



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**TO ANALYZE OF WEATHER SEAL SOUND
TRANSMISSION LOSS BY ACOUSTIC SIMULATION
SOFTWARE**

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor's Degree in Mechanical Engineering Technology (Automotive Technology) with Honours

by

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfilment of the requirements for the Degree of Bachelor's in Mechanical Engineering Technology (Automotive Technology) (Hons). The member of the supervisory is as follow:

.....
MUHAMMAD NUR BIN OTHMAN
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ABSTRAK

Dengan cara memandu kereta pada kelajuan tinggi, bunyi angin bertukar menjadi bunyi utama dan boleh menyebarkan ke dalam rongga dalaman kenderaan melalui celah atau saluran pada permukaan kereta. Melalui prestasi meterai yang baik, sistem pengedap pintu automotif dapat mengurangkan bunyi angin dalaman kenderaan untuk meningkatkan kededapan bahagian dalaman. Dalam kajian ini, model meterai 3D (3-dimensi) untuk sistem pengedap pintu automotif, yang bersentuh antara permukaan saluran antara pintu automotif dan bingkai badan kereta dibina untuk menentukan nisbah mampatan dengan mensimulasikan mendapan beban mampatan (CLD) analisis dengan menggunakan Catia V5. Tambahan pula, analisis akustik elemen finite melalui Va One software juga digunakan untuk meramalkan kehilangan penghantaran bunyi (STL) pada sistem kedap pintu. Perubahan nilai parameter melalui satu millimeter dan dua millimeter meterai yang dinyatakan pada nilai ketebalan yang disahkan mempunyai pengaruh pada hasil kehilangan pada penghantaran bunyi. Mengambil kira nisbah mampatan, dua ketebalan yang berlainan digunakan untuk menilai kesan penghantaran bunyi terhadap getah meterai terhadap dua millimeter menunjukkan kesan kehilangan penghantaran bunyi yang lebih tinggi seterusnya mengurangkan bunyi di dalam kereta. Jadi, bentuk meterai yang dihasilkan ini akan membantu untuk meningkatkan kededapan didalam kereta tanpa gangguan bunyi daripada luar kereta.

ABSTRACT

By way of the car drives at high speed, wind noise turn into the main noise and can propagate into the vehicle interior cavity through the slits or channels on the automotive body surface. Through a good weather seal performance, the automotive door sealing system can reduce the vehicle interior wind noise so as to reduce the interior sound pressure level. In this study, a 3D (3-dimensional) of seal model of the automotive door sealing system, which considers the force during the mating surface of the channel between the automotive door and body frame, is built to determine the compression ratio by simulate Compression Load Deflection (CLD) analysis by using Catia V5 software. Furthermore, finite element acoustic analysis of Va One software also used to predict the Sound Transmission Loss (STL) of door sealing system. The changes of parameters value specified on thickness value verified to have an influence on the sound transmission loss result. Taking the compression ratio into consideration, two different thicknesses which are one millimeter and two millimeter of weather seal are used to evaluate the effect of the sound transmission loss for the seal rubber. Consequently, seal with the improved on thickness which is two millimeter will increase the sound transmission loss and affect the lower sound pressure level that transmit through the interior car cabin. So that, the design of this new weather seal strip will help to isolate the proton's car compartment from interior noise.

DEDICATION

Every challenging work needs self-efforts as well as the guidance from the elders. Those who have lending their hand to help me, such as my friends, along with all hardworking and respected lecture especially my supervisor. Not to forget, my humble effort I dedicate to my sweet, loving and supportive father and mother for their support, love, encouragement and prayers of day and night until I am able to get such a success and honour.

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LIST OF ABBREVIATIONS AND SYMBOLS

CLD	-	Compression Load Deflection
CR	-	Compression Ratio
FEA	-	Finite Element Analysis
STL	-	Sound Transmission Loss
SPL	-	Sound Pressure Level
PP	-	Poly Propylene
PE	-	Poly Ethylene
EPDM	-	Ethylene Propylene Diene Monomer
TPE	-	Thermoplastic Elastomers
TPO	-	Thermoplastic Olefin
E	-	Tensile Modulus
τ	-	Transmission Coefficient
ρ	-	Material density
ν	-	Poisson's ratio
z	-	Loss factor

CHAPTER 1

INTRODUCTION

1.0 Introduction

This chapter will afford some details regarding to the purpose of this research. The overview of the project background, problem statement, objective, project scope and significant of this project will be thoughtful in this chapter. This chapter will classify the fresh methods for this project. More detail about this project will be talk over in the next chapter.

