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## **THE NOISE MEASUREMENT OF SOME HAND-HOLD FARM MACHINES**

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*Ручные, переносные, и малогабаритные сельскохозяйственные машины широко применяются в малых сельскохозяйственных и садово-парковых предприятиях. Однако, при их работе возникают повышенные шумы, оказывающие вредное влияние на здоровье операторов. В статье приведены результаты измерения шума указанных машин и его сравнение с существующими нормативными требованиями.*

### ***Introduction***

Much of the operations in the farms are made by hand-hold machines, as motocultivators, chain saws, trimmers, hedge shears and others. They allow high productivity, but emit harmful noise. The noise is caused by the engine and the technological operation, [1,2,3,4,5]. There are guiding international standards on the measurement of airborne acoustical noise and evaluation of its effects on human beings, [6,7,8,9].

The aim of the investigation is to indentify the noise value of some hand-hold machines while working. The objective of this paper is to meagure the noise of machines of this kind and to compare their date to the standart norms.

The Ministry of Labor and Social Politics and the Ministry of Health have a Regulation №6 at 15 august 2005 Year. This regulates the level at the expositions of noise by working with machines, they are able to harm the health of the workers. The day-level of exposition of noise and the pick of noise pressure are definite:

1. The limited values of exposition are - 87 dB(A) and  $p_{\text{peak}}$  200 Pa, according 140 dB(C).
2. The high value of exposition to undertake an activity are - 85 dB(A) and  $p_{\text{peak}}$  140 Pa, according 137 dB(C).
3. The low value of exposition to undertake an activity are - 80 dB(A) and  $p_{\text{peak}}$  112 Pa, according 135 dB(C)

The level of sound pressure by A (dB) is a sound pressure, defined by corrected sound characteristics of the humans ear.

### ***Material and Methods***

Researched hand-hold farm machines, [10,11,12,13]:

1. Motocultivator MK-9S.

Engine – Subaru Robin, power 6,6 kW, mode four stroke, petrol, 1-cilinder.

Height – 1120 mm.

Width – 595 mm.

Length – 2050 mm.

2. Chain saw – Stihl ST MS250.

Engine two stroke 2 MIX, cc - 45,4 cm<sup>3</sup>, power – 2,3 kW, weight - 4,6 kg, length – 40 cm.

Sound level – 99,0 dB(A) and sound power – 111 dB(A), K-factor – according to Directive 2006/42/EO=2,5 dB(A).

3. Trimmer Husqvarna – 128 LDx.

Weight – 4,9 kg, length – 1320 mm.

Engine – two stroke, petrol, cc - 28 cm<sup>3</sup>, power - 0,8 kW, nominal speed – 8000 min<sup>-1</sup>, max speed – 10000 min<sup>-1</sup>, idle - 2700 min<sup>-1</sup>.

Sound level – 94 dB (A), guarantee sound level - 114 dB (A), K-factor in accordance with Directive 2006/42/EO=2,5 dB(A).

4. Hedge shear - STIHL HSB1T.

Weight – 5,4 kg, length – 75 cm, engine – two stroke petrol, cc - 22,7 cm<sup>3</sup>, power – 0,7 kW.

Sound level – 94,0 dB (A) and sound power - 104,0 dB (A), K-factor in accordance with 2006/42/EO=2,5 dB(A).

The sound power levels of noise sources are determined using sound pressure  $p(t)$ .

Survey acoustical method uses a reference sound source. The support sound pressure  $p_0$  is 20  $\mu$ Pa. The used equation for calculation of day-sound level of noise  $L_{pA}$  is:

$$L_{pA} = 10 \lg \left[ \frac{1}{T} \int_0^T \frac{p^2(t)}{p_0^2} dt \right], \text{ dB} \quad (1)$$

where  $T$  is the work time.

The day level of exposition of noise by inconstant noise  $L_E$  is calculated by:

$$L_E = L_{pA} + 10 \lg \frac{T_E}{T_0}, \text{ dB} \quad (2)$$

where  $T_E$  is the day exposition of noise, h;

$T_0$  – the day work time, 8 h.

The level of sound power  $L_W$  is calculated:

$$L_W = L_{Af} + 10 \lg \frac{S}{S_0}, \text{ dB} \quad (3)$$

where  $S$  is the surface of measurement;

