Automatic Battery Stack & Cell Inspection

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THE X-RAY SOLUTION
by Christoph Grohmann

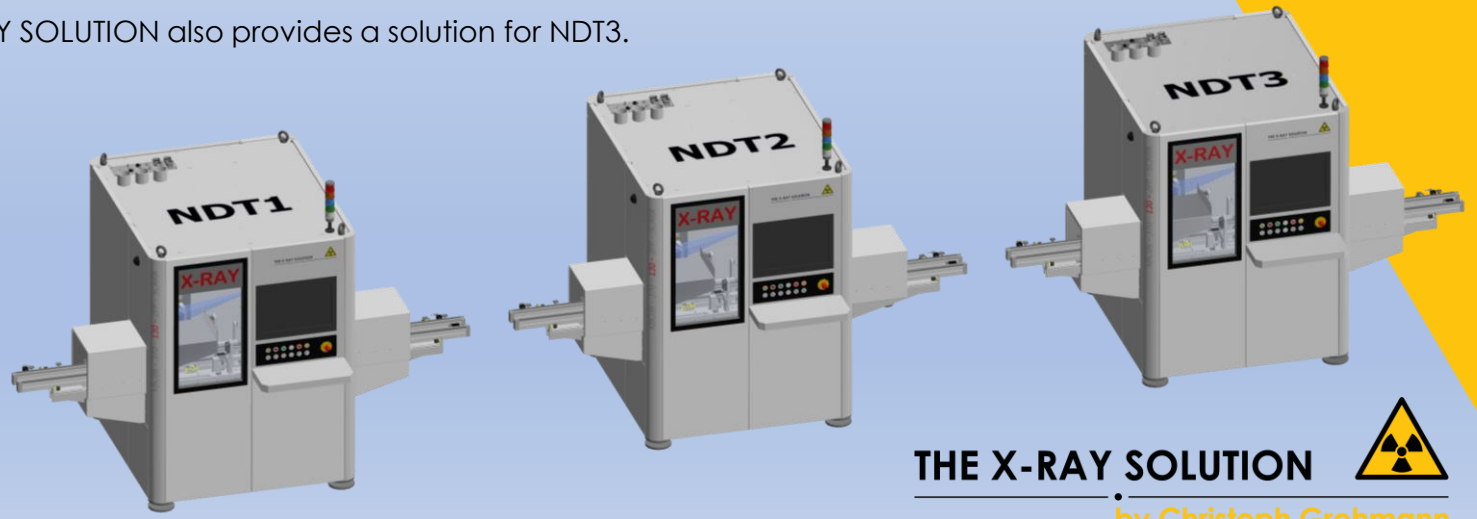
Automatic Battery Stack & Cell Inspection

THE X-RAY SOLUTION company is a well-known manufacturer of high-end X-ray inspection systems for industrial applications in the field of inline high-speed inspection of so-called safety parts for car- and aircraft-industries worldwide.

With an enormous range of experiences from developing standardized as well as customized X-ray inspection systems, THE X-RAY SOLUTION started the development of high-speed inspection systems for Lithium-Ion batteries in December 2021. Our first systems are installed already.

Since the spectrum of batteries for E-mobility is very wide with a numerous number of different sizes, shapes and concepts, THE X-RAY SOLUTION developed standardized systems covering the full range of prismatic and pouch cells for front-end and back-end inspection.
Common battery production lines for prismatic and pouch cells require two individual X-ray inspection systems, NDT1 for the stacks and NDT2 for the completely assembled cell, and cylindrical cell production requires a single X-ray inspection system.
All systems are based on the same standardized machine platform and controls and are fully designed in accordance with dry-room specifications.
Integrated transport systems are customized and guarantee a smooth handling of stacks and cells while reaching cycle times down to 3.75 seconds to serve mass-production lines with 16 PPM.
The inspection of cylindrical cells reaches 250 PPM.

If required, THE X-RAY SOLUTION also provides a solution for NDT3.



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The complexity of cell structure requires integrated methods to control production. **X-ray inspection** is the one method that will ensure that the cells are produced accurately, resulting in high-quality, zero-defect products.

