Co-funded by the
Erasmus+ Programme
of the European Union

Inspection and Testing of Welded Structures

iQVet project, WP3, Siófok, Hungary

03.06.2024

Dr. Alexandra Kemény

alexandra.kemeny@gmail.com

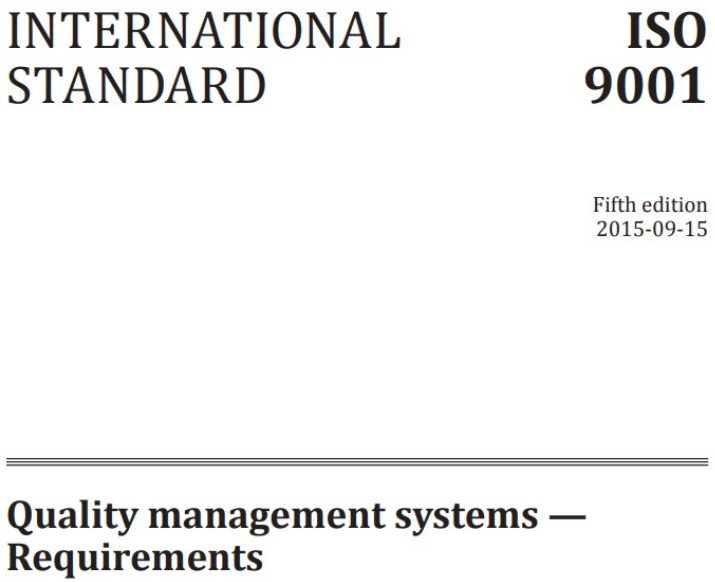
Inspection and testing plan (ITP)

Quality control documentation of a structure.

It could contain steps during:

- Scope and Objectives
- Responsibilities
- Inspection and Test Methods
- Schedule
- Acceptance Criteria
- Documentation
- Non-Conformance Procedures

According to ISO:9001 standard


INTERNATIONAL STANDARD

ISO 9001

Fifth edition
2015-09-15

Quality management systems — Requirements

Significance of ITP

Quality Assurance: ensuring that products or services conform to predefined quality standards. This helps prevent defects, reduces rework, and enhances overall quality.

Risk Mitigation: ITPs identify potential risks and establish protocols to address them proactively, reducing the likelihood of costly setbacks or failures.

Client Satisfaction: organizations can deliver products or services that meet or exceed customer expectations, fostering trust and long-term client relationships.

Inspection steps

Should include all planned action and testing (examination)

- Activity
- Procedure
- Deliverable
- Inspection criteria
  - Surveillance (S)
  - Execution (E)
  - Witness (W)
  - Hold Point (H)
  - Review (R)
  - Records (RE)
  - Test (T)

Inspection vs. testing

Inspection	Testing
• Examining the weld for conformance to standards and identifying surface flaws. • Usually qualitative and non-destructive. • Comparison with previous conditions.	• Evaluating the mechanical properties and integrity of the weld through measurements and analysis. • Quantitative and can be destructive or non-destructive.

Aim of non-desctructive and destructive methods

Non-destructive

- To identify internal or external deviations of the welded joint
- During the documentation and evaluation, it can be decided whether the given deviation is considered an error, i.e. whether it meets the acceptance level of a given standard (or common agreement) or not.

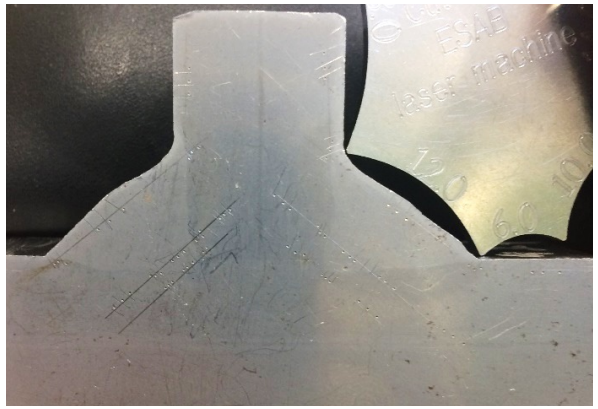
Destructive

- Examining the mechanical properties of the tested sample
- Checking the quality of the welded joint
- Assessing the welder's skills.

