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PRESSES & AUTOMATION

CASE STUDY:

155mm Shell Forging System

TABLE OF CONTENTS

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155MM SHELL FORGING SYSTEM

Delivering Integrated 155mm Shell Production at Scale

Macrodyne + UNION | Texas, USA

EXECUTIVE SUMMARY

To support rising demand for 155mm artillery shells, UNION built a next-generation forging facility designed for consistent, high-volume production with full process control and traceability. Many legacy lines lack the integration, automation, and scalability required to meet modern defense needs.

Macrodyne partnered with UNION to deliver custom, fully integrated press-line systems engineered as a unified whole, not standalone machines. The result is an automated 155mm shell forging operation capable of producing one finished shell per minute, with built-in repeatability, real-time monitoring, and compliance from raw material through final inspection.

Designed for long-term reliability and future growth, the Factory of the Future strengthens U.S. and allied defense readiness by delivering predictable, resilient production when it matters most.

THE CHALLENGE

Scaling 155mm Shell Production Without Sacrificing Control, Quality, or Readiness.

Demand for 155mm artillery shells has placed intense pressure on existing forging infrastructure. Many legacy facilities rely on fragmented layouts, manual handling, and aging presses from multiple suppliers. While these lines can produce quality parts, they struggle with consistency, real-time visibility, and the ability to scale output quickly and reliably.

Key challenges UNION needed to solve included:

- **Throughput & Surge Capacity:**
  Achieving sustained, high-volume output without introducing instability or excessive downtime.
- **Labor Dependence:**
  Reducing reliance on a small number of highly skilled operators for setup, handling, and trouble shooting.
- **Process Variability:**
  Minimizing upstream variation that leads to scrap, rework, and downstream bottlenecks.
- **Quality Control & Traceability:**
  Moving beyond manual documentation to real-time, in-process measurement with digital records.
- **System Integration Risk:**
  Avoiding the inefficiencies and commissioning challenges caused by mismatched equipment and controls from multiple suppliers.

UNION's objective was not to modernize an old line, but to build a clean-sheet "Factory of the Future" designed for predictable output, rapid recovery, and long-term defense readiness.

THE SOLUTION

An Integrated, Automation-First 155mm Shell Forging System.

Macrodyne was selected to design and deliver the press lines at the core of UNION's new facility based on deep experience in large-calibre defense production and a system-level approach to press-line engineering.

Rather than supplying standalone presses, Macrodyne engineered complete, integrated press lines where forming, automation, material handling, and controls were designed together from the outset.

What Macrodyne Delivered:

- **Custom-Engineered Press Lines:**
  Each press was purpose-built for 155mm shell geometries, tooling, and forming sequences. No off-the-shelf designs.
- **Tight Control of Force, Speed & Motion:**
  Critical forging, drawing, and nosing operations are executed with repeatable precision, supporting consistent wall thickness, geometry, and machinability.
- **End-to-End System Integration:**
  Presses, automation, and controls operate as a unified system, reducing commissioning risk and long-term integration issues.
- **Early Process Involvement:**
  Macrodyne worked with UNION early in the project to define forming sequences,press roles, and realistic throughput targets before finalizing the factory layout.
- **Single-Point Accountability:**
  One partner responsible for press performance, automation, and long-term support, lowering risk and simplifying ownership.

“Building a factory from a clean sheet is a chance to do it right. That’s why UNION picked Macrodyne for the most crucial process in our factory: our forging equipment.”

– Russell Varone, Head of Factory Operations at UNION

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INSIDE THE PROCESS

The factory operates as a true flow line, not a series of disconnected steps. Steel bar stock is received, verified, and cut to length, with traceability established immediately. Billets are heated as required and enter the first forming press, where material distribution and the basic shell shape are created.

The shell then moves through a controlled sequence of upsetting, reverse extrusion, and drawing operations. These steps progressively extend the shell to final length while tightly controlling wall thickness, straightness, and concentricity. Much of the final quality is locked in here. Dedicated nosing presses form the ogive and nose geometry using highly controlled motion and force profiles. After forming, shells undergo heat treatment, descaling, and preparation for machining.

Machining brings the shell to final dimensions, including threading and driving band features. Inspection is embedded throughout the process, not isolated at the end, allowing deviations to be caught early. Final steps include surface preparation, painting, inspection, certification, and packaging.

The defining feature is continuity. Material handling, automation, and data tracking connect every step from raw material to finished shell.

AUTOMATION WHERE IT COUNTS

Consistency, Throughput, and Resilience.

Automation delivers its biggest impact in two areas: consistency and throughput. Automated transfer between presses ensures shells are positioned and handled the same way every time, dramatically reducing variability. That consistency upstream prevents issues later in machining, heat treatment, and inspection.

Throughput improves not just because machines move faster, but because the line stops less often and recovers more quickly after interruptions. Automated handling minimizes waiting between steps and reduces errors that lead to rework.

Quality control improves as part of normal production. Process data and inspection results are captured automatically, creating full traceability without relying on manual paperwork or operator memory.

Labor efficiency improves by reducing physical handling of heavy parts, lowering dependence on a small group of specialists, and making training and shift-to-shift consistency easier to maintain.

THE OUTCOME

Predictable, High-Volume Production Built for Long-Term Readiness.

The press-line system was designed around clear, system-level performance targets:

- Throughput: 60 parts per hour (one completed shell per minute)
- Uptime: 80 percent, or roughly 20 productive hours per day
- Repeatability: Maintained through layered automation, PLC-based monitoring, and real-time alarms

Each production cell continuously monitors process conditions. Deviations trigger immediate alarms locally and at centralized control stations, while detailed logs support root-cause analysis and continuous improvement.

Compliance and traceability are enforced by design. Every shell is digitally tracked through its entire manufacturing sequence, with key parameters automatically recorded and time-stamped. Non-conforming parts are identified in real time and prevented from advancing until issues are addressed.

WHAT THIS MEANS IN PRACTICE

- Reliable, scalable 155mm shell production when demand increases
- Faster recovery after disruptions
- Reduced dependence on aging, fragmented manufacturing lines
- Repeatable quality and documented traceability for U.S. and allied defense requirements
- A facility designed to evolve and operate for decades

WHY THIS PROJECT MATTERS

This factory represents a shift from incremental upgrades to true system-level design.

By defining presses, automation, controls, and quality systems together from day one, UNION and Macrodyne created a forging operation that is predictable, scalable, and resilient by design. Output is less dependent on individual operators, variability is engineered out of the process, and performance improves over time through data-driven insight.

It's a practical blueprint for manufacturers facing rising demand, labor constraints, or the limits of legacy infrastructure.

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LET'S TALK

If you're planning a new forging facility, expanding capacity, or looking to future-proof a critical forming line, Macrodyne can help you design a system built for long-term performance.

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