Johannesburg 2006

OCCUPATIONAL HYGIENE

The requirements for the degree of Master of Public Health in University of the Witwatersrand, Johannesburg in partial fulfillment of A research report submitted to the Faculty of Health Sciences,

Dingiliwe Mazibuko

(ZIMBABWE) FROM 2003 TO 2006
IN SMALL-SCALE GRAIN GRINDING MILLS IN BULAWAYO

A DESCRIPTIVE STUDY OF OCCUPATIONAL NOISE EXPOSURE
Committee (Medical) of the University of the Witwatersrand, Reference no. PC—
I further declare that this research was approved by the Human Research Ethics

any other university.

This research has not been submitted for any degree of examination at this or

Johannesburg, South Africa.

Occupational Hygiene (MPhOH) University of the Witwatersrand.

The research is being submitted for the Masters in Public Health degree in

analysis and presentation of data.

Frankay K. Mutsa of the Zimbabwe Open University rendered assistance in the

1. DingiZewe Mazibuko declare that this research is my own work. However, Mr.

DECLARATION
Dedicated to my wife Nomuhye and daughters Hanahipa and Yumewe.
Registration records of the local authority,

Establishing employing 10 or fewer employees as compulsory from the licensing and

2005. The study population and sample were small-scale grinding mills in

collected by the Factories and Works Department from October 2003 to June

The research is a retrospective descriptive study of noise survey results routinely

appropriate noise prevention and control measures.

and intermittent noise occupational exposure limits and to recommend

of noise in these grinding mills, compare the prevailing noise levels with national

small-scale grinding mills in Bulawayo from 2003 to 2005. Identify major sources

The objectives of the study were to describe prevailing noise levels from 27

Informal and small-scale sector remains unavoidable in Zimbabwe.

exposure and cases of noise-induced hearing loss or impairment in this growing

health effect. Despite this, collected statistics on occupational noise levels, noise

pressure. Occupational-induced, noise-induced hearing loss is the most serious

with speech communication, annoyance, headaches, fatigue and high-blood

exposure include noise-induced hearing loss or impairment, tinnitus, interference

hazards identified in these small-scale enterprises. The adverse effects of noise

scale enterprises. Noise is one of the many occupational health and safety

Over the past fifteen years, Zimbabwe has experienced a proliferation of small-

Abstract
Monitoring, health surveillance and training programmes, administrative and engineering protection measures, coupled with noise employees from such exposure. Such measures can include engineering, There is therefore a need to put in place noise control measures to protect protection.

of 90dB(A) for periods exceeding 8 hours without any form of hearing

mills are significantly exposed to noise levels above the national OEL - TWA

The results of this study demonstrate that workers in small-scale grinding

protection of control measures in place, than 8 hours and all Z7 grinding mills (100%) did not have any form of noise

noise. 65% of employees in small-scale grinding mills worked shifts longer

standards. Grinding and de-hulling operations were the major sources of

levels of 85.5dB(A) satisfied both Zimabwean and international noise

Occupational Exposure Limit (OEL) of 90dB(A) and the international

measures (mean 95.4dB(A) were significantly above the Zimabwean Study

The measured noise levels ranged from 81.2dB(A) to 101.2dB(A). Over 96%

protection standards.

Distribution and relationships to national statutory and international hearing

Noise measurements results were statistically analysed to characterise their
My family for all the support and encouragement.

Scholarship for this programme.

Fugany International who made it all possible by offering me the

My employer, NSSA for granting me study leave to pursue this course.

the manuscripts.

My father-in-law, Mr James Hadebe for the preparation and typing of all

Mr Frank Ke K. Muhaise for assistance with data analysis.

My supervisor Mr Andrew Zwanebalo for all the expert advice.

Support rendered to completion of this study.

Professor David Rees for all the guidance and direction from formulation

I would like to express my sincere thanks and gratitude to the following for all the

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Occupational Exposure Limit
Time Weighted Average (Exposure)
National Institute of Occupational Safety and Health
Noise Induced Hearing Loss
Personal Protective Clothing and Equipment
Reserve Bank of Zimbabwe
Small Scale Enterprises
International Organization for Standardization
International Labour Organization

NOMENCLATURE

Workers being exposed to daily noise levels above 85dB A (American Newsletter on Increase in the number of machines in our workplaces. This has resulted in many industrial and agricultural revolutions. High levels of mechanisation resulting from the transportation and the mills. High levels of mechanisation resulting from the employment settings including manufacturing, mining, forestry, agriculture.

Hazards in today's occupational environment affecting workers in diverse communication or damage people's hearing. It is one of the most ubiquitous (Gray and Klear, 1984). Sound is regarded as noise if it has the potential to interfere sound pressure variations in the air or other medium that the human ear can detect.

Noise is known as unpleasant or unwanted sound but has been defined as any

Background

and objectives of this study.

including grinding mills is reviewed. The chapter ends with the outlining of the aims.

Noise as one of the occupational hazards found in these small-scale industries.

small-scale industries in Zimbabwe and sub-Saharan Africa and the prevalence of measurement methods and control measures for noise are covered. Literature on effects of prolonged cumulative exposure to moderately high noise are reviewed.

In this chapter, noise is defined and its characteristics discussed. The adverse
Effectiveness of prevention measures. Measurement methods and equipment vary.

Exposures, identification of noise sources, noise mapping or checking the environment cannot hear each other when conversing at normal auditory levels. Noise measurements are advisable when it becomes necessary to shout in order to measure to be taken timely (Bredel and Kjaer, 1964).

