Compression Testing Machine Complete Guide

Compression Testing Machine is a type of material testing machine specially configured to evaluate the mechanical properties of materials. This machine is specially configured to assess and evaluate the static compressive strength of products, materials, and parts. Therefore, a compression test machine measures features like ultimate compression strength, deflection, yield strength, tension, torsion, hardness, and modulus.

Furthermore, Material Testing machines are used to test various materials before they are being used for their various building activities. Such materials include metals, plastics, bio-medical, wood, spring, and electrical and electronic components.

Wood testing is a simple and reliable way to assess the strength and deformation properties of wood. Likewise, bend testing is used for testing the strength of wood when resistance to bending is required. Other fixtures are also tested to ensure that they correspond with the required qualities for domestic and industrial buildings.

Compression testing machine is just one of the material testing machines that are used in the construction industry. Other industries that use material testing machines include the plastic and ceramic industry. More so, the manufacturers of these machines offer them according to the need and requirement of the buyers.

What is Compression Testing?
Compression tests are used to determine how a material or substance reacts when it is compressed, crushed, squashed or flattened. Thus, data from the test are gathered through fundamental parameters emerging from the behavior of the specimen under a compressive load. These parameters include the elastic limit which is otherwise known as the yield point or yield strength. More so, Young Modulus is another vital parameter and is given by the tensile strength versus tensile strain.

Types of Compression Testing
There are basically three types of compression testing. These are:

- Flexure/Bend
- Spring Testing
- Top-load/Crush

Benefits of Compression Testing
So, why is compression testing important? Generally, compression testing gives the data regarding in safety and integrity of materials, substances, and products. It helps manufacturers to ensure that their finished goods are up to the required standard and quality. More so, it assists the construction
companies to ensure that the materials they are about to use for construction are of top-quality and poses the exact features needed for a particular construction.

Likewise, the data and information gathered from a compression test can be used in many ways. Some of their uses are:

- Determining the batch quality
- Determining the consistency of productions
- Assessing the features of materials before they are put into use
- Ensuring that the materials to be used suit the construction feature
- Ensuring that materials and products comply with the national and international standard

Materials under Compression

Materials under compression typically obey the Hooke’s law which is given by the contrast between stress and strain. Therefore, this means that these materials show a linear relationship between stress and strain as given below.

\[ E = \frac{\text{Stress} \ (s)}{\text{Strain} \ (e)} \text{ (where } E \text{ is the Young’s Modulus for the compression.)} \]

The value from this analysis represents how much a material will deform under a standard compressive force. Meanwhile, the ability of the material to return to its initial shape after undergoing a series of compression and deformation is called elasticity.

The degree of elasticity varies from material to material. For instance, vulcanized rubbers are known to have a high elasticity value. They have the ability to return back to their original shape and structure after a compressive force has been applied. Also, metals, concrete, and brick have their different electricity limit for compression.

A material can be totally deformed or lose its ability to return to its original shape if a certain stress or force threshold is reached. At this point, the linear relationship stops and the material start to lose its shape. This threshold is called the proportional limit and the point exceeding this limit is called the yield point or yield strength.

The material will exhibit either of these two properties; continue to lose form until it eventually breaks or distort and become flat. At the point of maximum load, the compressive strength value of such material is determined. Hence, all information gathered from this analysis will form the basis of the physical characteristics of the material under test.

Some materials like PET bottle totally distort during a compression test and are represented by the degree of distortion. However, other materials like ceramics exhibit a definite compressive strength value.
Other Applications of Compression Testing
The process and system of compression testing are adopted by several companies and industries. In fact, the technique is widely used to ascertain the quality level of materials, items, products, and components. Furthermore, the typical use and application of compression testing are highlighted below.

- Auto and Aero Industry
- Construction Industry
- Cosmetics Industry
- Electrical and Electronic Industry
- Medical Device Industry
- Packaging Industry
- Paper and Board Industry
- Rubber, Plastics and Elastomers Industry
- Safety, Health, Fitness and Leisure Industry

1. **Auto and Aero Industry**
   Compression testing is applicable to the automotive and aerospace industry for the following functions:
   - Actuation tests on switches, pedals, and solenoids
   - Spring testing

2. **Construction Industry**
   Compression testing is applied in the construction company to:
   - Measure the flexural strength of insulation boards, sheet construction materials, and roofing panels.
   - Test the penetration resistance of pipes, plasterboards, and shotcrete

3. **Cosmetics Industry**
   Compression testing is also used in the cosmetics industry for:
   - Examining the actuation force of sprays and dispensing pumps
   - Checking the strength of lipsticks, balms, and lip and eyeliners
   - Testing the compaction strength of eyeshadows and powder compacts
   - Testing the dispensing force of creams and lotion from their containers
4. **Electrical and Electronic Industry**
The electrical and electronic industry uses compression testing for:
- Testing the actuation force of push buttons and switches
- Testing the compression force of LCD screens and keypads

5. **Medical Device Industry**
Compression testing is used in the medical industry to:
- Test the 3-point bending of needles
- Test the actuation force of metered dose inhalers and pen injectors
- Check the sharpness and penetration force of needles and scalpel blades
- Affirm the actuation of the syringe plunger and assess its travel force.

