

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, IC engine valves, two wheeler horns, brakes, clutches, 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 the 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 problems on the applications of the springs for proper uses and creates a problems in working of that machine components.(1)By considering this problem we can easily measure spring stiffness by using this machine in low cost compare to digital machine.

Keywords- Hydraulic cylinder, Pascal's law, Hydraulic jack, Load and Deflection, Compression.

1. INTRODUCTION

A spring is defined as an elastic machine element, which deflect under the action off the load and returns to its original shape when the load is removed. Stiffness and spring index are the main parameters of spring design. Spring stiffness is the force per unit deflection.(2) Stiffness of the spring means load required for unit deflection, It is also known as spring index and is main parameter for specification of springs. Springs like Compression helical spring, Tension helical spring, Leaf spring of various sizes and shapes are designed and manufactured. But to check their stiffness is very difficult unless we have such machine. In low cost we can use hydraulic operated spring stiffness testing machine, this machine contains less parts and easily understandable. Digital spring stiffness testing machine have high cost as compared to hydraulic spring stiffness testing machine, so by using hydraulic spring stiffness testing machine we can check spring stiffness at low cost in motor garage, small industries etc.

2. HYDRAULIC SPRING STIFFNESS TESTING MACHINE

2.1 Problem Definition

- In automobile garages we want to change spring of suspension system for this purpose we have to check stiffness of spring.
- For checking stiffness of spring we require such machine with low cost.
- Digital spring stiffness testing machine have high cost as compared to hydraulic spring stiffness testing machine.

2.2 Problem Formulation

- Understanding problems, we can use hydraulic spring stiffness testing machine for spring having different diameter and length.
- Hydraulic spring stiffness testing machine is used in garages in low cost instead of digital machine.

2.3 Methodology

- Dissertation research papers are discussed dealing with the spring stiffness testing machine which includes the application of hydraulic spring stiffness testing machine.
- Discussion on hydraulic spring stiffness testing machine results will be done here to get the conclusions.

2.4 Objectives

1. Main objectives of this machine are to checking the stiffness of spring with higher accuracy and precision.
2. Designing and constructing a spring stiffness test rig that is capable of testing a various types of springs of different height, diameters and of materials.
3. To reduce the time required for testing and increase the profit of small scale industries and also to reduce inventory and investment cost.
4. Low initial cost of machine and easily operated.

3. WORKING OF HYDRAULIC SPRING STIFFNESS TESTING MACHINE



Fig.1 Hydraulic spring stiffness testing machine

- First of all close the pressure relief valve.
- Then adjust the spring in between hydraulic jack and hydraulic cylinder.
- By using handle operates the hydraulic jack. The machine contains hydraulic piston and cylinder arrangement to press spring under testing. By manual pumping hydraulic piston move forward and compress spring.
- Due to compression in spring, force is applied on hydraulic cylinder and deflection occurred in spring.
- This pressure is displayed on pressure gauge in kg/cm square.
- Take pressure gauge reading and measure spring change in length.
- By measuring spring deflection and pressure we calculate stiffness.
- Formula for calculating spring stiffness
$$k = \text{force} / \text{deflection N/mm.}$$

3.1 The main component of this machine

1. Hydraulic cylinder



Fig.2 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.3 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.

4. RESULTS

- Procedure For Calculation Of Stiffness By Using Hydraulic Spring Stiffness Testing Machine
- For spring length = 250 mm wire dia. 8 mm

1] For pressure 0.2 kg/cm² = 0.2*0.0981= 0.01962 N/mm²

Deflection = 10mm
 Force = pressure * area
 = 0.01962*1256
 = 24.6427 N
 K = Force/Deflection
 = 24.6427/10
 = 2.464 N/mm.

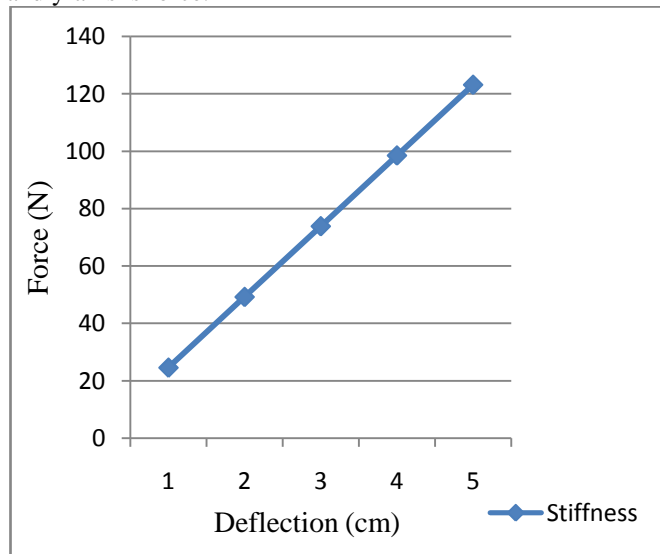
Following values are calculated by above procedure.

Sr. No	Deflection Mm	Pressure kg/cm ²	Force N	Area mm ²	Stiffness N/mm	Avg. stiffness N/mm
1	10	0.2	24.64	1256	2.464	2.464
2	20	0.4	49.28	1256	2.464	
3	30	0.6	73.92	1256	2.464	
4	40	0.8	98.57	1256	2.464	
5	50	1.0	123.2	1256	2.464	

Table.1 Results of spring stiffness

- Graph is plotted on the basis of spring stiffness value.

- On graph x-axis is deflection and y-axis is force.



Graph. Spring stiffness at various force.

5. COST COMPARISON

- From market survey maximum Cost of hydraulic spring stiffness testing machine is up to Rs 5000 and the cost of digital spring stiffness testing machine is more than Rs 10000.
- Hydraulic spring stiffness testing machine we can manufacture in low cost.
- Component of hydraulic spring stiffness testing machine are cheap and easily available in market.

6. ADVANTAGES

- Spring of different diameters can be checked.
- Spring can be check without damaging the spring.
- The testing is carried out in very less time, so production rate is very high.
- One man effort is enough to check the spring.
- Semi-skilled and unskilled labor can operate this machine easily.
- The system is self-lubricating.
- The system is noiseless.
- It is portable and could be carried anywhere.

7. DISADVANTAGES

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

8. 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.

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