Sound may cause damage to hearing, thus permitting appropriate corrective measures to sound provides critical and affordable means of determining when measurement of sound provides critical and affordable means of describing and

2000/2)

condition between 2000 and 2002 (Commissioner's Annual Report, South Africa, noise-induced hearing loss was the leading reported non-occupational exposure, American Occupational Health, 1996). In impaired however, is the most common and probably the most serious adverse effects and the increased risk of accidents. Noise-induced hearing loss or

with speech communication annoyance, headache, high blood pressure, fatigue, hearing loss or impaired (either temporarily or permanent). Minus, interference

hearing effects to workers, especially if they are not using any hearing protection. Protracted exposure to moderately high noise levels is known to cause adverse
Rural business centres have also mushroomed as part of this growing economic sector. (Business Chronicle, 2005) Small-scale grinding mills in urban areas and a major contributor to the National Gross Domestic Product and a growing employer scale sector which has come to be recognised and acknowledged by government as In the past fifteen years Zimbabwe has seen a major growth of the small to medium

(Arlabu & Ngoma 2005; Ife A.M 2005)

workshops (panel-beating), metal fabrication, wood working and hammer milled
health and safety hazards in small-scale industries including motor vehicle repair
studies in Sub-Saharan Africa have indicated noise to be one of the prominent

1.2 Statement of the Problem

exposed workers.

at source. Reduction of noise transmission and provision of ear protection devices to
workplaces. These measures include environmental noise control, control of noise
1976). To this end, noise prevention and control measures should be put in place at all
health and safety statutory requirements (factories and works General Regulations,
noise levels of more than 90(3) for eight hours per day in terms of Zimbabwens
because of the noted adverse health effects, workers should not be exposed to
always undertake such noise measurements.

person who has received adequate training in noise measurement techniques should
depending on the type and the reason for the measurement being undertaken. A
Noise: unwanted or unpleasant sound.

can detect:

Sound: Any pressure variation (in air, water or other medium) that the human ear

1.4 Definition of Terms

85dB(A) Respectively

To compare prevailing noise levels in small-scale grinding mills with the
To identify major sources of noise in small-scale grinding mills.

1.3.2 Specific Objectives of Study

To describe noise levels in 27 small-scale grinding mills in Bulawayo from

1.3.1 Aim of the Study

Industry hence the need for this study.

As much is known about noise levels, exposures and impacts in this

1.3 Alims and Objectives

occupational stressors, no studies have been carried out so far in Zimbabwe to

Although it is known and accepted that noise is one of the most ubiquitous
Occupational Exposure Standard: a health-based workplace standard to protect workers from adverse exposures (e.g., TWA's, STEL's, TWA's).

Small-scale sector: Small-scale units producing and distributing goods and services.

Implementation of hearing conservation procedures.

Implementation by the control of noise through engineering methods and the prevention or minimization of noise-induced hearing.

Max P: The maximum noise peak level in the weighted measurement line.

is expressed as L(eq) to 10 minutes.

Equivalent: Continuous A-weighted sound pressure level determined over 10 minutes.

Weighted sound pressure level in decibels, determined over a time interval. L

Refers to A.

Equivalent continuous A-weighted sound pressure level: (L(eq)) refers to A-

Ear and is used to estimate ear damage potential of any noise.

A-weighted sound pressure level dB(A): a sound pressure level (noise) frequency

Hearing: 0.16 meter sphere, diameter surrounding the head.

Threshold: A threshold, meaning sound in one or both ears.

and employing up to 10 workers.
That are achieved at the expense of their workers in terms of hours of work, intensity

according to the ILO, small-scale enterprises often operate on small profit margins

employing up to 10 workers.

2004). For purposes of this study, small-scale grinding mills were defined as those

production of goods and services for sale in both rural and urban areas (Konongo)

small-scale private units employing less than 10 persons and involved in the

according to Konogo (2004), small-scale enterprises are broadly conceived as very

1998).

markets, formal credit training or public services amenities (ILO Encyclopedia,

unregulated and unrecorded in official statistics, with little access to organised

independently, self-employed producers which are for the most part,

small-scale units producing and distributing goods and services and consisting

The International Labour Organization (ILO) defines small-scale enterprises as "very

are managed or the size of their capital investment.

occupational health legislation, the type of industry, the level at which the enterprises

based on the number of workers in the establishment, their coverage by

common definitions that have been used by various countries or organisations are

There is no standard definition of what constitutes a small-scale industry. Some

2.1 Small-Scale Enterprises

2.0 Literature Review

CHAPTER 2
Reserve Bank of Zimbabwe estimated that the small-scale sector was employing
employment creation and its contribution to the national focus. In 2000, the
has grown and has assumed increased national economic significance in terms of
employment and sustenance. Over the years, the small-scale sector in Zimbabwe
coming into the employment market have lured to the small-scale sector for
the growing numbers of these unemployed persons, including school leavers.


Even the relocation of companies from the country with consequent loss of
has now reached four digits. This has seen the closing down, the down sizing and
reduced foreign currency inflows and in an increase in the country’s inflation rate that
shrinkages in the mining, manufacturing and tourism industries. This resulted in
reduced outputs in the agricultural sector (the economy’s backbone), coupled with
have resulted in a marked decline in the country’s economic performance, with
The political and economic challenges Zimbabwe faces faced in the past fifteen years

2.2 Emergence of small-scale sector in Zimbabwe

Formal industries and otherwise would be unemployed (Ranjan et al., 1994).

Countries they offer employment to the workforce that is no longer employed by
small-scale enterprises are highly employment-intensive and even in indusrialised
span and are very mobile, changing premises to cut costs and survive.
Encyclopedia, 1998). As a result, most small-scale enterprises have a short life
of workplaces and exposure to occupational health and safety hazards (LO
compared to large formal enterprises (Framenau et al., 1994). The occurrence of hazards and their severity in SSEs may be exceptionally high. Studies in less developed and newly industrialized countries show that the

2.3 Occupational Health and Safety Problems of Small Scale Enterprises

African, including Zimbabwean occupational health risks in the small-scale sector still inadequate. However, several studies have been carried out in sub-Saharan Africa about the occupational health status, problems and needs of this sector or industry is despite its growing importance and significance to the nation's economy, information domestic product (Business Chronicle, 1 March 2005).

The growth of this industry and it's contribution to the country's cross sector's importance to the national economy, the government has set up a July-

(RZV Weekly Economic Highlight, June 2000). In recognition of this emerging manufacturing sector accounting for 28% of the total small-scale sector employees million people or 55% of the sector. The mining sector employed 10% with the 2000, agriculture was the largest informal sector employer, employing about two The small-scale sector in Zimbabwe now covers all sectors of the economy. In 

Domestic Product (RZV Weekly Economic Highlight, June 2000) around 3.8 million people and had contributed in estimated 16% to the Gross
In an ergonomic study carried out in Minna, the capital of Niger State in Nigeria, 2004 workers were exposed to excessive noise, dust, metallic fumes from welding and soldering, and ergonomic hazards. Such small-scale industries as garages, metal workshops, hammer mills and wood in small-scale industry workers in Dar es Salaam, Tanzania, revealed that workers in another study by Dr. Lerman in 1996 on occupational exposures and health problems of chemical, biological, psychosocial, and ergonomics hazards (Atembo C. 1996). A survey carried out in 1995 by Helen C. Atembo in the Kall industries which are and equipment (PPG & E) for their workers.