Types of inspection and testing methods

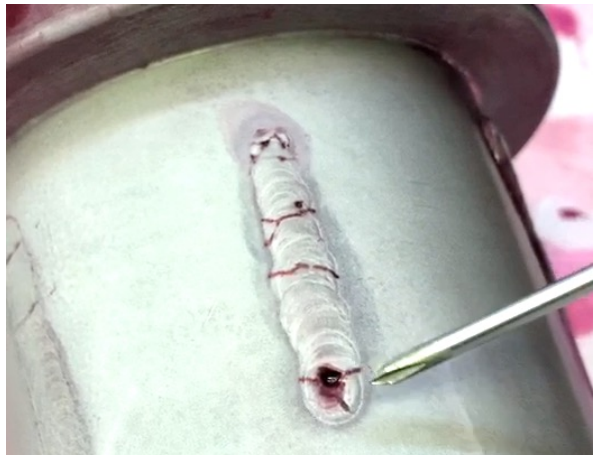
Visual Testing (VT): Examining the weld for cracks, porosity, misalignment, and other visual defects.

ISO 17635:2016 Non-destructive testing of welds — General rules for metallic materials



Penetrant Testing (PT): A non-destructive test that uses a colored liquid to reveal surface cracks and imperfections.

ISO 23277:2015 Non-destructive testing of welds — Penetrant testing — Acceptance levels

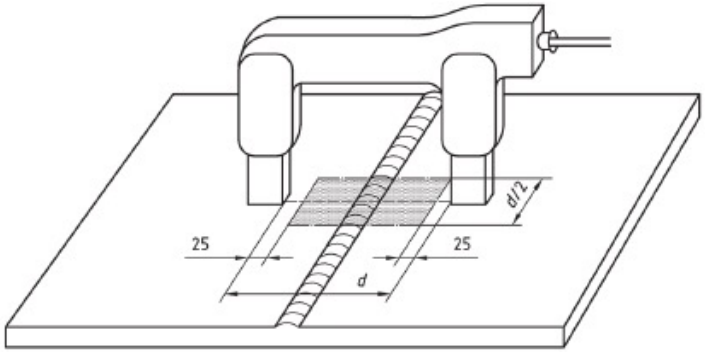


Types of inspection and testing methods

Magnetic particle testing (MT): uses a magnetic field to detect surface and some subsurface cracks.

ISO 17638:2016 Non-destructive testing of welds — Magnetic particle testing

ISO 23278:2015 Non-destructive testing of welds — Magnetic particle testing — Acceptance levels



Ultrasonic Testing (UT): Uses ultrasound waves to detect internal defects throughout the weld volume.

ISO 17640:2018 Non-destructive testing of welds — Ultrasonic testing — Techniques, testing levels, and assessment

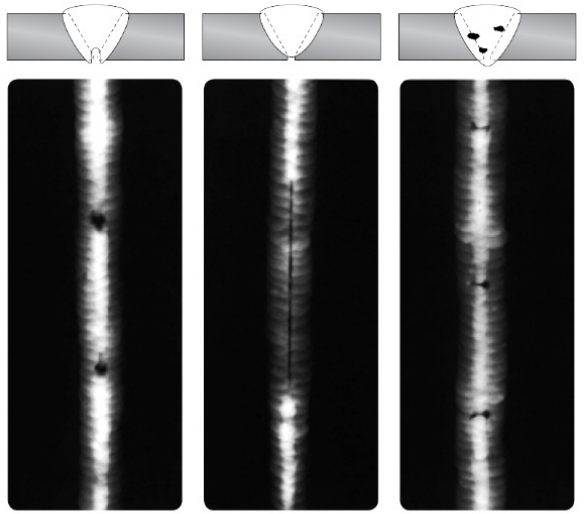
ISO 11666:2018 Non-destructive testing of welds — Ultrasonic testing — Acceptance levels

Types of inspection and testing methods

Radiographic testing (RT): Uses X-rays to create an image of the weld, revealing internal defects like cracks and voids.

