

PERFORMANCE EVALUATION OF THE VACUUM-TYPE BRAKE FLUID BLEEDER AND RECOVERY MACHINE

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ABSTRACT: In this paper, performance evaluation of the developed vacuum-type brake fluid bleeder and recovery machine has been conducted in terms of brake fluid bleeding, brake fluid recovery & quality of fluid in the system by light indicator (water contamination). These parameters are tested in various types of vehicles; namely: Mitsubishi Adventure, Honda City, Toyota Rush, Toyota Revo & Multi-Cab. The evaluation showed promising results par better than any machine available in the market today. Further, results of the performance evaluation of the machine on five (5) different types of vehicles in terms of bleeding and fluid recovery is much better compared to the traditional way of doing the process in terms of time and as well as the fluid is water-free.

Keywords: brake fluid bleeder, recovery machine, vacuum-type, brake fluids, performance evaluation

1. INTRODUCTION

One of the challenges of small-scale automotive service providers and training institutions and schools is the unavailability of appropriate equipment for automotive hydraulic brake maintenance and servicing. Conventionally, car technicians use the manual manner of pulling-out air inside the system, known as brake fluid bleeding process, by depressing the brake pedal repeatedly with another person taking charge of closing and opening of the bleeder valve at the wheel cylinder under chassis to extract the air contaminant of the brake fluid in the system. This old-style way of removing air contaminant from brake fluid or bleeding brake servicing is actually time-consuming, task heavy, laborious and practically unsafe to life and environment considering that the brake fluid should not be spilled to the ground, the car upholstery and paint. Hence, a proper brake fluid recovery is necessary whenever hydraulic brake system servicing is conducted. Moreover, used brake fluid can still be valuable by having it filtered very well and reused for economic reason and to avoid wastage of material or of improper waste disposal to help environment preservation.

To address such problem, a vacuum-type Brake Fluid Bleeder and Recovery Machine (VBFBRM) has been conceptualized, designed and developed that is capable of taking out brake fluid dirt impurities, remove air in the brake system and detect water content in brake fluid. This device is designed and developed that can be best utilized for brake fluid recovery; extracting air from fluid assisted by an alarm as to when the bleeding task is completed; measuring the amount of destructive water present in the brake fluid; and purifying brake fluid from impurities (dirt) and determining if the fluid is eligible for reuse. This unified functions and capabilities make this innovative and unique brake servicing equipment comparable to other existing hydraulic brake system service facilities. Figure 1 shows the various views of the vacuum -type brake fluid bleeder and recovery machine. In Figure 2, the Exploded Components of the machine is shown. And in Figure 3, the screen shots of the actual machine are presented.

This machine specialized on distinct functions such as the ability to purify and reuse the fluid after the recovery and bleeding process; the fluid would be found free of water and

air contamination since this machine can accurately recognize the presence of water that mixes with the fluid or

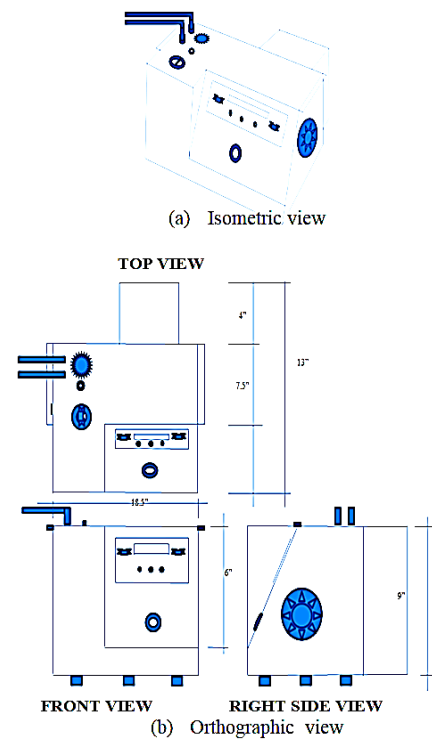


Figure 1. Various Views of the Vacuum -Type Brake Fluid Bleeder and Recovery Machine (VBFBRM)

air bubbles that form through electrical resistance principle. A large amount of water decreases the electrical resistance between the two opposing electrodes or sensors. The resistance of the sensors is related to the water content, and a value of water possible can be calculated using its predetermined relationship with water content. The machine was equipped with a 12-volt wet cell rechargeable battery to enable it to operate under the absence of alternating electrical power (provided with a 5-ampere battery charging circuit). The direct current produced from the battery will supply energy to run all electrical-powered components that comprise the normal operation of the machine, namely: (a) the 25 watts/30 and 60 RPM DC motor that will drive a mechanical pump that shall to pull out the

brake fluid from the car brake system through a vacuum force; (b) the 0.16 amperes, 12-volt DC cooling fan will be responsible for maintaining the normal operating temperature of the machine; and (c) the air extractor alarm facility is a 12-volt DC consuming electrical system component incorporated in the machine to make the operation more refined. An alarm will sound off a few minutes after the machine is switched-on to inform the operator/serviceman that the bleeding process is completed or the braking system is free of air).



