HYDRAULIC SPRING STIFFNESS TESTING MACHINE

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ABSTRACT

In many engineering machines and mechanisms spring is an essential component used for proper functioning of that machine for maximum efficiency, there are many applications of springs in automobile suspension system, measurements of weights, for storing energy such as in spring type accumulator, in shock absorber, in hydraulic components such as hydraulic cylinders, pressure relief valves, flow control valves etc. But according to our market survey and observations sometimes spring used in above applications having a many defects such as manufacturing defects, processing defects like defects occurs at the time of hardening sometimes this causes the more hardened spring which has more stiffness value and sometimes causes a less stiffness value of

spring, hence this creates a problem on the applications of the springs for proper uses and creates a problem in working of that machine components. By considering this problem, we can easily measure spring stiffness by using this machine in low cost. In Industries they purchase the springs for their hydraulic valves but they are facing the problem of checking the spring stiffness. After understanding the Industries problems for spring testing we designed and developed hydraulic spring stiffness testing machine. The main objective of this project is to determine the stiffness which is commonly known as spring constant of a compression spring under various load. The kit which has been built into a machine to stretch or compress test springs, while measuring load and displacement is called spring testing kit. It tests springs and finds their properties good for mechanical workshops use.

Introduction

A spring is an elastic mechanical element that deforms under the influence of a load and returns to its original shape when the load is removed. Rigidity and spring index are the main parameters of spring design. Spring stiffness is the force per unit deflection. The stiffness of the spring means the load required to deflect the unit. Also called the spring index, it is an important parameter for specifying a spring. Spring designs and manufactures include compression coil springs, extension coil springs, and leaf springs of various sizes and shapes. But without such a machine, it is very difficult to check the stiffness. A hydraulic spring rigidity tester can be used at low cost, and the number of parts is small, making it easy to understand. Digital spring stiffness testers are more expensive than hydraulic spring stiffness testers. The hydraulic spring stiffness tester allows you to perform cost-effective spring stiffness tests in automobile repair shops and small industries. A spring is an elastic mechanical element that bends when loaded and returns to its original shape when released. Before using a spring for various purposes, it is necessary to measure the stiffness of the spring. The machines available to measure stiffness are more expensive and time consuming. Therefore, they are not suitable for small industries. Therefore, there is a need to develop a measuring instrument that can measure spring rigidity at low cost. For automotive springs, the main performance characteristic is stiffness under load or "spring".

Objectives:

1) Main objectives of this machine is to check the stiffness of spring with higher accuracy and precision.
2) To understand the basic principle of our project.
3) Designing and constructing a spring stiffness test rig that is capable of testing a various type of springs of different height, diameters and of materials.
4) Describe the construction and working of various parts of our project.

5) To reduce the time required for testing and increase the profit of small scale industries and also to reduce inventory and investment cost.

Methodology:

1) Research
2) Selection of components
3) Preparation of 3-D model
4) Fabrication and Attachments
5) Assembly
6) Final product
7) Testing and results

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Design & Working of Project:

1) Hydraulic cylinder:

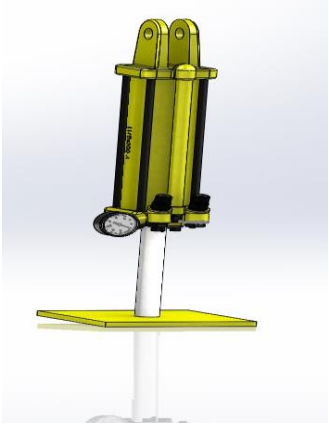


Fig. Hydraulic cylinder

As shown in fig. single acting cylinder pressure capacity 10 kg/cm² and force applied about 100 kg used to combine the action of deflection and load measured to give output. The Bourdon tube is a metal tube of elliptical shape. The inside of the tube is exposed to the pressure to be measured. The Bourdon tube is held fixed at one end connected to the pressure source. A pointer is mounted on the shaft. The needle moves over a circular scale that indicates the pressure. The position of the needle is determined by a pressure act on it.

