

The exposure of working environment noise in the agricultural service workplaces

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Abstract: The noise belongs to the leading harmful factors which pollute the environment and negatively influences human health. An overview measurement concerning the noise characteristics has been done in agricultural service workplaces. The sound pressure level has been measured and the length of the workers exposition has been elicited in each workplace. The obtained data has proved that some agricultural service workers have been exposed to a noise above the permissible exposure limit.

Keywords: auxiliary plants of agriculture; noise load of service workers; limits of noise exposure

The intensity of noise has been increasing in recent years as a result of the developed civilisation (industry, traffic, urban areas etc.). The noise and consequently the noisy working environment have an exceptional position because of their harmful effects. A long exposure to high levels of noise without any hearing protection leads to serious damage of hearing and even to deafness (a professional disease). Moreover the noise contributes to the occurrence of working accidents and injuries (at noisy workplaces more accidents and injuries occur). Besides that, the noise contributes to the development of some diseases and disorders caused by stressful conditions such as high blood pressure and other psychosomatic diseases (HAVRÁNEK *et al.* 1990; HLÍNA & GERYK 1991). Through its negative influence on the workers' concentration, the noise contributes to a significant increase of the number of mistakes in the production processes (ANONYMOUS 2001).

The solution of the noise problems belongs to the major tasks of work hygiene as it is technologically and time demanding. Apart from a good orientation in law and legislative measures, the solution requires high professional knowledge in medical and technical fields. Furthermore, there is a need for the continual contact with new findings about the noise in the environment and in particular professional areas.

The Czech Republic has been participating in The Right Practice programme for several years. This is a project which supports the exchange of information and organises the campaign "The European Week of Working Safety and Health Protection". This is held under the sponsorship of the European Agency of Health Safety and Protection, Bilbao, in the north of Spain. The programme The Right Practice focuses on modern approaches to the solution of the particular working problems. Last year, the campaign was focused on the problems of noise.

MATERIAL AND METHODS

The overview measurement concerning the noise load of workers was made in the selected agricultural service workplaces. Through the sound technology media (the sound-level meter type 00023, producer Robotron SRN, the preamplifier MV 102 and the condenser microphone MK 102 connected with the mobile PC via the tablet), the sound pressure level was measured at a frequency of 8 kHz and a weight filter A in the service workplaces of the agricultural production (Table 1).

The measurement and calculation method was carried out according to The Collection of Laws No. 148/2006, "Government regulation on health protection from the adverse reaction of noise and vibration",

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Table 1. The noise load of monitored workplaces with particular service operators

Measured place of service worker at monitored workplace	Equivalent sound pressure level A $L_{Aeq,T}$ (dB)	Exposure time per worktime T_e (min)	Measured place of service worker at monitored workplace	Equivalent sound pressure level A $L_{Aeq,T}$ (dB)	Exposure time per worktime T_e (min)
Meal machine operation 1 (diagram No. 1)			meal machine operation 2 (diagram No. 5)		
Tractor at vacuum pump	109.9	30	switching on of meal machine place	92.7	20
Between trailer and meal machine	107.5	20	background noise at meal machine	47.7	
At meal machine	99.3	30	workplace	78.5	120
At meal supply containers	77.0	70	store full bags	72.1	120
Conveyors at meal supply containers	77.3	60	background noise	47.7	
Background noise	66.9				
Workshop (diagram No. 2)			lathe work shop (diagram No. 4)		
Hammer	99.6	360	lathe	74.2	60
Grinding machine	86.6	50	background noise	46.5	
Background noise	78.7				
Potato assorting line (diagram No. 3)			service garage (diagram No. 6)		
Workplace A	86.4	480	workplace A	66.0	360
Workplace B	86.4	480	at tractor, workplace B	71.8	300
Workplace	86.6	480	background noise	45.3	
Background noise	51.2				

valid from April 2006 and according to the Czech Technical Standard ČSN ISO 9612, valid from November 2000 (ANONYMOUS 2006; ČSN ISO 9612 2000).

