

## Fabrication of Spring Compressors for Automotive Workshops

(Fabrikasi Pemampat Spring untuk Bengkel Automotif)

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### Abstract

Nowadays, conventional methods are often used in compressing the coil spring in the car absorbers for the removal process and the Macpherson strut spring compressor set is the most popular choice. However, this method is very time-consuming with the installation, compression, and removal processes. Therefore, air gun tools with compressor systems have been the option to substitute or replace the method to accelerate the process. The only drawback of this method is it is relatively expensive for small and medium automotive workshops. Therefore, this project aims to design and fabricate an upgraded version of the old spring compressor set to facilitate mechanical work. This tool is portable, easy to use and cheap to purchase. This tool consists of a cylindrical frame with the top section, a compression head secured to and axially adjustable relative to the frame, and the bottom section to support one opposite section of the strut assembly. Then, the bottom section is applied with force from the hydraulic jack to compress the coil spring and enable strut removal from the top section. Finally, the dismantling process can be easily performed. A simple market survey and the questionnaire form have been distributed to ten workshop mechanics in Kuching, Sarawak. The feedback gained was very encouraging and positive. Post-testing also showed that this spring compressor tool could remove the coil spring in a shorter time, which was 2 to 3 minutes, compared to the old spring compressor method, which required 4 to 5 minutes in the pre-testing process. Lastly, this machine is cheap at a cost of RM295.50. Therefore, this tool shows great potential to replace the current conventional methods in automotive workshops.

Keywords: Spring, compressor, automotive, absorber

## INTRODUCTION

A coil spring is also known as an elastic object which stores mechanical energy, and they are usually made of a certain material which commonly is steel. There are a lot of spring designs in the market. Of most vehicles nowadays contains suspension. In a vehicle, shock absorbers reduce the effect in the cabin whenever the vehicle is travelling over rough ground, leading to improved ride quality and vehicle handling. Shock absorbers do not just limit excessive suspension movement but also damp spring oscillations (Coiling Technologies, 2022). Some vehicles use components known as struts, which combine a shock absorber and spring into an integral component of the suspension system. The spring is very strong and under significant tension (Ahead, 2020). Hence, if a mechanic tries to remove the surface nuts that hold it in place, the spring will immediately recoil and can badly injure the person conducting the process. Therefore, a spring compressor is typically required to safely accomplish this task and to facilitate the reassembly of the strut.

In the automotive industry, having a spring compressor is a must in workshops, especially for those who work in the suspension field. The spring compressor is utilized for compressing a coil spring during the assembly of subassemblies of automotive suspension systems and has a head plate positioned above a base and is movable concerning the base (Matsuura, 1985). The type of spring compressor that should be used depends upon which type of front suspension the car has. Generally, there are three types of spring compressors in the market, namely external, internal and stand strut spring compressors. The internal strut spring compressor is conventional and used on vehicles with separate struts and shock absorbers. They work by utilizing two hooks on a steel threaded bolt. The assembly is fit through the inside of a coil spring and the hooks latch onto the coil. When you tighten the threaded bolt, the hooks squeeze the coils together, temporarily shortening the spring height (Brookline Media, 2022).

The Macpherson strut spring compressors or the external strut spring compressors as shown in Figure 1 work similarly to an internal compressor, but they come in pairs and are fitted to the outside of the coil spring. There are two sets of threaded rods, each with two hooks and pin detents to latch onto the spring coil. Users must work slowly and tighten each side a little at a time, but it helps to compress safely a spring's height (Brookline Media, 2022). Lastly, the stand strut spring compressors are most often seen in repair shops, and they work with threaded handles on large bolts to compress springs for suspension work. These compressors only work on struts and springs that are not installed in a car (SERP, n.d.).



Figure 1. MacPherson Strut Spring Compressor (Brookline Media, 2022)

Eventually, there are modern and high-tech coil spring compressors available in the market too. Typically, they can be classified into pneumatic and hydraulic-operated spring compressors. These coil compressors are meant for massive loads with compression force up to 1600kg that provides sufficient power to cover the most known standard production cars/vans. It requires a filtered air supply between 6-10 bar (90-150psi) and costs approximately RM24900 (The Tool Connection Limited, n.d.). In exchange for its functionality, this pneumatic spring compressor weighs around 65kg and is not that convenient for mobility. Then, the hydraulic coil spring compressor features the ram bracket slides providing multiple height adjustments that have a max capacity of up to 2000kg. It can cost up to RM588.00 (Techno Tools & Equipment Sdn Bhd, 2022). The downside of this hydraulic spring compressor is that it is very complicated as high maintenance is required to prevent any oil leakage.

