Industry 4.0 and NDE – AutosonicTM mini + Auto: Automatic system for periodical inspection and test of seamless aluminum-alloy gas cylinders (ISO 18119)

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Abstract: The Non Destructive Evaluation (NDE) is a fundamental process when high safety standards for the tested component are required. The evaluation may imply a combination of methods to achieve the highest Probability of Detection (POD) resulting in several data available which must be properly collected, processed, and stored for future reviews and for traceability reasons. All these requirements imply a sophisticated digital infrastructure and the usage of the most advanced Information Technology (IT) solutions to achieve computation speed, safe data processing and accessibility of the information. The Industry 4.0 revolution is the result of the combination of digital technology to industrial processes for rethinking the performances in terms of automation, integration, crosslinking, availability and sharing of information. These principles can be applied in the NDE process as several products on the market are tested and monitored during the whole lifetime. The tracking of data, the secure data validation, and the need to avoid misuses and manipulations are new additional requirements for the NDE 4.0. Block chain technology, mainly known for crypto applications, is a promising technology for storing digital identity and test records offering traceability, safety and availability of the data. The present paper wants to present the Swiss Safety Center AG approach for a specific application case (retesting of gas cylinders according to ISO18119) where the guidelines and trends of NDE 4.0 have been successfully integrated in a fully automatic system, first in class for this application. The paper wants also to provides some insights about future trends and potential developments which may not be limited to this specific case but can be applied for other similar applications, e.g. in railways, manufacturing industry, automotive, aerospace and more in general in the NDE applications.

Keywords: traceability, safety, IoT, Digital Twin, NDE 4.0, ISO18119, Autosonic, gas cylinders, digital data, block chain
Industry 4.0 and NDE *Autosonic*™ mini + Auto: Automatic system for periodical inspection and test of seamless aluminum alloy gas cylinders (ISO 18119)

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*Swiss Safety Center AG - Industry 4.0 and NDE Autosonic™ mini + Auto - Luca Scaccabarozzi*
Swiss Safety Center

Services, products, qualifications and conformity assessments
TIC: Testing, Inspection and Certification

### Materials Technology
- Accredited test lab
- Materials technology
- Non-destructive tests
- Analytics
- Mobile lab
- Automation

### Industry Services
- Fire protection inspections
- Notified body for pressure equipment
- Welding technology
- Functional safety
- Conformity assessment
- Dangerous goods containment
- Leisure facilities

### Certifications
- Systems
  - ISO 9001
  - ISO 14001
  - ISO/IEC 27001
  - ISO 45001
  - ISO 13485
  - Etc.
- Products
  - Mountain & Alpine
  - Pressure devices
  - Personnel
  - Risk manager
  - SCC
  - Welder
  - Fire protection

### Expertise Services
- Fire protection
- Safety audits
- Environmental safety
- Hazardous substances
- Dangerous goods
- Explosion protection
- Occupational health & safety
- Integrated risk management
- Emergencies, crises, BCM
- Security

### Academy
- Professional development
- Courses
- Conferences
- CFPA-E (excl. provider CH)
- Recognition for VKF, SUVA, BAG, CZV, GefaSuisse, SGAS
- Inhouse trainings
- E-Learning

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**Independent 3rd party for:**
- Inspections, tests, audits
- Conformity assessments
- Certifications for systems, products and people
Swiss Safety Center
Trusted innovative NDT provider

Field Inspections

- Acoustic Emissions (AT)
- Eddy Current (ET)
- Magnetic Testing (MT)
- Phased Array (PAUT)
- Time of Flight Diffraction (ToFD)
- Penetrant Testing (PT)
- Radiography (RT)
- Ultrasonic Testing (UT)

Product lines:
- Autosonic™
- AutoTest PT
- AutoVISIO

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Life Cycle of a gas Cylinder

1st check → Refill → Re-Test (VT, Weight, UT/Pressure test) → ISO18119 (T-PED) → >10 years → Recycle
Testing process

