PREVENT

Noise Induced Hearing Loss

Noise Assessment Tool

Ontario

Health & Safety ONTARIO

Occupational Health Clinics for Ontario Workers Inc.

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This document is intended to assist in the understanding of practical methods that can be used to minimize the causes of noise and prevent sound transfer in the workplace. It is a resource intended to be used in conjunction with other processes when planning the implementation of corrective action.

The contents are organized to complement the Noise Assessment Procedures & Resource Materials document and to facilitate in implementing a participatory risk management and control processes. This approach is recommended by the European Union SOBANE process based on the recommendations of a team headed by Jacque Malchaire of the Occupational Hygiene and Work Physiology Unit, Université catholique de Louvain, Brussels, Belgium.

This document utilizes many images from, or based on, images used by J. Malchaire's group to explain the SOBANE Process as well as many images based on images from resources of The Swedish Work Environment Fund both of which are in the public domain.

The material contained in this manual is for information and reference purposes only and not intended as legal or professional advice. The adoption of the practices described in this manual may not meet the needs, requirements, or obligations of individual workplaces.

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Noise Assessment Tool

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1. Noise Assessment

LEVEL 1: Basic Recognition

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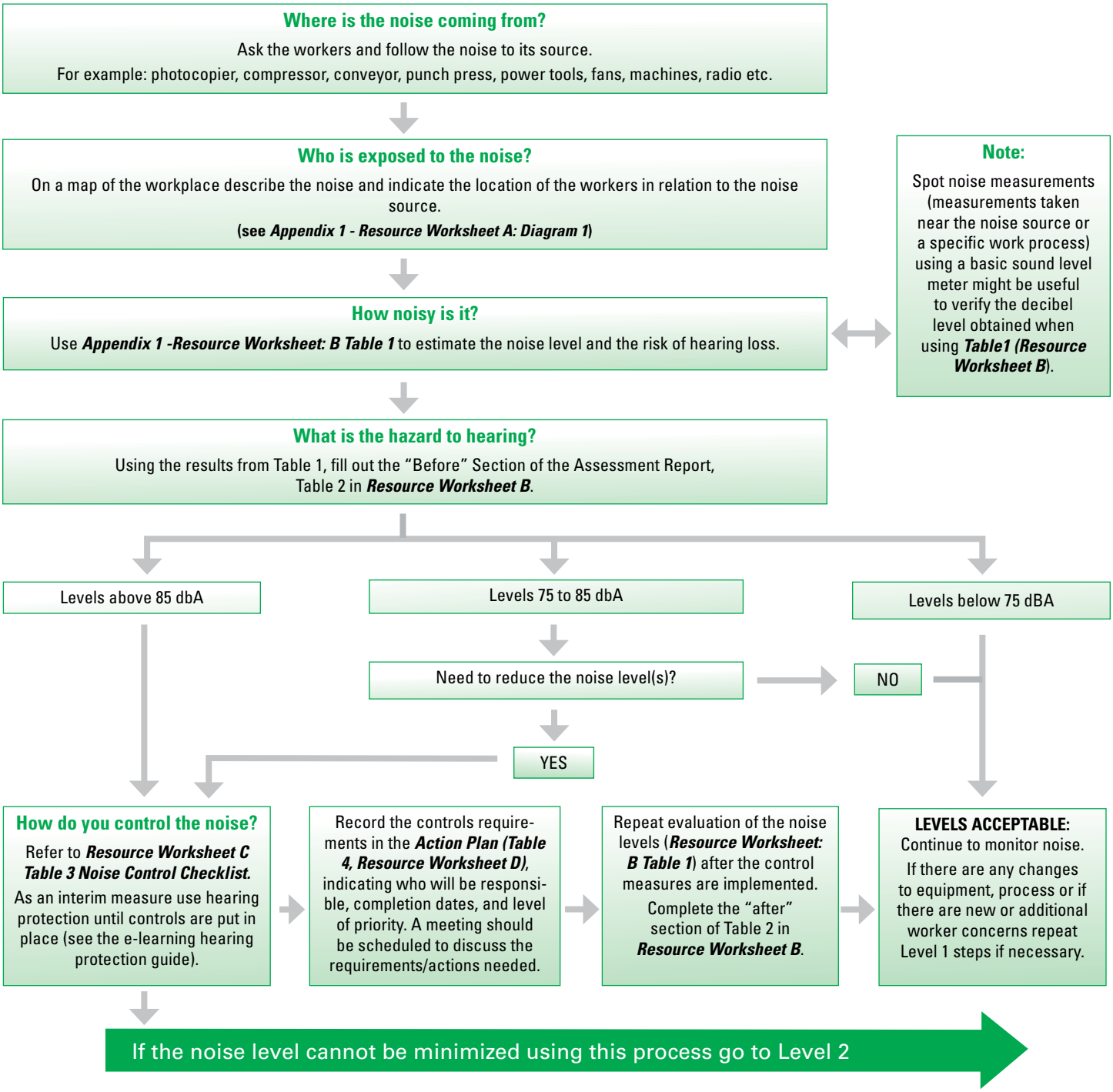
NOISE ASSESSMENT

