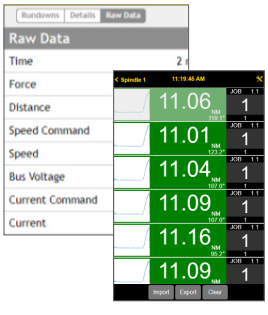
STANLEY
Engineered Fastening



Fastening Process Monitoring & Fastening Control

The Power Of Real-Time Data

eBook

Real Life Examples of HVAC, Truck & Trailer & Heavy Equipment Manufacturers Leveraging Real Time Fastening Data To Drive Manufacturing Efficiencies.

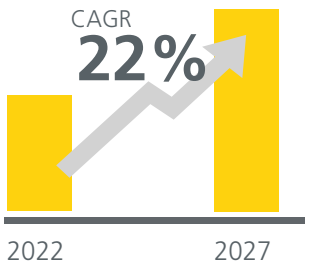
In today's Industry 4.0 era, ensuring quality outputs is paramount for industrial manufacturers. The Internet of Things (IoT), Artificial Intelligence (AI), and smart technologies are revolutionizing how we monitor and control manufacturing processes. As a result, collecting and processing real-time data from the fastening processes for quality assurance has become more critical than ever.

According to a recent report by MarketsandMarkets[1], the global smart manufacturing market size is projected to grow from USD 84.2 billion in 2022 to USD 228.2 billion by 2027, at a CAGR of 22.0% during the forecast period.

This growth is largely driven by the increasing adoption of industrial automation and the rising emphasis on regulatory compliance and quality control in manufacturing processes, further underlining the importance of advanced process monitoring and process control systems.

This eBook explores how blind fastening tools, stud welding systems and threaded fastening systems enable both process control and process monitoring, and provides examples of manufacturers worldwide leveraging these technologies to drive manufacturing efficiencies.

GLOBAL SMART MANUFACTURING MARKET SIZE



Monitoring a Fastening Process vs. Controlling A Fastening Process: Understanding the Key Differences

Fastening Process Monitoring

In a production line environment, monitoring a fastening process involves systematically checking each fastener installed in every application to ensure it meets specifications. For example, blind fastening tools with process monitoring capabilities can collect and transmit critical data such as pull force, distance, stroke, and other relevant parameters in real-time to a centralized IT or PLC system. These error-proof capabilities provide immediate insights into the fastening process, allowing manufacturers to identify and remove non-compliant fasteners before they reach their customers – whether they are end-users or part of another product assembly. Ensuring consistent quality and reducing the risk of fastening variability is key to preventing returns and recalls.

Fastening Process Control

Process control in fastening refers to systems that manage the fastening parameters before the actual assembly takes place. It focuses on controlling the process and setting fastening parameters before the operator places the fastener, ensuring it meets target specifications. A great example is torque control for the installation of big threaded fasteners. Before initiating the fastening operation, the operator inputs specific torque parameters into the controllers. The tool then delivers precisely to those specifications, ensuring each fastener is installed according to the required standards. Advanced torque control systems and tools also utilize in-process control, where transducers continuously measure torque in real-time, feeding data into the system for immediate analysis and adjustment.

Simultaneous Process Monitoring and Control

Some fastening systems allow for both process monitoring and process control within the same operation. Stud welding systems that are widely used in construction are an example of this capability. These systems, equipped with microprocessors, collect data during the welding process, including weld current, arc voltage, lift movement, and penetration depth. The system then compares the performance of the specific weld to an optimum weld profile. Not only does the system notify the operator if the performed weld deviates significantly from the optimum by signaling or warning, but it can also automatically adjust its settings to deliver optimal parameters in future welds. This dual functionality of monitoring and control ensures consistent quality and efficiency in the welding process.

Why Are Manufacturers Increasingly Adopting Systems With Process Monitoring and Process Control For Their Fastening Processes?

Manufacturers are increasingly turning to advanced fastening systems with process monitoring and control capabilities for several reasons:

Enhanced Quality Assurance

- Error-proofing capabilities reduce the risk of variability, minimizing quality issues by ensuring consistent fastening performance.
- These systems prevent assembly errors by proactively providing actionable fastening cycle information.

- Real-time data collection enables immediate corrective actions and early identification of potential problems, preventing costly recalls and customer returns.