2) Hydraulic Jack:

Fig. Hydraulic Jack

Figure shows Hydraulic jack, Hydraulic jack used in this setup is single acting type of cylinder and it has a capacity to exert 5 tons of force i.e. 5000kg. Force, at the time of loading of spring load is applied with the help of the hydraulic jack. Hydraulic jack used in this setup is lever operated which required only 200N of force for lever operation. Maximum stroke length of hydraulic cylinder is 150mm.

3) Helical Spring:

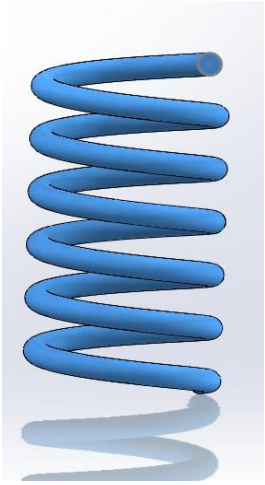


Fig. Hydraulic Jack

A coil spring is a spiral mechanical device that is wound to close and open. Coil springs store mechanical potential energy. They can be made of elastic materials or metals such as hardened steel. Coil springs are found in many common items such as farm tools, toys and trampolines. Coil springs can serve three basic purposes. It stores and releases energy, absorbs shocks and maintains contact between the two surfaces.

4) Pressure Gauge:

Fig.Pressure Gauge

The operating principle of the pressure gauge is based on Hooke's law, "The force required to expand or compress the spring scale changes linearly with respect to the space of expansion or compression, and there are internal and external pressures." When applied, the elliptical tube (Bourdon tube) attempts to form a circular cross section. This creates stress and straightens the tube. Therefore, depending on the amount of pressure, the free end of the tube flaps upwards. The deflection and display mechanism is mounted on the free end and rotates the pointer to display the pressure reading. The materials used are typically phosphor bronze, brass and beryllium copper. If a typical C-tube has a diameter of 2 inches, the available free end stroke is approximately 1/8 inch. C-type tubes are the most common, but other shaped tubes such as spiral tubes, twisted tubes, and spiral tubes are also used.

5) Supporting Frame:

Fig. Supporting Frame

Frame rigid structure that supports a structure put all equipment like Hydraulic Jack, Spring, Hydraulic Cylinder, Pressure Guage etc.

Main Assembly:

Fig. Main Assembly

Working of the Project:

It works on the principle of Pascal's law of pressure transfer in confined liquids. It describes pressure changes that occur somewhere in a confined incompressible fluid, such as Ashfaq. World Journal of Engineering Research and Technology www.wjert.org 3 Through liquids, ensure that the same changes occur everywhere. That is, the pressure exerted on the sealed liquid at any point is equally transmitted to all other points. This principle is the same as for hydraulic presses. Working method We designed the testing machine based on the above principle. It consists of a hydraulic jack or similar device, a frame with a sliding mechanism, an assembly table for mounting springs to test, and a display unit that provides the desired output results. When pressure is applied through a hydraulic jack or compressor (depending on the compressive strength of the spring being tested), the spring attached to the test table is compressed. The spring opposes the pressure of the fluid and its stiffness is obtained by calculating or recording this resistance of the spring.

Pressure measurement The most important part of this device is the component that measures the stiffness or force of the spring. There are two options for this. One is a load cell and the other is a pressure gauge.

Formula for calculating

spring stiffness k = force / deflection N/mm.

Results:

- Procedure For Calculation of Stiffness By Using Hydraulic Spring Stiffness Testing Machine.
- For spring length = 227 mm wire dia. 7 mm.