1.1 Background of study

Automotive weather channel usually has dual extrusion rubber and dense rubber extruded seats on either the door or the car body to cover the car cabin space. The seal can be held in several ways such as intermittent pushpins, continuous bearers and have a variety of high shapes with a height of about 10-30 mm. The seal wall thickness is usually several millimeters to produce a maximum sealing area at low compression power.

Exclusive the car door, generally the seal line runs around the perimeter of the door. Once departing the door to the door primary plate, the remainder of the door is in connection with the door primary plate on the pivots at the opposite of the door, the padlock instrument at the back of the door and over the seal line around the border of the door. The sealing line assures some residual strength and viscoelastic input to the door sustenance condition besides shows a part in the technique noise and outside ambiances can bing to the inner of the compartment.

Recently, separation topics are significant, and the strategy concerned with to isolating the cabin section is improved than outflow of water and air. Today, the over-all tendency in seal plan is concerned with to the isolation of passenger section from sound and vibration. From numerous sound viewpoints, geometry like the form of the 3D section methods laterally the border of the door, the constitutive sensible of the rubber quantity, changes the car door's sound level and the outside energy loss instrument to the car frame.

Present are some features of the weather seal typical that must to be full frequently into interpretation when design meant for a best compartment door weather seal. That one can be definite with certain issues which characterize the seal static load analysis shows, to be exact the compression load deflection performance (CLD), the shape of the weather seal after the compression and the sound transmission loss (STL) of the weather seal. Compression ratio of a weather seal study must be completed to achieve deformed seal geometry in its operational state. Formerly, deformed geometry should be relocated to acoustic analysis in which the sound transmission loss typical of the seal structure is gotten.

The sign of this project is to study the sound transmission loss of the of the proton's vehicle weather seal profile by using Va One software. In order to perform this project, a static analysis of weather seal is desired to perform to get the compression ratio of weather seal by using Catia V5 software. After that, acoustic finite element acoustic system of Va One software is used to determine sound transmission loss of weather seal. Furthermore, the different parameters value of weather seal also being to be investigate in order to find a better weather seal for proton's vehicle. Henceforward, the accurate representation of this study will give benefit to reduce the sound pressure level that transmits from the exterior to the interior of the car cabin.

1.2 Problem statement

Nowadays, the isolation matter of proton's car cabin is turns into significant. This is since of the noise ingoing the car cabin from the external of the car. So that, the design of weather seal strip must to improved isolate the proton's car compartment from noise contamination. The airborne noise produced at the outside of the car such as airstream noise, deplete noise, engine noise and tire noise is diffuse to the inside of the car cabin over the weather seal that close to the door opening panel. So, these noises are sometimes offending the driver to focus on driving. Therefore, this study is supported to analyse the profile of proton's car weather seal permitted to reduce the noise that ingoing the car cabin through the weather seal.

1.3 Objectives

The objectives of this project are:

1. To study the profile of the proton's vehicle weather seal on compression load deflection analysis using Catia V5 software.
2. To determine sound transmission loss analysis of weather seal by using Va One software.
3. To improve the parameter value of weather seal that effect sound transmission loss.

1.4 Project scope

This project focuses on the study of the profile of proton's vehicle weather seal due to sound transmission loss analysis. The vehicle used in this project is Proton Persona. This project starts with the static load analysis using Catia V5 software to find a compression ratio of weather seal. Then, the deformed compression model of weather seal will be transfer to Va One software to determine sound transmission loss. From the sound transmission loss result, a new parameter design of weather seal will be come out in order to get the optimal design of weather

seals to find the sound transmission loss. The parameter control in this project is focused on the thickness of the weather seal.

1.5 Significant of project

The purpose of this study is to studies and improves the profile of the proton's vehicle weather seal in order to predict the sound of transmission loss through the weather seals. There are a few steps are necessary which is static analysis to undergo the deformation of seal shape after compression or door closure event, acoustic analysis based on dynamics parameters to determine sound transmission loss of weather seal. This step can be held by using Catia V5 software and Va One software for the analysis of geometry, compression, loading cases and sound transmission loss.

Hence, accurate representation of the door seals is essential in the analysis used for designing the optimal weather seal design through the parameter concern of the vehicle. Thus, it is believed that the outcome of this project will give a new contribution in the automotive industry in terms of improvement of weather seal design analysis. This project will contribute a better design of weather seal to give a better impact for the proton's car users.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

This chapter will deliver various enlightenments concerning to the determination of this research. The indication of this research and the previous research that has been done by researchers will discourse in this chapter. This chapter will be recognise the relevance of the research and new approaches that related to the research the details on this research will be discuss in the next chapter.

