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Joint Coal Board

TECHNICAL BULLETIN

ASSESSMENT OF PERSONAL NOISE EXPOSURE AND EQUIPMENT NOISE LEVELS IN UNDERGROUND COAL MINES

Prepared for:

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INTRODUCTION

Noise measurements may be conducted in underground coal mines for two purposes:

1. To evaluate the **noise exposure** of individual miners, and

2. To assess the **noise levels** of mining equipment.

The aim of this Technical Bulletin is to recommend uniform procedures for conducting noise measurements in underground coal mines to suit both purposes, in general accordance with the various applicable Australian Standards for hearing conservation and equipment noise level measurements.

Exposure to noise levels above the noise exposure limits increases the risk of permanent hearing damage for individual miners. Noise exposure measurements enable high risk tasks or operations performed by miners to be identified. Engineering noise controls must be investigated for high noise level areas and suitable personal hearing protection worn by all miners until controls can be implemented.

Noise levels of mining equipment should be measured at least once per year to monitor noise levels and to provide baseline data for equipment purchase specifications.

The Technical Bulletin consists of three sections:

Section 1 contains a list of intrinsically safe sound level meters and dosimeters approved for use in underground coal mines in NSW.

Section 2 contains the recommended procedures for calibration of sound level meters.

Section 3 contains the recommended procedures for evaluating the noise exposure of individual mine workers using sound level meters and dosimeters, according to Australian Standard, AS1269–1989, "Acoustics – Hearing Conservation".

Section 4 contains the recommended procedure for assessing the noise levels of mining equipment using sound level meters.

SECTION 1

Sound Level Meters and Dosimeters

1.1 Types of Sound Measuring Instruments

Noise exposure or sound pressure level may be assessed using either a personal noise dosimeter or an integrating sound level meter.

(i) Sound level meters

An integrating sound level meter generally provides a direct reading of the following acoustic parameters.

$L_{Aeq,T}$	equivalent continuous A-weighted sound pressure level for measurement duration, T.
T	duration time of measurements.
PND	partial noise dose corresponding to $L_{Aeq,T}$, sometimes called "Dose".
DND	projected (i.e. estimated) daily noise dose, corresponding to $L_{Aeq,\ 8hr}$.
L_{peak}	unweighted linear peak.
"F"	"Fast" time weighting.
"S"	"Slow" time weighting (Larson Davis Model 710M only).

The meter may be used for evaluation of noise exposure of underground miners using measurement times of 1-5 minutes. The methods are described in Section 3.4.

(ii) Noise Dosimeters

A noise dosimeter is worn for the entire shift and measures the actual noise exposure of the wearer on that day.

The following acoustic parameters are generally output from the keypad or via printer or computer software.

$L_{Aeq,T}$	equivalent continuous A-weighted sound pressure level for shift duration, T.
T	duration time of shift.

PND	noise dose accumulated during shift duration, T.
DND	projected (i.e. estimated) daily noise dose corresponding to $L_{Aeq, 8hr}$.
L_{peak}	unweighted linear peak.
"F"	Fast time weighting (Larson Davis Model 700, Metrosonics Models dB301 iS, dB3100e iS (approval pending)).
"S"	Slow time weighting.

1.2 Approved I.S. Instruments

Intrinsically safe sound measuring instruments approved for use in underground coal mines in NSW are listed below:

1.2.1 Sound Level Meters

Bruel & Kjaer Type 2225 – Approval No. MDA Exia 1480

Larson Davis Laboratories Model 700/710M – Approval No. MDA Exia 10087.

Metrosonics Model dB3100e iS (Approval pending)

1.2.2 Dosimeters

Larson Davis Laboratories Model 700/710M – Approval No. MDA Exia 10087.

Quest Models M–27, M–28, M–28D and M–29 – Approval No. MDA Exia 11190 (Approval Pending).

Metrosonics Model 301 iS – Approval No MDA Exia 1414

SECTION 2

CALIBRATION OF SOUND LEVEL METERS & DOSIMETERS

2.1 LABORATORY CALIBRATION

Sound level meters, dosimeters, calibrators and pistonphones must be calibrated by a certified NATA laboratory, at least every two years, in accordance with Australian Standard, AS1259–1982, "Sound Level Meters".

Instruments which have a high usage rate should be laboratory calibrated each year.

The date of the most recent laboratory calibration must be recorded on a label attached to the instrument.

Instruments which do not comply with these requirements may be inaccurate and are not recommended for use in underground coal mines until compliance can be demonstrated.

2.2 FIELD CALIBRATION CHECKS

Field calibration checks are to be conducted for sound level meters and dosimeters in accordance with Australian Standard, AS2659–1 – 1988, "Guide to the Use of Sound Measuring Equipment, Part 1 – Portable Sound Level Meters".

Sound level meters are to be check calibrated using an acoustic calibrator or pistonphone both before and after each series of measurements, or at more regular intervals for longer series of measurements.

Dosimeter calibration checks are recommended to be conducted at the beginning and end of each shift being measured.

The calibration check is performed by applying the acoustic calibrator to the sound level meter or dosimeter microphone and confirming that a correct indication of the calibrator's reference level has been obtained on the meter or dosimeter.

If the calibration reading is not correct then the gain on the meter is trimmed (usually a screwdriver adjustment) until a correct reading can be obtained.