LEVEL 1: Basic Recognition

Steps to assess the presence of a noise hazard can be followed by members from the workplace who are familiar with the working conditions including workers, health and safety committee members/representatives, supervisors or the employer. They do not necessarily need to have technical training in noise control because at this level only general information on noise sources and conditions of exposure is all that is required.

Do you have a Noise Problem?

Let's find out using very simple techniques. You will need ***Appendix 1 - Resource Worksheets: A,B,C,and D***



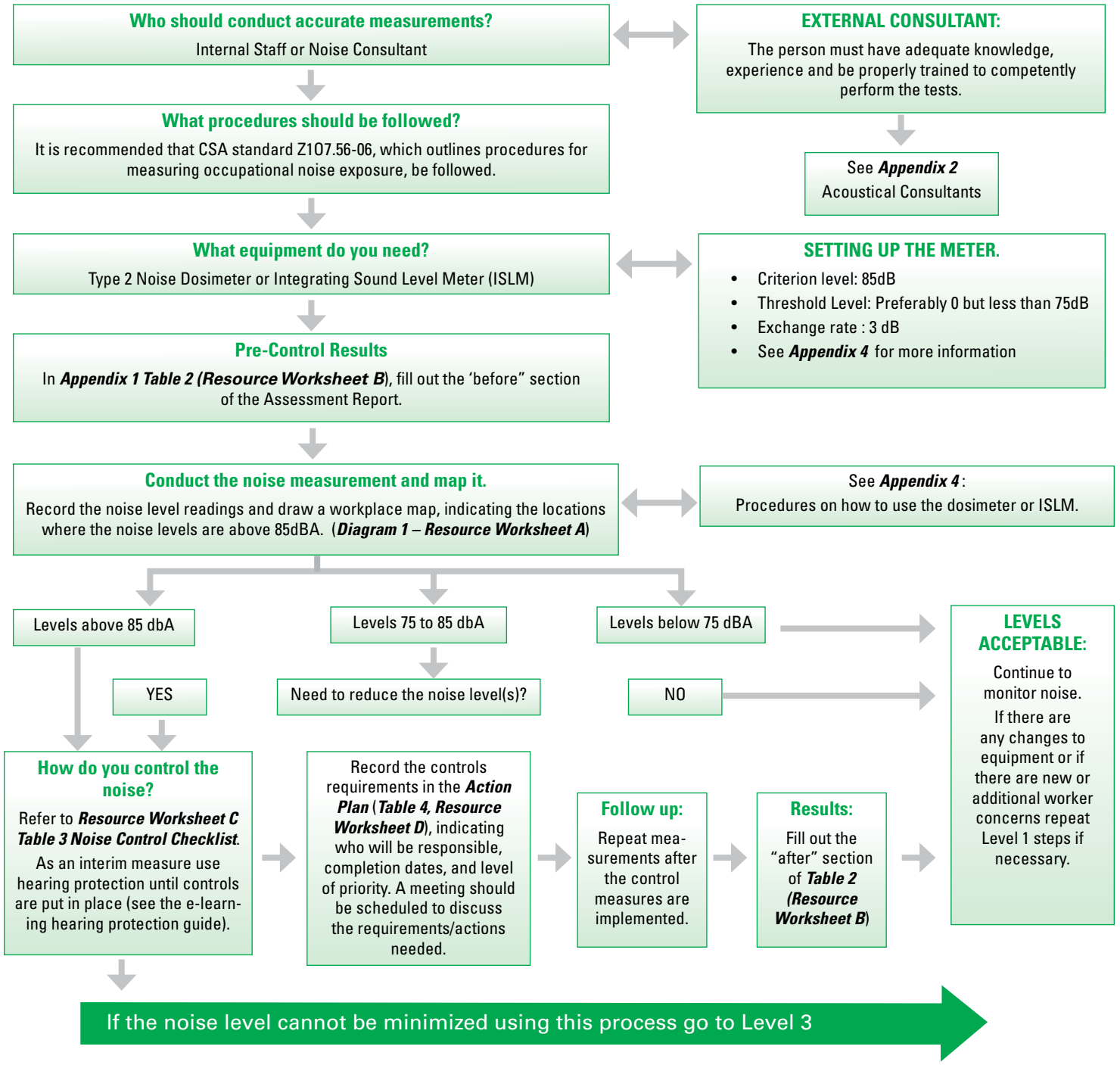
NOISE ASSESSMENT

LEVEL 2: Measurements

If you need accurate measurements to determine worker exposure then you require a Type-2 Sound-Level instrument such as a Noise Dosimeter (see Appendix 3 for description of Sound Level Meters (SLM)). A Type-2 noise instrument requires significantly more investment (they cost around $1,000 to $3,000) and adequate training to be able to use all the features of the equipment and to correctly interpret the data. People from the workplace who are familiar with the working conditions including workers, health and safety committee members/representative and supervisor or employer should be involved with the assessment at this level.

How loud is it?

Conduct accurate measurements. You will need Appendix 1, Resource Worksheets A,B,C,D, & Appendix 2 and 4.



NOISE ASSESSMENT

LEVEL 3: Professional and Specialized Help

