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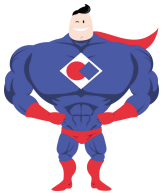
Destructive and non-destructive material testing methods



Materials testing is an essential part of quality assurance in the steel industry.
steel industry. It comprises various test methods aimed at evaluating the mechanical properties and integrity of materials. This white paper outlines the key points of destructive and non-destructive testing methods.

Destructive testing methods

Destructive test methods are tests in which the material is loaded to destruction in order to determine its mechanical properties.

Tensile test

The tensile test is a basic test method in which a sample is stretched until it breaks. Important characteristic values that are determined are

- Modulus of elasticity (E): Measure of the stiffness of the material.
- Upper yield strength (ReH): Stress at which the material begins to deform plastically.
- Tensile strength (Rm): Maximum stress that the material can withstand.
- Elongation at break (A): Elongation of the sample until it breaks.
- Constriction at break (Z): Reduction in cross-section at the point of break.

Tensile creep test

This test is carried out at high temperatures and constant load in order to determine the creep rupture strength and creep strain limits of high-temperature steels. It is particularly important for components that are exposed to high temperatures, such as steam pipes in power plants.

Compression test

The compression test is the counterpart to the tensile test and is used to determine the compressive strength of a material. A cylindrical sample is compressed until it breaks.

Fatigue strength test (Wöhler curve)

This test evaluates the fatigue strength of a material under cyclic loading. The fatigue strength (σD) is a decisive characteristic value that emerges from this test.

Charpy impact test

The Charpy test measures the toughness of a material by applying an impact load to a notched sample. The Charpy impact energy (Kv) provides information about the material's resistance to crack propagation and breakage.

Technological test methods

Technological test methods evaluate the workability and mechanical properties of materials under specific conditions.

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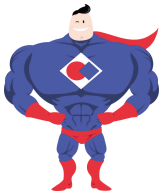

Hardness test

The hardness test measures the resistance of a material to penetration by a test specimen.
The most common methods are:

- Brinell hardness test (HB): Uses a hard metal ball as the test specimen.
- Vickers hardness test (HV): Uses a pyramid-shaped diamond.
- Rockwell hardness test (HRC): Measures the penetration depth of a diamond cone.

Non-destructive testing methods

Non-destructive testing methods make it possible to examine materials without damaging them. They are crucial for quality assurance and defect detection in finished components.

Surface inspection

- Dye penetrant method (FE): Uses dyes to make surface cracks visible.
- Magnetic particle inspection (MP): Uses magnetic fields and iron powder to detect surface defects.
- Eddy current testing: Generates eddy currents in the material surface to detect cracks and other defects.

Volume test

- X-ray inspection: Uses X-rays to identify internal defects in materials
- Ultrasonic testing: Uses high-frequency sound waves to detect internal defects and determine their size.

Conclusion

Destructive and non-destructive testing methods are indispensable tools for ensuring material quality and integrity. ensuring material quality and integrity. They provide important data for the design and safe operation of components and structures.