SUPERVISOR DECLARATION

"I hereby declare that I have read this thesis and in my opinion this report is sufficient in terms of scope and quality for the award of the degree of
Bachelor of Mechanical Engineering (Structure & Materials)"

Signature :.....

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DESIGN OF A NOISE ENCLOSURE FOR PORTABLE GENERATOR

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DECLARATION

"I hereby declare that the work in this report is my own except for summaries and quotations which have been duly acknowledged."

Signature:

Author :

Date :

Special to my beloved

Father and Mother

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ABSTRACT

A portable generator is a one of sources that affect the environmental noise. Although the noise level might not harm the human hearing, the noise emitted by a portable generator causes disturbance to the environment. In practice, most people do not cover the portable generator to reduce its noise emission. In this project a simple box-shaped, for portable generators For this project, the sound power level emitted by a portable generator was measured according to ISO 3746. From this, a single partition of noise enclosure was design using mild steel panel having thickness 4 mm. It is found that the sound power level can be reduced by 13dBA. However this is not agree well with the theory due to compromised situation in the design, such as the introduction of holes for air intake and exhaust.

ABSTRAK

Sebuah penjana kuasa mudah alih adalah merupakan salah satu sumber yang mempengaruhi pencemaran bunyi. Walaupun tahap bunyi yang dipancarkan oleh penjana kuasa mudah alih mungkin tidak membahayakan pendengaran manusia, namun ia menyebabkan gangguan bunyi kepada persekitaran. Dalam aplikasi seharian, kebanyakan orang tidak menutupi penjana kuasa mudah alih ini dengan penyerap bunyi untuk mengurangkan bunyi yang dipancarkan. Didalam projek ini, sebuah penyerap bunyi yang berbentuk kotak direka untuk penjana mudah alih. Tahap bunyi yang dipancarkan oleh penjana kuasa mudah alih diukur mengikut piawaian ISO 3746. Daripada itu, sebuah penyerap bunyi telah direka mengunakan besi ringan. Didapati bahawa tahap bunyi dapat dikurangkan sebanyak 13 dBA. Namun ia tidak sama dengan teori kerana pada rekaan penyerap bunyi terdapat lubang udara untuk pengaliran udara keluar masuk dan juga ekzos.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

NOMENCLATURE

L_{eq}	Equivalent sound level
$L_{\max}$	Maximum equivalent sound level
$L_{\min}$	Minimum equivalent sound level
$L\ p$	Sound power level
p_{ref}	Reference acoustic pressure
p	Acoustic pressure
L_w	Sound power
DI	Directivity Index
r	Radial distance between receivers to the source
f	Frequency (Hz)
f_c	Critical frequency (Hz)
pc	Characteristic impedance in air
T	Sound transmission coefficient
W_T	Transmitted sound power
W_i	Incident sound power
W	The 0 dB reference level
TL	Transmission Loss

L_{pA}	The A-weighted surface sound pressure level in decibels
L_{pAi}	The A-weighted sound pressure level at the i^{th} measurement position
N	The total number of the measurement position
L_{WA}	Sound pressure level of the source
K	The environmental correction to account for the influence of reflected sound
L_{Wtc}	Calculated transmitted sound power level
L_{Wi}	Incident sound power level
W_{total}	Total of sound power level
L_{Wtmea}	Measured transmitted sound power level

CHAPTER I

INTRODUCTION

1.1 BACKGROUND

1.1.1 Environmental Noise

Noise means any unwanted sound that we are exposed everyday without any consideration. Noise defined as a sound or sounds at such amplitude as to cause annoyance or to interfere with communication and it was mentioned that noise was psychological and subjective feeling. It can be block, change or interfere with the meaning of a message in human, animal and electronic communication. Noise can cause a physical problem such as permanent hearing loss and also the psychological problem, like stress.

Environmental noise is unpleasant or unwanted outdoor sound that disrupts the human life activity. This unwanted and unpleasant outdoor sound mostly generated by traffic and industry. Road traffic is the most widespread source. It has a lower priority than other environmental pollution such as air pollution and water pollution. It also recognised that, despite significant reduction in the noise produced by individual source, total exposure to environmental noise has not change significantly.