The value of the stable and flexible noises in the workplace was expressed by the equivalent sound pressure level A $L_{Aeq,T}$, calculated according to the relation:

$$L_{Aeq,T} = 10 \log \left(\frac{1}{T} \int_0^T 10^{0.1L(t)} dt \right) \text{ (dB)} \quad (1)$$

where:

$L(t)$ – instantaneous sound pressure level in dB

T – time which the instantaneous level refers to

The measurement was repeated three times in order to get the objective results and the final equivalent sound pressure was calculated according to the relation:

$$L_{Aeq,T} = 10 \log \left(\frac{1}{T} \times \sum_{i=1}^m T_i \times 10^{\frac{L_{Aeq,T_i}}{10}} \right) \text{ (dB)} \quad (2)$$

where:

L_{Aeq,T_i} – equivalent sound pressure level A, occurring in the time interval T_i

T – equates to $\sum_{i=1}^m T_i$ where m is the total number of the partial time intervals

The hygienic limit of the noise exposition for other than eight-hour working time T (480 min) was obtained by adding a correction to the permissible exposure limits for the eight-hour working time.

$$K_T = 10 \log \left(\frac{480}{T} \right) \text{ (dB)} \quad (3)$$

where:

T – working time in the noise per shift (min)

The hygienic limit of the stable and flexible noise exposure of 85 dB was set for the eight-hour working time expressed by the equivalent sound pressure level A $L_{Aeq,8h}$ according to The Collection of Laws No. 148/2006. The correction was added according to the Eq. (3).

RESULTS AND DISCUSSION

The value of the equivalent pressure level A L_{Aeq,T_e} and the length of the personal day noise exposure of a worker T_e in minutes per shift in each particular

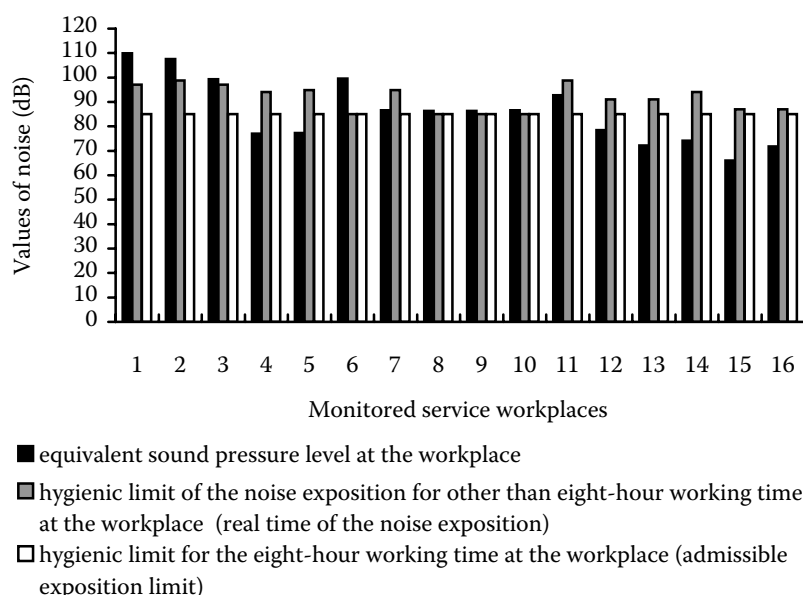


Figure 1. The value comparison of noise for the monitored workplaces
 1 – at a tractor and a vacuum pump; 2 – between a trailer and a meal machine; 3 – at a meal machine; 4 – at a meal supply containers; 5 – conveyors at a meal supply containers; 6 – hammer; 7 – grinding machine (Figure 2); 8 – place A; 9 – place B; 10 – workplace (Figure 3); 11 – switching on of the meal machine; 12 – workplace; 13 – store full bags (Figure 5); 14 – lathe (Figure 4); 15 – place A; 16 – at the tractor, place B (Figure 6)

monitored workplaces (servicing workplaces) is given in Table 1.

