What is a Compression test?

Compression testing is a method used to quantify the strength of an object by applying a compressive load, or essentially pushing it. It can be also employed to evaluate functionality of the object, including its mechanical safety and comfort. Compression testing is one of the means to improve and stabilize the quality of manufactured products. It can be used to evaluate whether the strength is sufficient and whether the product can be operated with just the right amount of force. It is utilized not only to ensure product safety but also to enhance brand image.

INDEX

1. Overview of Compression Testing

Key Points

- Compression testing is a type of force measurement where force is applied in the direction of crushing or compressing the test specimen. (Tests such as bending, compression, shear, and puncture are also classified as compression tests.)
- The purpose of compression testing can be broadly categorized into "strength testing," which defines the material's physical properties themselves, and "functionality assessment," which evaluates factors, such as safety, by adding specific criteria to the strength test.
- Compression testing uses force measurement devices such as force gauges or universal testing machines.
- The unit for compression load values is the Newton (N).

Force Measurement

Force measurement refers to the measurement of force, which includes such forces applied in compression, tension, peeling, and friction, among others. These forces can be measured using instruments and sensors like force gauges or universal testing machines. Understanding the strength of an object and then using that knowledge to ensure safety and comfort in manufactured products through specific indicators is one of the means of force measurement.

Compression Test

Compression testing is a type of force measurement where a compressive force, directed towards crushing the test specimen, is applied to assess the strength and functionality of the specimen. Compression tests are conducted by pressing the test specimen on the sensor part of a force gauge or universal testing machine equipped with compression testing fixtures. It's important to note that compression testing encompasses various types, including bending, compressive, shear, and puncture tests, depending on the direction of the force is applied.(Rerer to page 6 for more details)。

Strength Test

Strength testing is a type of test where a compressive force, directed towards crushing the test specimen, is applied to determine how much compressive force the test specimen can withstand. This test defines the physical properties themselves and comes in two main categories; Material Strength Testing (Assesses the strength of the material itself) and "Structural Strength Testing (Evaluates the strength of a fully assembled and completed product). (Refer to page 4 for more details.)

Functinoality Accesment

Functional evaluation is a type of test where, in addition to strength testing, other indicators are included to assess aspects such as safety, comfort, protection, etc. These evaluations are crucial for determining product quality and, consequently, customer satisfaction. From a branding perspective, they are also essential as they directly impact the perception of the product's quality and performance in the market.(Refer to page 4 for more details.)

2. Why is Compression Testing Necessary in the First Place?

For example, let's say you're inquiring with manufacturers about the dimensions of a product you're considering purchasing. If you receive a vague answer like, "It's slightly shorter than the width of 5-euro bill," you would likely think, "Can you please measure it precisely and tell me the exact dimensions?" It's unlikely that manufacturers would provide vague answers when it comes to dimensions. However, when it comes to mechanical strength and functionality, it is often the case that they are not quantified and measured.

Let's consider a scenario where you're looking for a sturdy cardboard box. You inquire with two companies, and they provide the following responses:

Company A's response	Company B's response
We guarantee that it won't break even under a force of 300N (30kgf). It can withstand the weight of a toddler comfortably. We conduct strength measurements and quality control, so please rest assured.	It's sturdy, you know. It won't break easily.
✓ It is reliable.	? The lack of evidence causes anxiety.

Wouldn't Company A be more reliable? Numerical data provides strong persuasive material for users.

Even though Company B may not have conducted strength measurements, there are cases where quality is measured by human senses, such as pushing a box and comparing its resistance to crushing to the usual. However, relying solely on the senses which can lead to significant individual variations and unstable product quality. Furthermore, in product development, not having numerical data as a basis can significantly reduce the productivity of verification processes.

In recent years, containers such as boxes are expected to fulfill two conflicting requirements: being sturdy while also easy to crush when disposed of. Pursuing such delicate strength characteristics necessitates quantification and analysis through compression testing.

The advantages of conducting compression testing lie in the quantification and analysis of strength and operability, which leads to stable quality and accelerates the speed of product development verification..