Level 3 Assessments deal with circumstances that require complex measurements or situations where it is determined that an external noise consultant is required to resolve complex noise control problems. It may be necessary to collect additional noise measurements that require sophisticated Type I Sound Level Instruments for which noise consultants are trained. A workplace team consisting of those familiar with the workplace and the working conditions should be formed. The team should include workers, health and safety committee members/representative, supervisors and the employer as appropriate. The team will be responsible for selecting the noise consultant and work with them throughout the noise assessment implementation process.

Noise consultants can provide expertise in many different specialty areas. Their task will vary greatly depending on what is required.

Still Need Help?

Use a Noise Consultant. You will need Appendix 1 and 2.

Have you contacted your Health and Safety Association?

Contact your Health and Safety Association and ask for the ***Occupational Hygienist (Appendix 2)***. They will be able to either conduct the noise assessment for you or they can help you in the selection of a noise consultant who can implement the controls/measurements required for your workplace.

See Appendix 2 for tips on hiring a good noise consultant.

Assessment Plan

Has the hired noise consultant formalized an assessment plan to address the noise problem in consultation with the team members?

Noise Consultant's Report

Has the noise consultant conducted the necessary assessment and prepared a report for implementation?

Implement Noise Consultant's Report

Implement the noise consultant's recommendations and verify the controls are effective. Complete ***Table 2 (Resource Worksheet B)*** to see if levels are now acceptable)

LEVELS ACCEPTABLE:

Continue to monitor noise. If there are any changes to equipment or if there are new or additional worker concerns repeat Level 1 steps if necessary.