- **Inspection content of stacks:**
  - Deviation of sheet-alignment between anode and cathode sheets
  - Counting the number of sheets
  - Deformation of sheet edges

  Optional inspection:
  - Condition of tab-welding
  - Metal particles inside the stack

- **Inspection content of cells:**
  - Position and distances of the stacks inside the can
  - Condition and distances of pole-connectors between stacks and can

  Optional inspection:
  - Deformation of the stacks, even of a single sheet
  - Deviation of sheet-alignment
  - Welding inspection of can-cover

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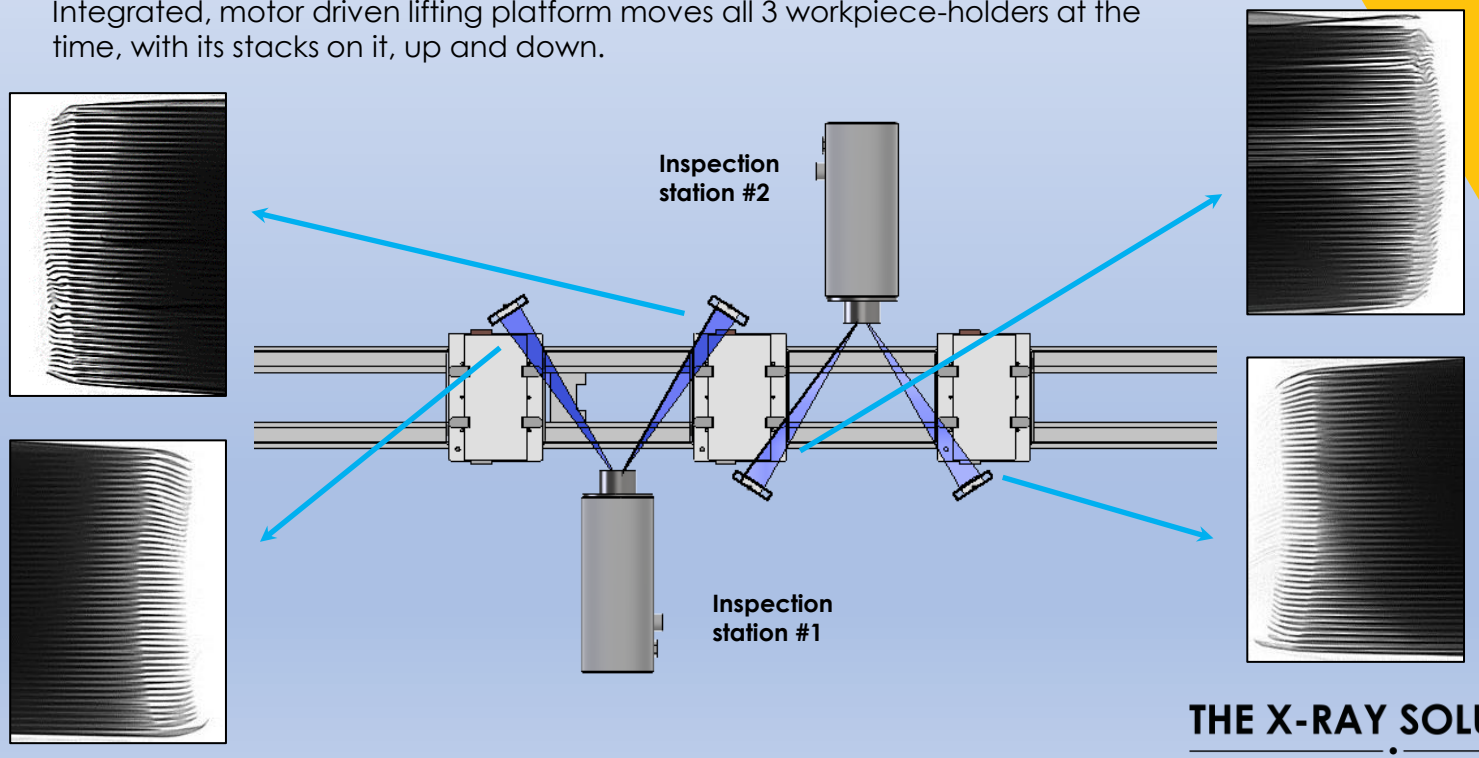
Principle of X-Ray Inspection of Stacks

The stack inspection is based on a flat workpiece-holder, where the stack is safely clamped. This inspection concept consists of two separated inspection areas, so that 4 images of 3 different stacks will be grabbed at the same time, which results in an extremely short cycle time.

The inspection software merges the 4 images related to the same stack, so that the sheet deviations can be calculated according to same stack.

The images are produced by horizontal 2D imaging process.
Integrated, motor driven lifting platform moves all 3 workpiece-holders at the time, with its stacks on it, up and down.