Most people are affected by noise exposure more than any other environmental stimulus. The most widespread problem created by noise is nuisance. Noise has been known as stressor which can cause a several serious health effect. Environmental noise affects us in the following areas:

a) Hearing Loss

The most notable effect of environmental noise is hearing loss. It affected if the noise is loud enough and the exposure long enough. Noise induced hearing loss is usually gradual and painless, but unfortunately, hearing loss is a permanent effect. Once destroyed, the hearing nerve and it sensory nerve cell do not regenerate.

b) Cardiovascular Effect

Exposure to environmental noise during sleep bring to a number of physiological effect such as increased of blood pressure, increased heart rate and an increase in body movements. Environmental noise probably affects the cardiovascular system through the stimulation of hormones in our body such as cortisol, noradrenaline and also adrenaline.

c) Annoyance and Quality of Life

Environmental noise is a subjective experience and feelings of annoyance are profoundly affected by personal attitudes and also belief. It is because environmental noise is commonly perceived to be an avoidable form of harm and an intrusion into personal privacy that creates such unhappiness. Road traffic is the main effect that causes environmental noise. The noise from the transport is associated with productivity losses by an inability to concentrate at work and tiredness caused by disturbed sleep.

d) Sleep Disturbance

Insomnia and sleep disturbance caused by environmental noise can affect the quality and quantity of sleep. Difficult to falling asleep, awakenings and alternations of sleep stages or depth, especially a reduction in the proportion of REM-sleep (REM = Rapid Eye Movement) are examples. Road traffic is the largest cause that affects sleep quality and quantity.