As in Kuching, most of the mechanics are still using the conventional methods which are the conventional spring compressor or the Macpherson spring compressor. This could be due to budget constraints or complications arising from the sophisticated setup of modern compressors. By considering the abovementioned problems, this project is an effort to fabricate a portable and easy-to-operate spring compressor. The objectives of this project are to decrease the time taken to remove the absorber by 10% and reduce the cost of the tool by 10% when compared to compressors available in the market.

### METHODOLOGY

The development of this compressor is based on the flow chart in Figure 2.

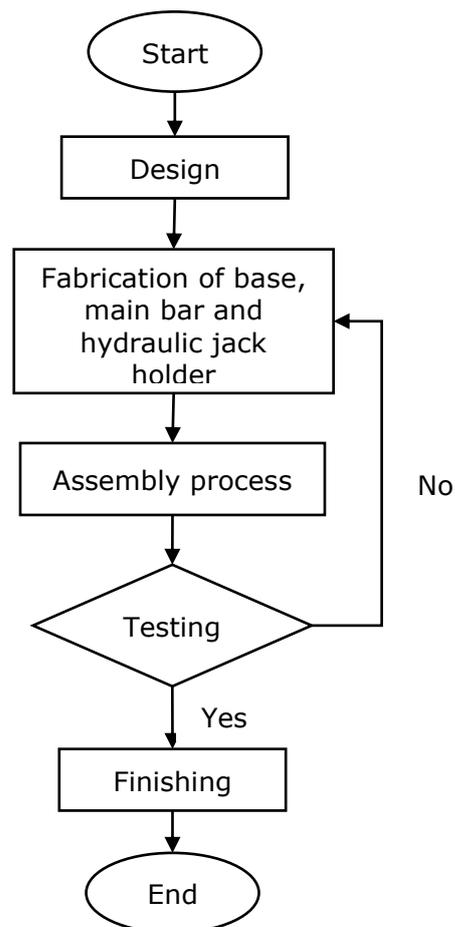


Figure 2. Flow chart of Spring Compressor tool

The first process is the design process using Autodesk Inventor. Figure 3 shows the final design of the project. During this process, various sketches have been developed based on the literature review conducted and the final design was selected based on the morphology chart with criteria such as mobility, effectiveness, cost and technical aspect is taken into consideration.

