical changes, improving sort accuracy, reducing downtime, and maintaining compliance with cleanroom and device manufacturing validations.



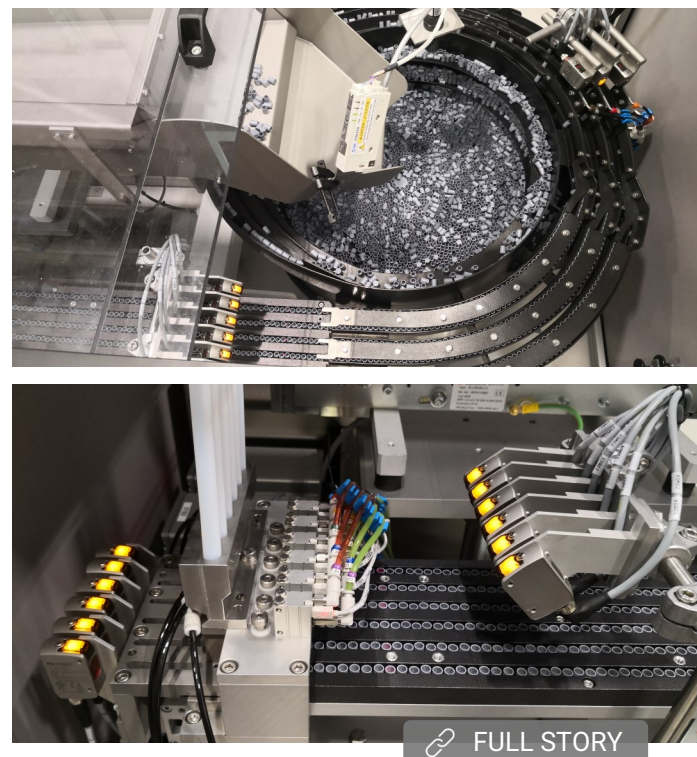
CASE STUDY #2

Multi-lane Linear System to Feed and Orientate Syringe Caps

A global medical device OEM required a system to feed and orientate syringe caps with high accuracy and reliability. Existing solutions suffered from frequent jams and misfeeds in their high-speed assembly line.

RNA designed a multi-lane linear system incorporating a vibratory bowl coated with FDA-approved polyurethane for gentle handling.

The system, equipped with 6-lane linear out-feed and blow feed escapement, delivered syringe caps up to 240 parts per minute across six lanes. Validated for ISO 8 cleanroom use, it enhanced efficiency and compliance with stringent medical standards.



CASE STUDY #4

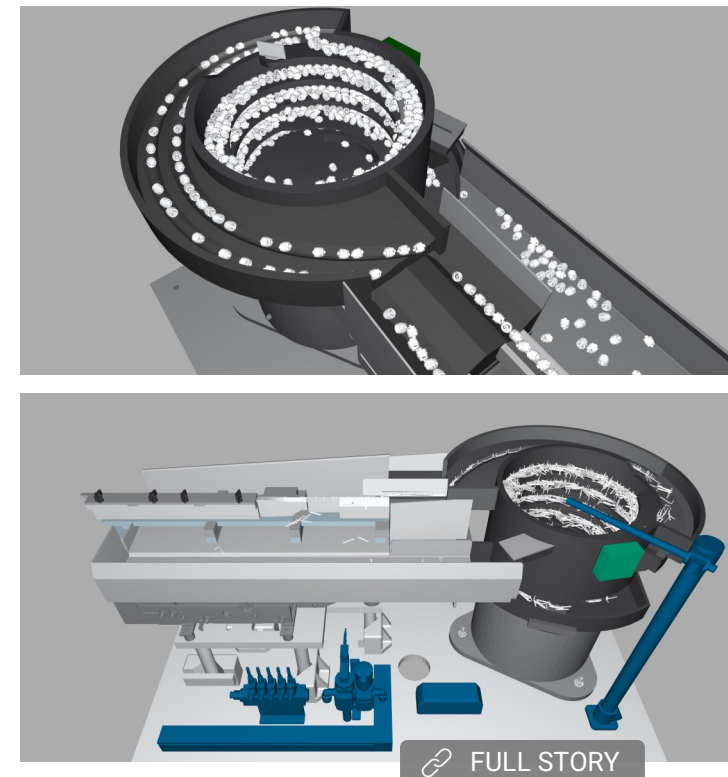
Digital Feeder for Medical applications

Bringing a new medical product to market presents significant challenges, with high development costs and the need for rapid iteration.