The purpose of the calibration check is to:

- check that the meter is functioning correctly and accurately;
- ensure that measurements are consistent with each other;

- allow measurements recorded at different mines or over long time intervals to be compared;
- identify deterioration in meter accuracy over time which may necessitate repairs or laboratory re-calibration.

Calibration checks are to be recorded on all noise measurement reports in the space provided, as shown in Figure 1 below (for noise dosimeter measurements).

METER TYPE: .....

Serial No. ..... Last Calibration Date: .....

CALIBRATION:

Start .....dB(A) OR .....Reference Noise Dose

Finish .....dB(A) OR .....Reference Noise Dose

If variation between start and finish is less than ± 1 dB or ± 10% Reference Noise Dose then the measurement is valid. ☐ **Tick if OK**

Figure 1 – Standard Report – Calibration Section

2.3 ENVIRONMENTAL FACTORS

Environmental factors such as dust, oil or grease, high relative humidity, moisture, wind, vibration and electric or magnetic fields can cause incorrect readings of sound level meters or dosimeters when check calibrated or used in underground coal mines.

Windscreens must be used for microphones of sound level meters and dosimeters when used in underground coal mines to provide protection against dust, oil and grease, moisture and wind.

Field calibration checks should be conducted in a clean area.

SECTION 3

NOISE EXPOSURE OF INDIVIDUAL MINERS

3.1 NOISE EXPOSURE LIMITS

The national standard[1] for occupational noise exposure limits is:

(a) an eight–hour equivalent continuous A–weighted sound pressure level, $L_{Aeq.8h,}$ of 85 dB(A); and

(b) a linear (unweighted) peak sound pressure level, L_{peak} of 140 dB(Lin).

The exposure standard is exceeded if either of the levels specified in (a) or (b) of this section is exceeded.

The noise to which an employee is exposed is defined to be the noise at the employee's ear position, determined in accordance with Australian Standard, AS1269 – 1989, "Acoustics – Hearing Conservation", without taking into account any protection which may be afforded by personal hearing protection devices.

In the previous superseded national standard, the eight–hour equivalent continuous A–weighted sound pressure level, $L_{Aeq,8h}$, was 90 dB(A).

3.2 NOISE EXPOSURE ASSESSMENT

The occupational noise exposure of a mine employee is assessed by measuring noise levels in terms of the following:

(i) the 8–hour equivalent continuous A–weighted sound pressure level ($L_{Aeq,8h}$), which is commonly called the daily noise dose (DND, $_{8h}{}^{1}{}_{r}$);

AND

(ii) the linear peak sound pressure level limit (L_{peak}).

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1 "National Standard for Occupational Noise" and "National Code of Practice for Noise Management and Protection of Hearing at Work" by National Occupational Health and Safety Commission (endorsed March 1992).

The 8-hour equivalent continuous A-weighted sound pressure level ($L_{Aeq,8h}$) is defined as the steady sound pressure level which in an eight hour period would have the same A-weighted sound energy as that due to the actual varying sound pressure level experienced during a representative working day.

An $L_{Aeq,8h}$ value of 85 dB(A) corresponds to a daily noise dose, **(DND, $_{8hr}$)** of unity under the new national standard and is termed the **reference value of noise exposure per day.**

The Daily Noise Dose (DND) is defined as the ratio of the noise exposure experienced by a person during a representative day to the reference value of noise exposure.

The DND may be measured directly with a noise dosimeter over the duration of a representative shift. It may also be estimated (i.e. projected) by the dosimeter for a standard 8 hour shift from measurements which occurred in a shift with a different duration than eight hours.

DND may also be defined as the sum of the partial noise doses to which an employee is exposed throughout a representative working day. **Partial Noise Dose (PND)** is defined as the ratio of the noise exposure experienced by a person at a particular location, task or activity during part of a representative working day, to the reference value of noise exposure per day. The noise exposure for PND assessment may be measured directly with an integrating sound level meter or calculated from the equivalent continuous A-weighted sound pressure level ($L_{Aeq,T}$), for the duration, T of each location, task or activity.

3.3 EVALUATION OF NOISE EXPOSURE - DOSIMETER METHODS

3.3.1 -Prepare the dosimeter for use according to the manufacturer's instructions. Set the noise exposure limits (where available) to 85 $L_{Aeq,8h}$ and 140 L_{peak}. Set the time-weighting setting to **Fast(F)**, if not available, then **Slow(S)** may be used. Set the frequency-weighting to A-weighting. Clear previously saved $L_{Aeq,T}$ values stored in memory and set the elapsed time to zero (if applicable).

-Check the calibration in accordance with Section 2 above and record the indicated reference level directly on the standard noise exposure report.

-Attach the microphone **near to the ear which is likely to receive the higher noise exposure.** The microphone may be fitted to the workers' helmet above the ear (facing in the direction of vision) or to the shoulder (facing towards the ear). The dosimeter and microphone with its protective windshield, should be carefully fitted. Care is required to check that the microphone does not rub on clothing or hair throughout the shift duration to ensure accurate measurements and to minimise the risk of damage to the microphone.

- The dosimeter is to be worn for the entire shift, including crib breaks, entry and exit from the pit. The measured DND and shift time shall be reported for the entire shift. Work tasks and locations are to be noted on the noise exposure report and on the daily noise level–time graph (when plotted) by the noise officer.

