



# Lasers for quality assurance in battery production

Non destructive testing (NDT) with Pulsed-Phase-Thermography (PPT)

## Task

With the massive increase in sales of electric vehicles, scalable, fully automated testing of battery cell weld connections is becoming increasingly important. The cells are usually connected by laser or ultrasonic welding. If a welded contact is not made properly in the process, the entire battery can fail. Many batteries in the automotive sector consist of several hundred round cells, where every contact must be reliably made. Electrical testing alone is not sufficient to guarantee the desired reliability.

## Procedure

Laser thermography enables an inspection of welding points reliably and quickly in a non-contact, non-destructive way – and in less than a second. Thermographic testing is able to determine the connection cross-section. If the parameters are below the prescribed area, or in extreme cases, if there is a completely missing connection between the cell and the contacting (so-called “false friends”), the faulty battery is sorted out or reworked.

## Challenge

The challenges lie in the accessibility of the joining connection, the high thermal conductivity of the joining partners and the short cycle time available. As a rule, there is only one-sided access here, so that the contacts cannot be tested simply with conventional methods.

In addition, the plastic carrier system must not be heated too much by the scattered radiation. The surface conditions are also challenging; there is a large number of irregular reflections, and weld spatter in particular can light up strongly during the inspection process.

## Result

The PPT process allows for fast, non-contact localization of flaws that might have been undetected with other testing techniques. The diode laser as a precise and homogenous heating medium in conjunction with a sophisticated camera system and software to evaluate the data can detect surface and inner holes, pores and cracks in a weld seam as well as indicate if the connection is present. This highly accurate testing method helps significantly reduce the risk of a costly future recall of the vehicle.

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**Material:** Various

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**Task:** Inspection of battery components

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**Laser:** LDM 1000-40 or 2000-40

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**Optics:** OTZ-5 (flexible zoom optics)

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**Parameters:** short duration pulse Millisecond pulses.  
Power depends on the illuminated area

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**Result:** Reliable, cost effective NDT

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# Pulse-Phase-Thermography (PPT)

## Comparison to Competing Technologies

| Comparison                      | In Process Surveillance<br>e.g. PlasmO Observer           | Surface Scanning                 | Electrical Resistance<br>Measurement                      | Active Thermography                                                                  |
|---------------------------------|-----------------------------------------------------------|----------------------------------|-----------------------------------------------------------|--------------------------------------------------------------------------------------|
| Pros                            | In Process detection of process changes                   | Non-Contact method               | Direct measurement of electrical resistance               | Non-Contact method                                                                   |
|                                 |                                                           | Retroactive free                 | Detection of subsurface flaws                             | Retroactive free                                                                     |
|                                 |                                                           | Localization of flaws            |                                                           | Localization of flaws                                                                |
|                                 |                                                           |                                  |                                                           | Detection of subsurface flaws                                                        |
|                                 |                                                           |                                  |                                                           | Measurement of joined area<br>> Correlation to mechanical and electrical performance |
| Cons                            | No defined failure identification / verification possible | Indirect measurement             | Pressure of probes on specimen to be tested > Retroaction | Indirect measurement of electrical resistance                                        |
|                                 | Only differences in welding process detectable            | No detection of subsurface flaws | Detection of flaws dependent on their position            |                                                                                      |
| Failures in Weldments           | In Process Surveillance                                   | Surface Scanning                 | Electrical Resistance<br>Measurement                      | Active Thermography                                                                  |
| Welding seam present?           | ○                                                         | ✓                                | ✗                                                         | ✓                                                                                    |
| Surface pores/ holes/cracks?    | ✗                                                         | ✓                                | ✗                                                         | ✓                                                                                    |
| Connection established?         | ✗                                                         | ✗                                | ○                                                         | ✓                                                                                    |
| Inner big cracks, holes, pores? | ✗                                                         | ✗                                | ○                                                         | ✓                                                                                    |



thyssenkrupp Automation  
Engineering pulse phase  
thermography offline  
semi-auto station

✓ Yes   ○ Some   ✗ No

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