Improved Traceability and Compliance

- Advanced systems provide detailed audit trails, facilitating accountability and compliance with industry and customer quality management systems (QMS).
- This comprehensive documentation of the assembly process offers real value for quality audits and regulatory requirements.

Increased Shop Floor Productivity

- By adopting tools with process control, manufacturers can significantly reduce scrap rates and reworks.
- Real-time monitoring, predictive maintenance, and adaptive control strategies contribute to long-term time savings and reduced cost of assembly.

Continuous Improvement and Minimized Downtime

- The data generated by fastening tools with process monitoring and process control drives analytics, enabling ongoing refinement of manufacturing processes. This continuous improvement cycle leads to greater speed to market.
- Remote control and troubleshooting capabilities decrease line downs and increase takt times, further enhancing operational efficiency.

Versatility in Application

Modern fastening monitoring and control tools can be adapted for various needs, allowing manufacturers to tailor their processes to specific product requirements and seamlessly manage production application changeovers.

TOOLS WITH PROCESS MONITORING HELP REDUCING THE DROPOUT RATE OF THE FASTENERS IN PRODUCTION

For example Lean 6 sigma output is DPM0 (Defects Per Million), a sigma level of 6 (with 1.5 sigma shift), the CpK (or process capability) of 2.0 means the defect rate of 3.4 per million with near-perfect quality with 99.99966% accuracy.

Blind Riveting Systems Two Real Stories on How Manufacturers Turned to STANLEY Engineered Fastening to deliver Process Monitoring in Critical Riveting Applications for HVAC and Truck & Trailer Industries

Smart blind riveting systems have been in the market for many years, with an increasing number of manufacturing facilities adopting process monitoring capabilities and smart tools, especially for critical riveting applications where washers are needed to place rivets which cannot be installed crooked.

Riveting tools with process monitoring capabilities not only install the rivets but they also catch defects such as missed or wrong rivets, missing washers and confirms the correct installation by counting rivets, ensuring correct pull force (correct deformation) and correct pull distance (correct stack of materials) to report results on the tool screen, on the controller (when connected to the controller) or to the plant system.

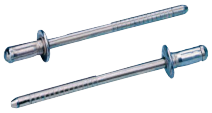
CASE STUDY 1

Full Data Traceability with The BR12PP-8 Process Monitoring System For An Italian Heat Pump Door Manufacturer

A great example of successful fastening monitoring implementation comes from an Italian HVAC manufacturer of heat pump doors that introduced the full STANLEY Process Monitoring System solution.

BR12PP-8 PROCESS MONITORING SYSTEM

SAT® BR12PP-8 Process Monitoring Smart Blind Tool with Barcode Scanner



Avdel® Avibulb® 4mm Aluminum/ Steel Shouldered Rivets

SAT® QBE Controller with Alpha Toolbox Software

The manufacturer needed to rivet their heat pump doors to the highest standard while recording data for each rivet installed. The system captured force, distance, speed, current, and bus voltage in real-time for every rivet, connecting this information to their Programmable Logic Controller (PLC) system for centralized quality monitoring and auditing.

After just one month of implementing the BR12PP-8 STANLEY Process Monitoring System, the manufacturer saw:

- Increased quality control through comprehensive fastening cycle information collection.
- Full data traceability.
- Reduced risk of quality issues due to error-proofing capabilities.
- Ensured correct assembly of each door to specifications.

CASE STUDY 2

Field Trial Of The New BRF30PB-20 With A Truck & Trailer Bumper Assembler Proved To Effectively Reduce Errors In The JIT Production Environment

For manufacturers requiring higher precision and volume capabilities, Stanley Engineered Fastening is launching the new BRF30PB-20 tool in Q1 2025. This tool extends the capabilities of the existing process monitoring blind riveter and is designed for high-volume assembly applications. The BRF30PB-20 advanced force and distance monitoring capabilities, coupled with support for multiple communication protocols, ensures seamless integration into various manufacturing environments. It can recognize incorrect rivets, catch improper hole sizes or formation issues, and detect missing pieces in the stack-up, such as washers. Furthermore, the BRF30PB-20 can catch extra space or gaps between surfaces in the assembly, ensuring a tight, secure fit. To prevent missed rivets, the BRF30PB-20 incorporates a rivet counting feature. Finally, the tool's versatility shines through its ability to configure and install up to 16 different multi-step job parameter sets, making it adaptable to a wide range of assembly requirements.

