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Case Study

## Critical aircraft maintenance system gains new capabilities with advanced SIMATIC controllers

**Bauer redesigned its next-generation aircraft tire inflation system using the SIMATIC S7-1200 controller, saving costs while gaining new capabilities and flexibility for future feature add-ons.**

### Abstract

Airlines and armed forces worldwide use the Bauer 5012 Automatic Tire Inflator system to ensure efficient nitrogen-filling and precise inflation of aircraft tires, which are subject to extreme landing stresses. Bauer decided to update the system's controls with the Siemens SIMATIC S7-1200 PLC, HMI Comfort Panel and WinCC Professional HMI software to improve the customer experience. The TIA Portal was used for software programming and feature simulation. Bauer was able to cut weeks off completing the first newly designed unit by developing the system's software in parallel with the manufacture of its hardware. The new inflator system offers more capabilities than its predecessor model, with flexibility for adding new features in the future. Bauer gains new competitiveness and potential cost-savings, while the new model can reduce customers' costs, too, and ensure the safety of the tire-filling procedure.

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## What most people ignore on the ground can't be ignored in the skies

By some estimates, half of all drivers today are rolling on under-inflated tires, ignoring known safety issues and reduced treadwear. But every one of them would be most alarmed, if they were aboard a commercial aircraft weighing as much as 400 tons and learned that it had anything less than perfectly inflated tires when landing at 180 miles per hour.

For many of the world's top airlines, proper tire inflation is never in doubt, thanks to their use of the Bauer 5012 Automatic Tire Inflator system. This product is part of the Bauer company's broad range of expert test solutions for fuel, lubrication, pneumatic and electro-mechanical applications that it provides to the aviation industry around the world.



Customers of this pioneering, 100-year-old company include major airlines and armed forces worldwide. Of course, given each one's multinational, even intercontinental operations, they all share a mandatory requirement: reliable and responsive global support and service. They also expect Bauer's test and support equipment to incorporate the latest technology innovations, to help them keep their fleets flying safely yet economically. And they need their ground crews to be as efficient and productive as possible.

**Easy does it.** The inflation process, which typically uses pure nitrogen from a cryogenic source, is a delicate procedure that must be done carefully to avoid overfilling an aircraft tire. Otherwise, massive damage can result, ruining tires costing as much as \$5,000 each and a safety cage costing much more. On top of that, an exploding tire can be a disruptive safety incident requiring investigation, documentation and possible reporting to regulatory authorities.

**Updating technology.** Several years ago, Bauer decided to update the controls of its tire inflator system to add more features and capabilities for customers wanting them and to improve the user experience. Although the system's filling algorithm worked just fine, it could be better implemented with newer PLC technology that could also monitor more parameters and execute many more different recipes for different makes and models of aircraft tires.

**Time for change.** As it was, the prior filling process required a number of inflation intervals, marked by time-consuming manual steps. Operators would inflate a tire partially, then have to gauge how much more was needed to fill. They'd repeat these steps until they'd reach the specified inflation level. If they overshot the tire pressure, they'd vent the extra nitrogen, which would waste money. Clearly Bauer had an opportunity to upgrade the tire inflator system, using a newer PLC and supporting technologies

## New capabilities and flexibility with the Siemens SIMATIC S7-1200 PLC

As mentioned, Bauer's worldwide customer base needed a tire inflator system that could be serviced and supported anywhere they operated. With that requirement in addition to Bauer's technology specifications, the company evaluated two global automation suppliers, both with compelling PLC offerings and a support operations footprint sufficient to meet the requirements of Bauer's customers.



Siemens was chosen for its newest SIMATIC PLC technology, especially its Totally Integrated Automation (TIA) architecture and the TIA Portal engineering framework. Bauer had already standardized on Siemens S7-1500 for its custom aircraft component test systems, so it was familiar with the time-savings capabilities of the TIA Portal. It also valued the SIMATIC intrinsically safe I/O, which enables the tire inflator to be installed in areas subject to gas or dust explosion hazards.

Compared to the other vendor, Siemens was much more responsive to Bauer's RFP and more consultative in its approach. If questions arose, either the Siemens distributor near Bauer's Connecticut headquarters or an assigned Siemens applications engineer would quickly answer them.

**The future, delivered.** For the tire inflator system's core intelligence, Bauer chose the Siemens SIMATIC S7-1200 PLC, instead of the S7-1500 model it uses in its custom test equipment. With WinCC Professional HMI software, the S7-1200 would provide plenty of processing power, features and I/O capabilities for the tire inflator system, all in a compact package to save space. Bauer uses the S7-1500

in its custom equipment because it offers more of everything for the flexibility to meet the unknown but typically higher-end requirements of particular customers.

For the HMI, Bauer chose a nine-inch SIMATIC HMI Comfort Panel. A smaller comfort panel made sense for smaller pieces of equipment like the tire inflator system, but still would deliver all the features its customers would need.