	Quality Control	R & D
Conduct compression test	Quality stabilizes through numerical confirmation and management.	High productivity in verification is achieved because analysis is based on numbers.
Not conduct compression test	Quality is unstable.	It is difficult to create evidence, and the verification productivity is low.

3. What is the Difference Between Strength Testing and Functionality Evaluation?

Strength Testing: Strength testing involves defining the physical properties of a product, such as "This cardboard box has a compressive durability of 300N." It focuses on quantifying how much force a product can withstand and is mainly concerned with determining the strength of the material or product itself.

Functional Evaluation: Functional evaluation, on the other hand, goes beyond just defining strength and involves assessing how well a product meets specific functional criteria or requirements. For example, evaluating whether the cardboard box can withstand a maximum load of 20kg during transport is a functional evaluation. It considers factors like protection, safety, and performance under expected usage conditions.

Strength test primarily defines the extent of strength, while functional evaluation compares the product's performance to predetermined standard.. In the case of protecting the contents of the cardboard box from damage when a load is placed on top, this evaluation aspect differs from strength testing.
Furthermore, how protection is defined can vary, leading to different evaluation criteria. For example, if the assumption is that the maximum is increased to 50kg, the evaluation criteria may need to be adjusted accordingly. Conversely, if no load will be placed on top, the strength criteria can be lowered.

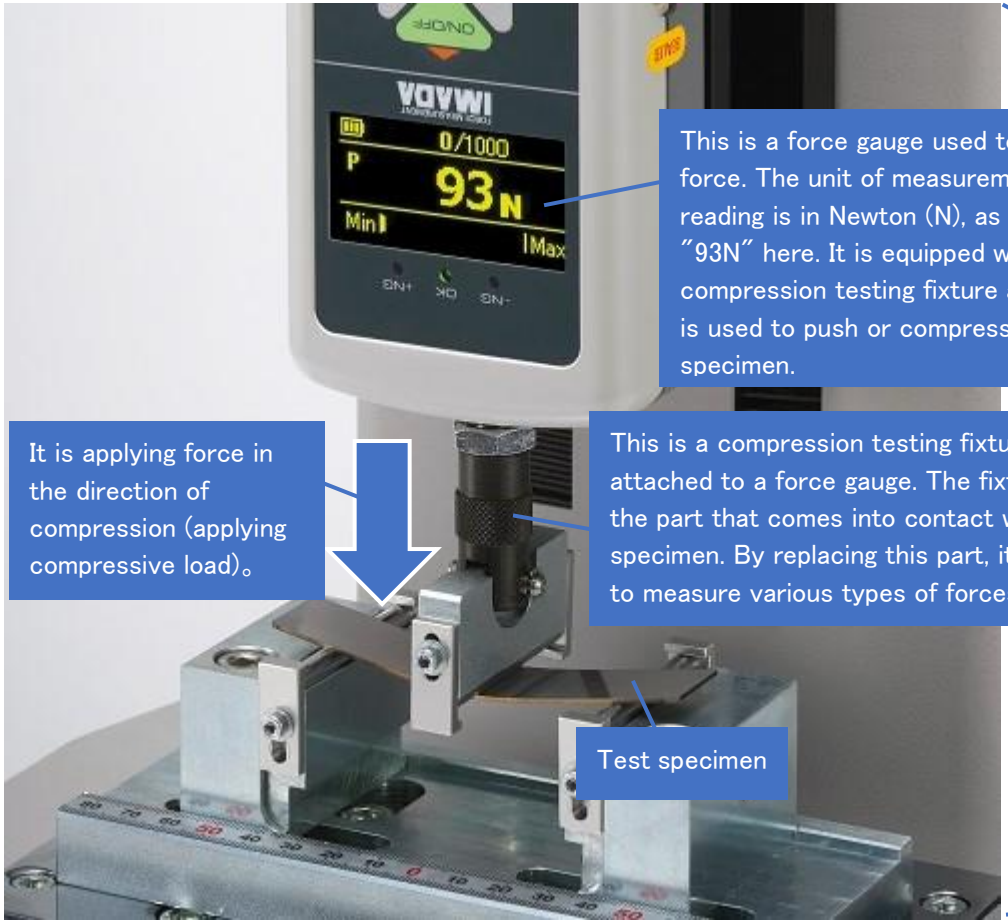
It's worth noting that evaluation criteria can differ among companies and individuals, so there is no uniform value. Standards like ASTM, IEC, JIS, TAPPI, and other various international standards aim to reduce variation in safety, and quality, and other areas.. It's important to consider and adopt them where relevant and applicable to ensure product quality and safety.