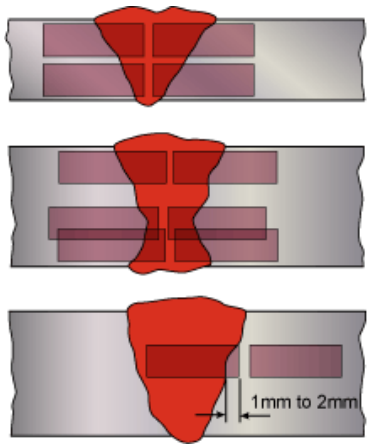
ISO 17636:2022 Non-destructive testing of welds — Radiographic testing

ISO 10675:2021 Non-destructive testing of welds — Acceptance levels for radiographic testing



Impact test: A notched specimen is struck with a swinging pendulum, measuring the absorbed energy and a material's toughness (resistance to fracture under impact).

ISO 9016:2022 Destructive tests on welds in metallic materials — Impact tests — Test specimen location, notch orientation and examination



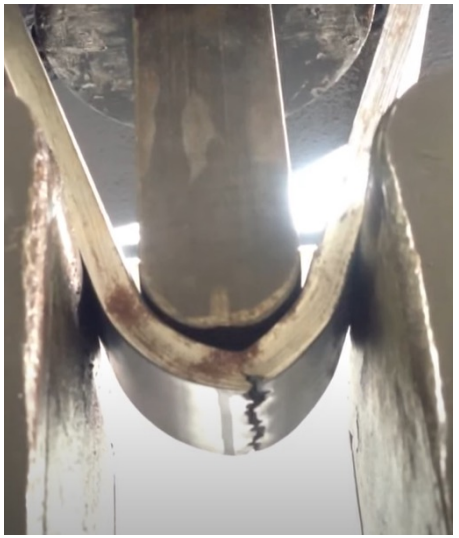
Types of inspection and testing methods

Tensile test: A specimen is pulled until it fractures, measuring its strength (maximum stress) and ductility (amount of elongation before fracture).

ISO 4136:2022 Destructive tests on welds in metallic materials — Transverse tensile test

ISO 5178:2019 Destructive tests on welds in metallic materials — Longitudinal tensile test on weld metal in fusion welded joints

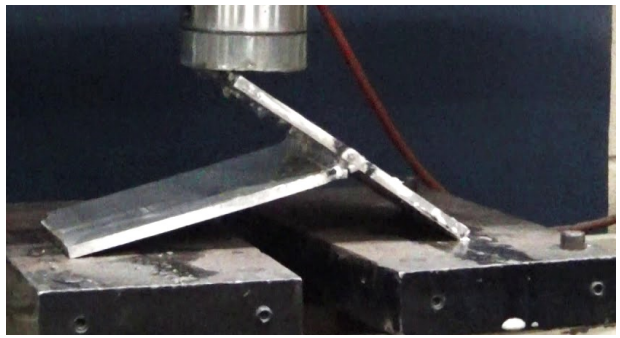
Bend test: A specimen is bent to a specific angle or until it fractures, assessing its ductility and susceptibility to cracking under bending stress.