One key requirement was connecting a bar-code scanner. This would enable an operator to input a tire's make and model, quickly and error-free, so the S7-1200 could call up the correct inflation recipe from its catalog. Another was printing out a label and report at the end of the tire inflation procedure, attached to the tire with details of the fill. The comfort panel's USB port provided this capability, as well.

**Flexible capabilities.** Programming was done via the TIA Portal. Bauer was able to leverage its library of function blocks as well as those Bauer uses for its custom equipment based on the SIMATIC S7-1500 platform. With the integrated S7-1200's PID V2.0 technology, the solution could be easily configured for any number of loops to read the system's 20 parameters as the system required.

The TIA Portal provided many time-saving capabilities. One was verification that the tire inflation algorithm was correctly ported from the old system to the new system. Bauer's software team did that in about two days, when it would have taken two weeks without it.

**Simulations for feedback.** Another was using the TIA Portal to create HMI simulations. With these, Bauer representatives were able to easily present design concepts to customers all over the world, to ensure the look and feel not only worked well for Bauer's engineers, but also for them. The flexible nature of the TIA Portal Project structure has enabled Bauer to set a new design standard that can be easily applied to future product design updates.

## Bauer 5012 Automatic Aircraft Tire Inflator System: New Feature Summary

The following summarizes the new capabilities the SIMATIC S7-1200 and Comfort Panel, combined with software programming via the TIA Portal the Bauer 5012 Automatic Tire Inflator system:

### Hardware

- Barcode scanner speeds data entry, reduces errors
- Label printer helps tracking the wheel assembly

### HMI

- I/O overrides offer manual control if needed
- Automatic alarm reporting and logging

### Reports

- Report generator for well-formatted printouts

### Security

- Operator login required and tracked
- Secured engineering and diagnostic functions

### Recipes

- Tire sizes and inflation pressures stored
- Other parameters for better fill control

### Calibration

- Ten-point lookup table
- Live calibration

### Simulations

- Built-in PLC and HMI operating simulations
- Logic-testing, before equipment manufacture
- Commissioning time minimized

### Diagnostics

- Onboard diagnostics via web browser
- Field troubleshooting possible without TIA Portal

## Customers delighted to learn about new capabilities – and give feedback

Bauer customers were delighted to learn about the many new capabilities that it has been able to design, engineer and build into the automatic tire inflator system, using the SIMATIC S7-1200 PLC, HMI Comfort Panel and the TIA Portal software engineering framework. Even more, they appreciated being invited to provide feedback to the simulated HMI and its operations, even before the first inflator was built.

One feature they especially liked is the tire inflator system's catalog of recipes that provide operators with much more control over the filling process than before. That's because all the key inflation parameters can be stored as configurable options and invoked using the barcode scanner.



Left, the Bauer 5012 Automatic Tire Inflator fully assembled, with the HMI and barcode scanner visible. Doors are interlocked for safety and process notification. Right, the doors are specially designed to open into the box, to provide protection in the event of a tire failure. Wood absorbs energy in case of a tire failure.

**Operator time-savings.** The recipe catalog saves their operators a lot of time and minimizes the chances of errors. The process otherwise required a varied number of manual steps with a lot of back and forth using a regulator – akin to the process used at gas station air pumps by drivers who do keep their tires properly inflated (or their mechanics).

Bauer also leveraged the integrated system diagnostics built into the S7-1200 PLC, making them available via a web browser in the HMI or remotely from anywhere in the world. This feature facilitates predictive and preventive maintenance, while helping to ensure faster response in case of problems like wire breaks or communication issues.

**Simplified troubleshooting.** Integrated diagnostics also simplifies troubleshooting in the field when a technician might lack access to the TIA Portal, with alarms that clearly guide troubleshooting efforts. Overall maintenance costs are greatly reduced, too, thanks to fewer mechanical parts and more features provided by the solid-state electronics of the SIMATICS S7-1200 PLC and HMI Comfort Panel.

Internally, Bauer's manufacturing team got value from the TIA Portal-enabled HMI simulations. That's because its software engineering team was able to design, engineer and fully test the system software's logic long before the physical equipment was even painted. When the first new tire inflator system came out of assembly, the software was ready to be loaded and a full system test successfully conducted.

**Reduced project time.** The ability to develop the system's software in parallel with manufacturing its hardware helped cut weeks of project time. That's time Bauer would have otherwise needed, if the hardware and software phases were done more in tandem. As a result, Bauer can substantially reduce its delivery commitments, which can provide a potential competitive edge in some cases. And, once delivered and set up onsite, commissioning time is minimized.

The flexible nature of the TIA Portal's software engineering framework has enabled Bauer to set a new design standard that can be easily applied to future product design updates. Among the company's next steps with the SIMATIC S7-1500 and S7-1200 PLCs is to continue raising the levels of standardization across the entire portfolio. This will ultimately further improve delivery commitments, competitiveness and profitability. Siemens will also keep adding features to the company's standard equipment designs, such as new user-interface and automation improvements, which will also enhance competitiveness while helping ensure customer satisfaction.

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