

# DETERMINATION OF THE RESOURCE OF AGCO SISU POWER ENGINE BY ENGINE SOUND LEVEL

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## Abstract

*This research represents an attempt to determine the sound level variance of AGCO SiSu Power using Sound Level Meter and measurements were taken during the fall harvest seasons of 2017 and 2018.*

*We measured the sound level in accordance with the methodology of standartization MNS 5044:2010 "The Requirements and Measurement Method for Vehicle Inspection Centers". From the results of measurement, the sound level varies with linear dependence when the engine gets old and the engine sound level increases when the engine years of operation increases.*

*According to the comparison made between the results of basic diesel engine and CRD diesel engine, it is proved that the sound level of basic diesel engine is 8% higher than the other one.*

**Keyword:** *Sound level, Soundmeter, CRD engine, Basic diesel engine*

## 1. Introduction

There are large number of tractors including John Deere, New Holland, Challenger, Case, SAMPO that are being imported from Canada, the USA, Japan, Finland, Germany to the agricultural field of Mongolia and they are with AGCO SiSu Power diesel engine.

Among them, the "SAMPO" is one of the most well-known and suitable technic for agricultural production technology, agrotechnical requirements, technical operating conditions and the amount of grain grown in Mongolia.

There are totally 67 SAMPO combine-harvesters that imported by individuals, dealers and agricultural support fund in Mongolia. From them 55 SAMPO combines have already operated for 17 years (1).

Currently, there are 17 SAMPO in Bulgan province, 1 SAMPO in Darkhan-Uul province, 1 SAMPO in Orkhon province, 4 SAMPO in Tuv province, 1 SAMPO in Khovd province and 43 SAMPO in Selenge province. Among them, 12 SAMPO combine are with the AGCO SiSu Power CRD diesel engine, the others are with basic AGCO SiSu Power diesel engine. Hence, it is necessary to study the chances to determine the life resource and to assessment the technical state of engine. This condition reveals us that it is requisite to make a research to localize the modern machines in Mongolia, to improve the knowledge of technical operation, service, diagnosis and usage for increasing the technical benefit and to fully use the technical life resource in condition of Mongolia (2).

## 2. Methods and tools of the research

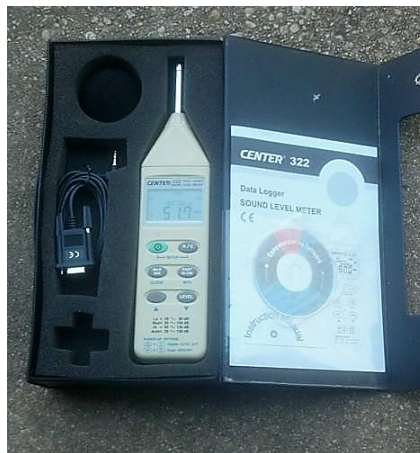
### 2.1. Study Objection: AGCO SiSu Power diesel engine

We measured the sound level in accordance with the methodology of standartization MNS 5044:2010 “The Requirements and Measurement Method for Vehicle Inspection Centers”

- Measuring level of sound /Method A/
  - To express sound meter values with decibel.
  - There are 0.3-0.4 m between sound level measuring points and upper, middle and lower parts of engine.
- Location of measurement point
  - Sound level of measurement environment should be lower 10dB than the sound of engine including wind noise.
- Measurement tools
  - Sound meter tool has to be portable, to be accredited and to have technical definition of manufacturer,
  - Limit of measurement tool:
    - Higher level: 70-140 dB
    - Lower level: 30-90 dB
    - Measurement presicion: 1.0 dB
- Measurement condition
  - The engine shall be heated to the working temperature (+80 - +95 °C).
  - The weather should be warm (-5 ° C - +30 °C), without precipitation.
- Requirement of sound level
  - Sound level depends on type of engine, year of manufacture
  - Sound levels are noted in the paper of technical inspection (3).