2.1 Character of the car door seal in the noise carriage

Whereas an automobile is roaming at a speed over 120kph, the airstream noise will show the main role for the internal noise (A. Kloess, 2004). Dimensions designate that the wind noise level at the person along for the ride ear is reduced by 1-3dB via shifting from a sole seal to a dual seal, and is added reduced by 1-3dB after a top blow is supplementary (M. Koike, 1990). It displays that the noise concluded the car seals is a main provider to the airstream noise. Thus, augmentation of the sound transmission loss over the automobile seals is an indispensable process to cut inner wind noise level.

Automobile entrance seals, placed all over the place the passenger door as realized in Figure 2.1, position a foremost part in important remoteness of the traveller section from water and dropping wind noise exclusive the car (J. Park, 2003). Figure 2.2 diagrams a section car door sealing structure. The seals condense the wind noise classified the automobile by two techniques, foremost, the seals

essential stay in connection among the door and the car body to nearby and secondly, weaken the noise from the door and car external to the maximum possible range.

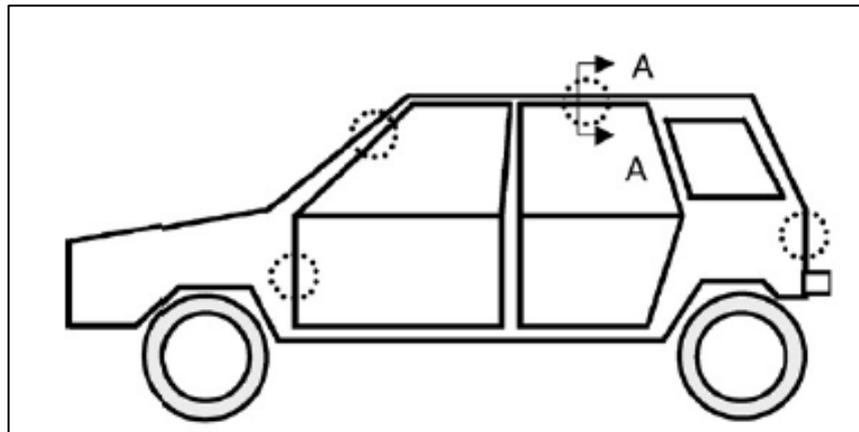


Figure 2.1: Position of door seals (J. Park, T. Siegmund and L. Mongeau, 2001)

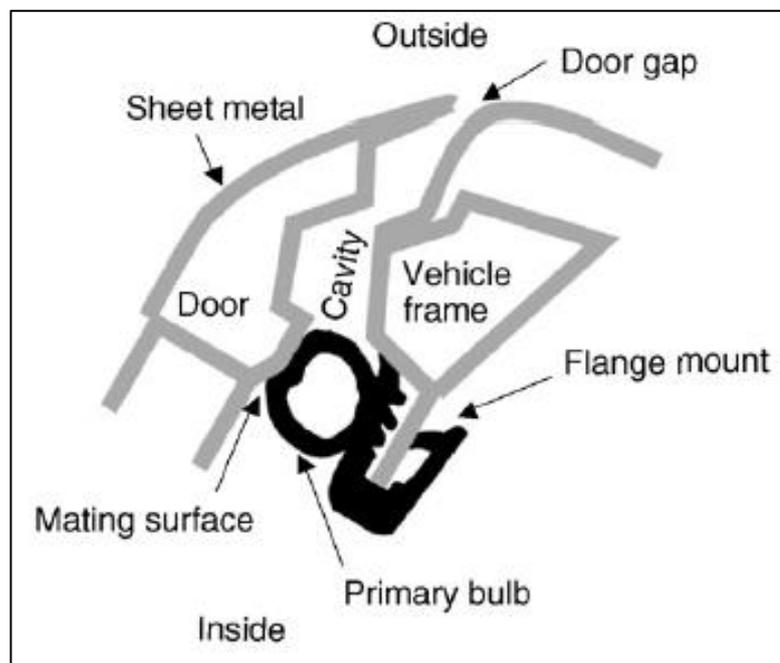


Figure 2.2: Section of door sealing structure (J. Park, 2003)

Desire noise is formed when the seal is wrongly deliberate which will noticeably indorse the inside clamour (Won Wook Jung, 1995). In the fresh centuries, countless labours have stayed place on the door ultimate properties (David A. Wagner, 1997) while acoustic apparatus of the car seals is repeatedly deserted as of the compound geometry of the section. Bulb seals are generally castoff everyplace the seals requisite put up the dissimilarities of the arrangement in door slit closing.

