Iso 6892 1 2016 Metallic Materials Tensile Testing

3rd Iron and Steel Symposium(UDCS'17)3-5April 2017 Karabuk-TURKEY

The Changes in ISO 6892-1:2016 Metallic Materials Tensile Testing Standard

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***Abstract*— Today, as the current standard tensile test for metallic materials ISO 6892-1 standard are used. The English version of the standard in 2009 and the Turkish version in 2011 were published. The English version was renewed in 2016. In this study, we aimed to summarize the major changes made in this standard. In this way, it is aimed to be transmitted detailed and accurate information for related person.**

***Keywords*— ISO 6892-1, Tensile test, Metallic materials**

I. Introduction

Along with the developing technology, tensile testing practice and calculation differences in results bring about changes in standards. When you search at the changes in the standard of tensile testing in metallic materials in our country; TS 138 EN 10002-1(1996, 2004) and TS EN ISO 6892-1(2011) are published. The English version of the standard is published in ISO 6892-1(2009), and it is published as TS EN ISO 6892-1(2011) by the Turkish standard TSE. In 2016, ISO 6892-1(2016) was revised and published, but Turkish has not been published yet [1-3].

In the metal industry, at room temperature, the tensile test standard comes out against ISO 6892-1(2016) and ASTM E8/8M(2016). ASTM standards are used in America, whereas, ISO standards are used in Europe. Japanese Industrial Standards (JIS) and GBT (Chinese Standards) in Asia have adopted the ISO 6892-1 standard.

The tensile test for metallic materials at ISO 6892-1 ambient temperatures is a very detailed standard. This standard describes the method to be applied in the experiment, the calculations used, the results to be reported, as well as the equipment to be used for the test. The changes in this standard are likely to affect everyone in the metal industry.

This study has highlighted important changes between the ISO 6892-1(2016) standard and the previous ISO 6892-1(2009) standard [1,2]. On this study, it is aimed to give detailed and accurate information to the persons who are related to the emphasis of differences of this standard which is used in metal industry.

II. The Changes of ISO 6892-1:2016

Its summary is given below those changes between 2016 to 2009 version of ISO 6892-1 tensile testing method of test at room temperature of metallic materials

A. New terms and definitions

The 2016 version of standard is added the following term and definitions.

Item 3.12 computer-controlled tensile testing machine: machine for which the control and monitoring of the test, the measurements, and the data processing are undertaken by computer.

Item 3.13 modulus of elasticity (E): quotient of change of stress ΔR and change of percentage extension Δe in the range of evaluation, multiplied by 100 %.

$$E = \frac{\Delta R}{\Delta e} . 100\%$$

Item 3.14 default value: lower or upper value for stress respectively strain which is used for the description of the range where the modulus of elasticity is calculated

Item 3.15 coefficient of correlation (R^2): additional result of the linear regression which describes the quality of the stress-strain curve in the evaluation range

Item 3.16 standard deviation of the slope (S_m): additional result of the linear regression which describes the difference of the stress values from the best fit line for the given extension values in the evaluation range

Item 3.17 relative standard deviation of the slope ($S_{m(rel)}$): quotient of the standard deviation of the slope and the slope in the evaluation range, multiplied by 100 %.

$$S_{m(rel)} = \frac{S_m}{E} . 100\%$$

The symbols of item 4 in the standard are added the new term defined in item 3 [1,3].

B. The changes in test speeds

Test speeds or test rates in heading 10.3 of ISO 6892-1:2016 standard have been changed and the speeds are explained in more detail as Method A1, A2 and B, respectively. The extension speed of the method in the 2009 version of the ISO 6892-1 standard was defined as two methods in the 2016 version. It is expressed as Method A1 (Closed loop strain control) and Method A2 (Open loop strain control).

Closed loop strain control, method A1, is the strain rate control based on the feedback of the data obtained from the instrument's extensometer. The application for this method is given by the tolerances of the required 4 step speed standard. The standard speed steps are schematically shown in figure 1 [5-7]. The other method, Method A2, open loop strain control,

ISO 6892-1:2016 metallic materials tensile testing is a critical standard that governs the methodology for tensile testing of metallic materials. This standard is essential for engineers, manufacturers, and quality control professionals, as it provides a consistent framework for assessing the mechanical properties of materials used in various applications. Understanding this standard not only helps in achieving compliance with international norms but also ensures the reliability and performance of metallic components in real-world scenarios.

What is ISO 6892-1:2016?

ISO 6892-1:2016 is an international standard published by the International Organization for Standardization (ISO). It outlines the procedures for conducting tensile tests on metallic materials. The primary aim of this standard is to provide consistent, reproducible results that can be used to compare different materials and their performance under stress.

Scope of ISO 6892-1:2016

The scope of ISO 6892-1:2016 includes:

- Test Methodology: It provides guidelines for the preparation of test specimens, the testing process, and the interpretation of results.
- Material Types: The standard applies to various metallic materials, including ferrous and non-ferrous metals.
- Applications: It serves industries such as automotive, aerospace, construction, and manufacturing, where the mechanical properties of materials are crucial.

