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NOISE EXPOSURE ASSESSMENT IN AGRICULTURE

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1 INTRODUCTION

The introduction of the Noise at Work Regulations 1989[1] which come into force 1st January 1990 will place a duty on most employers to consider whether they and their employees are likely to be exposed to levels of noise above a first action level of 85 dB(A) ($L_{ep,d}$), or to a peak action level of 200 Pa.This assessment is required in order to decide whether to call in a 'competent' person for a more scientific assessment.

Whilst the requirement to provide a safe working environment including noise, forms part of the HASAW Act 1974 and while most people in agriculture are aware to some extent of the hazards of excess noise exposure, there is undoubtedly widespread ignorance of noise nomenclature, of the decibel scale, and of level*time relationships.

Unlike the case in many industries where there may be specialised staff to call upon,in agriculture some 130,000 full or part time farmers managers or directors are responsible for a work force of approximately 609,000 workers[2] with a typical staff of 1 to 3 persons on each farm

In agriculture therefore there will be large numbers of people calling for information and attempting to make these important judgements.Their task will be complicated because of seasonal variations in the tasks undertaken,in the mix of tractors and equipment used, and by the variety of activities with different exposure periods undertaken by each worker from day to day.

This paper looks at some of the information available to the farmer with respect to the legislation and discusses which activities are likely to require action under the new legislation without involving him or her in too many new concepts or unfamiliar calculations.

2.FARM WORKER NOISE EXPOSURE

The tractor with its vast range of applications is the most frequently used tool in agriculture. Since 1976[1] all tractors sold in the U.K. have had to conform to a maximum driver ear noise level with a closed cab of less than 90 dB(A).Modern tractors now consistently test at levels between 78 and 82 dB(A).Reports[4] on an individual tractor's performance which includes noise levels are available but test data is not available in a collated or readily available form.
A survey of tractor operations[5] showed closed cabs were used on only about 42% of field operations because of the driver's requirements for ventilation or access to controls etc. The effect of open windows for a tractor alone hauling a dynamometer car showed increases in driver ear noise levels 0.5 to 6.5 dB(A) depending on the external sound field of the tractor and the sophistication of the cab design.

Operation with a machine attached to the tractor can add to the noise received by the driver.Details of the noise levels of tractors under open cab conditions and of the contributory effects of machinery noise are not generally available although they can be expected eventually to be included as the norm in operating manuals following the initiatives[4] of the Health and Safety Executive Agricultural Inspectorate. In the case of the vast numbers of old and obsolete machines which continue in use this data is unlikely to ever be available.

Data on noise exposure levels in agriculture has been published by the H.S.E.[7]. Extracted values showing average shift lengths,average working levels (short term L_{eq},s) and the mean and range of exposure levels $L_{ep,d}$ are given for fixed equipment in Table I.Data for self propelled machinery is given in Table II, and for tractor powered machinery in Table III. Notable in these results are the very long shift lengths worked for many harvesting linked operations, and the wide range of values obtained within similar classes of activity.

With fixed equipment most operations seem to be involve exposure above the first action level required by the new legislation.With self propelled machines, such as beet and potato harvesters and including tracklaying tractors there is clearly cause for concern and it will be difficult to be certain about the extent of risk with many machines in this class without resort to measurement,

(the cabs on self propelled machines are not covered by tractor cab noise legislation). In the case of tractor powered equipment the means of the levels for most groups are above the first action level while work with some groups such as disc mowers, orchard sprayers and straw choppers give exposure levels above 90 $L_{EP,d}$.

3. NUMBERS AT RISK

Some $91*10^6$ man days are worked per year in agriculture. The H.S.E. survey estimates that some 18% of these are at noise exposure levels of 85 $L_{EP,d}$ or higher,while 8.7% are at or above 90 and 0.9% are at or above 100 $L_{EP,d}$.

4. ADVISING THE FARMER

What advice can be given to the farmer? The following seem to be simple rules to follow where there is no specific information available for his equipment.First action levels are likely to be exceeded whenever:

(a) Tractors are operated on full power or at maximum engine speed with the cab windows and or doors open or removed.

(b) When tractors are operated in conjunction with noise generating machines such as forage harvesters, rotavators, mowers or balers with the tractor cab rear window open.

(c) With most types of fixed equipment, particularly when operated for long shift lengths.

(d) When self propelled machinery with a high power requirement is used without a noise control cab fitted.

Methods of measuring the noise contribution of tractor powered machinery have been proposed ' Such methods will allow manufactures to provide farmers with estimates of the expected noise contribution to the man in the cab.This must then be added to the cab levels which will also be made available by manufacturers.Since the farmers requirement is to know if his particular combination of equipment is likely to exceed the first action level,a simple dB adding chart is presented in Figure 1 which covers the area of interest for the two action levels. Where

short term L_{eq} measurements are possible, some of the complexity of making allowances for rest periods, breakdowns etc. may be reduced by using the relationship established during the H.S.E. worker exposure survey which links shift length to the correction which can be applied to short term L_{eq} measurements to obtain an estimate of exposure level.A correction chart is given in Figure 2.,this estimate includes the many interruptions and the cyclical nature of most field work and includes rest breaks preparation time and transport time.The chart is not applicable to man carried equipment such as chain saws or brush cutters because of the very different work patterns associated with those machines.