4. The Differences between "Compressive force", "Compressive load", and "Compressive stress"

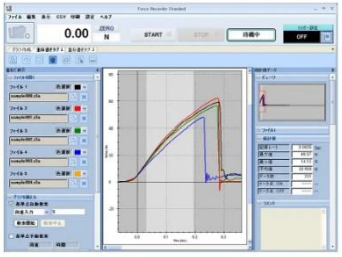
*The term "Compressive stress" is similar to "compressive force (load)," but they are distinct concepts.

	Comoressive Force / Compressive Load	Compressive Stress
Definition	Refers to the actual physical force or push applied to an object or material in the direction of compression.	Is a measure of the internal resistance within a material to deformation under a compressive load. It is calculated by dividing the compressive force by the cross-sectional area of the material being compressed.
Unit	N (Newton), lbf (pounds-force), kgf (kilogram-force) *Only N is SI unit.	Pa (Pascal) or N/m^2 (Newton per square meter) 1Pa = 1N/m^2 (1MPa =1N/mm^2)
Measuring instrument	Force gauges, etc.	Universal testing machine, etc.

5. Overview of Compression Tester and How It Conducts Compression Test
(3 point bend test of metal plate using a force gauge)

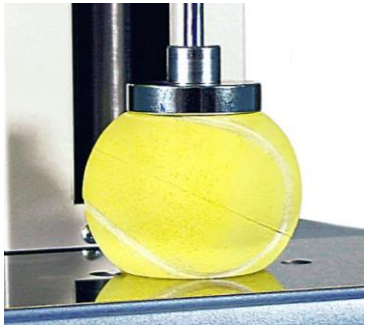


Overall diagram of compression tester:
A force gauge is mounted on a test stand, and the stand is responsible for moving the force gauge in the compression direction (pushing downward).



<- Using software to graph the measurement values allows for evaluation and analysis, especially in the context of functional assessment. Graph analysis is particularly important for assessing functionality.
For example, in the context of evaluating functionality, there's the example of a switch push-in force test. A smoothly operable switch will result in a graph of the force required to push the switch showing a smooth waveform. Conversely, a switch with rough or sticky operation will produce a graph with jagged peaks and valleys. By graphing the values, it becomes possible to discern trends and characteristics that may not be evident when looking at individual force value alone.

6. Types of Compression Force

Bending	durability	Penetration	Shear	Hardness/Repulsion
				

Operability	Door closing force	Pinching
		

In this way, even though we refer to it as compressive load, there are various types, leading to a wide range of compression testing fixtures.

7. Contact for Compression Testing

The optimal shape and type of compression testing fixture varies depending on the test specimen. Feel free to reach out to IMADA for consultation on compression testing, including test methods and fixture selection. As a force measurement specialist, we will offer the best compression testing.
(We specialized in force measurement of strength test or mechanical functionality evaluation, up to 5000N. For measurements of large force or stresses exceeding 5000N, please contact a universal testing machine manufacturer.)

- Contact us: https://www.forcegauge.net/en/contact/consultation (Go to a contact form in IMADA's website)
- Compression test cases (vides): https://www.forcegauge.net/en/solution/force/compression_test (Go to "Compression" in IMADA's website)
- About IMADA: https://www.forcegauge.net/en/company/profile (Go to "About us" in IMADA's website)