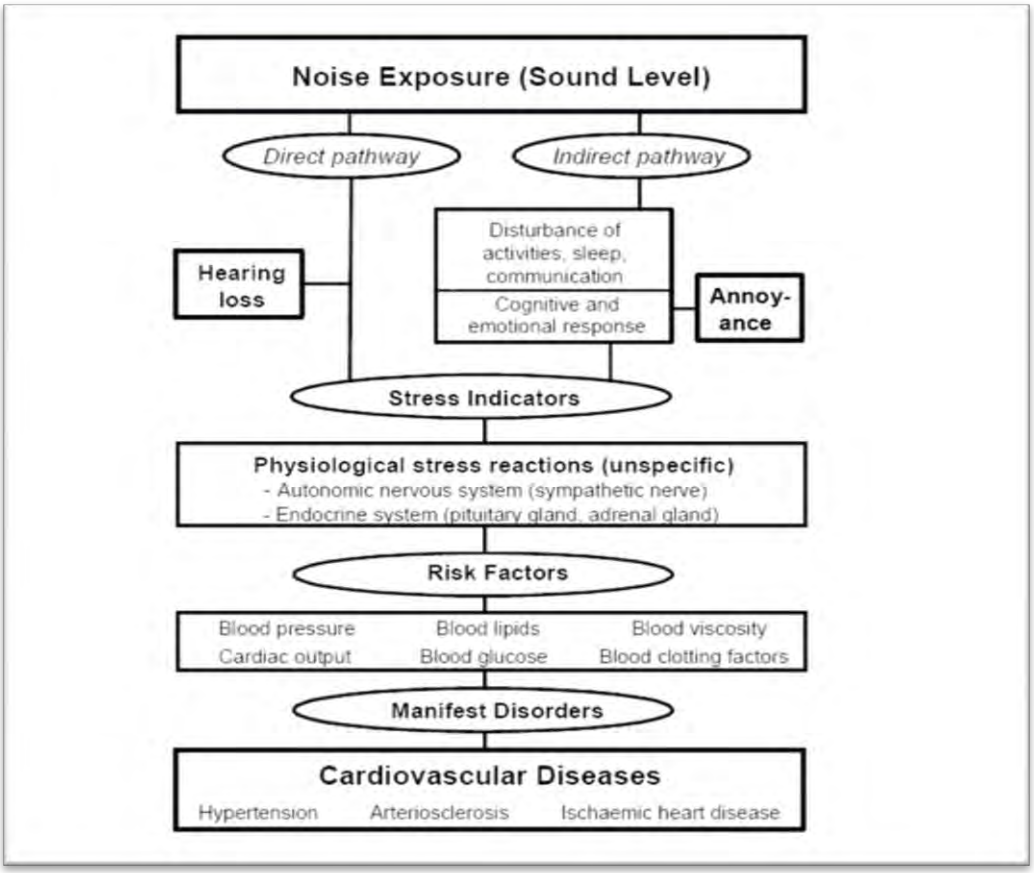

Figure 1.1: Environmental Noise Effect Schemas

1.1.2 Noise Standard

According to the Occupational Safety and Healthy Administration OSHA, exposure to high level of noise for long durations may lead to hearing loss, create physical and psychological stress, reduce productivity, interfere with communication and contribute to accidents and injuries by making it difficult to hear warning signals. The maximum permissible occupational noise exposure limit in the range of 90-85 dB(A) Leq for 8 hour per day (40 hour per week) have been recommended by the International Standards Organization (ISO).

The OSHA of the U.S Department of Labor regulation sets the limits of exposure to workplace noise. Based on the noise exposure criteria that were verified in 1983 by OSHA, continuous exposure to noise level greater than 115 dB(A) is not permitted for any duration. Occupational and no occupational permissible noise exposure standards based on the durations of exposure are given in Table 1.1The maximum exposure noise level in workplace for duration of 16 hours should not

exceed 85 dB(A). For non-occupational areas, the maximum level for a duration of 16 to 24 hours is 70 dB(A). Figure 1.2 illustrates typical sound levels for several conditions.

Table 1.1:Guideline for Occupational and Non-occupational Noise Exposure Time Limit

Maximum exposure noise level dB(A)	**Exposure Time Limit (hours per day)**	
	Occupational(OSHA)	**Non-occupational**
70	-	16-24
75	-	8
80	-	4
85	16	2
90	8	1
95	4	0.5
100	2	0.25
105	1	0.13
110	0.5	0.07
115	0.25	0.03

ECMA Standard specifies procedures for measuring and reporting the noise emission of information technology and telecommunications equipment. This Standard is considered part of *a* noise test code for this type of equipment, and is based on basic noise emission standards ISO 3741:1999 , ISO 3744:1994 , ISO 3745:2003 and ISO 11201:1995 . The basic emission quantity is the A-weighted sound power level which may be used for comparing equipment of the same type but from different manufacturers, or for comparing different equipment.

Three basic noise emission standards for determining the sound power levels are specified in ECMA Standard in order to avoid undue restriction on existing facilities and experience. The first basic standard (ISO 3741) specifies comparison

measurements in a reverberation room; the other two (ISO 3744 and ISO 3745) specify measurements in an essentially free field over a reflecting plane. Any one of these three basic noise emission standards may be selected and shall then be used exclusively according to this Standard when determining sound power levels of a machine.

The A-weighted sound power level is supplemented by the A-weighted emission sound pressure level measured at the operator position(s) or the bystander positions, based on the basic noise emission standard ISO 11201. This sound pressure level is not a worker's emissions rating level, but it may assist in identifying any potential problems that could cause annoyance, activity interference, or hearing damage to operators and bystanders.

The ECMA Standard is suitable for type tests and provides methods for manufacturers and testing laboratories to obtain comparable results. The methods specified in ECMA Standard allow the determination of noise emission levels for a unit tested individually.

The procedures may be applied to equipment which emits broad-band noise, narrow-band noise and noise which contains discrete-frequency components, or impulsive noise.

The sound power and emission sound pressure levels obtained may serve noise emission declaration and comparison purposes and if sound power levels obtained are determined for a number of units of the same production series, they can be used to determine a statistical value for that production series (ECMA-109).