1996). Only 5% of the enterprises provided any form of personal protective clothing. The manufacturing sector’s small-scale enterprises covered in the study (Lowerson, 1996). Noise, dust and road problems were found in 55% of chemical (Lowerson, 1996). Noise, long hours of work, poor workplace design and exposure to hazardous noise, long hours of work, poor housekeeping, poor lighting, and equipment that they needed many occupational health and safety hazards. Similar to a study by Dr. Renee Lowerson in 1996 on small-scale enterprises in Zimbabwe.
industries where units in developing countries and up to 20% of workers in industrialized countries (Fransen et al. 1994). More than 50% of workers, particularly in mining and transportation are exposed to levels of 100 or dB(a) or more, which workers in numerous different activities such as construction, manufacturing, according to Fransen et al. noise is evidently the most common physical factor to

levels above 80dB(A) (ILO Encyclopedia, 1992). The manufacturing sector are exposed to levels of noise above 85dB(A) and 53.1% of United States of America's Department of Labour estimates that 19.3% of workers in average A-weighted noise levels of 85dB(A) (ILO Encyclopedia, 1992). The Newsletter on Occupational Health and Safety, 1992). Occupational hazards, although not necessarily the most dangerous (African, enterprises including mining mills' is recognized as one of the most ubiquitous of all.

Noise, one of the hazards identified in the various studies carried out in small-scale

2.4. Noise as an Occupational Health and Safety Problem

became the mode of communication between the operators and the clients. Mills' communication was so hampered by the noise levels that sign language

in the mills were higher than the recommended value of 80dB(A). In some of the

range from 83.4dB(A) to 103.9 dB (A) (Viras G, M. 2005). The noise levels measured and noise, the results of the noise measurements taken at operations' ear-level

in various areas, which included man-machine and human dimensions, temperature
hearing impairment depends on the level and frequency of noise, the duration of
friends, and a loss of sensitivity to sounds in the environment. The severity of the
There is only a gradual, progressive loss of communication with colleagues, families.
often unnoticed because there are no visible effects and in most cases no pain.
occupationally. Although noise-induced hearing impairment is very common, it is
impairment is the most well-known and probably the most serious, especially
Of all the adverse effects of noise exposure, noise-induced hearing loss or

lower noise exposures (Schulte, P. C. 2005),
environment have more lose-time accidents and are less productive than those with
important role on work performance. Studies have shown that workers in high-noise
headaches, high blood pressure, fatigue etc. Noise has also been shown to play an
impairment (NHL), tinnitus, interference with speech communication, annoyance.
The adverse health effects of noise exposure include noise-induced hearing loss or

2.4.1 Health Effects of Noise

and prevalence of noise-induced hearing loss on Zimbabwean Industries is available.
1992). No collated scientific data on noise levels, noise exposures and incidence
noise-induced hearing loss at the level of 30% has been reported (Revere et al.
hearing protection is either poor or non-existent and as a result prevalence of
machinery used in their industries tends to be older in these developing countries.
as engineering controls are not used as widely as in developed nations and the
(994). The noise levels are higher in less developed countries (including Zimbabwe)
countries may be exposed to noise levels in excess of 85dB(A) (Revere et al.,

For checking the effectiveness of prevention / control measures:

- For noise mapping
- For the identification of noise sources
- For stationary purposes
- The assessment of personal noise exposure

Purpose including:

- Bird (Buel and Kjær, 1984). Noise measurements can be carried out for various determinants to human health, thus permitting appropriate corrective measures to be assessed. Noise to enable the determination of noise-level thresholds which may be measurement of sound provides detailed and objective means of describing and

2.4.2. Measurement of Noise

(Commissioner for Health Annual Reports 2000/2002)

- 191 cases or 56.5% of all received cases in 2002
- 176 cases or 55.3% of all received cases in 2001
- 170 cases or 46.3% of all received cases in 2000

Commissioner for Health within 2000 and 2002 were as follows:

- Occupational conditions, claims for noise-induced hearing loss received by the prevent it from occurring. In South Africa, hearing loss is one of the leading reported
- 1965. This type of hearing damage can never be repaired. Thus the critical need to sensitivity caused by damage to the sensory organs of the inner ear (Gural and Klear

Long stays in a noisy environment can lead to permanent reduction of hearing
Reports and certificates of such calibration should be maintained.

calibrated at 12-months intervals by an accredited laboratory (SABS C083:1996).

should be ensured by the use of instruments that have been electric-acoustically

be based on a random sampling strategy and the accuracy of the measurements

whether there are noise peaks (NIOSH, 1996). Noise measurements should always

used to determine noise levels, to identify the sources of noise and to evaluate

been exceeded (see Table 2.1 below). The integrated sound level meter can also be

1996), where the noise is more than 100% of the daily TWA of 90 dB (A) has

a worker's pocket and the read-out is directly in percentage above (deviation of el

during the work shift (OSHA, 1998). The noise dosimeter is convenient as it gives the

cases where the noise levels fluctuate or when the worker moves around frequently

1998). Personal noise dosimeters are more suitable for measuring noise exposure in

the use of noise dosimeters or A-weighted integrated sound level meters (DIN).

measurements are being undertaken. Personal noise exposure can be evaluated by

Measuring methods and equipment used vary depending on the purpose for which
Elimination of noise sources, processes or equipment.

Noise control and prevention measures include the following:

- To improve employee comfort and work efficiency.
- To prevent the hazard of permanent hearing damage.