Deflection = 54mm

Force = pressure * area

= 0.1019*153.86

= 15.678 N

K = Force/Deflection

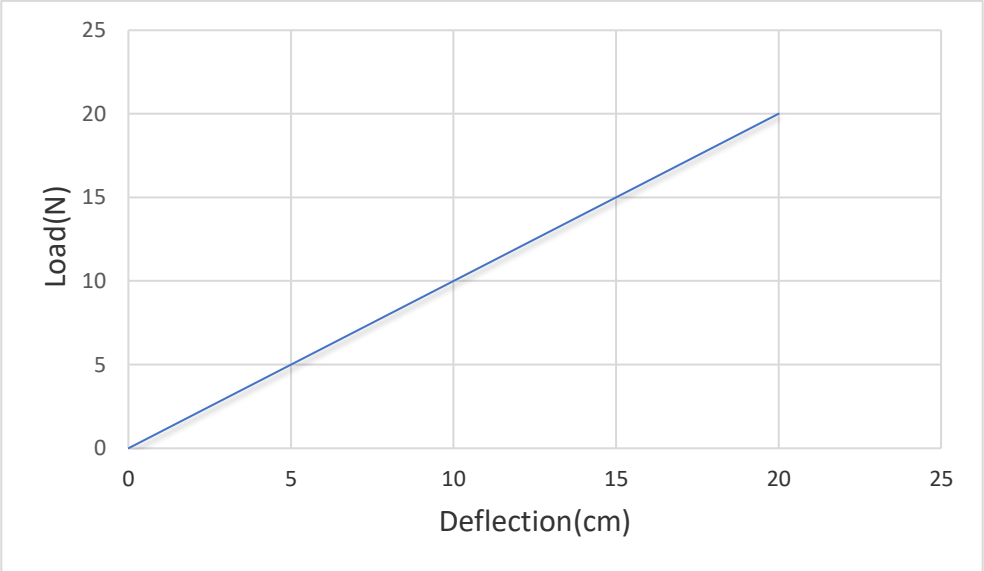
= 15.678/54

= 0.290 N/mm.

Following values are calculated by above procedure:

Sr no.	Deflection mm	Pressure kg/mm²	Force N	Area mm²	Stiffness N/mm
1	54	0.1019	15.678	153.86	0.290
2	65	0.2039	31.372	153.86	0.482
3	95	0.3059	47.065	153.86	0.495
4	124	0.4078	62.744	153.86	0.506

- Graph is plotted on the basis of spring stiffness value.
- On graph x-axis is deflection and y-axis is force.



Graph Of Load & Deflection

Advantages:

1) Spring of different diameters can be checked.
2) Spring can be check without damaging the spring.
3) The testing is carried out in very less time, so production rate is very high.
4) One man effort is enough to check the spring.
5) Semi-skilled and unskilled labour can operate this machine easily.
6) The system is self-lubricating.

Disadvantages:

1) Spring wire diameter cannot be checked below 40mm and above 70mm.
2) As system is hydraulic, leakage may occur and hence refilling of coil is necessary.

3) Proper reading of load and displacement is necessary.

Application of Project:

1) The spring stiffness testing machine is used for measuring stiffness of different spring.
2) Spring testing machine used in spring manufacturing industries in quality control department.
3) It is used in educational institute to compare the theoretical design and practical spring stiffness.
4) Spring testing machine is used in garages also for checking suspension of various automobile.

Conclusion:

As compare to digital stiffness testing machine hydraulic spring stiffness testing machine is cheap. Hence this machine we can use in garages and small industries, also we can use in collages for practical purpose. Hydraulic spring stiffness testing machine is easily manufacture in workshop.

The spring stiffness testing machine is designed and developed by using hydraulic principle. It consists mainly large cylinder, small cylinder, deflection scale and bourdon tube gauge. On the spring stiffness testing machine, we can test spring having diameter range of 40 mm to 70 mm. The results have been verified with the calibrated digital stiffness testing machine. This machine reduces the checking time and cost when compared with conventional machine.

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