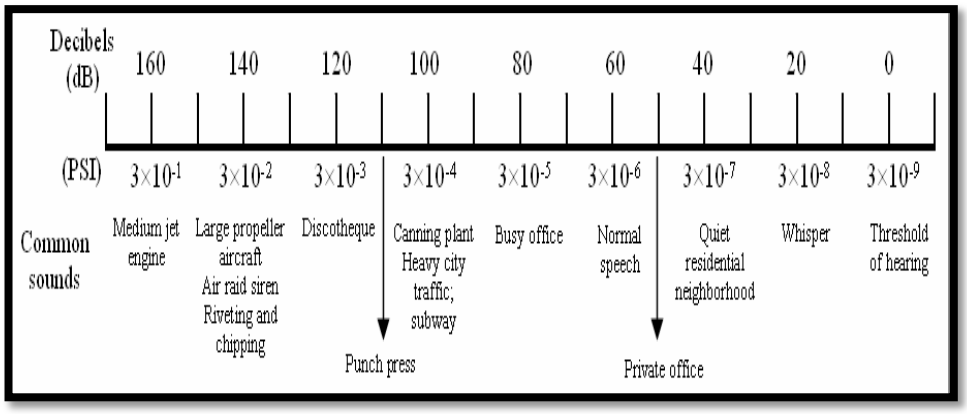

Figure 1.2:Typical sound level in sound pressure level (decibels) and PSi

1.1.3 Environmental Noise From Portable Generator

Portable generators are used very commonly in construction, shops, offices and homes today in order to supply and maintain power during power shutdowns or in an emergency power outage. The generator needed to be both mobile and quiet since it would often be used near commercial or residential areas. These generators emitted very high levels of noise, in addition to noxious air emissions. The noise may be generated by aerodynamic effects or due to forces that result from combustion process or may result from mechanical excitation by rotating or reciprocating engine components.

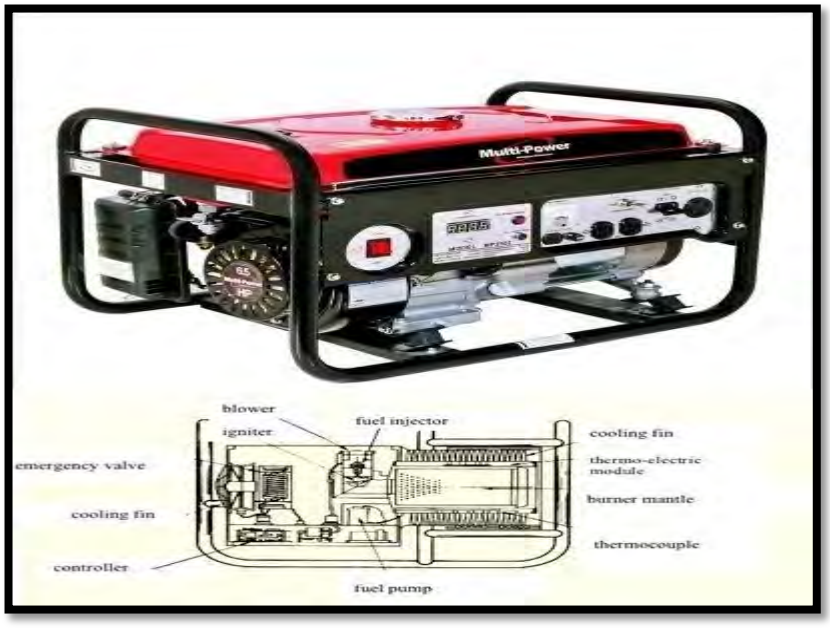

Figure 1.3: Portable Generators

1.2 PROBLEM STATEMENT

A portable generator is a one of sources that affect the environmental noise. Although the noise level might not harm the human hearing, the noise emit by a portable generator cause disturbance to the environmental. Moreover, in practice, most people do not cover the portable generator to reduce its noise emission.

1.3 OBJECTIVES OF THE PROJECT

The objectives of this project are:

a) To measure the sound power level that emitted from a portable electric generator.
b) To design and manufacture a simple enclosure for reducing environmental noise from a portable electric generator.

1.4 METHODOLOGY

This project begins with a literature review, particularly related to theory of the sound transmission loss and also the theory of sound power level measurement. Literature review consists of studying the previous research established journal, articles, academic book and other related references to obtain the theory.

After obtaining all the theory related, the next step is to measure the sound power level that emit by the portable generator. The measurement of the sound power level will conduct outdoor which is with minimum background noise and reflecting surface. The sound power level that emit by portable generator will be measure by using acoustic microphones.

Once the sound power level is obtained, this becomes ‘an input’ to design an enclosure to meet the target of noise reduction. Theoretical formula will be used to calculate the dimensions and type of material for the enclosure. This involved the sound and structural vibration analysis. The nest step, the measurement of the sound power level from the portable generator with the noise enclosure which has been designed will be conducted. The result will be compared with the acceptable noise standard.

The final step is to summarize the study in the final report. Suggestion and recommendation for the future work will also given.