The design of the measurement is displayed in the scheme below (Figures 3–8).

The noise load of the service workplaces in the monitored operations is displayed in exposition limits compared in Figure 1, 2.

Monitored operations

Meal machine operation 1 shown in Figure 3.

It appears from the measured noise values of a tractor and trailer with a vacuum air pump that the noise exceeds the acceptable limits for the work of this kind, even if the service workers spend there

rather a short time necessary for switching the machine on and off and occasional checking. That place was the noisiest in the meal operation.

The measured noise came from the tractor, vacuum pump, and meal machine. Between the trailer and the meal machine, the measured noise was slightly lower. At the meal machine, where the service workers are necessary for switching the machine on and off and for the adjustment of the machine, the levels of the noise also exceeded the allowed exposure limits. In the interior work place at the meal supply (workplace A) where the noise comes mainly from the screw conveyors, the service operators check the function of the conveyors and the filling of the supply containers.

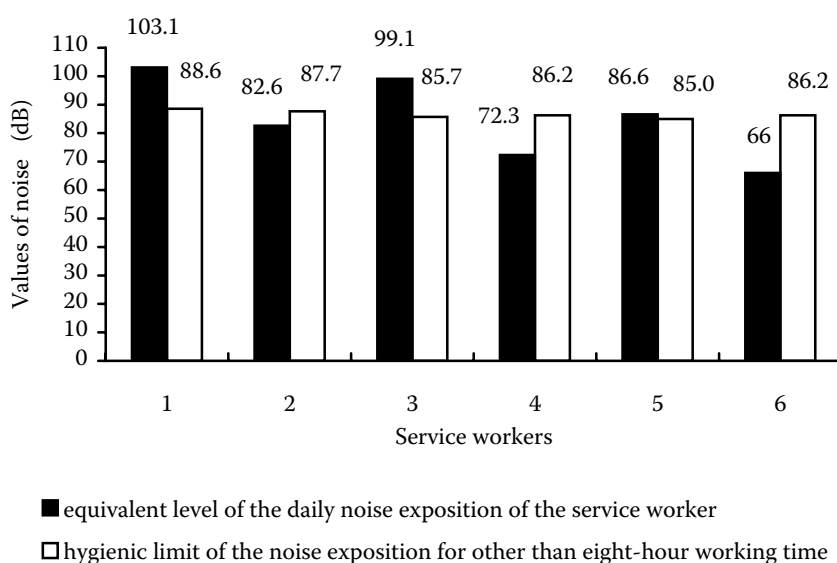


Figure 2. The values comparison of an equivalent level and a hygienic limit for the service workers

1 – servis operator of the meal machine 1, time of exposure at the workplace – 3 h 30 min (Figure 1); 2 – servis operator of the meal machine 2, time of exposure at the workplace – 4 h 20 min (Figure 5); 3 – servis operator of the hammer and the grinding, time of exposure at the workplace – 6 h 50 min (Figure 2); 4 – worker at the service garage place B + the lathe, time of exposure at the workplace – 6 h (Figure 4 and 6); 5 – worker of the potatoes assorting line, time of exposure at the workplace – 8 h (Figure 3); 6 – worker at the service garage place A, time of exposure at the workplace – 6 h (Figure 6)