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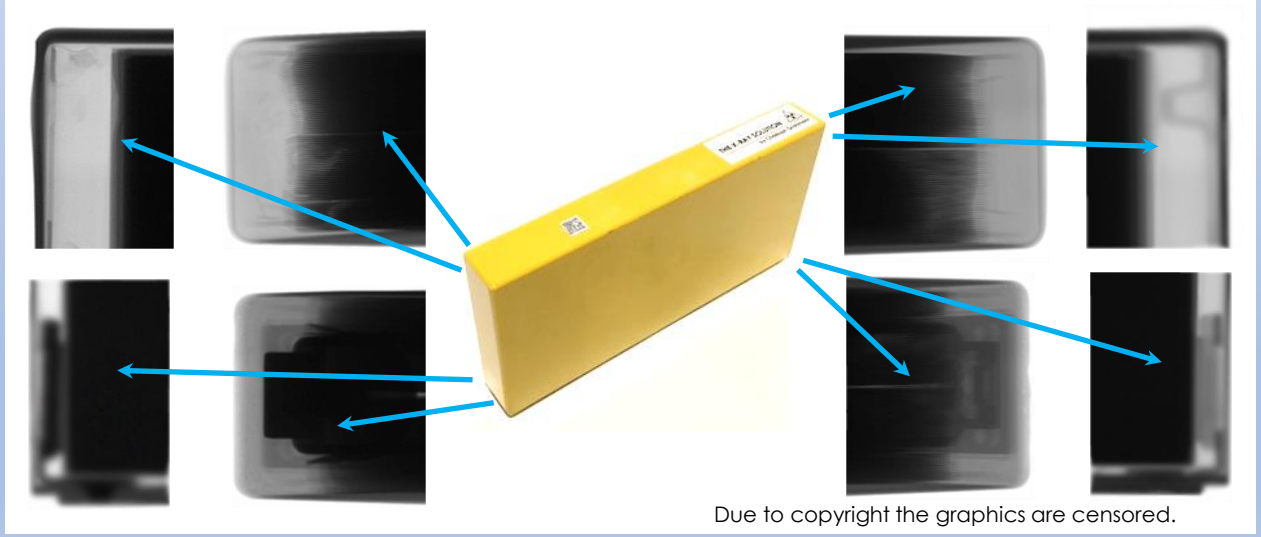
Principle of X-Ray Inspection of Cells

The cell inspection is typically based on upright standing cells on workpiece-holder, where the robot is picking up the cell after identifying its DMC. After inspection is finished, the cell will be returned to its workpiece-holder.
A set of 4 laser measurement units give axis offsets to the robot routing according to the individual positioning tolerances of the cell on its workpiece-holder.

Thanks to the 6-axis robot and the overall space inside the cabin, additional inspection areas can be applied to the 4-corner standard inspection.

The design of the robot gripper guarantees proper handling with an accurate positioning of the cell in high-speed production and is free of any dead zones. This robot-driven solution serves 8 PPM lines with a cycle time of 7.5 seconds.



Due to copyright the graphics are censored.

Customized solutions with high-speed cycle-feed conveyors are available with a cycle time of 3.75 seconds to serve 16 PPM lines.

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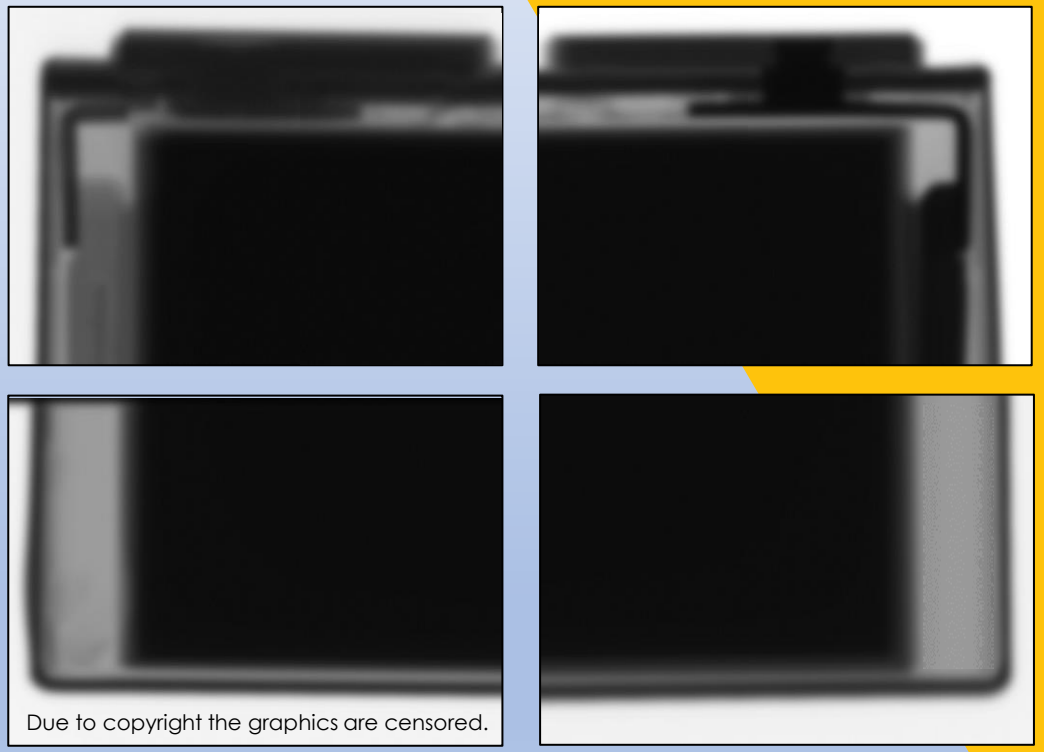
Standard Inspection Areas of Cells