Maximum of the entrance seals are finished from effervesced rubber so that they can enthusiastically be modified to change coupling surfaces and car casings. Nearby are three imaginable instruments for flowing noise actuality diffused to the internal of a car (Junhong Park, 2002) which is sound transmission over the seals themselves, sound transmission done the shaking of the physical constituents supportive the seals or the outflow through poorly sealed localities where a slight gap happen.

2.2 Rubber Seal Structure

Sponge dense rubber seals are cast-off widely in the building of the current auto, and have been combined into this learning, to let an additional realistic and precise study to be accepted. Self-propelled door seals are multifaceted in occupation and commonly income the method of muffled extruded pieces of elastomeric measureable that ride everywhere the border of the entrance or a car body by (Da Desai, 2010).

After the door is locked, the seal attends towards retain water plus extra factual commencing the exterior atmosphere out of the nearside cabin, reimburse for engineering charities of countless frame fragments, exploit the seal among immobile and transferable mechanisms then afford particular checking intended for the vibratory gesture of the door boards. The tendency in seal plan is primarily leaning near segregating the traveller cabin as of noise and shuddering.

The seal communicates a mark of enduring stiffness then viscoelasticity towards the door provision circumstances and pieces a character in the method in which vibration is conducted to the door boards of the car. The viscoelastic stuff consents the seal to preserve a continual form after distortion, though instantaneously gripping automated drive. Door seals are regularly measured acoustically translucent, namely, they parade nothing sound transmission loss features at incidences in the district of a serious air quantity reverberation occurrence. A distinctive self-propelled door seal contains of dualistic fragments, as specified in Figure 2.3 beneath.

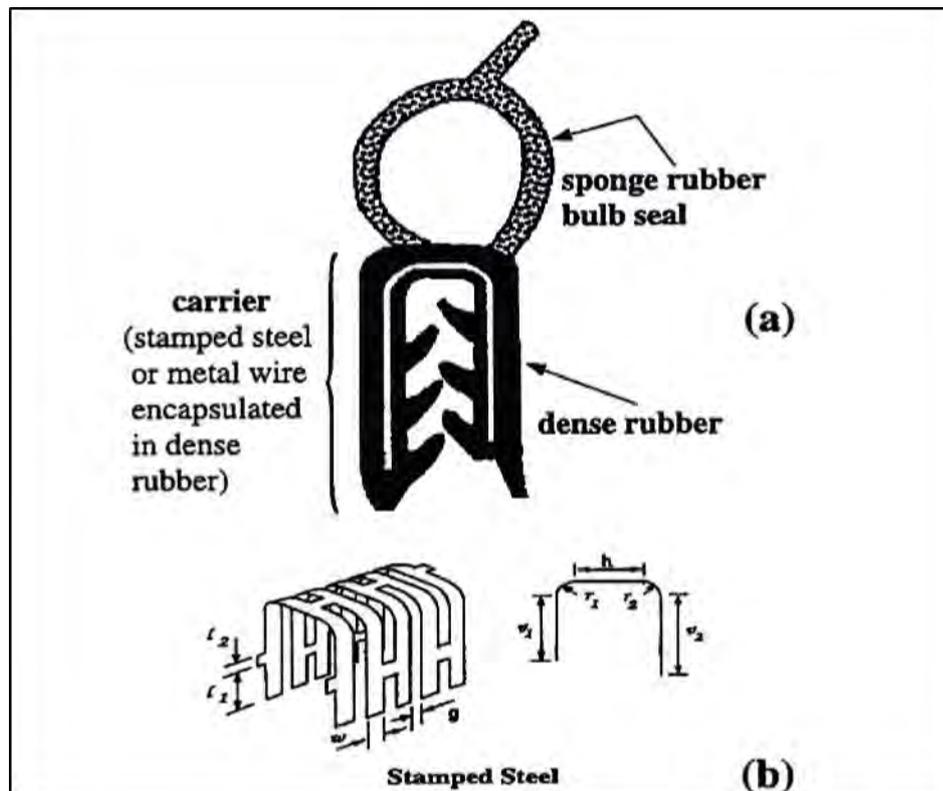


Figure 2.3: Characteristic creation of a door seal (Da Desai, 2010)

2.3 Variety of Seal Sensible

In the carriage arrangements, elastic substances have distant attainment. The consumption of elastic matters in the compartment commercial can be inaccessible hooked on tire out, which are consumer stuffs and have a little lifecycle anticipation,