The control program is two-fold:

- Implementation of noise control and prevention measures. The purpose of any noise control and prevention measures.
- The outcome of the noise measurement provide a sound basis for the planning and

### Table 2.1: Conversion From Personal Noise Exposure to 8 hour TWA

<table>
<thead>
<tr>
<th>Noise Level</th>
<th>TWA Limit (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>90</td>
<td>110</td>
</tr>
<tr>
<td>90</td>
<td>100</td>
</tr>
<tr>
<td>88</td>
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<td>86</td>
<td>60</td>
</tr>
<tr>
<td>85</td>
<td>50</td>
</tr>
</tbody>
</table>

Sound level
Regulations, 2003)

Limit at 85dB(A) at South Africa Noise Induced Hearing Loss
Progressive legislation internationally has however placed the TWA noise exposure
should not be more than 90dB(A) (Fairclough and Works Regulations, 1975).
Weighted average (TWA) noise exposure for an 8-hour day and 40 hour week
The Regulations and Works (General) Regulations of 1982, the maximum Time-
(OLEs) have been gazetted in Zimbabwean health and safety statues. According to
Noise is one of the few workplace stressors for which Occupational Exposure Limits
2.4.4. Legal Limits

Programmes.
All these principles are encompassed in well-designed Hearing Conservation

- Use of hearing protection device by exposed personnel (Schultheis et al, 2005).
- Improving machinery maintenance procedures.
- Controlling noise transmission through the workplace.
- At source noise reduction.
- Processes (i.e. welding for riveting).
- Substitution of noise generating processes by non-noise generating
Knowledge

measurements to establish occupational exposure limits. Thus, adding to scientific

sources of noise in these grinding mills and compare the collected noise

27 grinding mills in the Bulawayo area from 2003 to 2005. To identify common

levels in small-scale grinding mills by analyzing measurement results collected from

Therefore, the aims of this study are: to determine and describe the prevailing noise

evaluate the extent and magnitude of this problem in this fast growing sector.

a growing employer of labour. However, no studies have been carried out to

recognized as a major contributor to the National Gross Domestic Product as well as

years seen a major growth of the small to medium scale sector, which has now been

and safety hazards in small-scale industries. Zimbabwe has over the past fifteen

Studies in sub-Saharan Africa have identified noise as one of the prominent health

hazard (its adverse health effects) have been well documented in various studies.

The ubiquity of noise as an occupational hazard and the seriousness of this

2.5 Rationale of study
Membership Register of the Bulawayo Chapter of the Small-Scale Mills Association was generated from the City of Bulawayo’s License Register and from the employing 100 fewer workers in their operations. A list of such small-scale mills provided by the study population were all the small-scale grinding mills in the Bulawayo area.

3.3 Study Population and Sample

In the Bulawayo area, a noise survey carried out in small-scale grinding mills from October 2003 to June 2005. This study was a retrospective descriptive study of results from a cross-sectional analysis.

3.2 Study Design

In this chapter, the materials and methods used in carrying out this study are described. The study design, study population and sampling strategy are discussed.

3.1 Introduction

Methods and Materials

CHAPTER THREE
Survey

disqualified, leaving a total of 27 grinding mills whose results were used in this
After the application of the inclusion/exclusion criteria, 6 grinding mills were

Exclusion criteria: Grinding mills employing 10 or less workers within the Bulawayo area.

Inclusion criteria: Grinding mills in the Bulawayo area employing 10 or fewer

For purposes of this study, the following inclusion and exclusion criteria were set:

assessments from October 2003 to June 2005, a period of 20 months.

were visited and noise measurements carried out as part of routine workplace

From the above two sources, an initial list of 33 grinding mills was drawn up. All 33

Operating illegally and unregistered.

By the City of Bulawayo. Typical of small-scale entrepreneurs, several could be
necessary members of the Small-Scale Millers Association. The information they all disclosed
representation of all the small-scale grinding mills in Bulawayo as millers are not all

It should however be appreciated that the generated list is not complete and
Repealed throughout the day.

and grinding operations take approximately 10 minutes per load (bucket), which are located. All the milling operations in essence take place in one room. The de-hulling, processing machines viz: de-hullers, grinding machines, and packing area are above.

The majority of small-scale grinding mills consist of one open room in which all the

The conventional milling process involves many more intricate steps than mentioned normally 5 kg's, 10 kg's and 20 kg's, which are sealed (sewn) before being dispatched.

Grain, The milled grain is then packaged into packages of varying size and weight.

husked grain is then fed into the grinding machine where it is milled to the required

severs. This step is optional and many small-scale grinding mills skip it. The de-

hulls are removed. The grain can then be further sieved using mechanical

process. From here, the grain goes into the de-hulling machine where the husks of

stones, pieces of wood and other extraneous matter. This is virtually a manual

sieves where the grain is sieved with use of a wire-mesh screen to remove dust.

consumption. In the unconventional small-scale grain milling, the process includes

Corn goes through several steps and processes to be prepared for human
Typical grinding and de-hulling machines mounted in small-scale.

FIG. 3.1.
were noted:

The following measurement parameters were taken for 10 minutes duration in each case. Noise measurements were taken separately with all other machines switched off. Noise levels for each machine were measured individually.

The grinding machines and packaging machinery (stitching machines) were tried. These mills. At most mills, such equipment or machinery included dehulling equipment. All such grinding mills, noise sound level measurement was calibrated before and after each measuring. A copy of the calibration certificate is attached. Further, the K2000, a copy of the calibration certificate is attached (Appendix C). Further, the K2000 calibration was performed by a Bruel and Kjaer calibrator. The Bruel and Kjaer calibrator was calibrated with the assistance of a Bruel and Kjaer Model 2237, serial no. 22550740.

The instrument used for the study was a Bruel and Kjaer Integrating Sound Level.

To evaluate whether therapy are any noise peaks, intermittent noise, to determine the noise levels, to identify the sources of noise and measurements of short-term sound pressure measurements and non-steady state or Type 2 Sound Level Meter. A Type 2 Integrating Sound Level Meter is useful for Standard ISO 22494 survey method. The noise measurements were done using a

The noise measurements were done following the International
Noise control measures available/PC issued.

Shift duration.

Max P - peak sound pressure level.

L A eq 10 equivalent continuous level.

Millling machinery or equipment installed.

Number of employees.

Location/Address.

Trading name.

Information and details were routinely captured.

At each grinding mill where noise measurements were done, the following measurements were done during regular working hours.

Middle machinery and ear level within the monitored employees hearing zone.

The noise measurements were made at an average distance of the operator from the grinding mill.

Integrating sound level meter does not have the capacity to do frequency analysis.

The noise could not be characterised in terms of frequency, as the Type 2 results are in decibel (dB).

(II) Max P - peak sound pressure level.

Sound pressure level determined over 10 minutes was used.

About 10 minutes long, the L A eq 10 equivalent continuous A-weighted level in decibels determined over time integral. Because the milling cycles are

L A eq 1 - equivalent continuous sound level, which is the A-weighted sound pressure.
Presence of noise control measures.

The data was also analysed to assess noise exposure periods (work shift) and potential noise-induced hearing loss cases from this sector.