6. **Packaging Industry**
Compression testing is used in the packaging industry to test the:
- The compressive strength of cardboard packaging
- Actuation force of dispensing pump
- The top-load strength of cardboard and plastic containers, Bevcas, and PET bottles

7. **Paper and Board Industry**
Compression testing is used in the paper and board industry to test the:
- The comprehensive strength of cardboard

8. **Pharmaceuticals Industry**
The applications of compression testing in the pharmaceuticals industry include the following.
- Testing the strength of gel and gel rupture
- Testing the press-out force of blister packs
- Measuring the features of tablets and capsules. Features like breaking, crumbling, hardness, and powdering.

9. **Plastics, Rubber and Elastomers Industry**
Compression testing used in the plastic and rubber industry to test the:
- 3-point bend and flexural features of plastic and rubber
10. Safety, Health, Fitness and Leisure Industry
Compression testing is applied in the safety and leisure industry to test the:

- Performance of golf, cricket, and tennis balls
- The compressive strength of car seat

Selecting a compression testing machine
Before you choose a compression test machine, your first step is to determine your sample size, geometry, and strength characteristics. Consequently, you will be able to shop for the correct compression tester. After this, you need to determine the test data you want. This will help to affirm the perfect controller and test software that suits your test.

A compression tester machine uses a high oil pressure as a power source and exerts a relatively large force. Also, most of these machines are hydraulic and exerts a pressure that is significantly over 200KN. In a construction company, this machine is used to test materials like concrete, cement, bricks, rubber, and metals.

Components of a compression testing machine
There are four components of a compression testing machine. Each of these parts has their distinct functions and features.

- **Main machine**: cross beam, rod, cylinder, frame, and the bottom plate
- **Hydraulic part**: oil tank, hydraulic filter, motor, oil back valve set, oil delivery valve set, etc
- **Controller part**: controller, inner printer, sensor, etc.
- **Computer series** (optional): software, computer, and printer

How to select the right concrete compression testing machine
The work of a concrete compression machine is very clear. It tests the properties of concrete materials for structural strength requirements. Furthermore, these machines are versatile and can adapt to different types of samples. So, construction companies seek compression tests to ensure that the materials they are about to use have the required features and properties.

Technical and technological advancements have enhanced the level of accuracy, efficiency, and repeatability of the machine. As a result, these machines are often equipped with all necessary components to cater for the test. Discussed below is a quick guide on how to select a perfect compression testing machine that suits your purpose.

1) Understand Frame Capacity and Stiffness
The National Ready Made Concrete Association affirmed that the compressive strength of concrete is the most popular performance measure adopted by most engineers in the building and construction of
buildings or other structures. When choosing a concrete compression machine, it is essential to select the one that complies with the ASTM C39, ASTM, and AASHTO standards.

More so, it should adhere to the rigidity recommendations state in the ACI 363 Report on High-Strength Concrete – a recommendation which proposes that the load frame should have a minimum total capacity that is 20% greater than the expected total load of the cylinders. Ultimately, this will ensure a uniform specimen loading, reduces explosive failures, and prolongs the lifespan of the machine.

2) Know Your Sample Types and Strength Requirements
Compression testing machines have a specific maximum capacity they can examine at a time. Of course, this will influence the size of specimens to be tested in it. There are different machine products out there each with their distinct compression testing capacity. Hence, an understanding of your sample type and strength will guide you in choosing the perfect machine for your analysis.

3) Operation and Data Collection
How do you intend to handle the test data and results? Generally, some machines can effectively save up to 600 test results with an option to transfer it to PC or printer. However, if you have only a few cylinders to test, you can take your recordings using pencil and paper.

Moreover, if you intend to use the machine for commercial purposes or perform tests on a regular basis, you may need to leverage additional technology for data collection and storage. Thus, this will help you generate comprehensive reports, maximize the machine, and avoid human error as much as possible.

4) Increase Versatility with Adaptive Products
Once you have determined the major components, features, and capacities of your dream machine, the next thing is to increase its function and versatility through model-specific accessories. Generally, adaptive accessories help to enhance the functionality of the compression testing machine. More so, these accessories increase the machine’s versatility to allow testing of different sample types, form, and shape.

When choosing model-specific accessories for your machine, you should consider what it requires to install them. For instance, some accessories are very heavy and difficult to install unless you use the carrier bracket options.

5) Pick the Compression Testing Machine that Best Meets Your Needs
Generally, there are different machinery types. We have the hydraulic, manual, semi-automated, fully-automated, and computerized compressive testing machine. More so, machines vary in compression test force, usually from 300kn-3000kn but some special could be up to 10,000,000kn. While Some are fitted to test cylinder-sized samples, some are best adapted for flexural beams. Nevertheless, you can place a special order based on your preference and requirements.
Conclusion
Compression testing machine plays a crucial role in evaluating the strength and compression ability of materials and products. In fact, it is widely used for different purposes and in different industries. Generally, manufacturers use a compression tester to evaluate the quality and properties of their finished products. Construction companies, on the other hand, use a compression testing machine to ensure a material has the required properties and features.

About Author.
Zhejiang Luda Machinery Instrument Co., Ltd.

Luda Machinery Instrument is a leading company that specializes in cutting-edge testing machine and laboratory equipment. Infrastructure including roads, railways, airports, telecommunications and other public facilities are a cornerstone to the urban developments across the globe and more structures come up every day. The quality of any structure greatly depends on the efficiency of the testing equipment and laboratory instruments used during the construction process. At Luda we are dedicated to attending to the ever-changing demands of our clients in high-end testing machines and laboratory equipment. Our number one goal is to ensure that our clients get the best available testing.

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