A leading medical device manufacturer partnered with RNA to address these hurdles during the design of a new feed system.

Using RNA's Digital Feeder simulation platform, the engineering team was able to model part flow, orientation, and fault scenarios virtually, before committing to physical prototypes.

This digital-first approach shortened iteration cycles, reduced prototyping costs, and optimised the design for availability, performance, and reliability. The result was an accelerated development process and a robust feeder ready for medical validation.



Compliance and Cleanroom Consideration

In medical manufacturing, compliance and cleanroom compatibility are not optional—they are fundamental requirements. RNA designs feed systems that meet the stringent cleanliness and traceability demands of ISO-classified environments, supporting both ISO 7/8 production spaces and, when required, ISO 5 capabilities delivered through RNA Group expertise.



Materials like stainless steel (304/316L) and anodised aluminium ensure durability and minimal particle generation, meeting stringent FDA/GMP requirements. These materials resist corrosion and are ideal for medical manufacturing environments. RNA applies FDA-approved coatings, such as Teflon and polyurethane (PU), to enhance cleanability and reduce contamination risks. For glass components, cleanroom-suitable hardening treatments ensure robustness without compromising hygiene.

Equally important is the finish: feed surfaces are polished to eliminate micro-abrasion sites, ensuring that material handling remains both clean and consistent throughout prolonged operation.

Compliance extends beyond materials. RNA provides comprehensive traceability and documentation to support regulatory audits, including certificates of conformity for materials, coating processes, and system validation. Each system is built under documented procedures that align with GMP expectations, ensuring manufacturers can demonstrate compliance from installation through operation.

By combining hygienic design, certified materials, and robust documentation, RNA ensures its feed systems are not only mechanically reliable but also fully aligned with the compliance and cleanroom requirements that define modern medical manufacturing.

Why RNA for Medical Manufacturers and OEMs

RNA Automation delivers custom-engineered feed systems tailored for regulated industries, ensuring compliance, precision, and repeatability in every application. Our solutions, including vibratory bowl feeders, flexible feeders and digital feeders, are proven in high-throughput, critical manufacturing environments, and handling delicate components with precision.

Designed and built on a foundation of European engineering excellence, RNA systems are supported by a global service

network that provides manufacturers with local expertise and long-term assurance. This combination of innovation, reliability, and international support makes RNA a trusted partner for medical manufacturers and OEMs.

By aligning robust engineering with regulatory compliance and operational performance, RNA offers more than feeding systems: it delivers confidence, continuity, and peace of mind in the most demanding production environments.

Conclusion

Medical manufacturers operate in environments where precision, compliance, and reliability are non-negotiable. Feeding technology sits at the heart of these processes, influencing product quality, throughput, and operational resilience. Drawing on more than a century of expertise, RNA combines proven mechanical engineering with continuous innovation to deliver feeding solutions that consistently meet regulatory, hygienic, and operational requirements.

For medical applications, every system is engineered to balance accuracy with robustness, supporting fragile or complex components without compromising throughput. This innovation-led approach ensures adaptability to changing product geometries and evolving industry standards, giving manufacturers confidence in both current and future production needs.

Equally important is RNA's commitment to uptime and operational assurance. By focusing on durability, low maintenance, and validated cleanroom compatibility, RNA provides feeding solutions that maximise efficiency while minimising risk. For medical manufacturers and OEM partners, RNA delivers not just advanced technology, but peace of mind—systems that perform reliably in the most demanding environments.

About RNA

RNA Automation is part of the Rhein-Nadel Automation Group, Europe's leading specialist in automated feeding and handling solutions with over 120 years of engineering heritage. Certified to ISO 9001 and experienced in delivering systems for GMP- and FDA-regulated industries, RNA combines robust European engineering with a global footprint, supporting manufacturers worldwide with local expertise and service. From concept to commissioning, RNA provides custom-engineered solutions that meet the highest standards of precision, reliability, and compliance.



For more information, visit www.rnaautomation.com or contact us at sales@rnaautomation.com | Tel: +44 (0)121 749 2566 to explore how RNA can enhance your manufacturing efficiency.



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