International standards by the small-scale milling industry and also identify any

international standards with national standards limits (TWA-OEL) and

90dB(A) and the internationally recommended level of 85dB(A). The results will be

national Time-Weighted Average – Occupational Exposure Limit (TWA-OEL) or

The data was also analysed to indicate whether or not noise levels were above

machines and packaging machines.

activity producing the loudest noise between the grinding machines, de-hulling

The results of the analysys will be used to identify the grinding mill equipment or

significance.

variance (ANOVA) and Fisher's least significant. The test was done at 5% level of

with national and international OELs. This was achieved through analysis of

noise levels from various milling equipment or operations and whether they complied

packaging were analysed to determine whether there were any similarities in the

calculated. Measurements from the grinding machines, de-hulling machines and

mean, sample variance, sample standard deviation and sample range were

Data were analysed to show the distribution of noise measurements. The sample

3.6 Data analysis plan
analytical results were presented.

Names and locations of the grinding mills were not released. Only pooled data
analyzed of secondary data and no human subjects were involved.

PC. J/444/dsk/06 (see Appendix B) as the focus of the research was mainly the
Human Research Ethics Committee (Medical) on 26th June, 2006: Reference number:

Ethics approval for the study was granted by the University of Witwatersrand.

3.7 Ethics and confidentiality
processes, viz. de-hulling, grinding and packaging.

Standard deviation and range among other variables for each of the four milling
were analyzed to determine sample mean values, sample variance, sample
ranging or intermittent sources better than Max Peak measurements. The data
therefore selected for data analysis because LAG characterises noise from
grinding operations is intermittent in its nature. LAG measurements were
figures were analyzed and presented for this study as the noise from the
study. The overall results are presented in Table 4.1. The LAG measurement
measurement results from 27 grinding mills were available for analysis during this
pressurer levels) and 83 max P (maximum peak sound pressure levels)
A total of 83: 10 minutes LAG (equivalent continuous A-weighted sound

4.2 Description of statistics

These results are then discussed.

and 85dB(A) respectively through the use of frequency tables, implications of
Zimbabwean and international Occupational Exposure limits of 90dB(A)
mean noise levels from the various milling operations are then compared with
levels between grinding machines, de-hulling machines and packaging. The
variance (ANOVA) is used to examine and describe the relationship of noise-

The data were first simply described and its distribution characterised. Analysis of
in this chapter, the analyzed results of the study are presented and discussed.

4.1 Introduction

CHAPTER 4

RESULTS AND DISCUSSION
## Table 4.1  Results of noise survey in 27 small-scale grinding mills

<table>
<thead>
<tr>
<th>GRINDING MILL</th>
<th>NO OF EMPLOYEES</th>
<th>SHIFT DURATION</th>
<th>PPC USE</th>
<th>DE-HÜLLER dB(A)</th>
<th>GRINDING MACHINE dB(A)</th>
<th>PACKING MACHINE dB(A)</th>
<th>SIEVER dB(A)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L_Aeq</td>
<td>Max</td>
<td>L_Aeq</td>
<td>Max</td>
</tr>
<tr>
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<td>10</td>
<td>9 hours</td>
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<td>96.1</td>
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<td>97.5</td>
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<td>6</td>
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<td>96.1</td>
<td>97.3</td>
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<td>B.S.4</td>
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<td>B.C.6</td>
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<td>271</td>
<td>26</td>
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<td>65.6</td>
</tr>
</tbody>
</table>

Scale grinding mills

Table A.2 Description of 10-minute mean noise measurements from 27 small.

Table A.2

Noise levels ranged from 81.2 dB(A) to 104.2 dB(A) The results are presented in the following formula:

Average Lp = \( \frac{1}{10 \log_{10} \frac{1}{n} \sum_{i=1}^{n} \left(10 \log_{10} L_p^i + 4.2\right) \right) \)

Average Lp = \( \frac{1}{10 \log_{10} \frac{1}{n} \sum_{i=1}^{n} \left(10 \log_{10} \left(1/p + 1/p_{104.2} \right) + 4.2\right) \right) \)

Following formula:

The sound pressure level of the average sound pressure was determined using the (dB) first of all, the average sound pressure in Pascals (Pa) was calculated. The in calculating the sample mean noise levels of average sound pressure levels (in
machines (2.08).

The noise measurements for packaging (c.8) and the least variance from de-hullimg
than de-hullimg machines. The standard deviations indicated a larger variance in
96.2dB(A) and 95.4dB(A). However, grinding machines were marginally noiser.

Sample mean values for grinders and de-hullers were almost the same (i.e.
machines to 96.2dB(A) (C1: 94.5 to 96.7dB(A) for grinding machines. The
mean noise levels varied from 96.3dB(A) (C1: 79.6 to 91.4dB(A) for shaving
Fig. 4.1: Combined line graph showing the distribution of mean noise levels from 27 grinding mills.

Figures 4.1 and 4.2 show the distribution of the mean and maximum noise levels.
The noise patterns for both the Lay and mex P groups were similar.

Recorded noise levels for sawing machines were the lowest (all below 90dB) in the laying machines were generally higher with peaks of over 100dB being observed. Both mean and maximum peak noise readings from grinding machines and de-

Levels from 27 grinding mills

FIG. 4.2 Combined line graph showing the distribution of maximum noise

Grinding mill

Noise level (dB(A))
From the one-way ANOVA table:

\[ F = \text{Fisher's test statistic} \]
\[ F_{79} = \text{critical value selected} \]
\[ MS = \text{mean squares} \]
\[ SS = \text{sum of squares} \]
\[ df = \text{degrees of freedom} \]

Where: \( a = \text{level of significance} \)

\[ a = 0.05, F_{0.05} = 3.394 \]

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>MS</th>
<th>df</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Error</td>
<td>79</td>
<td>8.90</td>
<td>79</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1720.69</td>
<td>23.94</td>
<td>82</td>
<td></td>
</tr>
<tr>
<td>Treatment</td>
<td>339.32</td>
<td>101.79</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

Table 4.3: One-way ANOVA noise readings treatment results table

The results of ANOVA are presented in Table 4.3. The hypotheses being tested is there is a significant difference. The results of ANOVA are difference between the above mentioned noise measurement; the alternative basic assumption of hypotheses for the analysis was that there is no significant difference between the noise measurement, grinding machinery, stamping machines and packaging. The noise exposure levels form the four different milling processes or equipment, viz.:

- Analyses of variance of ANOVA was used in this study to compare and to determine whether there were any significant differences between the measured.
are presented in Table 4.4.

national and international OELs and the Action Level was analysed. The results

Compliance of the noise levels of each of the grinding mills' four processes with

Action Level (WHO, 1980).

contamination programs are supposed to be initiated. This is known as the

is a noise exposure problem. BGB 6(4) is the noise level at which hearing

South Africa nearly have recommended an 8-hour OEL of 85dB(A). Where there

regulations. However, international organisations like ILO, ISO, NIOSH and even

noise exposure over 8-hour working period is 90dB(A) (Factories and Works

according to Zimbawwean legislation, the Occupational Exposure Limit (OEL) for

4.4 Do noise levels comply with statutory exposure limits?

machines, conveyors and packaging at 5% level of significance.

there are differences in the noise levels between the grinding machines, de-hulling

The null hypothesis was therefore rejected in this case and it was concluded that

F (38, 144) > F (3.9, 3.4)
machines complied with the national OEL. For noise exposures, however, 66.7% of packaging operations and 100% of sieving operations complied with the national stationary requirement of 86.4 dB(A). The majority (over 96.2%) failed to comply with the national stationary requirement of 68 dB(A). 3.7% of grinding machines had noise measurements below the OEL of 90 dB(A). For the national (Zimbabwean) OEL, only 3.9% of the de-hulling machines and machines complied with this standard.

<table>
<thead>
<tr>
<th></th>
<th>3.33</th>
<th>0</th>
<th>0</th>
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<td>66.7</td>
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<td>0</td>
<td>6.9</td>
</tr>
<tr>
<td>3.7</td>
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<td>7.2</td>
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<tr>
<td>3.9</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>6.4</td>
</tr>
</tbody>
</table>

All the leaf noise measurements from all the four milling processes were above 9.0 dB(A).

Table 4.1 (a) International OEL, 85-85dB (a)' and (b) Zimbabwean OEL - 90dB (a)

Compliance of leaf noise measurements with a Action Level-80dB...
operations.

Shifts increase the exposure of grinding mill employees to noise from the milling
10-hour shifts (33.33%). Only 11.1% worked the normal 8-hour shift. Long work
From the above table, the majority of employees worked 6-hour shifts (51.9%) and

<table>
<thead>
<tr>
<th>N  =  27</th>
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<tbody>
<tr>
<td>3.70</td>
</tr>
<tr>
<td>33.33</td>
</tr>
<tr>
<td>51.90</td>
</tr>
<tr>
<td>88.88</td>
</tr>
</tbody>
</table>

employees in the 27 grinding mills.

Table 4.5 Frequency table showing the length of shifts worked by
presented in the frequency table 4.5.
The results of the exposure periods of workers in the 27 grinding mills are

4.5 Exposure periods

compliant with the international OEL of 65dB(A)
and packaging operators were in compliance with Zimbabwem OEL, but not fully
comply with both Zimbabwem and international OELs for noise exposure. Seeing
Generally, noise measurements for de-hulling and grinding machines related to
Machine operators exposed to the highest noise levels.

This study was exposed to high noise levels with de-filling and grinding employing 10 workers. All 195 employees in the 27 grinding mills covered in employees with 29.63% of the mills employing 7 workers and 25.93% to 10. Over 50% of the grinding mills however employed more than 7.

The various grinding mills employed a total number of workers ranging from 3.

Small-scale grinding mills

Fig. 4.3 Line graph showing the distribution of employees in the 27

A line graph was used to describe the distribution of employees in small-scale grinding mills, refer to figure 4.3.

Exposed population
Table 4.6 Frequency table showing provision of noise control measures

<table>
<thead>
<tr>
<th>Measure</th>
<th>100</th>
<th>27</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise control</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

In 27 grinding mills.

Of the 27 grinding mills covered in this study, none (0%) had any form of control existing noise controls.
exposure standard of 85 decibels (A). The workers' noise levels did not significantly cover
Zimbabwean OEL, 74.9, at 89 decibels (A) was still in excess of the international noise
study. The mean noise level for grinding machines, although in compliance with the
study, was higher than the mean noise level of 68.2 decibels (A) from the milling machine.
For grinding machines, the mean noise level was 91.2 decibels (A) and for deskilling machines, it was 65.4 decibels (A).

The mean noise level significantly in excess of the Zimbabwean standard OEL, 74.9 to 90 decibels (A) and the
introduction of a recommendation exposure standard for the plant's grinding machine.

Workers in small-scale grinding mills in Bulawayo are exposed to noise levels
exposed to noise levels above 60 decibels (A). The results of this study established that
M. G. Sites in Zimbabwe, a relies on national health regulations that 36 operations in these mills were
exposed to noise levels above 60 decibels (A).

Long hours of work, another ergonomic study on small-scale grinding mills by
exposure to excessive noise, chemical hazards, dust, poor lighting, manual handling and

(2004) identified some of these occupational health and safety problems, as being

Several studies undertaken in various parts of sub-Saharan Africa have denominated
with national and international OELs of 90 decibels (A) and 85 decibels (A) respectively.

Several of noise in these grinding mills and to compare the prevailing noise levels
in the Bulawayo area. The study was specifically meant to identify the major

The aim of this study was to describe noise levels from small-scale grinding mills

Discussion

DISCUSSION AND LIMITATIONS

CHAPTER FIVE
The extent of hearing loss or hearing impairment depends on the level and frequency of noise. The duration of the exposure and the susceptibility of the ear vespernes.

To be one of the major occupational health and safety problems facing small-scale businesses, both Lowenson (1989) and Alzheimer (1989) studied long hours of work. The worked 6-hour shifts and 37.7% of the mills. Of the mills, 68.7% worked 6-hour shifts. The majority (61.9%) of the mills recommended 8-hour shifts, on which OEL-24A exposure standards are based.

Over 65% of employees in grinding mills worked shifts longer than half a day. Level of 86 dB(A) for packaging was mostly due to background noise from grinding.

The mean noise which is 34 dB higher than the one alone (before and after 1986). The mean noise from two equally intense sound sources operating together produce a sound level expected is double up to about 38 dB(A). This is based on the premise that noise simultaneously (as is often the case in busy cafés) the resulting noise exposure is significant. In cases where the grinding and de-scaling machines are operated.

There was no significant difference between the two machine types at 5% level of de-scaling machines. With noise levels of 98 dB(A), and 85-45 dB(A), the major sources of noise in grinding mills were found to be grinding machines.

