

Aluminum sorting system relies on modular safety for flexibility, protection, and diagnostics

(Image source: Kwangmoozaa@shutterstock.com)

Highlights:

- The new Autosort Pulse machine from Tomra Recycling uses high-power lasers
- Extensive safety measures are critical to reducing risk
- Tomra Recycling integrated a modular safety system for flexible configuration, tamper protection, and intelligent diagnostics

"The intuitive software allows for easy configuration and implementation of safety functions such as emergency stop, safety access panel monitoring, and mode selection."

– Tomáš Potanko

Customer profile: Tomra Recycling

At Tomra Recycling, a leading provider of sensor-based sorting solutions, safety plays a key role. A prime example of this is the new "Autosort Pulse" sorting machine, which separates aluminum alloys using dynamic laser-induced breakdown spectroscopy (LIBS) technology and meets the highest safety standards. The safety concept combines the PSRmodular configurable safety system and the PSRswitch RFID-coded safety switches from Phoenix Contact. The combination ensures high flexibility, comprehensive tamper protection, and intelligent diagnostics (Figure 1).



Figure 1: The Autosort Pulse multifunctional sorting machine from Tomra. (Image source: Tomra)

continued →

© PHOENIX CONTACT USA, Inc.

Challenge: Protection against serious eye and skin injuries

Today, the safety of machinery is more than just a legal obligation. It supports efficient and sustainable industrial processes. In times of increasing automation and digitalization, it contributes to the availability and productivity.

The “Autosort Pulse” machine uses LIBS technology in conjunction with 3D object recognition, single-point scanning, and AI-based object separation to precisely sort aluminum alloys. LIBS enables the separation of alloys such as 5xxx (Al-Mg) and 6xxx (Al-Mg-Si), which are essential for the aluminum industry.

Tomáš Potanko, Electrical Design Engineer at Tomra Recycling, explained, “We achieve purity levels of 92 to 95 percent in the recovery process. This is a major step forward for the circular economy and the quality of recycled materials.” The compact design of the machine facilitates integration into existing systems and significantly reduces the space required. The combination of LIBS and AI achieves unprecedented sorting accuracy, which clearly increases the efficiency of recycling processes.

The machine works with four Class 4 lasers in accordance with EN 60825-1. The high-power lasers generate particularly high-energy radiation that can cause serious eye and skin injuries through direct or reflected exposure.

Extensive protective measures minimize these risks. The laser chamber is fully encapsulated and equipped with redundant shutdown. The system controls access at several levels. Only authorized personnel receive access. Warning notes and safety labels clearly identify the danger zone. In addition, safety circuits immediately deactivate all lasers when a safety access point is opened.

The physical separation of the laser area from the operating area is a central element of the safety architecture. In addition, monitoring of the safety access panel ensures seamless control. The entire safety architecture complies with the requirements of EN 60825-1 and is enhanced by additional measures such as tamper-proof switches and redundant shutdown circuits.

Solution: Combining a safety system and RFID-coded safety switches

The safety concept combines the inherent design, technical protective measures, and organizational measures in accordance with EN ISO 12100. The PSRmodular configurable safety system monitors up to 160 safe inputs and outputs and supports the PROFINET and Modbus/TCP communication protocols.

The PSR-M-B2 base module, combined with the gateway functionality for PROFINET, enables fast, secure data transmission.

“The intuitive software allows for easy configuration and implementation of safety functions such as emergency stop, safety access panel monitoring, and mode selection,” explains Tomáš Potanko. The advantage of this solution is its ability to adapt flexibly to changes in the machine layout. Built-in diagnostic functions reduce downtime. Predictive maintenance is also made possible (Figure 2).

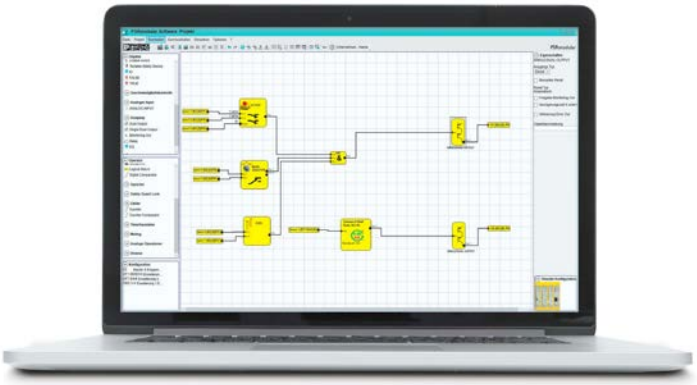


Figure 2: Intuitive safety configuration with the PSRmodular software tool from Phoenix Contact. (Image source: Phoenix Contact)

The PSRswitch product family comprises RFID-coded safety switches with high tamper protection in accordance with EN ISO 14119. The devices are designed for safe series connection of up to 30 sensors. They provide detailed status information, such as switch status, tampering attempts, or errors, directly to the controller via the IO-Link communication system. The information supports predictive maintenance and can increase system availability (Figure 3).