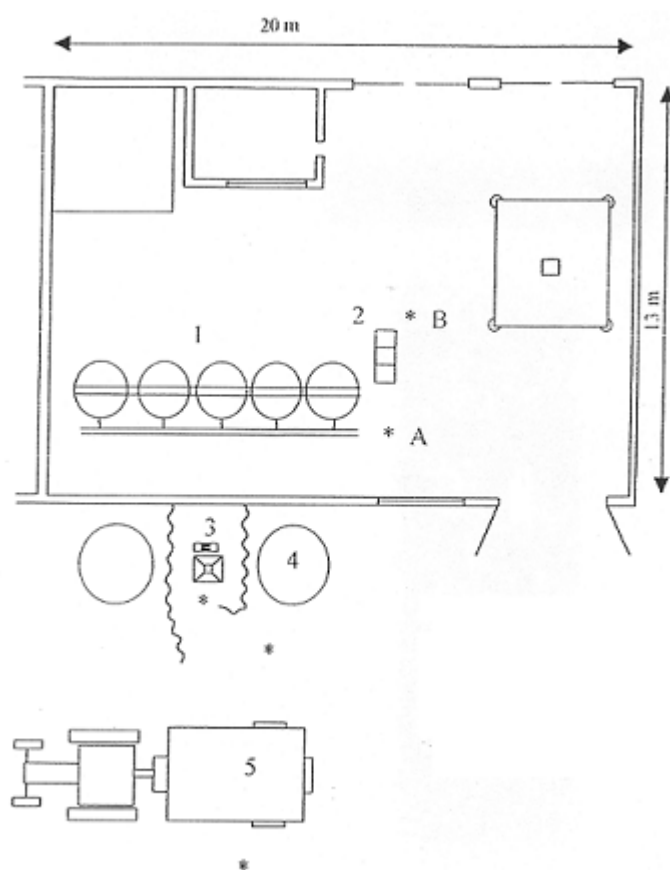


Figure 3. Meal machine operation
1 – corn containers; 2 – bucket conveyors;
3 – meal machine; 4 – meal supply containers;
5 – trailer with vacuum pump; * – measured place

At workplace B, the service operator adds some mineral additives into the meal. The levels of the noise were there lower than the acceptable ones at places A and B. The working hours at the meal machine are 3.5 hours a day (210 min), therefore the service operator is exposed to the noise level of 103.1 dB.

Those high values of the noise load during a long lasting and repeating exposure can lead to the damage to hearing.

Potatoes assorting line shown in Figure 4.

At all the monitored places, the values of noise were higher than the limit allows (the service operator place C, 1.6 dB more than the limit). Therefore, the service operators at the potato assorting line can be endangered by the hearing damage (HAVRÁNEK *et al.* 1990; HLÍNA & GERYK 1991). The noise is mostly caused by the chain and geared transmissions of the conveyers, especially by the electromotor with the chain transmission, placed at the end of the conveyer

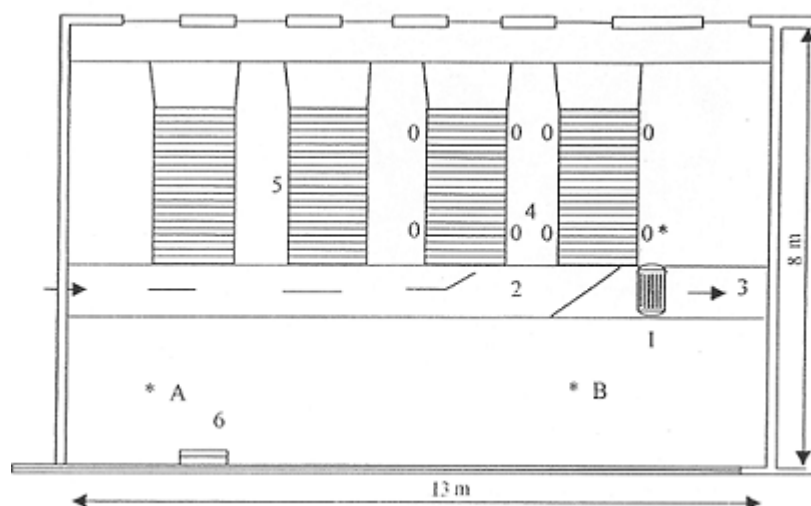


Figure 4. Potato assorting line
1 – electromotor with the chain transmission; 2 – band conveyor; 3 – waste conveyor; 4 – workplace; 5 – roller conveyor – assorting table; 6 – electric fan; * – measured place