- The calibration of the dosimeter is to be re–checked again at the end of the shift. If a variation of more than ± 1dB in the reference sound pressure level (or more than ± 10% of the reference noise dose reading) is found, then the measured DND is to be considered invalid and the measurement must be repeated.

- All measurements ($L_{Aeq,T}$; T ; Dose (i.e. PND); Proj DND (i.e. DND, $_{8hr}$) and activity observations are to be reported on the **standard noise exposure report** shown in **Appendix A.** The number of exceedances of the L_{peak} = 140 dB criterion and the actual L_{peak} levels are generally obtained from the printed output from the dosimeter or from computer software if available. The daily noise level–time graph (when plotted) is to be attached to this report noting representative times for all tasks, activities and locations (refer to the examples shown in Appendix B).

- It must be noted that dosimeter readings provide an indication of the occupational noise exposure experienced by a miner on one particular day only. Dosimeter readings on the same miner may be expected to vary on other days due to variations in tasks, locations and duration times. To increase the confidence level in the noise exposure results, DND values should ideally be measured regularly or for more than one day for each miner. Work tasks or locations may be selected to give "best", "normal", or "worst" noise exposures if assessments occur over more than one shift per miner.

3.3.2 Calculation of $L_{Aeq,8h}$ and DND from Noise Dosimeter Measurements

Noise dosimeters measure noise exposure levels in terms of DND or $L_{Aeq,T}$ (i.e. daily noise dose or equivalent continuous sound pressure level for a time period, T, which may be greater or lesser than 8 hours) or projected DND (i.e. DND, $_{8h}$ – estimated daily noise dose for an 8 hour shift).

In the sample results from a Metrosonics dosimeter shown in the plot of Appendix B1, the projected noise dose and measured noise dose are given in the **summary print-out at the top of the graph,** as detailed below:

Summary Print-Out Details

Measured noise dose, DND	=	Dose (85)	74.57%
Measurement time, T	=	Run Time	03:18:03
DND, $_{8h}$	=	Projected Dose (85)	182.81%
$L_{Aeq.8h}$	=	Leq	87.62 dB(A)
L_{Peak}		Not Given	

The value of $L_{Aeq,8h}$ may be calculated from the DND and T values to confirm exceedance or compliance with the noise limit of 85 dBA, as follows:

T = time period during which the daily noise dose was measured in minutes.

DND =daily noise dose in measurement period T.

$$L_{Aeq,8h} = 85 + 10 \log 480/T_{(min)} + 10 \log (DND)$$

If the dosimeter does not calculate the projected DND from the measured noise data, this may be calculated as follows:

$$DND, _{8h} = DND \times 480/T_{(min)}$$

Examples:

(i) A partial noise dose (PND) of 79% was recorded by a dosimeter during a 2 hour measurement. What is the $L_{Aeq,8h}$ for a miner who typically works at this location for an 8 hour shift?

$$L_{Aeq,\ 8h} = 85 + 10 \log (8/2) + 10 \log (0.79)$$

$$= 90 \text{ dBA}$$

Conclusion: Noise limit is exceeded. Engineering noise control should be investigated. Personal hearing protection should be worn or time of exposure reduced until noise level can be reduced.

(ii) What is the projected DND for 8 hours for this miner?

$$DND,_{\ 8hr} = 0.79 \times 8/2$$

$$= 3.16$$

$$= 316\%$$

Conclusion: Miner is being exposed to more than three times the recommended daily noise dosage. Long term exposure at these levels enhances the risk of permanent hearing loss.

3.3.3 Linear Peak, L_{peak} Assessment

The linear peak level, $L_{peak,}$ may be determined directly from the history print–out for each sampling period (see Larson Davis Model 700 example provided in Appendix B2 – Note: RMS means $L_{Aeq,T}$).

If the dosimeter does not have a L_{peak} function, a separate measurement of L_{peak} with a sound level meter will be required for each work location an activity. Levels are to be recorded on the standard report sheet.

3.4 EVALUATION OF NOISE EXPOSURE – INTEGRATING SOUND LEVEL METER METHODS

3.4.1 Integrating Sound Level Meter Measurements

- Prepare the integrating sound level meter for use according to the manufacturer's instructions. Set the time–weighting setting to **Fast(F)**. Set the frequency–weighting to **A–weighting.** Clear previously saved $L_{Aeq,T}$ values stored in memory and set the elapsed time to zero (if applicable).

- Check the calibration in accordance with Section 2 above and record the indicated reference level directly on the standard noise exposure report.

- The equivalent continuous A-weighted sound pressure level, $L_{Aeq,T}$, the duration, T , and the linear peak sound pressure level L_{peak}, are to be measured for each work location, task or activity during the shift or typical work day. The microphone position is to be as close to the ear of the person whose noise exposure is being assessed as is safe and practical. The measurement position is to be located near the ear which is expected to have the higher noise exposure (if applicable).