References

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TABLE I

SURVEY DATA FOR FIXED EQUIPMENT

Work task	Av.Shift Hr.Min	Av.Working Leq	Exposure Level Mean $L_{ep,d}$	Range
Grain driers				
cascade	9.24	93.4	92.3	89.6 - 97.4
tower	12.30	84.6	84.5	-
cross flow	11.24	93.8	95.5	89.9 - 102.1
batch	16.30	85.5	87.9	-
Green crop drier	12.00	89.8	90.8	90.3 - 91.4
Hammer milling	5.00	85.5	87.2	-
Roller milling	5.30	92.3	94.8	-
Packing sheds				
grading	7.18	89.0	87.9	84.4 - 94.5
washing	5.26	87.2	85.1	78.8 - 88.7
packing	6.15	90.3	98.0	85.5 - 95.5

TABLE II

SURVEY DATA FOR SELF PROPELLED MACHINES

Work task	Av.Shift Hr.Min	Av.Working Leq	Exposure Level Mean $L_{ep,d}$	Range
Combine				
<15'+ cab	11.12	85.3	87.7	84.0 - 94.2
<15'no cab	8.17	91.3	89.7	86.6 - 93.0
>15'+ cab	11.17	88.4	88.7	82.3 - 93.4
Forage harvesters	12.00	87.3	86.1	-
Potato harvesters	7.15	89.7	88.5	81.9 - 94.4
Beet harvesters	9.22	91.7	91.2	84.6 - 99.9
Swather	10.06	87.4	87.4	84.6 - 88.8
Track layers				
(slow)	8.16	97.3	95.8	89.5 103.3
(fast)	9.15	99.8	98.2	88.7 102.8

TABLE III

SURVEY DATA FOR TRACTOR POWERED EQUIPMENT

Work task	Av.Shift Hr.Min	Av.Working Leq	Exposure Level Mean $L_{ep,d}$	Range
Forage Harvester cyl.	10.18	89.3	88.8	83.4 - 93.1
flywheel	9.12	88.9	88.2	85.3 - 93.4
Drum mower	5.00	90.6	78.6	-
Disc mower	9.21	91.1	91.5	84.0- 101.9
Gang mower	8.10	86.8	86.5	84.5 - 88.3
Power mower	10.25	87.7	87.4	82.0 - 94.6
Rotary cultivator	5.15	90.4	83.5	-
Muck spreader	8.11	89.0	87.0	84.5 - 90.6
Ram baler	10.35	90.1	88.5	84.9 - 91.0
Round baler	12.10	86.5	87.3	86.0 - 88.5
H D baler	12.00	96.8	92.4	-
Flail hedge-cutter	8.18	91.4	88.3	80.5 - 98.9
Orchard sprayer	10.26	97.9	96.9	93.1- 101.8
Straw chopper	11.00	90.4	90.8	-
Beet harvester	10.25	89.0	90.5	89.2 - 91.9
Field sprayer	10.00	87.2	84.6	-

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Source 1 dB(A)	80	81	82	83	84	85	86	87	88	89	90
90	90	91	91	91	91	91	91	92	92	93	93
89	90	90	90	90	90	90	91	91	92	92	93
88	89	89	89	89	89	90	90	91	91	92	92
87	88	88	88	88	89	89	90	90	91	91	92
86	87	87	87	88	88	89	89	90	90	91	91
85	86	86	87	87	88	88	89	89	90	90	91
84	85	86	86	87	87	88	88	89	89	90	91
83	85	85	86	86	87	87	88	88	89	90	91
82	84	85	85	86	86	87	87	88	89	90	91
81	84	84	85	85	86	86	87	88	89	90	91
80	83	84	84	85	85	86	87	88	89	90	90

Source 2 ,dB(A)

Figure 1. Chart to add noise levels of two sources

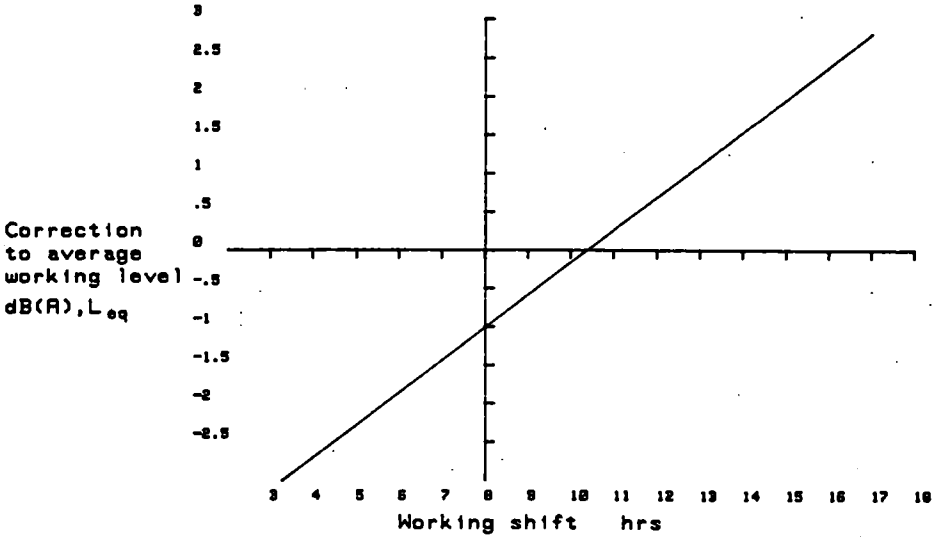

Figure 2. Graph to correct average working level to $L_{EP,d}$