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2. Appendices

APPENDIX 1- Resource Worksheets: A,B,C,D

APPENDIX 2- Noise Consultants

APPENDIX 3- Descriptions of Sound Level Meters

APPENDIX 4- Procedures for Using a Noise Meter

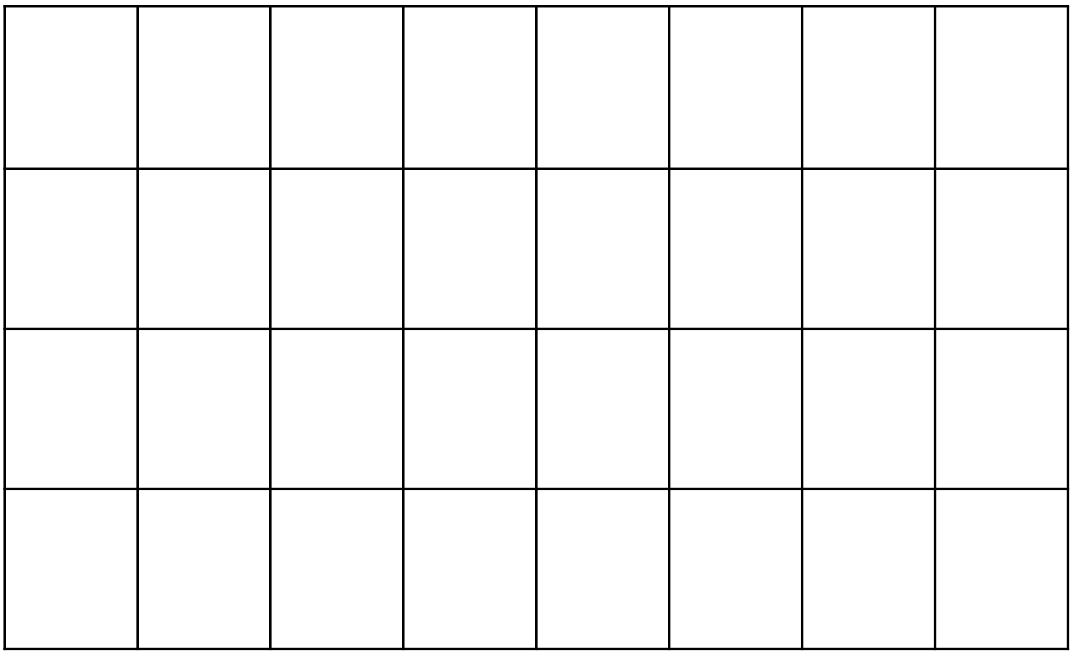
APPENDIX 5- Explanation of Terms

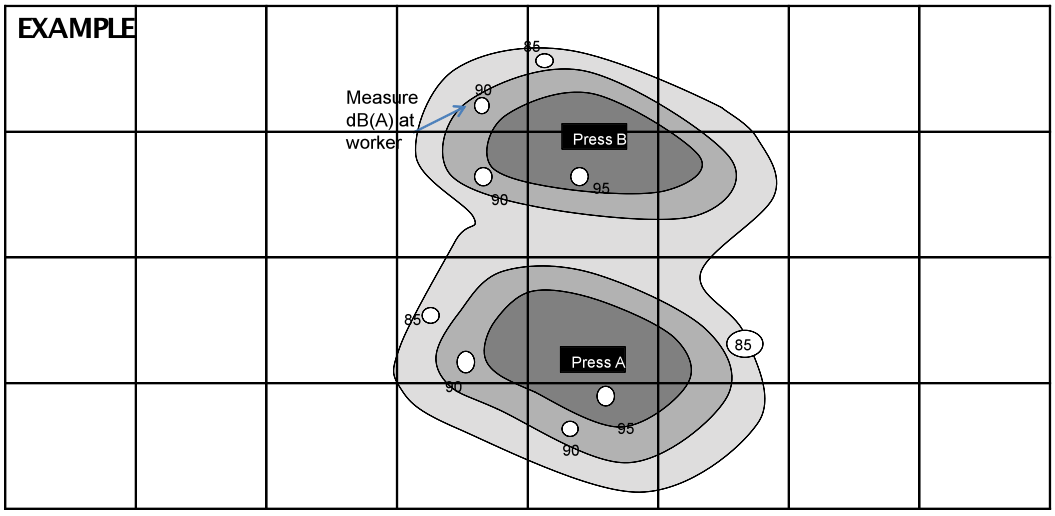
APPENDIX 1

Resource Worksheet A

Using the diagram below to draw a layout of the work area and the location of noise source(s). Insert worker locations and describe the pattern of noise through the day, whether it is continuous, intermittent, or consisting of sudden "impulse" noises.

Diagram 1: Workplace Layout and Noise Source





APPENDIX 1

Resource Worksheet B

Amount of noise and risk of hearing loss

Using the table below and the opinions of the workers estimate the voice level used one meter away, to estimate the noise level and the risk of developing hearing loss after prolonged periods of exposure to such levels.