Figure 2. Exploded Components of the Vacuum-type Brake Fluid Bleeder and Recovery Machine

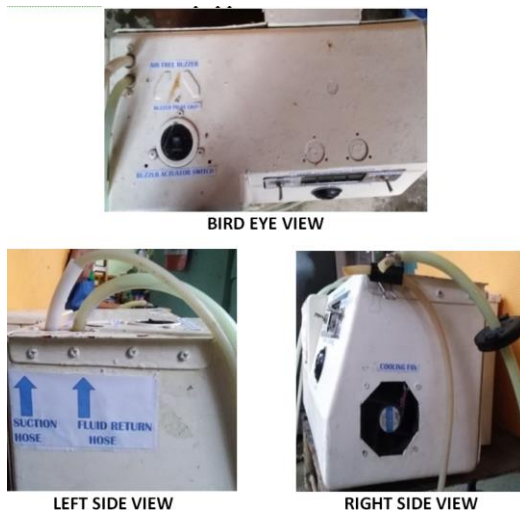


Figure 3. The Vacuum Type Brake Bleeder and Recovery Machine

With this device, shop technicians and automotive trainees and students can enjoy benefits such as time saved with less manpower utilization, safety from the danger of pulling out car wheels in conducting brake servicing, and extra caution in using the floor jack since shop workers have been identified to get killed when the floor jack slipped and the car fell on

them [1]. Moreover, such device is of great help to automotive training centers and schools in the area of automotive servicing, maintenance and repair. This is an effective and safe machine to use for students' laboratory performance on hydraulic brake system servicing.

Universities and colleges nowadays are striving their best to include in their mandates the localization and innovation of existing techniques, devices, machines and instructional trainers to contribute to the economic growth and welfare of the community by providing the appropriate technologies to increase the productivity and efficiency and reduction in cost and expenses as in [2-13]. There are various studies that involved the development of localized instructional devices and trainers to aid in the laboratory instructions in the fields of electrical[14], computers[15-16], automotive [17-22], and many others.

In this paper, a performance evaluation of the Vacuum Type Brake Fluid Bleeding and Recovery machine is conducted in terms of brake fluid bleeding, brake fluid recovery & quality of fluid in the system by light indicator (water contamination). These parameters are tested in various types of vehicles; namely: Mitsubishi Adventure, Honda City, Toyota Rush, Toyota Revo & Multi-Cab.

2. MATERIALS AND METHODS

The performance of the machine in brake fluid bleeding is evaluated. This is conducted on the four (4) wheels for each of the five (5) different types of vehicles, namely: Mitsubishi Adventure, Honda City, Toyota Rush, Toyota Revo & Multicab. Three (3) trials each are made on each wheel, and the time (in minutes) of bleeding performance per trial, is recorded and averaged.

In addition, the machine's performance in brake fluid recovery and the quality of fluid system is also conducted for (5) different 4-wheel type of vehicles, similar to the brake fluid bleeding. There are three (3) tests made for each wheel position in the sample vehicles, and the average time consumed in minutes of recovery performance per trial is likewise recorded.

3. RESULTS AND DISCUSSION

Test on brake fluid bleeding

Table 1 shows the machine's performance in brake fluid bleeding on the four (4) wheels for each of the five (5) different types of vehicles considered in the study. Three (3) tests each are conducted on each wheel where the time in minutes of bleeding performance per trial is recorded, then averaged.

Table 1. Performance Testing Matrix of the Machine Per Set of Wheels For Fluid Bleeding @ 10 psi Vacuum Pressure.

Car type	Fluid Bleeding on Wheel Number # (minutes)				Total Time (minutes)
	1	2	3	4	
Mit. Adventure	1.28	1.10	2.22	1.26	5.86
Honda City	1.22	1.10	2.18	1.12	5.62
Toyota Rush	1.29	1.15	2.12	1.28	5.84
Toyota Revo	1.31	1.16	2.23	1.30	6.00
Multi-cab	1.32	1.10	2.35	1.12	5.89
				Grand Total	29.21

In brake bleeding test 1 for *Mitsubishi Adventure*, there are three (3) trials made per set of wheels: the front right wheel came up with an average of 1.28 minutes, followed by 1.10 minutes on the front left, 2.22 minutes for rear right, and 1.26 minutes for rear left, which arrived at a total time consumed of 5.86 min.

The second testing of three (3) trials per set of wheels is done on *Honda City* that arrived at a total of **5.62** minutes of brake bleeding servicing for the set of four (4) brake positions being serviced broken down to 1.25 minutes for front right wheel, 1.11 minutes for front left wheel, 2.22 minutes for rear right wheel and 1.11 minutes for rear left wheel.

Similarly, the third brake bleeding test procedure with three (3) trials per set of wheels is conducted on a *Toyota Rush* vehicle that arrived at a total of **5.84** minutes time duration for the set of four (4) brake positions being serviced broken down to 1.29 minutes for front right wheel, 1.15 minutes for front left wheel, 2.12 minutes for rear right wheel and 1.28 minutes for rear left wheel.