- For **steady noise** levels (i.e. fluctuations within a range of ± 4 dB during the measurement period), a duration T , of 1–2 minutes is recommended for measurements. The $L_{Aeq,T}$ level and dose (PND) should be read from the meter and noted. The measured PND should then be multiplied by the appropriate factor to obtain the total time per shift typically taken for this activity.

  e.g. Tailgate drive area, measured levels were:

  $L_{Aeq,T}$ = 94 dBA

  T = 2 minutes

  Measured PND = 3.3%

  It is estimated that the specific miner in question spends 45 minutes per day in this area. Multiplication factor is, therefore, 22.5, i.e. 45/2 = 22.5.

  PND for total activity per shift = 45/2 x 3.3 = 74.3%

  The total estimated duration per day and estimated PND are to be entered on the standard noise exposure report #2 shown as Appendix C1. An example illustrating steady noise is shown as Appendix C2.

  For **intermittent noise** (i.e. where levels vary by more than ± 4 dB), the measurements may be conducted in two ways:

  (i) measure the $L_{Aeq,T}$, T_T, PND, and L_{peak} for the whole duration of the task or activity and enter the data directly in columns 1–4 in the standard report #2.

  e.g. (i) PET driver, measured levels were

  $L_{Aeq,T}$ = 99 dBA
  T_T = 1 hr/shift
  Measured PND = 340%
  L_{peak} = 112 dB

OR

(ii) measure $L_{Aeq,T}$, T_1, PND and L_{peak} for a time period that includes at least one complete cycle of the noise or process, for example, 5–10 minutes. The activity PND may then be obtained by multiplying by the time factor, as previously above for steady state noise. An example illustrating intermittent noise is shown as Appendix C3.

e.g. (ii) PET Driver, measured levels were:

$L_{Aeq, T}$ = 99 dBA

T = 10 minutes

Measured PND = 52.3%

A standard report illustrating these examples of intermittent noise is shown as Appendix C3.

- The calibration of the meter is to be re-checked again at the end of the shift. If a variation of more than ± 1 dB in the reference sound pressure level is indicated during any check then the measured levels are to be considered to be invalid and must be repeated.
- All measurements ($L_{Aeq,T}$; T; PND and L_{peak}) and work descriptions are to be reported **on the standard noise exposure report** #2 shown in **Appendix C1.**

An example that represents a total shift measurement is shown in Appendix C4.

4. NOISE LEVELS OF MINING EQUIPMENT

Noise levels of items of mining equipment may be measured for the following purposes;

(i) to identify and prioritise mining equipment for which engineering noise control investigation is desirable;

(ii) to monitor increases in equipment noise levels which are due to a deterioration in mechanical condition and for which maintenance or replacement action is desirable;

(iii) to determine appropriate purchase specification noise limits and measurement conditions for new mining equipment;

(iv) to assess the compliance of new mining equipment with noise levels and measurement conditions specified in purchase documents.

This section provides standard procedures for purposes (i) and (ii) above for the range of equipment typically found in an underground coal mine. Noise levels for purposes (iii) and (iv) should be estimated in accordance with relevant Australian Standards (where applicable) to ensure that results are accurate and repeatable.

Noise level measurements for the purposes of investigating or designing engineering noise reduction treatments are not included in this section. Specialised instrumentation and expertise which is outside the scope of this technical bulletin is normallly required for this purpose.

4.1 Noise Surveys

Equipment noise levels may be measured for the purpose of monitoring mechanical condition and to identify or rank equipment requiring engineering noise control action. The priorities for engineering noise control are best determined by using the method of Section 3.4 above where the PND contribution of each item of equipment to the daily noise exposure of individual workers is calculated.

The methods described in this section will determine the equivalent A-weighted sound pressure level due to each item of equipment. An indication of the exposure time of indiividual workers to that equipment will not be provided by this method.

All sound pressure level measurements are to be recorded using an integrating sound level meter set to Fast response and A-weighting (for $L_{Aeq,T}$) or linear (for L_{peak}). Sound pressure levels are to be measured in terms of $L_{Aeq,1min}$ for steady-state noise and $L_{Aeq,5min}$ for intermittent noise, as well as L_{peak} for both noise types. A minimum of two measurements of $L_{Aeq,T}$ will be recorded at each location and an average value reported.

The noise measurement locations for each type of equipment are generally defined in Table 1 with further details provided in the accompanying notes.

Equipment	Underground Measurements			
	Operator(1)	Passenger(2)	Bystander(3)	Perimeter @ 1m (4)
Mobile				
– moving	√	√		
– stationary				√
Continuous Miner (CM)				
– cutting	√		√	
– drilling & bolting	√		√	
Rock drilling & bolting	√		√	
Pumps				√
Longwall Shearer				
– cutting			√	
– chain empty			√	
Longwall Tailgate			√	
Longwall Main-Gate			√	
Longwall Crusher			√	
Longwall Stage Loader			√	
Longwall Pantechnicon – Pumps				√
Mobile Boot End – Loaded Drift Car	√	√		√
Hift Winch/Hoist Motors				√
Conveyors Drives				√
Workshop				
– Specific Tools	√			
– General			√	
Auxiliary Fans				√
Conveyor Transfer Points				√

Table 1 – Equipment Noise Survey Measurement Locations

Notes:

(1) Operator noise levels shall be measured near to the ear which has the higher noise exposure. For workshop equipment, the operator shall be defined to be the user of the tool or equipment.