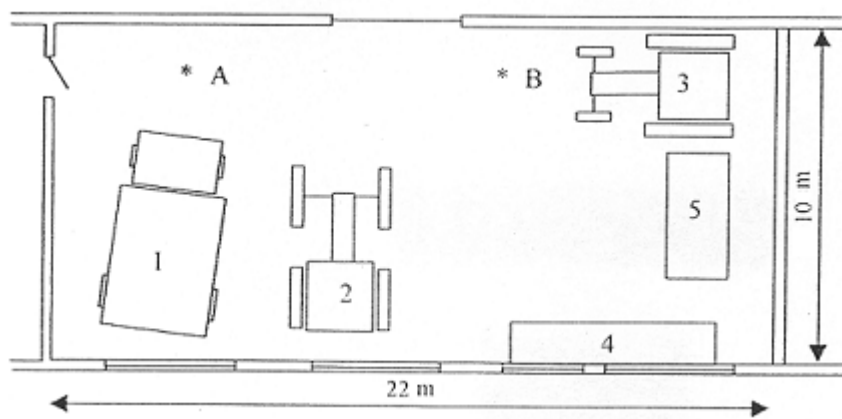


Figure 5. Service garage
1 – goods vehicle Liaz; 2 – tractor ŠT-180; 3 – tractor Zetor;
4 – work table; 5 – seeding machine; * – measured place

where the protection cover had been removed. There occurs not only a high value of noise but also a heavy dust nuisance causing health problems. Moreover, the service operators are exposed to those conditions for 8 hours a day for 5 months.

Meal machine operation 2 shown in Figure 5.

The loudest noise was measured at the meal machine (bag-filling machine Figure 1, column 11). The service operator spends there only the time necessary for switching the machine on and off and the regulation of the incoming amount of material. The measured values exceeded the acceptable limit. At the place where the service operator stores full bags, the noise level was below the acceptable limit.

The service operator spends there more than 4 hours a day (260 min). He/she is exposed to the lower noise load than that allowed by hygienic limits. According to HAVRÁNEK *et al.* (1990) and HLÍNA & GERYK (1991) the worker is not endangered by the harmful action of noise.

Service garage shown in Figure 6.

Transportation vehicles are repaired by three workers in that work shop area. Their working activity did not cause any especially high noise. The abnormal

noise was caused by their own talking and the radio while the third worker spent another 1 hour at the lathe – diagram 4 (Figure 2, column 4). All the workers are exposed to a low noise load which is 20.2 to 13.9 dB lower than the acceptable hygienic limit, therefore they are not endangered by any harm to hearing (HAVRÁNEK *et al.* 1990; HLÍNA & GERYK 1991).

Lathe work shop shown in Figure 7.

The lathe service worker is exposed to the noise load which is much lower than the acceptable limit allows. The average time of work is about 1 hour.

Workshop shown in Figure 8.

The workplace of the hammer service operator significantly exceeds the acceptable exposure limits. In the tillage season, the service operator is exposed to the noise for the whole work shift (8 hours). Off season, the exposure lasts about 6 hours. The grinding machine workplace is exposed to the noise which exceeds the acceptable limit. In the high season, the service operator at that workplace (the hammer and grinding machine) is exposed to the noise load of 99.1 dB for 8 hours a day. That high value of noise can cause the hearing damage during a repeating and long lasting action.