The “Autosort Pulse” sorting machine has a tiered safety concept with four operating modes:

- Level 1: Normal operation – all safety access panels are active, the laser is fully protected
- Level 2: Belt alignment mode – protective mechanisms are partially reduced, and movements are slowed down; the conveyor belts are aligned following replacement, and the lasers are deactivated
- Level 3: Valve test mode – advanced access, lasers are deactivated, safe motion monitoring is carried out, and components are tested
- Level 4: General alignment mode – optimized alignment of the lasers, which can only be performed by specially trained personnel with additional approvals

continued →



Figure 3: Interlocking guard with contactless PSRswitch technology. (Image source: Tomra)

This tiering ensures a high degree of safety combined with flexibility for servicing and maintenance work. Each operating mode is clearly defined and requires specific approval processes to prevent tampering. This is implemented via the PSRmodular safety system, which securely manages the operating modes and activates the corresponding safety circuits.

Validation of the safety-related software by Softema

As per the risk assessment, the maximum required performance level (PL d) is defined in accordance with EN ISO 13849-1. However, the safety architecture technically achieves PL e, providing an additional safety margin. The strict separation of safety and standard automation ensures that safety-critical functions are never influenced by process control. This meets the requirements of modern safety standards and significantly increases fault tolerance.

Along with the hardware, the software plays a decisive role in the safety of machinery. At Tomra, the Softema tool validates safety-related software. This tool allows standard-compliant evaluation and documentation of the safety functions in accordance with EN ISO 13849-1 and supports the calculation of the performance level. This ensures that the implementation of all safety functions is reliable and transparent. Validation also includes simulating fault scenarios and testing the response times of the safety circuits.

The “Autosort Pulse” sorting machine meets all the requirements of the Machinery Directive and relevant standards, including EN ISO 12100 (risk assessment), EN 60204-1 (electrical equipment), and EN ISO 13849-1 (functional safety). The safety of machinery is becoming increasingly digital: AI, cloud data via Tomra Insight, and predictive maintenance will be further integrated. This enables both higher system availability and continuous optimization of the safety architecture. Integrating safety data into cloud platforms opens new possibilities for remote diagnostics and global safety monitoring. “It’s no longer just about protection against mechanical hazards, but also about secure communication and data,” Potanko emphasizes (Figure 4).

Results: Adaptation to different machine layouts

The safety solutions from Phoenix Contact – especially PSRmodular and PSRswitch – perfectly complement Tomra’s concept. Their modularity and scalability allow for flexible adaptation to different machine layouts. Direct PROFINET communication and intuitive

Changes due to the new EU Machinery Regulation

On January 20, 2027, the new EU Machinery Regulation (EU) 2023/1230 will replace the existing Machinery Directive 2006/42/EC. This regulation is effective in all EU member states and no longer has to be transposed into national law. The changes take into account the digital transformation, new technologies such as AI, IoT, and collaborative robotics, and cybersecurity aspects.

Important new features:

- Digital operating instructions are permitted
- Software is classified as a safety-relevant component
- There are new conformity assessment procedures for high-risk machines
- The requirements for cybersecurity and AI are being expanded

Companies should prepare early on to adapt standards and safety concepts. For more details and practical tips, download the Phoenix Contact white paper at www.phoenixcontact.com/machinery-regulation.



Figure 4: Configurable safety with the PSRmodular safety system in a practical application. (Image source: Tomra)

configuration reduce the effort involved in commissioning and modification. With RFID technology and IO-Link, PSRswitch offers high tamper protection and supports predictive maintenance. Both systems meet the requirements of EN ISO 13849-1 and contribute to achieving performance level PL e.

The Phoenix Contact solutions complement Tomra's philosophy of intelligently combining safety and efficiency. They are not just a technical solution, but a strategic building block for the future of industrial safety. Learn more at www.phoenixcontact.com/safety.