(2) The number of passenger noise measurement locations will vary for each item of rubber tyred or rail mounted mobile equipment. Measurement locations should be selected to provide an indication of noise levels at representative passenger locations in each defined compartment of the mobile equipment.

(3) Bystanders are defined to be representative locations where members of workteams typically stand or may be located during coal cutting, rock drilling or bolting, or during normal operational or maintenance activities.

(4) Perimeter noise levels are to be measured at a horizontal distance of 1 metre from the near side of the equipment (eg motor or pump) centrally located on the side which is normally accessible to workers. The measurement position is to be located 1.2 metres above the floor or ground level in each instance.

All results are to be tabulated on the standard Equipment Noise Level Report #1, shown as Appendix D1. The standard report is to include equipment details, a plan view diagram showing clearly measurement locations, sound level meter and calibrator details. A check calibration is to be performed both prior to and at the end of measurements on each item of equipment or prior to entering and after leaving the pit.

The standard form includes provision for noise measurements under two operating conditions (if this is needed, such as coal cutting, roof drilling and bolting for continuous miners). For much equipment one operating condition will be sufficient.

Mobile equipment noise levels are to be measured whilst the machine is moving in the drift in low gear at maximum engine revs for the "moving" condition. All other equipment is to be measured under normal operating conditions. Stationary measurements are to be conducted at maximum engine revolutions or with transmission engaged (where applicable). To include the transmission noise in stationary measurements, the equipment may be mounted on blocks so that there is no wheel–roadway contact and the engine and transmission may be run at maximum engine revolutions in low gear.

4.2 Noise Levels for Specifications

Noise levels for the purpose of inclusion in tender specifications may be defined in terms of either underground sound pressure levels or a combination of **both underground sound pressure levels** and **surface sound power levels**, depending upon the type of equipment as recommended in Table 2.

Equipment	Underground Measurements				Surface Measurements
	Operator[1]	Passenger [2]	Bystander [3]	Perimeter @ 1m [4]	Sound Power Level (PWL)
Mobile – moving	√	√			
– stationary					√
Continuous Miner – cutting	√		√		
– drilling & bolting	√		√		
Rock drilling & bolting	√		√		
Pumps					√
Longwall Shearer – cutting			√		
– chain empty			√		
Longwall Tailgate				√	
Longwall Main-Gate				√	
Longwall Crusher				√	
Longwall Stage Loader				√	
Longwall Pantechnicon – Pumps				√	
Mobile Boot End – Loaded				√	
Drift Car	√	√			
Hift Winch/Hoist				√	
Motors Conveyors Drives				√	
Workshop – Specific Tools	√				
– General			√		
Auxiliary Fans				√	√
Conveyor Transfer Points				√	

Table 2 – Specification Noise Levels
(Notes re measurement locations – same as for Table 1)

Underground sound pressure levels are recommended to be specified as measured $L_{Aeq,T}$ and L_{peak} under the same locations and operating conditions as noted in Section 4.1 above.

Surface sound power levels shall be specified and measured in accordance with Australian Standard AS1217.5 – 1985. It is recommended that a specialist acoustic consultant be engaged to provide advice regarding sound power levels for purchase specification documents and for undertaking sound power measurements, due to the complexity of the concepts and procedures required. A standard report form has not been provided for this purpose.

5. REFERENCES

- Australian Standard 1217.5 – 1985, Acoustics – Determination of Sound Power Levels of Noise Sources, Engineering Methods for Free–Field Conditions Over a Reflecting Plant.
- Australian Standard 1259 – 1982, Sound Level Meters.
- Australian Standard 1269 – 1989, Acoustics – Hearing Conservation.
- Australian Standard 1633 – 1985, Acoustics – Glossary of Terms and Related Symbols.
- Australian Standard 2659.1 – 1988, Guide to the Use of Sound Measuring Equipment, Part 1 – Portable Sound Level Meters.
- Australian Standard 2659.2 – 1988, Guide to the Use of Sound Measuring Equipment, Part 2 – Portable Equipment for Integration of Sound Signals.

APPENDIX A

NOISE EXPOSURE REPORT

– DOSIMETER ASSESSMENT

NOISE EXPOSURE REPORT # 1

DOSIMETER ASSESSMENT

MINE: ..... DATE: .....
NOISE OFFICER: .....

Miner:	
Job Description:	

Dosimeter Serial No.	Type: ..... Last Calibration Date: .....
Acoustic Calibrator Serial No.	Type: ..... Last Calibration: .....

CALIBRATION	
Start ☐ dB(A)	or ☐ Reference Noise Dose
End ☐ dB(A)	or ☐ Reference Noise Dose
If variation between start and end is less ± 1 dB or ± 10 Reference Noise Dose, then measurements are valid. ☐ Tick if OK	

MEASUREMENTS

Measurement Time T = _____ hr:min:sec.

Equivalent Continuous Sound Pressure Level for Time T, $L_{Aeq, T}$ = _____ dBa

Measured Noise Dose DND = _____

Projected Noise Dose (for 8 hour Shift) $DND_{, 8hr}$ = _____ %

Number of Peak Exceedances (i.e. exceedances of 140 dB) = _____

DESCRIPTION OF JOB TASKS (during Dosimeter measurements).