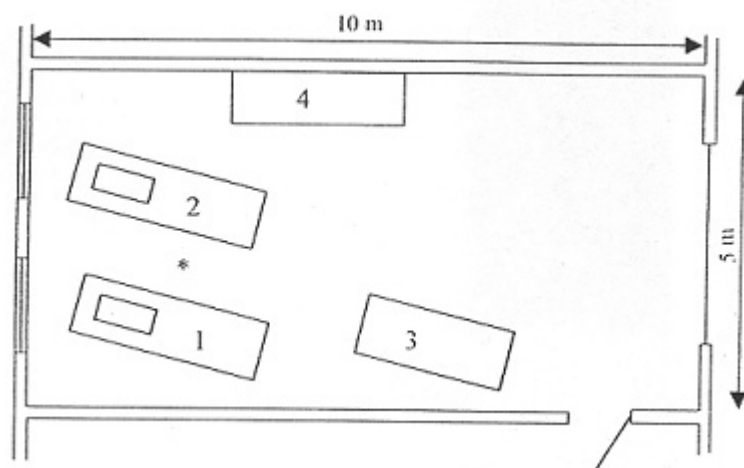


Figure 6. Lathe workshop
1 – measured lathe TOS; 2 – lathe;
3 – milling machine ; 4 – work table;
* – measured place

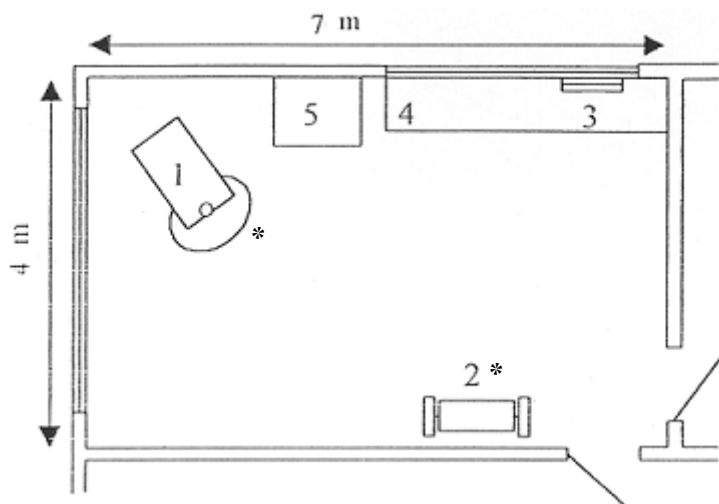


Figure 7. Workshop
1 – hammer AJAX 2; 2 – grinding machine; 3 – electric fan; 4 – work table; 5 – hearth; * – measured place

CONCLUSION

After measuring the sound pressure level at each operation service workplace and the evaluation of the noise load, it can be claimed that some workers in the

agriculture production are exposed to an excessive noise which is above the acceptable hygienic limit.

The meal machine service operator is exposed to the noise exposure of 103.1 dB (14.5 dB above the acceptable limit). The noisiness could be reduced