Table 1: Amount of Noise and Risk of Hearing Loss

Voice Level: at one meter away	Normal	Raised voice	Loud	Very Loud	Shouting	Maximum Shouting
Noise Level (in dBA)	50 to 60	70 to 75	80	85	90	100
Risk Level	None	Distracting, Annoying, No risk of Hearing Loss	Annoying, Unpleasant, Slight Risk of Hearing Loss	Some Risk of Hearing Loss	Medium Risk of Hearing Loss	High Risk Of Hearing Loss

NOTE:

Spot noise measurements (measurements taken near the identified noise source or a specific work process) might be useful to verify the decibel level obtain by using Table 1. Taking spot noise measurements does not require sophisticated equipment or highly trained personnel and can be conducted using a simple Type 3 sound level meter (see Appendix 3 for description of a Sound Level Meter). A Type 3 sound level meter can be purchased for approximately $100 from electronics suppliers.

Additional equipment may be available from your safety association.

Table 2: Assessment Report

Before				Control	After		
Noise sources or activities	Voice level	Noise level	Risk	Look over the Control Checklist (***Resource Worksheet C***) to see how to reduce the noise levels	Voice level	Noise level	Need for a detailed analysis
Noise Level (in dBA)	50 to 60	70 to 75	80		85	90	100
Risk Level	None	Distracting, Annoying, No risk of Hearing Loss	Annoying, Unpleasant, Slight Risk of Hearing Loss		Some Risk of Hearing Loss	Medium Risk of Hearing Loss	High Risk Of Hearing Loss

APPENDIX 1

Resource Worksheet C

TABLE 3: NOISE ASSESSMENT & CONTROL CHECKLIST (Pgs. 9-10)

For more information on each of these controls refer to the document "Noise Control"
Noise Control Checklist: place an x for not applicable, v' for applicable and ? for not sure

SOURCE	EXAMPLES OF CONTROLS	COMMENTS
Reduce Vibrations causing mechanical noise	■ Balance rotating parts	
	■ Sharpen blades	
	■ Use helicoidal gears instead of toothed gears in order to reduce the impacts associated with the interlocking gears and the associated noise and vibration	
	■ Install isolation dampers (springs, cork, etc)	
	■ Tighten parts or panels	
	■ Use flexible connections for electrical, compressed air or hydraulic piping	
	■ Use plastic (non-metal) materials (where safe to do so)	
	■ Change the speed of rotating parts to minimize pure tones	
	■ Cover parts with a rubber material (where safe to do so)	
Ground transmission of vibration	■ Install isolation dampers (springs, cork, etc.)	
Elimination or reduction of the shocks and impacts of parts on a hard surface	■ Reduce the falling distances of metal objects on metal	
	■ Tilt the plate on which the parts are falling so that parts fall on an angle rather than perpendicularly	
	■ Ease two objects into contact together before pushing one with the other(change work habits)	
	■ Cover it directly or in a sandwich with a rubbery material	

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For more information on each of these controls refer to the document "Noise Control"
Noise Control Checklist: place an x for not applicable, v' for applicable and ? for not sure

SOURCE	EXAMPLES OF CONTROLS	COMMENTS
Metal surfaces and containers	■ Cover them with noise dampening material (old rubber belting)	
	■ Dampen the blade on power saws	
	■ Construct bins, conveyors and chutes with "noise-less" steel (resilient material such as a rubber sandwiched between two sheets of steel)	
	■ Construct with wood, plastic or other similar metals	
Mechanical noise	■ Use helicoidal gears instead of toothed gears	
	■ Use plastic materials	
	■ Balance rotating pads	
Aerodynamic noise	■ Avoid discontinuities (elbows) or sharp edges in the air stream	
	■ Use silencers in ducts	
Compressed Air	■ Find another way to do the work without using compressed air	
	■ Reduce air pressures and velocity	
	■ Use air guns specially designed to be quieter	
	■ Design process (and/or change working habits) to avoid the impact of the compressed air stream on a sharp edge or perpendicular to a surface	
	■ Use exhaust mufflers for decompression air jet	
	■ Avoid directing air jet on a sharp edge or perpen-dicular to a surface	
Exhausting compressed air	■ Use a larger exhaust opening to reduce air speed	
	■ Place a silencer on the exhaust	
	■ Do not direct the exhaust towards a wall or at an object	

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For more information on each of these controls refer to the document "Noise Control"
Noise Control Checklist: place an x for not applicable, v' for applicable and ? for not sure