Field trials for this tool included a vehicle bumper assembler and manufacturer, a tier 1 truck, and trailer supplier. Their main challenge was ensuring parts were manufactured to Acceptable Quality Level (AQL) standards and delivered on time in a Just-In-Time (JIT) production facility. The trial utilized:

- SAT® BRF30PB-20 tool
- POP® Vgrip® 4.8mm rivets

Results:

- Real-time data capture allowed for precise identification of issues, ensuring robust quality control.
- Using the Lean 6 Sigma methodology, setting a tolerance of +/-7.5%, the STANLEY Engineering department was able to calculate a Defect Per Million (DPMO) of 6,200 per million – Sigma of 4 and CpK 1.33 which is an improved result versus prior technology used.
- Detailed audit trail facilitated accountability and compliance with industry standards.
- Improved overall efficiency and reduced errors in the JIT production environment – screen recorded report results in real time.

THE NEW BRF30PB-20 TOOL IS LAUNCHING IN 2025

SAT® BRF30PB-20 With Advanced Process Monitoring Capabilities

The new BRF30PB-20 tool with advanced process monitoring capabilities reduced Defect Per Million (DPM) for bumper truck manufacturer.

Advanced Torque Control From STANLEY Assembly Technologies Allows For Process Control In Critical Applications. A Case Study With A Heavy Machinery Manufacturer

Torque control in threaded fastening applications stands as a prime example of process control in manufacturing. The precise tightening of screws, nuts, bolts, washers, and other threaded fasteners to a specified torque is crucial for maintaining joint integrity, ensuring safety, meeting quality standards, and reducing costs across various industries.

STANLEY Assembly Technologies, a division of Stanley Engineered Fastening, has been a leader in this field for decades. Their expertise spans driving analytics, documenting quality assembly, decreasing takt times, and improving ergonomics by offering solutions, from cost-effective pneumatic clutch tools to sophisticated process monitoring DC tools with specialty heads, fixturing systems, and low reaction features that exchange torque reaction for vibration.

Advanced torque control systems are particularly critical in industries where security and quality are paramount, such as automotive and aerospace, as well as in heavy equipment manufacturing and consumer goods production (including kitchen appliances, water heaters, and climate control equipment).

In these applications, installation tools must provide precise torque and angle control, incorporate error-proofing mechanisms, and offer comprehensive data collection capabilities to verify proper installation. By meticulously controlling the tightening process through torque or angle control to specific specifications, manufacturers can ensure safe joint integrity, maintain quality standards, and create detailed records of the assembly process.

Controlling The Tightening Process Through Torque Or Angle Control Ensures Safe Joint Integrity.

At the heart of any threaded fastening system is the controller. Controllers not only act as communication hubs between multiple tools in the plant network and provide power supply for corded tools, but they also enable easy configuration of tools to meet specific requirements and facilitate advanced process control. This is especially important in critical component assembly requiring accurate and repeatable torque.

The STANLEY SC Controllers are compatible with the EB, B, BR, and BRF range of blind and threaded fastening tools and feature:

- High-speed communication for real-time process monitoring.
- Intuitive user interface for easy programming and operation.
- Integration with plant-wide information systems for seamless workflow.

Modern controllers, such as the newly introduced SC range, represent the next generation in tool control by featuring improved usability and additional connectivity features.

CASE STUDY 3

Precision Torque Control Enhances Safety and Quality For North American Heavy Machinery Manufacturer

A leading manufacturer of heavy machinery faced significant challenges in their production process, particularly in the critical assembly of air chamber fittings for the braking system.

They previously used impact pneumatic tools, which provided no quality data collection or process control, potentially leading to safety risks due to improperly tightened fittings. The company sought a solution that could offer clear visual feedback on torque quality, ensure traceability for each operation, and meet production line constraints: two lines with moving conveyors, each handling four fittings per line with a takt time of 30 seconds per piece of equipment.

To address these challenges, the manufacturer partnered with STANLEY Assembly Technologies to implement a comprehensive solution.