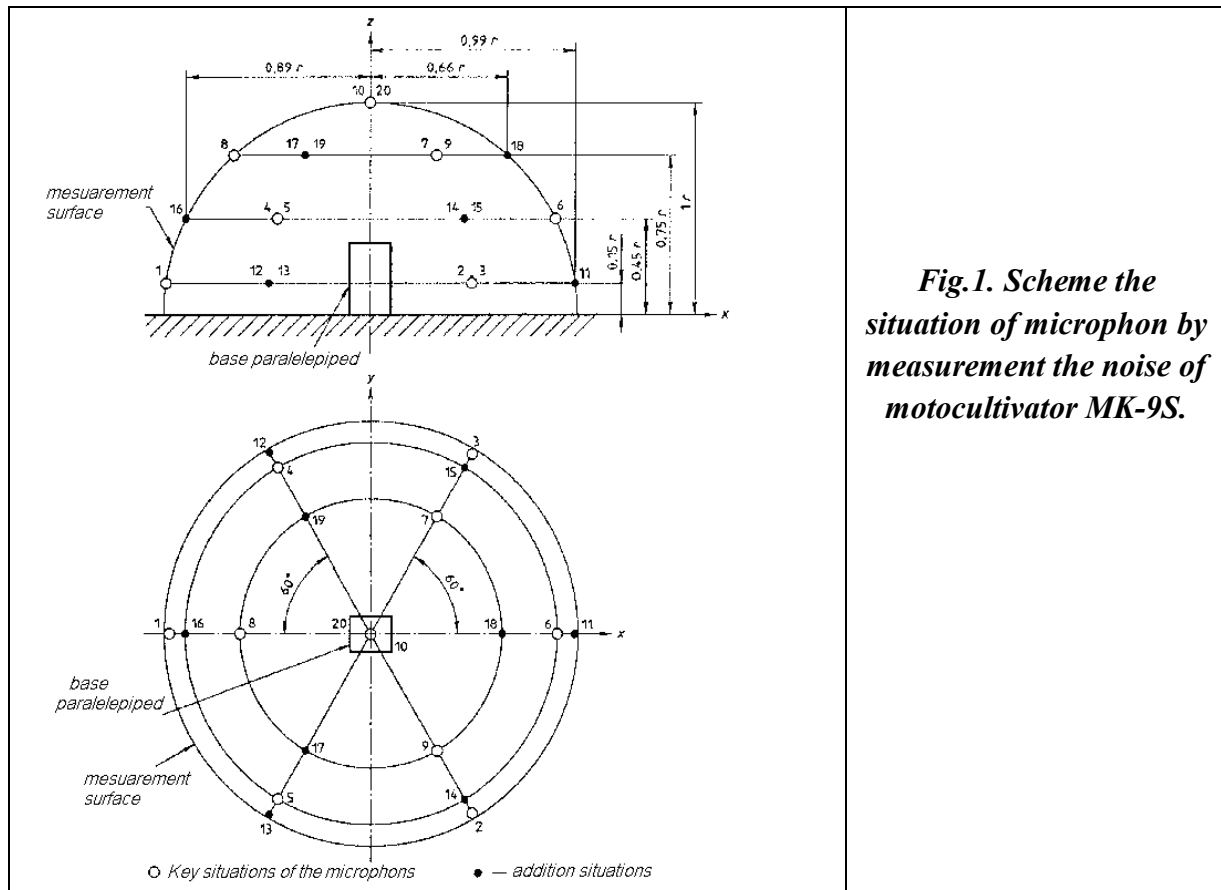
$S_0 = 1 \text{ m}^2$ ;

$L_{Af}$  - A-level of sound pressure of the surface.

Technical standard BDS EN-709 treats the verification of noise emission values of machinery and equipment. For motocultivator MK-9S is utilized sound levelmeter Puls 3560 C2510726 – producer B&K, microphone B&K 4188-A-2.

According to Technical standards BDS EN-1553, Technical standards BDS EN-11201 and Amendment 1:1993 EC 804:1985 Integrating-averaging sound level meters, and Amendment 1:1989, and Amendment 2:1993, sound level meter is CASELLA type CEL 244, sound calibrator RFT 05000.

The situation of microphon by measuremen the noise of motocultivator MK-9S is shown at fig.1.



*Fig.1. Scheme the situation of microphone by measurement the noise of motocultivator MK-9S.*

These engineering methods are designed for certification of production attitude of the emission noise. They are used for a measurement of the level of the noise in exploitation circumstances.

#### and discussion

The circumstances of the experiment and measured data are shown at **Tabl.1** and **Tabl.2**.

Tabl.1.

#### Results of measurement the motocultivators MK-9S noise

	Parameter	measured, dB
1.	<b>A-level of sound pressure at working place*</b>	
	measurement 1, 2, 3	79,95
2.	<b>A- level of sound pressure</b>	
	Microphone position 1	77,47
	Microphone position 3	76,03
	Microphone position 5	75,65
	Microphone position 7	77,78
	Microphone position 9	74,97
3.	<b>A-level of sound pressure of the surface</b>	
	mesuarement 1, 2, 3	76,23
4.	<b>A- level of sound power</b>	
	measurement 1,2,3	96,25

\* - by 3 measurements.

Tabl.2.

**Experimental date of noise at work with farm machines**

Farm machine	Operation	Equivalent level of noise, dBA	Peak level of sound pressure, dBC	Measured day-level of exposition the noise, dBA *
Chain sow STIHL ST MS 250	Cutting of branch	96	99	87
	Idle	76	76	-
Hedge shear STIHL ST HSB1T	Forming the bushes	96	99	87
	Idle	76	78	-
Trimmer Husqvarna	Cutting lower grass	92,5	92,5	83,5
	Idle	77	80	-

\* - the calculation is made by time of influence 1 hour.

\*\* - the idle rate is by minimal rotated speed of the engine.

The noise during operation with chain sow, hedge shear and trimmer is measured close to workers ears.

The analysis of the levels of the sound pressures of the motocultivators MK-9S shows that, the middle value, near the worker is 3,72 dB over than that one measured at the surface – 4m from machine.

The calculated value sound power  $L_W$  is 20 dB bigger than the value sound pressure  $L_{Af}$  at measurement surface.

Analysis of data in Tabl.2 indicate, that by idle rate the equivalent noise value  $L_{pA}$  for three investigated machines is about 20 dB lower than these by working rate. The high level sound pressure of chain sow and hedge shear is 3 dB higher than equivalent level.

By working time  $T_E$  – the calculated day-level of exposition  $L_E$  – for the three machines – is 9 dB lower than equivalent levels.

**Conclusion**

1. The investigation comes to the conclusion that, the equivalent value of noise during examined hand-held farm machines is lower than announced value in technical characteristics, and the peak level of sound pressure is near to announced value.

2. The day exposition of noise is lower than these within the limits of norms - 87 dBA according to Regulation №6, [9].

3. The level of the noise by experimental farm operations with hand-held and small machines is the reason for the undertaking some precautions, for example using antifones.

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