SOURCE	EXAMPLES OF CONTROLS	COMMENTS
Ventilation noise	■ Balance the rotating parts in fan	
	■ Isolate air handling unit from building structure and ducting system	
	■ Place materials noise absorbing materials inside the ducts and inside air handling unit	
	■ Eliminate any unnecessary bends or sharp angles in ducting	
Pure tone	■ Regulate the speed of rotating parts to minimize pure tones	
	■ Balance rotating parts	
	■ Dampen the blade on power saw	
	■ Use rubbery materials on resonating parts	
Relocation of the source	■ Move the source away from the workers	
	■ Install a noise barrier between sources and workers	
Acoustic treatment of the room	■ Add some absorbing materials if the room is highly reverberant	
	■ Check noise transmission from adjacent rooms or the outside	
Enclose noise source Acoustic enclosure on the machine	An enclosure can be effective to reduce the noise only if:	
	■ It is constructed of a sufficiently dense material	
	■ It is covered on the inside with a noise absorbing material	
	■ The openings are reduced to the minimum	
	■ It is not directly connected to the machine (or, if connected it is made from or covered with a resilient material such as plastic, rubber, nose-less steel, etc.)	
	■ Use hermetic enclosure covered wt h rubbery materials	
	■ Install sound absorbing materials inside the cover	
Preventative Maintenance	■ Ensure moving mechanical parts are serviced regularly	
	■ Ensure periodic overhauls are conducted on a timely schedule (semi- monthly, annual…):	
	– by a qualified person and,	
	– deteriorated parts are replaced before they break	

Resource Worksheet D

Table 4: Action Plan

Noise Source(s) or Process Locations	Actions			
	What is to be done?	Who is to do it?	When should it be done by?	Rank the Priority (see Table 1)

APPENDIX 2

Noise Consultants

Acoustical consultants can provide expertise in many different specialty areas. The acoustical consultant's task will vary greatly depending on what is required. Below is a list of common acoustic specialties to assist in the hiring of the right acoustical consultant:

ARCHITECTURAL ACOUSTICS

Architectural Acoustics consultant provides solutions that deal with sound propagation, speech intelligibility and provide recommendations on such things as room design and construction materials to be used to control noise.

INDUSTRIAL NOISE CONTROL

Consultants specializing in industrial noise control deal with noise and vibration generated by equipment and machines, and implement controls in order to protect workers. The consultant can determine workers' noise exposure and the impact it could have on hearing.

Consultants offer advice on the selection and installation of new equipment or can offer recommendations as to how to control workers' noise exposure. Common industrial noise control options include engineering controls such as enclosures and isolation methods.

MECHANICAL NOISE AND VIBRATION CONTROL

Typically, mechanical acoustics address noise and vibration from building systems, especially low frequency background noise from Heating Ventilation and Air Conditioning (HVAC) units.

Consultants can inspect ducting, unit specifications and unit locations to determine any potential noise concerns. Consultants can also measure noise being emitted from existing systems and make recommendations as to how to control noise and vibration concerns.

OCCUPATIONAL HYGIENIST

A professional occupational hygienist is a person possessing either a baccalaureate degree in engineering, chemistry, or physics or a baccalaureate degree in a closely related biological or physical science from an accredited college or university, who also has a minimum of three years of industrial hygiene experience. A completed doctoral in a related physical, biological or medical science or in related engineering can be substituted for two years of the three-year requirement. A completed master's degree in a related physical or biological science or in related engineering can be substituted for one year of the three-year requirement. Under no circumstances can more than two years of graduate training be applied toward the three-year period.

Tips on hiring the right noise consultant

The quality of service will defer amongst consultants, so take your time and research the market before hiring:

- Contact several consultants and describe the particular project that you will require services for. Make sure to research the consultants you are contacting and ensure you know what their specializations are. Confirm this information once contact is made.
- If you require a noise consultant, contact several consultants and describe the particular project that you will require services for. Make sure to ask the consultant what their specialties are. See http://www.ohao.org/PDF/10_consultants.pdf for the Directory of Consultants in Occupational and Environmental Health and Safety.
- Once you have found a number of potential consultants for your project, select a consultant that has knowledge, training and experience to fix the problem and reduce the noise level below 85dBA..
- Check references and the work of the prospective consultants.
- Determine a short list of possible consultants and select one.
- Once you have selected a consultant, obtain a proposal. Meet with the consultant to make sure the consultant has a clear understanding of your noise problem before preparing the proposal.
- Once the description of work and fees are agreed upon, the proposal is signed and work commences.