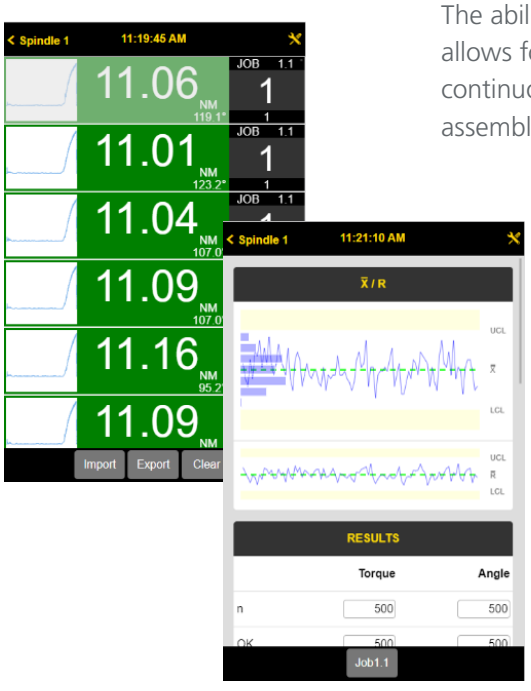
The new process revolutionized the assembly line operations. As each piece of the braking system entered the station, it was scanned for identification. Operators then performed two precise torque passes on each fitting, using tools pre-set to the correct torque and angle. Real-time visual feedback was provided through the centrally located SC Controller, allowing both operators on the floor and team leaders in the quality control room to monitor the torque status instantly.

This system ensured quality by preventing the equipment from advancing to the next station until all fittings displayed green status for both torque passes, effectively combining efficiency with stringent quality control.

TORQUE CONTROL SYSTEM FULLY INTEGRATED WITH THE CUSTOMER PINPOINT MANUFACTURING EXECUTION SYSTEM (MES)

SAT® B-Series Cordless Tools

SAT® SC Controller with Alpha Toolbox Software



This implementation resulted in numerous benefits for the manufacturer including:

Enhanced safety:
Ensuring proper tightening of air chamber fittings, preventing potential air leaks in the braking system.

Improved quality control:
Real-time visual feedback and data collection for each torque operation.

Increased traceability:
Barcode scanning and data collection in the MES ensure each piece assembly history is recorded.

Flexible tool management:
The STANLEY Alpha Toolbox Software allows for easy setup of torque, angle, scanning, and tool enabling/ disabling.

Visual verification:
Green visual inspection on the tool, controller, and team leader's screen provides multiple points of quality verification.

Process control:
The two-pass system with color-coded feedback ensures thorough and accurate torque application.

Data-driven insights:
The ability to inspect torque curves allows for deeper analysis and continuous improvement of the assembly process.

Conclusion

This eBook demonstrates the transformative impact of advanced fastening technologies on manufacturing processes, particularly in applications demanding high precision and stringent quality control. STANLEY Engineered Fastening solutions harness the power of real-time data to revolutionize fastening monitoring and control. By leveraging instantaneous data capture, these systems provide unprecedented insights into the fastening process, enabling full traceability and robust error-proofing capabilities. This power of immediate information allows manufacturers to make informed decisions on the spot, preventing issues before they escalate and ensuring optimal performance throughout the production line.

As we look to the future, it's clear that the continued advancement of real-time data capabilities in fastening technology will play a crucial role in meeting and exceeding the ever-increasing demands for precision, efficiency, and quality in modern manufacturing. The power of real-time data in fastening processes is not just a technological advancement – it's a paradigm shift that promises to redefine the standards of manufacturing excellence.

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Sources:

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AVDEL
Structural Blind Fasteners

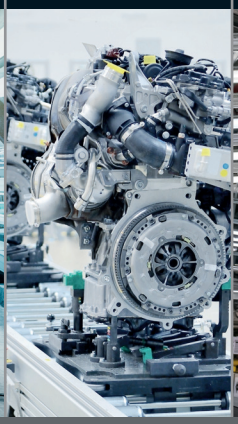
INTEGRA
Plastic Components

NELSON
Stud Welding

OPTIA
Threaded Fasteners

POP
Non-structural Blind Fasteners

STANLEY Assembly Technologies
Specialist Assembly



TUCKER
Automated Fastener Systems

STANLEY
Engineered Fastening

Stanley Engineered Fastening — a division of Stanley Black and Decker — is the global leader in precision fastening and assembly solutions. Our industry-leading brands, Avdel®, Integra™, Nelson®, Optia™, POP®, Stanley® Assembly Technologies, and Tucker®, elevate what our customers create. Backed by a team of passionate and responsive problem-solvers, we empower engineers to create the future.

STANLEY ENGINEERED FASTENING FAMILY OF BRANDS

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