Then, the fourth brake bleeding test performance test was done on a *Toyota Revo* which arrived at a total of six (6) minutes consumed for servicing the four (4) wheel positions of car brake components. It covered the following time frame averages of 1.31 minutes for front right, 1.16 minutes front left, 2.23 minutes rear right, and 1.30 minutes for rear left.

Lastly, a *Multi-cab* was the last vehicle serviced with three (3) trials as commonly done for every brake component of each of the four car wheels. The process resulted to average of 1.32 minutes consumed for the front right wheel, 1.10 minutes for front left, 2.35 minutes for the rear right, and 1.12 minutes for rear left, to arrive at a total of **5.89** minutes.

The brake fluid bleeding test process for the five (5) different types of vehicles was summed up to exactly **29.21** minutes on average, which could be applicable to the sample vehicles tested and those that are similar to them. This is so much better compared to the traditional way of brake fluid bleeding process that usually takes around 15 minutes for each of four wheels vehicle that it will last an hour to complete the bleeding task and required five hours to service the five different type vehicles as per actual experience of the researcher and other auto technicians in the field.

Test on Brake fluid recovery and the quality of fluid in the system by light indicator

Table 2 shows the machine’s performance in brake fluid recovery for five (5) different 4-wheel type of vehicles as indicated which are also used for the brake bleeding tests. There are three (3) tests made for each wheel position in the sample vehicles, and the average time consumed in minutes of recovery performance per trial is recorded.

Table 2. Performance Testing Matrix of the Machine Per Set of Wheels for Fluid Recovery and Quality @ 10 psi Vacuum Pressure.

Car type	Fluid Recovery on Wheel Number # (minutes)				Total Time (minutes)
	1	2	3	4	
Mit. Adventure	1.41	1.12	2.41	1.15	6.09
Honday City	1.25	1.11	2.22	1.11	5.69
Toyota Rush	1.36	1.16	2.30	1.15	5.97
Toyota Revo	1.35	1.21	2.26	1.31	6.13
Miulti-cab	1.35	1.14	2.40	1.12	6.01
	Grand Total				29.89

The first brake fluid recovery testing done is for *Mitsubishi Adventure*. There are three (3) trials conducted per wheel position, with the front right set of brake having an average of 1.41 minutes, followed by 1.12 minutes on the front left, 2.41 minutes for rear right, and 1.15 minutes for the rear left wheel to arrive at a total time consumed of **6.09** minutes. Red light came on not as glows as from green and yellow light indicating that water on fluid reaches an amount that need replacement.

The second testing of three (3) trials per set of wheel is done on a *Honda City* vehicle that reached **5.69** minutes of total time of brake fluid recovery servicing for the four (4) set of wheel positions of the brake system. This is broken down to 1.25 minutes for the front right, 1.11 minutes for the front left, 2.22 minutes for the rear right, and 1.11 minutes for the rear left. Red light at this test appears on and off. Water contamination means above the tolerable amount so with the test finding from the three other vehicles left.

For the third brake fluid recovery testing procedure of three (3) trials per set of wheel positions, this is conducted on a *Toyota Rush* vehicle. Total time consumed was **5.97** minutes for the four (4) sets of brakes being serviced, distributed to averages of 1.36 minutes for the front right wheel, 1.16 minutes for the front left wheel, 2.30 minutes for the rear right wheel, and 1.15 minutes for the rear left wheel.

For the fourth brake bleeding tests, a *Toyota REVO* vehicle is utilized, which resulted to a total average time of servicing consumed of **6.13** minutes, broken down as follows: 1.35 minutes for front right, 1.21 minutes for front left, 2.26 minutes for rear right, and 1.31 minutes for the rear left.

The *Multi-cab* is the last sample vehicle serviced with three (3) trials similar to the other sample vehicles for brake fluid recovery for the brake components for each of four (4) car wheels. The process resulted to 1.35 average of minutes consumed for the front right while, 1.14 minutes for front left, 2.40 minutes for rear right, and 1.12 minutes for rear left, that brought a total allotted to **6.01** minutes.

The brake fluid recovery testing process to the five different types of vehicles is summed to exactly **29.89** minutes. This shows a more advantageous performance rather than from the using other equipment the way of brake fluid recovery process, some machine will takes 15 minutes per wheel summing it up a total of one hour duration of fluid recovery servicing for a four wheels vehicle that will takes an average of **five (5)** hours to complete brake fluid recovery servicing of **5** different types vehicles [23].

4.0 CONCLUSIONS

Performance evaluation of the developed Vacuum-type Brake Fluid Bleeding and Recovery Machine (VBFBRM) has been conducted in terms of brake fluid bleeding; brake fluid recovery, and; testing the quality of system in terms of water contamination and all results showed promising outcomes par better than any machine available in the market today.

Results of the performance evaluation of the machine on five (5) different types of vehicles in terms of bleeding and fluid recovery is much better compared to the traditional way of doing the process in terms of time and as well as the fluid is water-free.

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