Automatic/manual (operator) handling

Visual Inspection
Weight check
Test UT/ Pressure
Stamping
Visual Inspection

Operator
Scale
Test system (Autosonic™)
System/Operator
Operator

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Automatic/manual (operator) handling

Visual Inspection
- OCR

Weight check
- Scale

Test UT/ Pressure
- Test system *Autosonic*™

Stamping
- System

Visual Inspection
- Visual check

Database, Cloud, AI

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**Autosonic™ mini+auto**

- UT station
- Scale
- Robot P&P 3D camera assisted
- Vision stations (x3)
- Stamping

**Swiss Safety Center AG** - Industry 4.0 and NDE **Autosonic™ mini + Auto** - Luca Scaccabarozzi
**Autosonic™ mini+auto – Vision Systems**

- Critical surface conditions
- Several fonts
- 3D - Laser Scanning
  - Data acquisition
- Smart picture rectification
- OCR
- Performance Optimization with Machine Learning

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**Autosonic™ mini+auto – UT station**

- Automatic calibration check, Good/Rejected automatic evaluation

- Inner/Outer, Longitudinal/transversal notches: from 0.2mm
- Wall thickness measurements
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LISBON – PORTUGAL, 3 – 7 JULY 2023

Stamping
Check of stamping quality
Robot
Sorting and palettization
Refill
>10 years
Re-Test
ISO18119 (T-PED)
1st check
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• Database proprietary information/exclusive access
• No or limited sharing of information between players
• No information for final user
Blockchain concept
Blockchain concept

Advantages:
- Immutable and safe collection of valuable/critical data
- Accessible to everyone

Limitations:
- Limited access and write speed due to the inherent security/redundancy of the structure

• Digitalization
• Decentralisation
• Disintermediation
• Transparency and verifiability
• Traceability of transfers
• Immutable

Data carry information
Distributed Ledger Technology (DLT)
Reachable by anyone
unbreakable, ineliminable and guaranteed by a system of cryptography

NFC (Near Field Communication)
Digital Twin
Inspection process with Blockchain structure

1. NFT identification
2. Smart contract / Wallet transfer: transfer from Gas-Cylinder-Wallet to Inspection-Wallet
3. Block chain change request and approval
4. Cylinder testing (ISO18119)
5. Saving of metadata in database (Pinata Library) and sharing in P2P-Network over IPFS protocol
6. Transfer from "Inspection-Wallet" to "Gas-Cylinder-Wallet" and new transition into the blockchain
VeChain (VET) is a blockchain platform that seeks to enhance supply chain management processes with specialized functions. It uses tamper-proof distributed ledger technology to determine the authenticity and quality of products purchased by platform users.

Vechain Thor is based on two tokens-model:
VeChain Token (VET) and VeChainThor Energy (VTHO) with the aim of 'speeding up' transactions and controlling their cost.

Application examples are:
• Health data accessibility (e.g. examination results, clinical tests)
• Food tracking (e.g. production, cold chain, transport, etc.)
• Anti-counterfeiting (e.g. luxury goods and others)
• Gas cylinder lifecycleNFT-Trace (own application, bachelor-thesis)
State of the art and future steps

State of the art
Swiss Safety Center has already developed solutions for data management, post-processing and archiving even in complex network architectures (also for clouds). There are two SW platforms Autosoft (for all Autosonic™ systems) and Automanager (for Autosonic™ mini+auto).

Future steps
1. Application of Blockchains:
   • Insight into Vechain and applicability to cylinder control
   • Research into technologies for secure and guaranteed cylinder identification
   • Pilot projects with strategic partners
2. Extend this case study (for Autosonic™ mini+auto) and the experience gained to sectors other than cylinder control, e.g:
   • Smart contract for project execution and plant life cycle management (production, testing, service, maintenance, certification, audit)
   • Concept to also embrace auditing and control by the notifying body
Thank you for your attention