APPENDIX 3

Descriptions of Sound Level Meters (SLMs)

Sound level meters come in three different types:

1. TYPE I -Precision Sound Level Meters
2. TYPE 2 -General Purpose Sound Level Meters
3. TYPE 3 Basic Survey Sound Level Meters

SLMs consist of a microphone and a read-out display. The instrument should be set on the "A" weighting because this weighting responds to sound, just like the human ear.

Typically, noise is not constant and fluctuates therefore sound level meters can be set to either a "fast" response or "slow" response. The Industrial Establishments Regulation requires meters to be set on the "slow" response. Refer to Appendix 4.

TYPE I - Precision SLMs

Type I sound level meters are accurate and expensive and are primarily used in acoustical engineering.

TYPE 2 - General purpose sound level meters (SLMs)

i. Noise Dosimeter

A noise dosimeter is a small, lightweight device that may be able to clip onto a person's belt. It has a small microphone that fastens to the person's collar near the ear. The dosimeter stores the constantly changing noise levels and calculates the average sound level (L_{ex8}). It is useful in industries where noise levels vary during the workday and/or when the wearer works at different locations with varying noise levels. A Type 2 noise dosimeter is ideal for personal noise sampling over an extended period of time. It gives an accurate picture of how much noise, from all sources, the wearer is actually exposed to over the course of the sampling period.

ii. Integrating Sound Level Meter (ISLM)

The ISLM is similar to the dosimeter (see above) however the ISLM is much larger and is a hand-held instrument as opposed to being worn by the worker. A Type 2 ISLM is generally used for measuring short term tasks and does not provide personal exposures because it is hand-held and not worn. The ISLM determines equivalent sound levels (Leq) at a particular location. It yields a single average reading of a given noise, even if the actual sound level of the noise changes continually.

iii. Non-Integrating Sound Level Meter

Non-integrating sound level meters simply measure noise levels at a given moment and cannot integrate, or average sound levels overtime. These meters may be used to take instantaneous or spot measurements to determine if further noise exposure measurements are necessary.

TYPE 3 - Basic Sound Level Meters (SLM)

Type 3 sound level meters are not capable of averaging noise levels and therefore are usually used for instantaneous or spot measurements. A Type 3 SLM is ideal for when an estimate is required. Note that a Type 3 SLM does not have the precision characteristics for testing compliance with legal exposure limits.

APPENDIX 4

Procedures For Using a Noise Meter

The following are procedures for conducting accurate measurements using a noise dosimeter or an integrating sound level meter.

A competent person must have adequate knowledge, experience and be properly trained to competently perform the tests using various noise measurement equipment such as noise dosimeters or integrating sound level meters (ISLM) (see Appendix III for more information on noise dosimeters and ISLMs).

CAUTION:

UNLESS THE NOISE IS CONSTANT THROUGHOUT THE SHIFT, IT MAY NOT BE APPROPRIATE TO USE SPOT, INSTANTANEOUS OR SHORT-TERM MEASURMENTS. MEASURE PERIOD MUST BE LONG ENOUGH TO REPRESENT THE WORKER'S AVERAGE EXPOSURE OVER AN 8 HOUR PERIOD.

Example: worker operating an electric saw for a short period of time.

A spot (instantaneous) measurement could indicate a noise level of around 95 dBA. However, if a longer reading period is used such as over the full eight-hour shift, the operator may only be exposed to an average of around 80 dBA. The reason for this is that the saw may not be operated continuously during the eight-hour shift. There will be times when the worker is performing other tasks, taking a break, or eating lunch.

A. Using a noise dosimeter

The simplest and most efficient way of measuring worker exposure is through the use a noise dosimeter.

This is a small device worn by workers while they perform their normal daily work duties.

During the course of the day the noise dosimeter continuously measures the sound level and continuously calculates the L_{ex8}. Dosimeters are able to directly compare the L_{ex8} to the allowable exposure level and when displayed as a percentage (%) dose, any result below 100% is acceptable.

Noise dosimeters must be set up in the following manner:

Criterion Level 85 dBA

Threshold Level = No higher than 75 dBA

Exchange Rate = 3 dB

Response Time = "Slow"

See Appendix 5 for an explanation of the above terms.