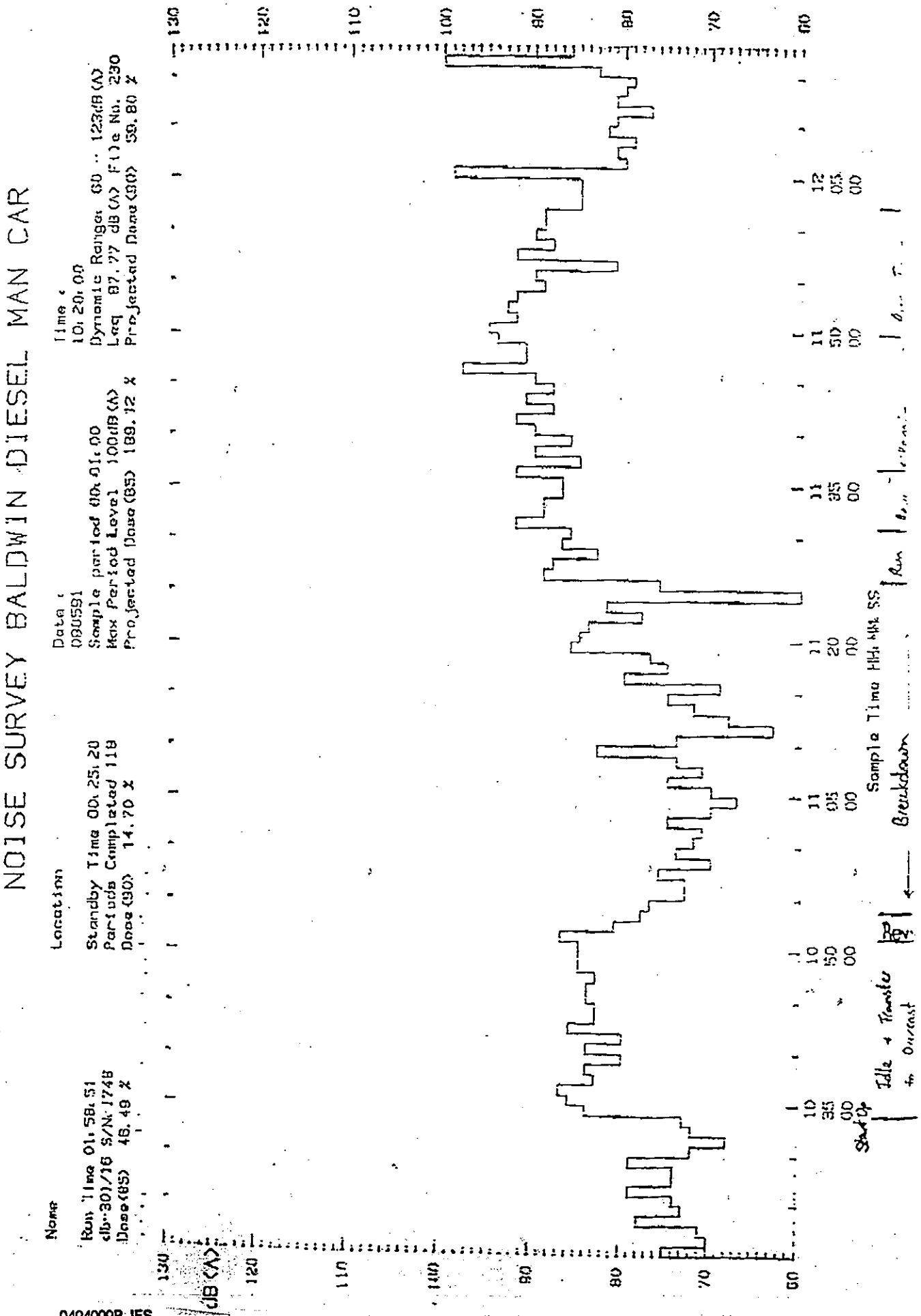
JOB DESCRIPTION		
Summarise locations, tasks and activities typically undertaken during the shift.		
LOCATIONS/TASKS/ACTIVITIES	APPROXIMATE DURATION	$L_{peak, dB}$

Note: L_{peak} levels may be determined from the printed history report (Larson Davis) or by check measurements using a sound level meter for each location/activity while the activity is in progress.