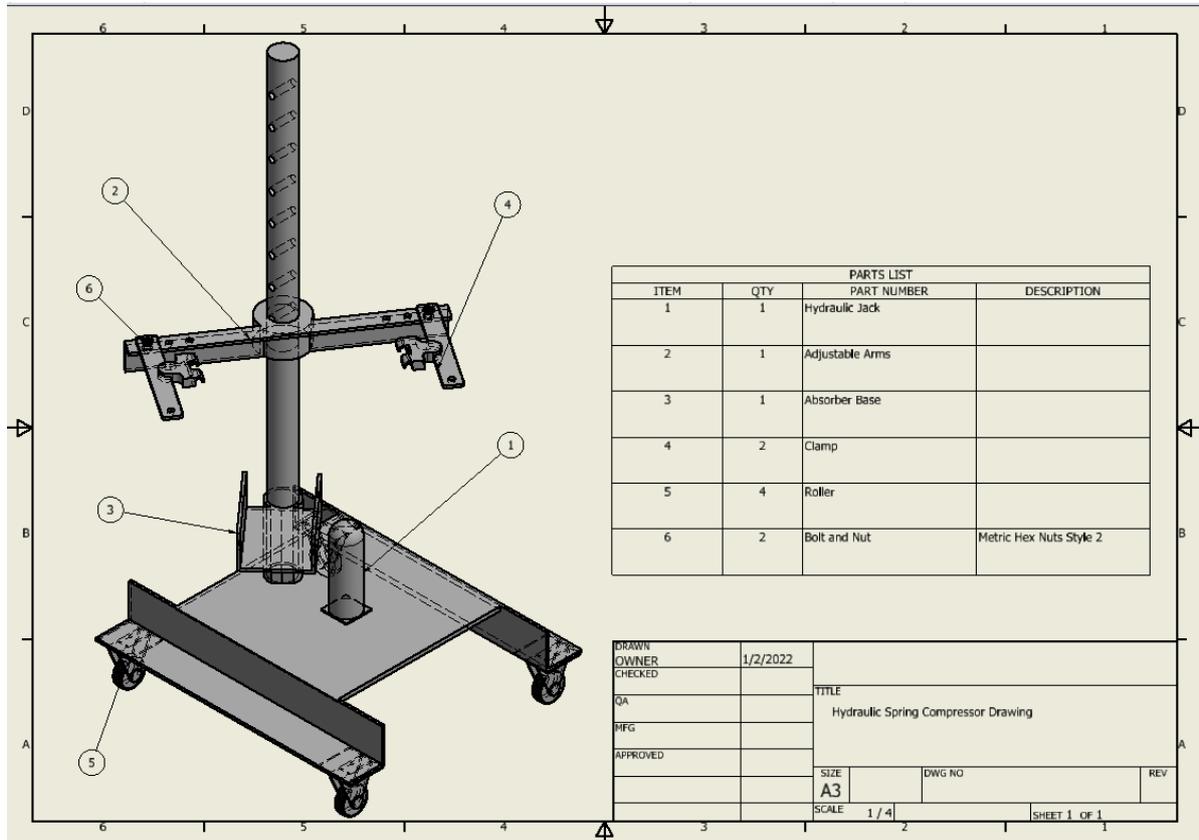


Figure 3. Design using Autodesk Inventor

Next, the fabrication process took place with a rectangular base (20cm x 13cm) of the solid steel plate and cylinder steel solid with a diameter of 45mm as the main bar was attached with arc welding. The fabrication and weldment of this main body were crucial as it is the core to sustain all the compression forces during the absorber removal process later. Subsequently, holes were made using a hand drill on the main bar to create an adjustable height feature for the absorber base that is supported by the hydraulic jack (Figure 4).



Figure 4. Measuring and drilling process for absorber base

Then, a hollow cylinder and steel plate were cut and welded to form the absorber base as shown in Figure 5. A U-shaped steel plate was welded to the absorber base to provide a more stable and wider platform to secure the coil spring (Figure 6). Holes were also created for the insertion of the pin through the main bar as its height is adjustable accordingly to the spring coil. The hydraulic jack was then attached to the rectangular base. The vertical movement of the absorber base is controlled by the piston of the hydraulic jack to enable the coil spring compression process.



Figure 5. Absorber base

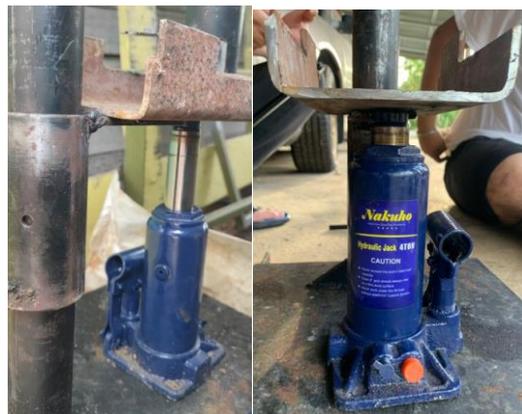


Figure 6. The platform between the hydraulic jack and the coil spring

As for the top section, the arms using flat iron were fabricated and hooks were installed to secure the coil spring from the top too. These flat irons were welded together to a ring that is inserted into the main bar (Figure7). Several holes were drilled in the main bar on the top section also to adjust the spring compression to the desired height.



Figure 7. Hook arms on the top section

Finally, the finishing process with polishing and spraying was executed (Figure 8) before the post-testing was conducted to evaluate the effectiveness of the compressor.



Figure 8. Finishing process

### RESULTS

The completed coil spring compressor is shown in figure 9.



(a)



(b)

Figure 9. Completed coil spring compressor; (a) isometric view, (b) side view

The operation of the current compressor is easy and simple. First, place the bottom part of the absorber on the U-shape steel plate of the compressor (Figure7). To avoid an injury or incident, the centre placement of the absorber is necessary. The top strut mount is facing upward to ease the dismantling of the top mount.



Figure 7. Insert the absorber

Then, secure the absorber using the hook arms by adjusting the hinge to avoid relaxation during the compressing process as shown in Figure 8.



Figure 8. Securing the absorber

The following step is to jack up the piston of the hydraulic jack to compress the coil spring (Figure9). While the coil spring remains in compression mode, a wrench is used to remove the nut in the top strut mount.



Figure 9. Press the hydraulic jack

After that, hold the absorber and release the hydraulic jack. Finally, release the coil spring from the hook arms and the spring removal process from the absorber is completed as shown in Figure 10.



Figure 10. Removal process completed

For the effective performance of the current compressor, a comparison with the conventional internal strut spring compressors was performed. The same unit of the absorber was used, and post-testing showed that this spring compressor tool was able to remove the coil spring in a shorter time which was 2 to 3 minutes compared to 4 to 5 minutes in the pre-testing process. The results reflect clearly that we have successfully achieved our objective for this project.