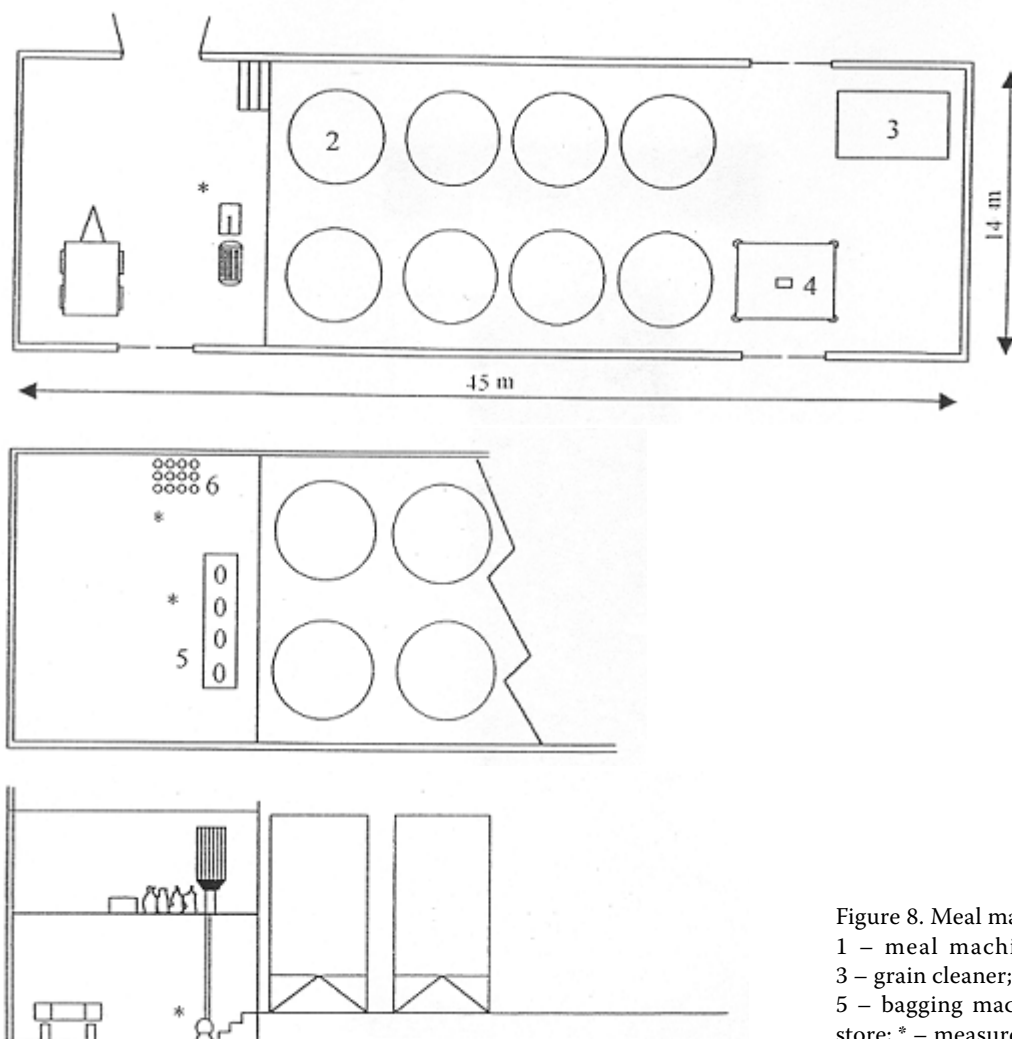


Figure 8. Meal machine operation
1 – meal machine; 2 – containers; 3 – grain cleaner; 4 – mobile container; 5 – bagging machinery; 6 – full bags store; * – measured place

by using wheels with a transversal tooth system, by using the missing protection cover, and also by using the right grease.

The hammer and grinding machine operator is exposed to the noise of 99.1 dB (13.4 dB more above the acceptable limit with 6-hour work shift, and 14.1 dB above the limit with 8-hour work shift).

The operator of the potato assorting line is exposed to the noise of 86.6 dB (1.6 dB above the limit); the noise at the monitored places is caused by the chain and tooth gearing systems, mainly by the electromotor with the chain gearing. A protection cover and the right grease could lead to the reduction of the noise to the acceptable hygienic limit.

The employer has to implement some measures to reduce the noise exposure. At least the employees should wear suitable personal protective facilities (e.g. ear plugs, ear defenders) which can contribute to the reduction of the harmful noise load to the acceptable exposure limit.

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Abstrakt

ŠÍSTKOVÁ M., PETERKA A. (2009): **Expozice hluku pracovního prostředí v pomocných zemědělských provozech.** Res. Agr. Eng., 55: 69–75.

Hluk patří mezi přední nebezpečné faktory znečišťující životní prostředí a negativně ovlivňuje lidský organizmus. V pomocných zemědělských provozech bylo provedeno přehledové měření týkající se hlukové zátěže na pracovišti. Na jednotlivých pracovních místech obsluhy byly za provozu pomocí zvukoměrné techniky měřeny hladiny akustického tlaku a zjišťována doba pobytu pracovníka. Ze získaných údajů lze konstatovat, že někteří pracovníci v zemědělských pomocných provozech jsou při práci vystavováni hluku přesahujícímu přípustný expoziční limit.

Klíčová slova: pomocné zemědělské provozy; hluk pracovního prostředí; přípustný expoziční limit

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