APPENDIX B

NOISE EXPOSURE

MEASUREMENTS & PLOTS

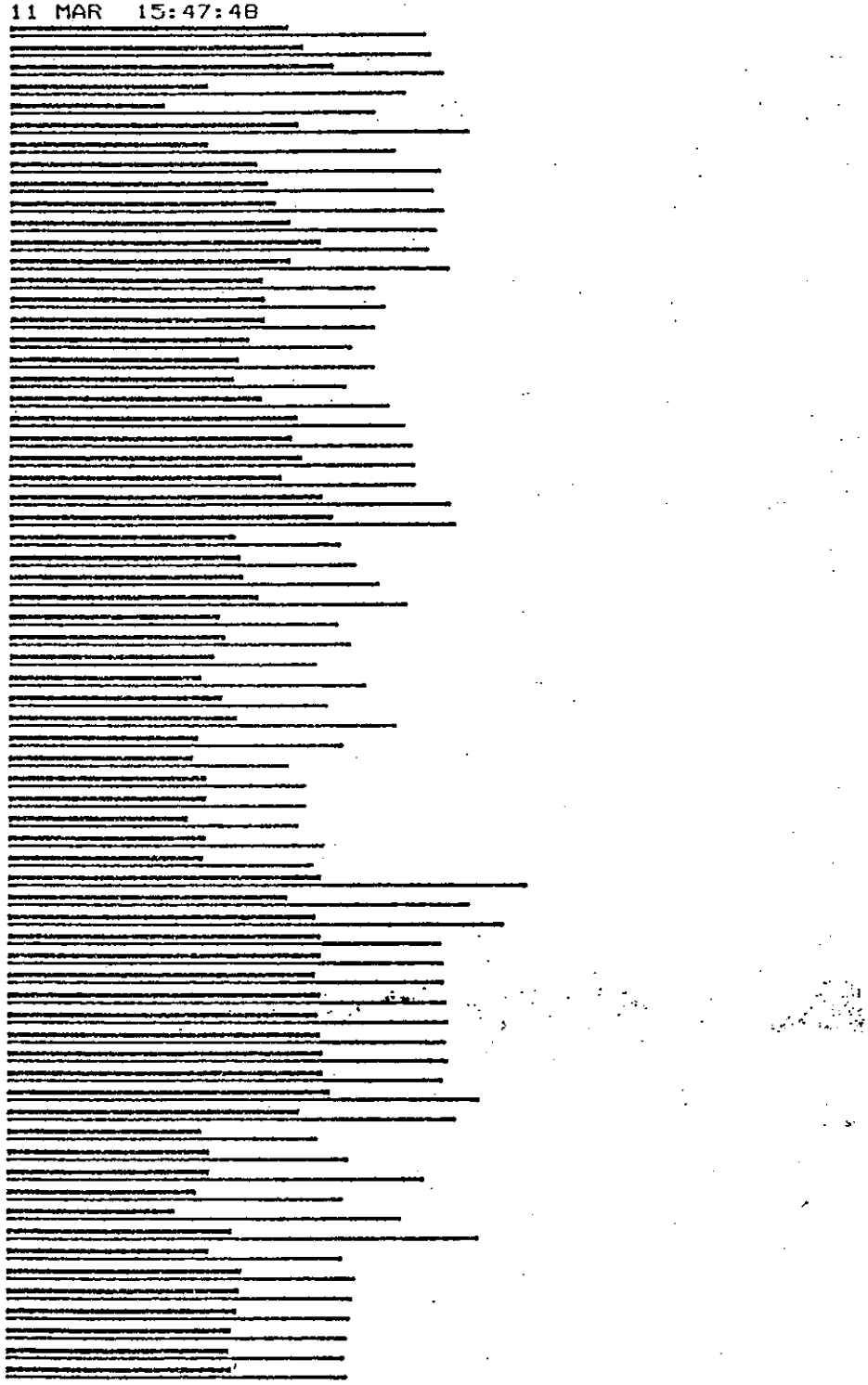


Appendix B1 – Dosimeter History Plot (Metrosonics)

HIST REPORT
LARSON-DAVIS LABS -- MODEL 700
03/11/85 16:19:12 SN 700A0144 PAGE 5

Base: 40.0 Per: 10.0 FAST
11 MAR 15:47:48

Cnt	RMS	Peak
0	RUN	0
1	81.0	108.5
2	84.0	109.5
3	90.0	112.0
4	65.5	104.5
5	57.0	98.5
6	83.0	117.0
7	65.5	102.5
8	75.0	111.5
9	77.0	110.0
10	78.5	112.0
11	81.5	110.5
12	87.5	109.0
13	81.5	113.0
14	76.0	98.5
15	76.5	100.5
16	76.5	98.5
17	73.5	94.0
18	71.5	98.5
19	70.5	93.0
20	76.0	101.5
21	83.0	104.5
22	82.0	106.0
23	84.0	106.5
24	80.0	106.5
25	88.0	113.5
26	90.0	114.5
27	71.0	92.0
28	72.0	95.0
29	72.5	99.5
30	75.5	105.0
31	68.0	91.5
32	69.0	94.0
33	67.0	87.5
34	64.5	97.0
35	68.5	89.5
36	71.5	103.0
37	64.0	92.5
38	63.0	82.0
39	65.5	85.5
40	65.5	85.5
41	62.0	84.0
42	65.5	89.0
43	65.0	87.0
44	88.0	128.5
45	81.5	117.5
46	87.0	124.0
47	88.0	112.0
48	88.0	112.5
49	87.0	112.5
50	88.0	113.0
51	87.5	113.5
52	88.0	113.0
53	88.5	113.5
54	88.5	112.5
55	90.0	119.5
56	84.0	115.0
57	65.0	88.0
58	66.5	94.0
59	66.5	109.0
60	64.0	93.0
61	60.0	104.5
62	71.0	119.5
63	66.5	93.0
64	73.0	95.5
65	72.5	95.0
66	72.0	94.5
67	71.0	94.0
68	70.5	93.5
69	71.0	94.0



Appendix B2 – History Report (Larson Davis LD700) showing $L_{Aeq,T}$ (RMS), L_{peak}, 10 second intervals, fast reponse and graphical plot of $L_{Aeq,T}$ and L_{peak}

APPENDIX C

NOISE EXPOSURE REPORTS

SOUND LEVEL METER ASSESSMENT

NOISE EXPOSURE REPORT #2

INTEGRATING SOUND LEVEL METER ASSESSMENT

MINE: ..... DATE: .....