Procedure

1. Calibrate the noise dosimeter to make sure it is accurate.
2. Attach the dosimeter around the waist of the worker and locate the microphone as close to an ear as possible and where it will not rub on the clothing.
3. Start the dosimeter (only after attaching the microphone).
4. Measure the worker's exposure for the full shift. When monitoring workers who have work shifts longer than 8 hours, the dosimeter will automatically calculate the Lex8,
5. Record the activities of the worker throughout the day. This is important because with good notes the noise data can be reviewed and used to pinpoint the decibel level of a particular noise source or task (the software that comes with the dosimeter allows noise exposure data to be manipulated and viewed minute by minute).
6. Note that anything out of the ordinary that could have an impact on the noise levels (e.g., a slowdown in production due to an equipment breakdown). Don't forget that the noise measured must be representative of the worker's usual exposure.
7. Record the Lex8 and the percentage dose reading and download the data onto your computer using the software that comes with the dosimeter.
8. Recalibrate the dosimeter to make sure it is still accurate.

B. Using an Integrating Sound Level Meter (ISLM)

Even though this instrument works the same way as a dosimeter, it cannot be worn by workers. It requires the person doing the measurement to follow workers around while they perform their normal tasks.

Procedure

1. Break down the tasks performed by the worker.
2. The set up of the ISLM is the same as the noise dosimeter:

   Criterion Level = 85 dBA

   Threshold Level = No higher than 75 dBA

   Exchange Rate = 3 dB

   Response = "Slow"
3. Calibrate the ISLM
4. Measures the noise exposures of the various tasks performed and record the average noise. It will be displayed as the Leq.

Leq is simply the average sound level measured over the time sampled

An example is shown in the following table:

Tasks	Time Exposed(hours)	Noise Level Leq
Loading Conveyor	2	87
Using a press	3	89
Office work	2	84
Lunch and breaks	1	82
Total Time	8	

5. Re-calibrate the ISLM to make sure it is still accurate.
6. Calculate the Lex8.
   This can be done using a web based noise calculator, such as the one produced by the Occupational Health Clinic for Ontario Workers (www.ohcow.on.ca/menuweb/noisecalculator.xls). To use the calculator, enter the amount of time spent performing each activity and the corresponding noise level. When this is done, the result is an Lex8 of 87 dBA. Because the Lex8 of 87 dBA (159.9% dose) is greater than the Lex8 of 85 dBA (100% dose), the exposure is not acceptable.

	Exposure Time		Noise Level	Dose
	(hrs)	(min)	(dBA)	(%)
Loading Conveyor	2	87	87	39.6%
Using a press	3	89	89	94.2%
Office work	2	84	84	19.9%
Lunch and breaks	1	82	82	6.3%
	Total Time		Equivalent Noise Exposure Level Lex8	Total Dose
	8.00		87.0	159.9

   OHCOW also has a calculator which shows that for an Lex8 of 87 dBA, a worker can only be exposed for 5.04 hours without the use of hearing protection during an 8 hour work shift assuming an exposure limit of 85 dBA for an 8 hour period.

   Note: The calculator automatically calculates an Lex8 for any shift length.

7. Recalibrate the equipment to make sure it is still accurate.

APPENDIX 5

Explanation of Terms

Criterion level

The criterion level is the maximum average noise level that is of 85 dBA permitted over an eight-hour day. The level of concern (criterion level) starts at 85 dBA. The criteria can be found in the current Industrial Establishments Regulation (0. Reg. 851/190, Section 139) and the Oil and Offshore Gas Regulation (0. Reg. 855/90, Section 41).

Threshold

The noise dosimeter ignores all noise below the threshold level when it calculates the average level. The threshold is set at less than 75 dBA because below this level the risk of suffering hearing damage is minimal.

Exchange rate

The exchange rate is the amount of noise increase which legally requires you to decrease a worker's exposure time by half. The exchange rate in Ontario is 3 dBA.

A 3 dB increase in sound level represents a doubling of the energy of the sound. This is reflected in the exchange rate and the exposure limits for noise. For example, for an exposure level of 85 dBA, the allowable exposure time without hearing protection is 8 hours. At 88 dBA, an increase of 3 dB (i.e. the energy is doubled), the allowable exposure time without hearing protection is halved to 4 hours. At 91 dBA, the limit is 2 hours, etc.

Response

Response refers to how quickly the dosimeter responds to fluctuating noise. It can be set to fast or slow. Noise exposure is measured using the slow response.