For mass-production lines it is necessary to inspect the 4 corner areas of the cell as shown below. By these 4 images a cycle time of less than 3.75 seconds is achievable.

The inspection software merges the 4 images of the cell.

The brilliant image resolution of the system allows the following inspection analysis:

- Position and distances of stacks inside the can
- Condition and distances of pole-connectors between stacks and can



Optional inspection:

- Deformation of stacks, even of a single sheet
- Deviation of sheet-alignment
- Welding inspection of can-cover

The images are produced by digital flat panel process.
Please see the following pages for standard inspection content.

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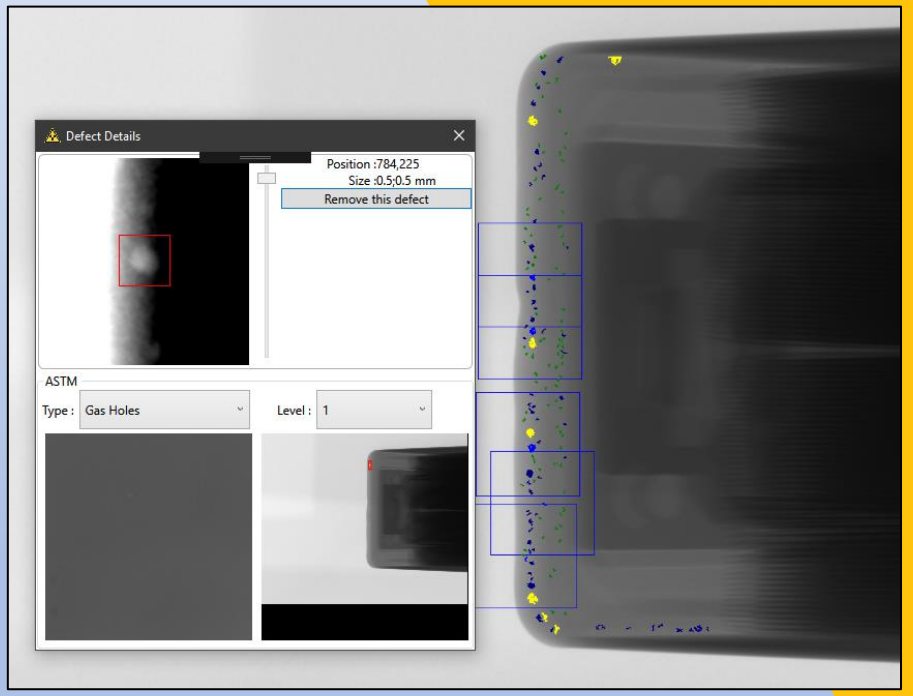
Advanced Inspection Areas of Cells

The minimum inspection of cells to ensure a quality cell is to take 4 images of the corners of the cell.
This standard inspection routine meets the high through-put of the production lines.

Beside this necessary inspection, the system also can run in advanced inspection mode, which includes additional inspection areas and penetration directions to evaluate additional process steps.
This is typically used during production line process optimization as well as for statistical process control (scheduled or on demand at any time).