Permanent hearing damage (NIOSH, 1999).

Average noise levels exceeding 80 dB(A) over 8-hour working day can cause exposure of the action level of 80 dB(A). If has been established that exposure to operations like de-scaling, grinding, sifting and packaging had noise readings in

packaging operations, so it is not possible to compare these. All four grinding
94 dB(a) (A) the recommended "safe exposure period should not be more than 4
and at 120 dB (A), only 30 seconds can be allowed. Therefore, at noise levels of
ZnMpeg, then at 93dB(a) (A), the time allowed will be 4 hours, at 67dB(a) (A) 2 hours
mill (Blair and Kheir, 1986). Where the 8-hour TWA limit is set at 90 dB (A) as in
environmental noise levels over each 3dB increase in noise level above the set TWA
Regulations, 1976) ISO standards require that the time spent in a noise
over the stationary time-weighted average limit (Factories and Works General
The legal requirement is that employees must not be directly exposed to noise
94 dB(a) (A) for the 10-hour shift (see Appendix D and E).
shifts the applicable daily noise dose (Lepd) from grinding machines becomes
nonmonotonically can be used to compute the daily noise dose (Lepd) based on these
of time for which each level exists over the working day (Harrison et al. 1996) A
increase, the daily noise or Leq is a function of both noise levels and the length
measure when assessing personal noise exposure where the noise levels
The daily noise dose (Lepd) of an employee is an important parameter to
assessment and occupational hygiene monitoring purposes (Occupational Health
exposure are the preferred parameters for quantifying noise exposure for both risk
hour working day and time-weighted average (TWA) 8-hour equivalent noise
individual exposed (ILC, 1998). Noise exposure level normalized to a nominal 8-
The occupational noise exposure assessment of small-scale grinding mills clearly indicates that workers in this sector are exposed to noise levels in excess of the recommended 8-hour TWA (90 dBA) for periods longer than the recommended 8 hours. This is consistent with the findings of a study by Hamilton et al. [1].

<table>
<thead>
<tr>
<th>Duration (min)</th>
<th>Noise Exposure (dBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>117</td>
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<tr>
<td>2</td>
<td>114</td>
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<tr>
<td>2 hours</td>
<td>96</td>
</tr>
<tr>
<td>4 hours</td>
<td>93</td>
</tr>
<tr>
<td>8 hours</td>
<td>90</td>
</tr>
</tbody>
</table>

Table 5.1: Noise exposures equivalent to 90 dBA for 8 hours based on TWA (98).
measurements. Although the sound level meter could have been one of
(built and later calibrated Model 2237) were done before and after all
equipment used to collect data. Daily field calibrations using an acoustic calibrator
0833: 1996) could not be done. To maintain some measure of accuracy and
dependability, annual standard calibrations of the equipment (as required by SABS
problems, annual standard calibrations of the equipment (as required by SABS
calibrated to ensure accuracy and reliability of results. However, due economic
It is important that all equipment used in such measurements should be correctly
measurements were made (5) years old of the commencement of the study in 2003:

(ii) The standard reference calibration for the equipment used for noise
be fully representative of the small-scale grain milling industries nationwide.
(i) The sample size for this study (60 cases less than 30) was rather small and might not

5.2 Limitations of the Study

without no precaution offered.
were exposed to a variety of occupational hazards including excessive noise levels
2004) and Nigeria (Tiega 2005) which established that employees in this sector
carried out in small-scale enterprises in Kenya (Achimbo 1999), Tanzania (Kagwe
The results of this study go a long way to confirm the results of other studies

concern, requiring further studies.
cases from a combination of the above-mentioned factors are a serious cause for
exposed employers. The implications on resultant noise-induced hearing loss
of prevention measures are being implemented by the mill owners to protect their
OES are based on. Despite this excessive exposure, no noise control reduction
and for longer periods than the reference exposure periods (Groups) on which
excess of both international and national occupational exposure standards (OES)
Warnered.

cased on or magnitude of potential NNL claims to be complicated can be
consequent noise induced hearing loss (NNIL) and to give a general idea of the
other small-scale enterprises need to be carried out. Further studies to explore
follow-up studies to give a more comprehensive picture of noise exposure in
industries is signifies by small-scale grinding mills. However, the long term
preventive measures suggest noise exposure for employees of small-scale
regarding the excessive exposure to occupational noise and the absence of
In spite of the limitations noted above, this study does provide useful information

(Department of Employment, UC 1972).

may be based on the sample periods that are typical of the working day
normally necessary to measure the sound level during the entire shift. Assessment
measurement to determine whether the acceptable limit is exceeded, it is not
would have given a more accurate assessment. However, when making
exposure periods and levels. The use of dosimeters (tielable) over a full shift
worker movements about their workplaces. All these inevitably affect the
breakdown of milling equipment, periods when there was no grain to mill and
contains to consider include the breaks between the milling cycles, possible
exposure levels over a longer 6 to 11 hour working day for 6 days a week
one or two milling cycle and more therefore not accurately characterize

lll) Measurements for this survey were once of each work-station covering

susceptible conclusions arrived at in this report.

been large enough to give any significant impact on the overall findings and
specification, I do not believe that any resulting measurement error would have
6.1 Conclusions

CONCLUSION AND RECOMMENDATIONS

CHAPTER 6
The legislation should also include the mandatory display of noise control measures, training, use of hearing protection devices, employment periodic and exit audiometric testing, preventive operations, measuring noise levels, health surveillance (pre), permanent issues as mandatory risk assessments to identify noisy comprehensive legislation and noise regulations to include such National Social Security Authority, need to put in place

6.2.2 Government through responsible ministries and statutory bodies e.g. noise reduces, as this is not a legal requirement

machinery manufactured locally (in Zimbabwe) does not display machinery with lower noise ratings, unautomated, most milling equipment, entrepreneurs should select grinding and de-hulling

6.2.1 When purchasing new grinding mill machinery or replacing older preexisting, control and protective measures that can be implemented. should be the last resort. The following are some of the recommended expose workers to lower noise levels, protective measures e.g. hearing protective devices, emphasise should always be on preventive measures, followed by noise in addressing the identified noise exposure problem in small-scale grinding mills.

6.2 Recommendations

preventive measures to address this situation.