ISO 5173:2023 Destructive tests on welds in metallic materials — Bend tests

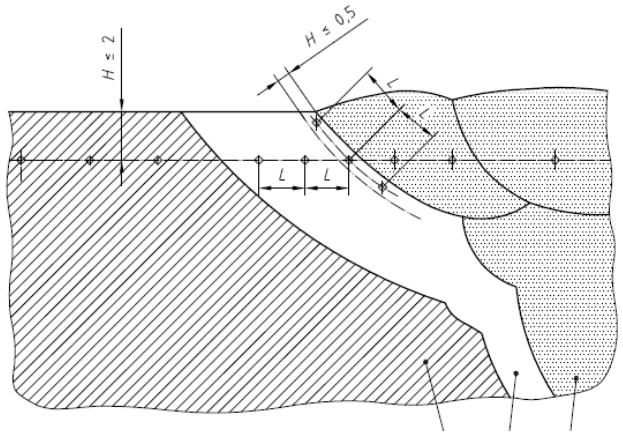
Types of inspection and testing methods

Fracture test: The joint is fractured to identify the internal imperfections such as porosities, cracks, lack of fusion, lack of penetration and solid inclusions on the fracture surface.



ISO 9017:2017 Destructive tests on welds in metallic materials — Fracture test

Hardness test: The indentation left by a penetrator on the material's surface is measured, providing an indication of its hardness and wear resistance.

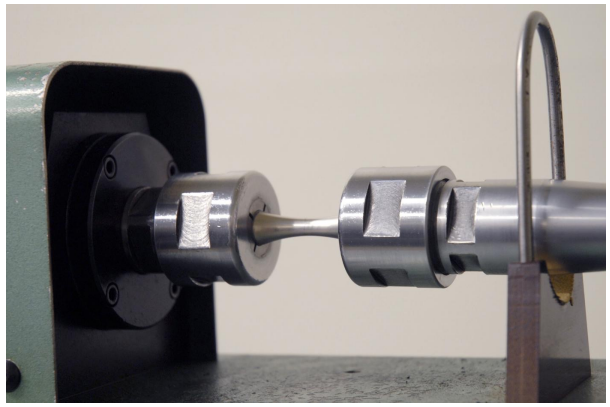


ISO 9015-1:2001 Destructive tests on welds in metallic materials — Hardness testing Part 1: Hardness test on arc welded joints

ISO 9015-2:2016 Destructive tests on welds in metallic materials — Hardness testing Part 2: Microhardness testing of welded joints

Types of inspection and testing methods

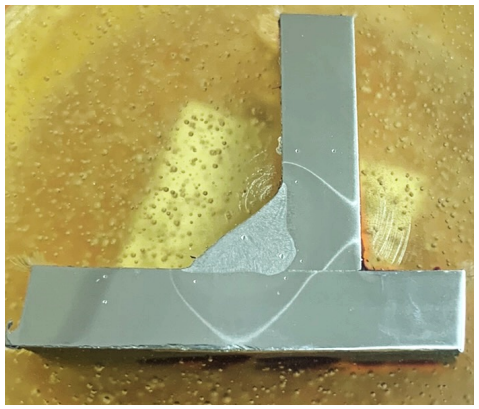
Fatigue test: A specimen is subjected to repeated cycles of stress (tension, compression) to determine its fatigue life (number of cycles before failure).



ISO/TR 14345:2012 Fatigue — Fatigue testing of welded components — Guidance

ISO 14324:2003 Resistance spot welding — Destructive tests of welds — Method for the fatigue testing of spot welded joints

Macro and microstructural test: Investigating the structure and phases of the weld and the surrounding materials.



ISO 17639:2022 Destructive tests on welds in metallic materials — Macroscopic and microscopic examination of welds

Choosing the Right Method

The specific inspection and testing methods used will depend on factors like:

- **Product criticality**: How important is the weld's performance for safety or function?
- **Material type**: Different materials require different testing methods.
- **Code requirements**: Industry standards might specify mandatory inspections or tests.

By following a combination of inspection and testing procedures, the quality and integrity of welded products can be ensured.

Thank you for your attention!