Examples of advanced inspection could include the following areas:

- Deformation of the stacks, even of a single sheet
- Deviation of sheet-alignment
- Welding inspection of can-cover

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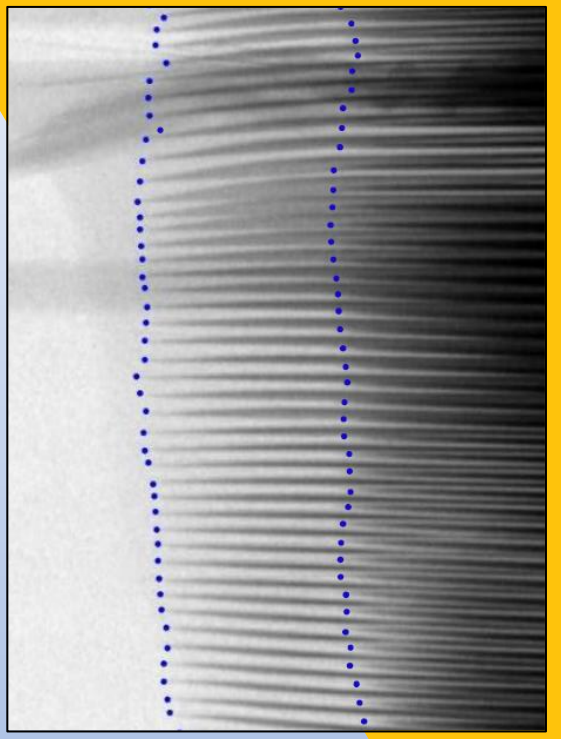
ViSpect Software

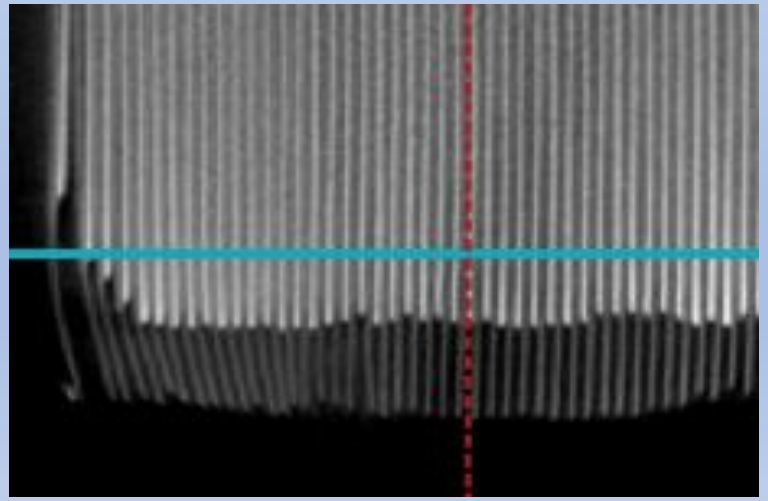
ViSpect is a proprietary software for ADR, developed by THE X-RAY SOLUTION.

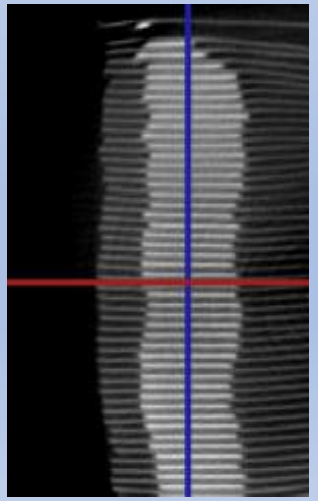
The user interface of the ViSpect software is structured simply, with multiple visual tools to facilitate the setting up of a specific inspection program within a short period of time and in an intuitive and easy to learn fashion.

The human machine interface is designed in accordance with the rules of ergonomic workplaces and is to be used in regular operation as well as in teach-in mode.

We are adopting state of the art AI technologies into our inspection software to boost our product's functionality, which can provide our customers with the advanced inspection reliability that is desired to continuously improve their production processes.







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Dry-Room and Service Features

The systems are made to meet the strict rules of dry-room conditions as well as to guarantee easy access for trouble-shooting, maintenance and service.

- **Dry-room features:**
  - Separated cooling environment for control cabinet
  - Separated exhaust of X-ray cabin
  - Easy to clean super-finish

- **Service and maintenance:**
  - Cabin-integrated control cabinet
  - Large service door for easy access
  - X-cams for process control and remote trouble-shooting

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Our Commitment

- ✓ Highest Level of German Machine Design and Quality
- ✓ World-class Components like Siemens PLC / Spectra IPC / Vieworks Flat Panel / Thermo Fisher X-Ray Sources
- ✓ Plug & Play System Concept
- ✓ Industry 4.0
- ✓ TUV Approval Certificate
- ✓ 2-Year Guaranty
- ✓ Service Contract with 24/7 Support
- ✓ Sustainability

ASK FOR DETAILED PERFORMANCE LIST
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FOR MORE INFORMATION, PLEASE CONTACT
contact@thexraysolution.de

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