6.1.5 There is therefore need to put in place innovative, comprehensive place to protect the workers.

6.1.4 Despite the evident risk of employees from this sector developing noise-
6.25 The interior of the grain feeding hoppers for both grinding and de-
shelling machines can be coated with resilient materials such as-
6.26 Sound reflexing or absoibing materials can be used to reduce the 
surface of the hopper and consequentlly reduces the noise produced.
be reduced. This reduces the impact energy of the grain on the 
hoppers. The height at which grain is poured into hoppers can also
synthetic rubber to reduce noise when grain is fed or poured into the
building machines can be coated with resilient materials such as

6.24 The milling machines should be mounted on vibration isolating or-
6.23 Reducing the power of the electric motors and diesel engines used
6.22 An ideal way to enable clients to make informed decisions when
products or sold in
6.21 The milling machinery (van Neckel, 2005)
Options for consideration include:

- Reducing exposure duration should be considered. Where possible, by avoiding exposure to noise.
- Reducing the noise exposure of employees who are exposed to noise sources.

6.2.9 If it is not possible to reduce the noise to below 85dB(A), the
unnecessary friction and vibrations that are potential noise sources,
of loose parts, replacement of worn parts. The reduction
includes
- Lubrication, greasing of moving parts and nipper. Tightening
- Servicing by competent persons. Maintenance of such machinery

6.2.8 All machinery in grinding mills is to be regularly inspected and
are not necessarily exposed to excess noise.

6.2.7

Openings in the partition, this will ensure that packaging
partition walls go up to the roof and that there are a minimum of
low noise areas need to be totally partitioned off by ensuring that
from packaging that is generally low noise operation. The high and
noisy operations viz. de-nailing and grinding should be separated

(Department of Employment, 1972)

Materials should not pass a fire or health hazard though.
Reduced by the use of absorbent materials on walls. Absorbent
large wave energies and is not easily reflected. It can however be
used to protect workers. Low frequency noise on the other hand has

can be reduced. Barriers or reflective surfaces can therefore be
not done in this study. High frequency noise is more directional and

appropriate controls. There is need to further characterise the noise

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Required collective measures. Government can assist by funding or

policies.

workplaces. Hopefully this can result in positive behaviour changes by both

of the adverse health effects of excessive noise exposure in their

can have sufficient understanding of their particular noise environments and

Awareness raising amongst owners and workers is necessary so that they

The hazard posed by excessive to the prevailing high noise levels.

6.2.12 From the study, it appears both employers and workers do not appreciate

Threshold loss (temporary or permanent).

Auditory metric levels to check for the incidence and extent of any hearing

6.2.11 All workers exposed to noise levels in excess of 85dBA(a) are to be sent for

encouraged and enforced by the employers.

The use of such hearing protection devices should be

effective hearing protection devices able to attenuate the noise to below

these areas are to be provided (free of charge) with appropriate and

designated as noisy areas and clearly marked as such. All employees in

6.2.10 All areas in the mills with noise levels in excess of 85dBA(a) are to be

efficiency or reduce overall production (Cambridge P.D. 1996).

These are to be implemented in such a way that will not affect

- provision of noise refuge at the workplace.

- for shorter periods. (20% rotation)

- reducing the length of the shifts so that workers are only exposed

  number of shifts.

- reducing the number of workers on a shift and increasing the
compensated in the future.

magnitude of potential noise-induced hearing loss claims to be from such exposures and to give a general idea of the case load of enterprises in general to explore potential noise-induced hearing loss give a more comprehensive picture of noise exposure in small-scale small-scale grinding mills. The results provide a basis for further studies to prevent noise exposure to occupational noise and the absence of any excessive exposure to occupational noise and the absence of any

6.2.14 This study provides useful baseline information on data regarding the

certified for this and other similar small-scale industries.

levels of over-exposed workers. Targeted hearing programs to be also assessments, noise measurements for milling premises and educational subsidizing special programs to routinely and regularly carry out risk

13. Lowerson R. Health Impact of occupational risks in the informal sector in

12. International Labour Organization Encyclopedia on Occupational Health

11. International Labour Organization. Encyclopedia on Occupational


No 263 of 1976, Section 6.

8. Factories and Works (General Health and Safety Regulations) R.G.N.


6. The Occupational Environment - Its Evaluation and
1972

5. Department of Employment, Code of Practice for Reducing the
Exposure of Employed Persons to Noise. Her Majesty's Stationery Office


3. British and Foreign Noise Control Principles and Practice. 1986

2. Business Chronicle, 16 March 2006

1. African Newsletter on Occupational Health and Safety, Editorial

Volume 2, Number 1, April 1992.

African Newsletter on Occupational Health and Safety, Editorial

mentions.
2004.  
OC Journal of Occupational Health and Safety, Volume 14, Number 3, December
among small-scale industry workers in Dar es Salaam. African Newsletter
Korgo L M, C. Information dissemination workshops reduce allergy
22. 
21. 
20. 
19. 
18. 
17. 
16. 
15. 
1996. .


List of Statistical Symbols used

Appendix A
Chail: Human Research Ethics Committee (Medical)
Professor Peter Cretzmans

Subject: Ethical Clearance

Your Reference:

The research is secondary data analysis and no human subjects are involved.

Compliance (Medical)
The centre that this project does not require clearance from the Human Research Ethics Committee.

The terms that this project does not require clearance from the Human Research Ethics Committee.

To: Dr. Mzwanele Masibuko, MPH

TO WHOM IT MAY CONCERN:

27 June 2005

PC.1444/148108

Johnsmurungi

of the Western University

Ethics Clearance Letter

APPENDIX B
RESULTS:

The measurements have been performed with the agreement of:

"..."

SPECIFICATIONS:

"..."

CALIBRATION CONDITIONS:

CLIENT:

"..."

CERTIFICATE OF CALIBRATION

DANAK

Page 1 of 2

Reg. No. 037

No. COO07343
Nomogram for the calculation of LEPd
Therefore, the L-10, for the 10 hours with everything being normal is

94.8dB(A)

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(1)

By converting 6.2dB(A) and 10 minutes, gives effective exposure J,

value of 0.998

(1)

(2)

Total J-values for 30 million cycles: 30 x 0.998 = 2.94

In a 10-hour shift, about 30 ten million million cycles are completed

Reading L-10'0 dB(A) value of 2.94 = 94.8dB(A)

Non-thermal

Calculation of L-10'0 for Estimating machine with mean noise level of 96.2dB(A) using

A P P E N D I X E