Importance of Tensile Testing

Tensile testing is a fundamental procedure in material science and engineering. It is crucial for several reasons:

1. Understanding Material Properties

Tensile testing helps determine key material properties, including:

- Yield Strength: The stress at which a material begins to deform plastically.
- Ultimate Tensile Strength (UTS): The maximum stress a material can withstand while being stretched.
- Elongation: The measure of a material’s ductility, indicating how much it can stretch before breaking.

2. Quality Control

Implementing ISO 6892-1:2016 in manufacturing processes ensures that materials meet specified standards, reducing the risk of failure in critical applications.

3. Material Selection

Engineers utilize tensile test results to select appropriate materials for specific applications, ensuring that components can withstand expected loads and stresses.

Test Procedure According to ISO 6892-1:2016

The ISO 6892-1:2016 outlines a detailed process for conducting tensile tests. Below are the main steps involved:

1. Specimen Preparation

- Material Selection: Choose the appropriate metallic material for testing.
- Specimen Dimensions: Prepare the specimen according to specified dimensions.
- Surface Finish: Ensure that the surface of the specimen is free from defects and contaminants.

2. Testing Equipment

- Tensile Testing Machine: Use a calibrated machine capable of applying load in a controlled manner.
- Extensometers: Instruments that measure elongation and deformation during the test.

3. Conducting the Test

- Mounting the Specimen: Secure the specimen in the testing machine.
- Applying Load: Gradually apply tensile load until the specimen fractures.
- Data Recording: Record the load and corresponding elongation throughout the test.

4. Analysis of Results

- Stress-Strain Curve: Plot the stress-strain curve based on the recorded data.
- Determining Properties: Calculate yield strength, UTS, and elongation from the curve.

Key Parameters in ISO 6892-1:2016 Testing

Understanding the various parameters involved in tensile testing is essential for accurate results:

1. Gauge Length

The gauge length is the length of the specimen that is used to measure elongation. It must be specified according to the standard to ensure consistent testing conditions.

2. Strain Rate

The strain rate is the speed at which the load is applied to the specimen. ISO 6892-1:2016 specifies the strain rates for different materials to ensure reliable results.

3. Temperature and Environment

Testing conditions, including temperature and humidity, can significantly affect material properties. The standard provides guidance on environmental conditions during testing.

Common Applications of ISO 6892-1:2016

ISO 6892-1:2016 tensile testing is widely used across various industries. Here are some common applications:

1. Automotive Industry

In the automotive sector, tensile testing is crucial for evaluating the mechanical properties of metals used in vehicle construction, ensuring safety and performance.

2. Aerospace Industry

Aerospace components must meet stringent safety standards. Tensile testing helps verify that materials can withstand the extreme conditions encountered during flight.

3. Construction

Materials used in construction, such as steel and aluminum, undergo tensile testing to ensure they can support structural loads and resist failure.

4. Manufacturing

Manufacturers rely on tensile testing to ensure that their products meet quality standards and can perform reliably under operational conditions.

Benefits of Complying with ISO 6892-1:2016

The adoption of ISO 6892-1:2016 offers numerous advantages:

- **Consistency:** Provides a standardized method for testing, ensuring consistency across different laboratories and manufacturers.
- **Reliability:** Enhances the reliability of test results, which is critical for quality assurance and product safety.
- **Global Acceptance:** As an internationally recognized standard, compliance facilitates international trade and collaboration.
- **Performance Verification:** Helps in verifying material performance under specified conditions, reducing the risk of material failure.

Conclusion

In conclusion, **ISO 6892-1:2016 metallic materials tensile testing** is an indispensable standard that plays a vital role in the evaluation and assurance of material properties. By adhering to this standard, industries can ensure the safety, reliability, and performance of metallic components in various applications. Understanding and implementing the procedures outlined in ISO 6892-1:2016 is essential for engineers, manufacturers, and quality control professionals aiming to achieve excellence in their materials and products.

Frequently Asked Questions

What is ISO 6892-1:2016?

ISO 6892-1:2016 is an international standard that specifies the method for tensile testing of metallic materials. It outlines the procedures for determining the mechanical properties of metals, such as yield strength, tensile strength, and elongation.

Why is tensile testing important in material science?

Tensile testing is crucial as it provides essential data on the mechanical properties of materials, helping engineers and designers understand how materials will behave under stress, ensuring safety and reliability in applications.

What types of materials does ISO 6892-1:2016 apply to?

ISO 6892-1:2016 applies to metallic materials, including ferrous and non-ferrous metals, alloys, and composite materials, making it relevant for a wide range of industries, including construction, automotive, and aerospace.

What are the key parameters measured in a tensile test according to ISO 6892-1:2016?

Key parameters measured include yield strength, ultimate tensile strength, elongation, and reduction of area. These parameters provide insights into the ductility and strength of the material being tested.

How does ISO 6892-1:2016 ensure consistency in testing?

ISO 6892-1:2016 provides standardized procedures for sample preparation, testing conditions, and data reporting, which helps ensure consistency and comparability of results across different laboratories and testing environments.

What are the implications of not following ISO 6892-1:2016 in tensile testing?

Not following ISO 6892-1:2016 can lead to unreliable results, which may compromise material selection and design integrity, potentially resulting in product failures and safety hazards in critical applications.

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