In the post-test also, a market survey has been done and the questionnaire forms have been distributed to ten different mechanics in workshops around Kuching, Sarawak. The distribution of the questionnaire was done via google form due to the pandemic situation. The result is shown in Figure 11. Overall interpretation of the survey finding shows that the users were satisfied with the fabricated coil spring compressor, particularly due to its durability and suitability for home or small workshop usage. As for the suggestion for future improvement, the safety and storage factors can be considered.

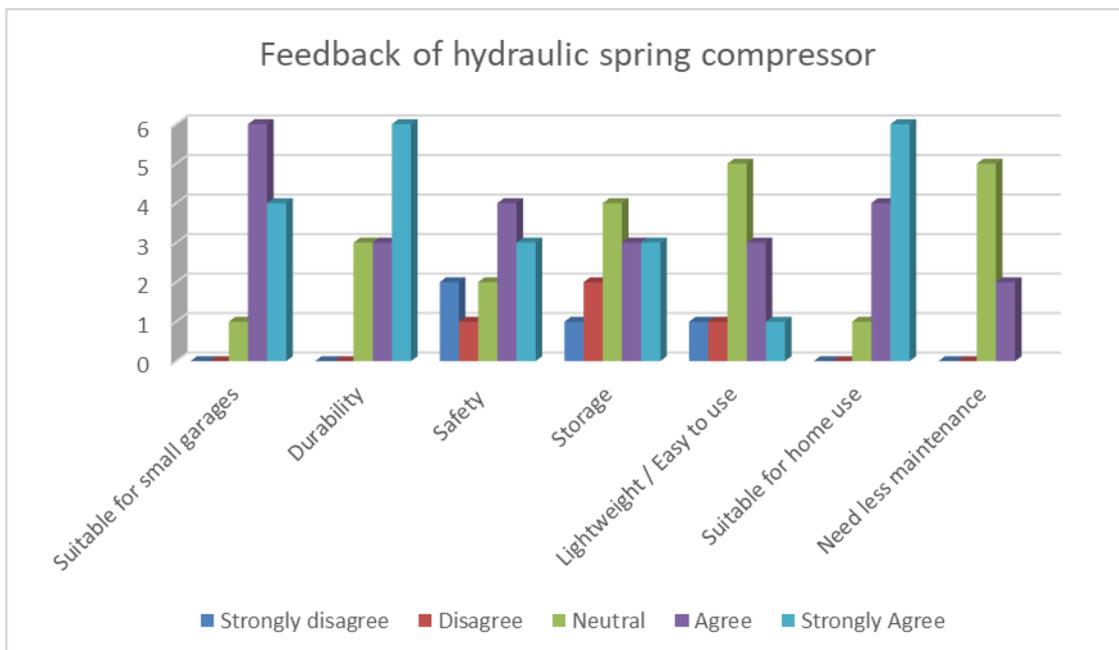


Figure 11. Survey result

Lastly, the second objective is to produce a cheaper version of the coil spring compressor and the total cost of this machine is estimated at RM 295.50 (Table 1). The recommended selling price for this machine is RM 400.00 which is very affordable, and the cost of buying is easily turnover with one small construction project only.

Table 1. Total cost

| No.          | Item                        | Quantity | Price per unit (RM) | Amount (RM)     |
|--------------|-----------------------------|----------|---------------------|-----------------|
| 1            | Steel 30mmx30mm             | 1        | 40.00               | 40.00           |
| 2            | Steel Plate 3mm thickness   | 3        | 30.00               | 90.00           |
| 3            | Steel Cylinder 1000mmX450mm | 1        | 25.00               | 25.00           |
| 4            | Bolt and Nuts               | 18       | 1.50                | 22.50           |
| 5            | Stainless Steel             | 1        | 40.00               | 40.00           |
| 6            | Hydraulic jack              | 1        | 78.00               | 78.00           |
| <b>Total</b> |                             |          |                     | <b>RM295.50</b> |

## CONCLUSION

The objective of this project is successfully achieved as the coil spring compressor is produced. Then, post-testing also was conducted to ensure it is functioning well. The results produced positive outcomes with a shorter time of 40% to remove the coil spring from the absorber when compared to a traditional internal spring compressor. The last objective is to produce a cheaper version of the spring compressor the fabricated spring compressor only cost around RM295.50 and is relatively cheaper compared to modern machines available in the market. Thus, this will bring benefits which will lead to an increase in productivity and enhance the economy of the country in long-term prospects. As for the suggestion or recommendations to improve the current design, the market survey results show that the safety aspect can be consolidated and storage in terms of the dimension of the product can be reduced.

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