NOISE OFFICER: .....

Miner:	
Job Description:	

Sound Level Meter Serial No:	Model: ..... Last Calibration Date: .....
Acoustic Calibrator Serial No:	Model: ..... Last Calibration: .....

CALIBRATION

Start ☐ dB(A)

☐ dB(A)

☐ dB(A)

☐ dB(A)

End ☐ dB(A)

If variation between successive measurements is less than ± 1 dB then measurements are valid.

☐ Tick if OK

Meter time weighting setting **F** or **S** (circle one only).

Location/Task/Activity		Measured Levels				Estimated Levels/Shift		
No	Description	Duration T_1 Min	$L_{Aeq,T}$ dBA (1)	PND %	L_{peak} dB (2)	Total Time T_T min (3)	Time Factor T_T/T_1	Total PND % (4)
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								

Calculation: DND, 8_h = (Total PND) x $\frac{480}{T}$ =

$L_{Aeq,}8_h = 85 + 10 \log (\frac{480}{T(min)}) + 10 \log (DND, 8_h)$

=

L_{peak} (maximum level) =

Total = T

Total = PND

Location/Task/Activity		Measured Levels				Estimated Levels/Shift		
No	Description	Duration T_1 Min	$L_{Aeq,}T$ dBA (1)	PND %	L_{peak} dB (2)	Total Time T_T min (3)	Time Factor T_T/T_1	Total PND % (4)
1	Tailgate	2	94	3.3		45	45/2=22.5	74.3
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								

Calculation: $DND,8_h$ = (Total PND) x $\frac{480}{T(min)}$ =

$L_{Aeq,}8_h = 85 + 10 \log (\frac{480}{T(min)}) + 10 \log (DND,8_h)$

=

L_{peak} (maximum level) =

Total = T

Total = PND

Appendix C2- Total PND Estimation - Steady Noise Levels - Example Only

Location/Task/Activity		Measured Levels				Estimated Levels		
No	Description	Duration T_1 Min	$L_{Aeq,T}$ dBA (1)	PND %	L_{peak} dB (2)	Total Time T_T min (3)	Time Factor T_T/T_1	Total PND % (4)
1	Measure for Total Duration							
2	(i) PET Driver	60	99	3140	112	60	-	3140
3								
4								
5	Measure for part duration only							
6	(ii) PET Driver	10	99	52.3	112	60	60/10=6	313.8
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
					Total = T		Total = PND	

Calculation: $DND,8_h$ = (Total PND) x $\frac{480}{T(min)}$ =

$L_{Aeq},8_h = 85 + 10 \log (\frac{480}{T(min)}) + 10 \log (DND,8_h)$

=

L_{peak} (maximum level) =

Location/Task/Activity		Measured Levels				Estimated Levels/Shift		
No	Description	Duration T_1 Min	$L_{Aeq,T}$ dBA (1)	PND %	L_{peak} dB (2)	Total Time T_T min (3)	Time Factor T_T/T_1	Total PND % (4)
1	Entering Pit	5	95	10.4	112	30	30/5=6	62.4
2	Driving Shuttle Car	10	86	3.0	110	180	180/10=18	54.0
3	Tailgate Drive Area	5	94	8.3	108	40	40/5=8	66.4
4	Conveyor Repairs	2	83	0.3	123	130	130/2=65	19.5
5	Wenco Pump Check	1	100	6.6	118	15	15/1=15	99.0
6	Crib	1	81	0.1	105	40	40/1=40	4.0
7	PET Driver	5	99	26.2	115	30	30/5=6	157.2
8	Exitting Pit	5	96	13.1	113	35	35/5=7	91.7
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
						Total = T = 500 minutes	Total = PND	554.2

Calculation: $DND_{,8h}$=(Total PND)x $\frac{480}{T(min)}$ =554.2x480/500=532.0

$L_{Aeq,8h} = 85 + 10 \log \left(\frac{480}{T(min)} \right) + 10 \log (DND_{,8h})$

= 85 - 0.2 + 27.3 = 112.1 dBA

L_{peak} (maximum level) = 123 dB

Appendix C4- Total PND Estimates - Whole of Shift - Example Only

APPENDIX D

EQUIPMENT NOISE LEVELS

APPENDIX D1

EQUIPMENT NOISE LEVEL REPORT #1

MINE: ..... DATE: .....
NOISE OFFICER: : .....

Equipment Brand & Type: .....
Identification Number: .....

Sound Level Meter Serial No:	Brand & Type: ..... Last Calibration: .....
Calibrator Serial No:	Type: ..... Last Calibration: .....

CALIBRATION	
Start ☐ dB(A)	End ☐ dB(A)
If variation is less than ± 1 dB then measurements are valid. ☐ Tick if OK	

Diagram (Plan view showing measurement locations)

Operating Condition (i.e. Gear and Engine Rpm)	Location	Sound Pressure Level Parameter	Time T	Measurement Locations							
				1	2	3	4	5	6	7	8
		$L_{Aeq,T}$									
		Av =									
		L_{peak}									
		$L_{Aeq,T}$									
		Av =									
		L_{peak}									