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"DESIGN AND FABRICATION OF HYDRAULIC SPRING STIFFNESS TESTING MACHINE"

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ABSTRACT

Springs are durable items and are easily inspected. If the ride height of a vehicle has decreased excessively or a coil/leaf has broken it is advisable to replace the springs in axle sets. Consumers also often change springs to alter their vehicle's ride and handling characteristics. Spring problems are generally easy to identify.Springs isolate the driver from road imperfections by allowing the tyre to move over a bump without drastically disturbingthe chassis. If the chassis remains fairly steady then the tyres are better able to follow road contours automatically. While springs do an excellent job of smoothing over bumps, they will keep bouncing once started. In other words, the chassis continues swaying and the tyres keep hopping long after the vehicle strikes a bump. Left uncontrolled, springs give an uncomfortable ride with very poor tyre to road contact. To control this undesirable behavior, a shock absorber keeps the spring from over reacting to everybump or dips and not, only prevents but also balances excess movement of the tyre and chassis.

INTRODUCTION

The most common method for checking the performance of shock absorbers is for the owner as well as mechanic to jump up and down on the car bumper also observe whether or not the car motion appears to be adequately damped. When shocks are completely worn out then it is clear that the damping is inadequate, however by the time the wear is readily observable, the car owner has been driving for extended period of time with bad shocks. By then the owner has learned to hate his vehicle, the tyres are normally worn, and the road ability has deteriorated to the point that he or she has driving dangerously all over the road. Main reason for replacement of shock absorber(spring) is physical damage. Spring stiffness must be checked before replacement. This testing will give the force applied on spring. With the help of force as well as deflection produced, we can calculate stiffness and deflection of spring. By varying the force, we can obtain corresponding deflections.

HYDRAULIC SPRING STIFFNESS TESTING MACHINE

Problem Definition

Many companies manufacture valves and they required the springs for installing in their products (hydraulic valves). Depending upon the valve size there is variations in sizes and shapes of springs, hence company are facing problem of checking stiffness of spring. Understanding the Industry problems, we have designed and developed a hydraulic spring stiffness testing machine.

Objectives of Study

The objectives are as follows:-

- To reduce testing cost.
- To reduce investment cost on machine.
- To increase profit of company.
- To save time.

METHODOLOGY

1. Design of ram/piston rod end threads.
2. Design of adjustable table screw.

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3. Design of hydraulic cylinder.
4. Design of table.
5. Selection of Material.
6. Design of main frame.

Deign of lever

By law of moments,

$F \times l = f \times L$

$F = f \times L/l$

where, f = force or effort applied and F = force obtained by leverage.

Now normally a person can apply a 20kg force. So we take f = 20kgf

Now L =46cm. And l = 4cm. Considered.

$\therefore$ F = 20 X 46/4 = 230kgf.

Force applied by leverage =230kgf.

design of bigger hydraulic cylinder

From hydraulic press formula,

$W = A/a \times F$

$W = (\pi/4\ D^2 \times F) / (\pi/4\ d^2)$

$\therefore\ W = D^2/d^2 \times F$

Now d = diameter of smaller cylinder = 1.5cm.

We have W= 1500kg & F = 230kg.

$\therefore\ 1500 = D^2/15^2 \times 230$

D = 3.8cm

D actual $\approx$ 4 cm

Therefore diameter of bigger cylinder = 40 mm.

Now for thickness of cylinder wall of bigger cylinder,

We have, $t = pd/2f_t$ (by Hoop's Stress)

where p = internal pressure, & d = diameter of cylinder,

f_t = permissible stress.

We have $p = F/A = 230 / [\pi/4 \text{ X } d^2] = 230 / (\pi/4 \times [4]2)$

$\therefore$ Internal Pressure (p) = 18.32 kg/cm ^{2}

Now ultimate stress for cylinder material = 800 kg/cm^2

Now ultimate stress for cylinder material = 800 kg/cm^2

Considering factor of safety as 5.

We get permissible stress = ultimate stress/factor of safety

$\therefore$ ft =800/5

ft = 160 kg/cm^2

Putting these values in the thickness formula,

We get, t = 18.32 x 9.8/2 x 160

= 0.753 cm.

t $\approx$ 0.8cm. = 8 mm.

Outer dia of cylinder = 40 + (2 x 8) = 56 mm

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Since the design stress is much more less than the allowable tensile stress.

Hence the design is safe.

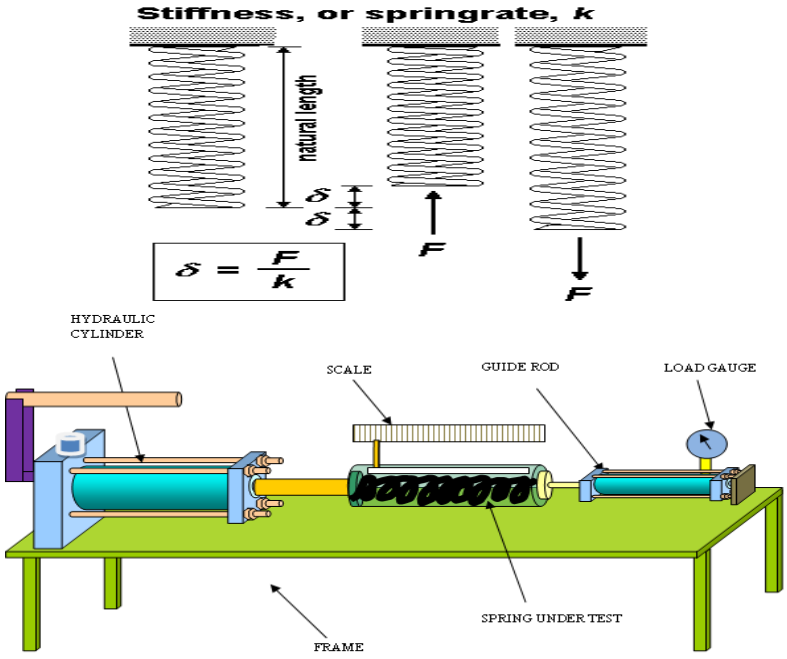

Fig1. Conceptual view of hydraulic spring stiffness testing machine

Result

SR. NO.	LOAD (N)	DEFLECTION (mm)	SPRING STIFFNESS (N/mm)	AVG. STIFFNESS
1.	60	60	1	
2.	60	60	1	1
3.	60	59	1.016	

ADVANTAGES

1. Spring of different diameters can be checked without damaging it.
2. The testing process is carried out in very less time, so production rate is very high.
3. One man effort is enough and no skill is required.
4. The system is self lubricating, noiseless and portable

DISADVANTAGES

1. Spring wire dia. cannot be checked below 40mm and above 60mm. (If we check the diameter of spring below 40mm there arechances for spring to buckle)
2. As system is hydraulic, leakage may occur and hence refilling of oil is necessary

APPLICATIONS

1. The machine is used for measuring spring stiffness for different spiral and helical springs in the range of 40mm to 60mm.
2. Can be used in garages where frequent inspection of the suspensions of various automobiles is carried out.
3. With the help of this machine it is possible to analyze when to replace the suspension by comparing the stiffness of the testingsuspension with that of the standard stiffness

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CONCLUSION

The spring stiffness testing machine is designed and developed by using hydraulic principle. It consist 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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