**2.2. Tools of the research:** Sound Level Meter used to measure AGCO Sisu Power engine sound level.

**Figure 1.** Sound Level Meter- CENTER 322



## 3. Result

### 3.1. Mathematical process

Within the scope of field measurement and experimental purposes, we calculated that required number of measurements was equal to  $n = 36$ . This calculation is based on the mathematic statistical methods using preliminary measurements made with 10 combines with CRD power engine, 7 combines with basic diesel engine. We made also a mathematic statistical processing to define whether the numerical value created by field measurement meets the requirement of research. Student test is made to define whether there is any over-quantitative measurement due to the problem of observation during the measurement of engine sound level. The test of whether the measurement values are homogeneous is done by the dispersion of the parameters described by the test. Since the measurement value is  $n < 50$ , Shapiro – Wilk W test is made to whether the line is normal and resulting it is subject to normal distribution rule.

The experimental curve is created with the data of sound level variance and operating years using the measured values. The experimental and theoretical curves based on measurable data of engine's operated years and sound level variance were created in Data Analysis of Microsoft Excel. The compatibility of mathematic model is analysed with Fisher's exact test. According to our result,  $F_k = 0.0027 < F_x = 4.08$  and  $F_k < F_x$  condition is proved that the mathematic model is fully compatible to our studying process (4).

Using the data above, it is determined that there is a linear relationship between operation years and sound level and the mathematical model that is able to fully express the arithmetic of the process and the theoretical and experimental curves are shown in Figures 2,3 and 4.

### 3.2. Analyze of the measurement results

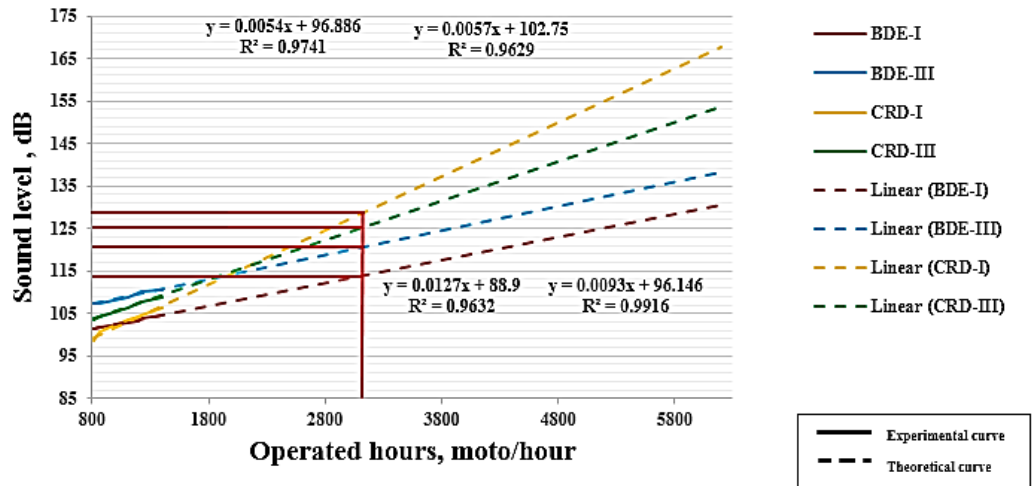
In 2009, MUST researcher and Ganbat, D., Ph.D worked on a monograph "Diagnostic Survey of Diesel Engine Injection" and held the doctor's title, modifying injection design of CRD engine (5).

Also, MULS researcher doctorate Zolboo, N. and Hulan, B., MSc attempted to plan the operating repair and overhaul for Agco Sisu Power Engine in their last thesis "Determination Of The Resource Of AGCO Sisu Power Engine By Engine Oil Pressure And Soot In Oil" in 2019. In conclusion, they have planned that the operating repair needs be done in 2500-3000 moto-hours while the overhaul needs to be done in 5800 moto-hours. These values were also compared to the manufacturer's recommendations (6).

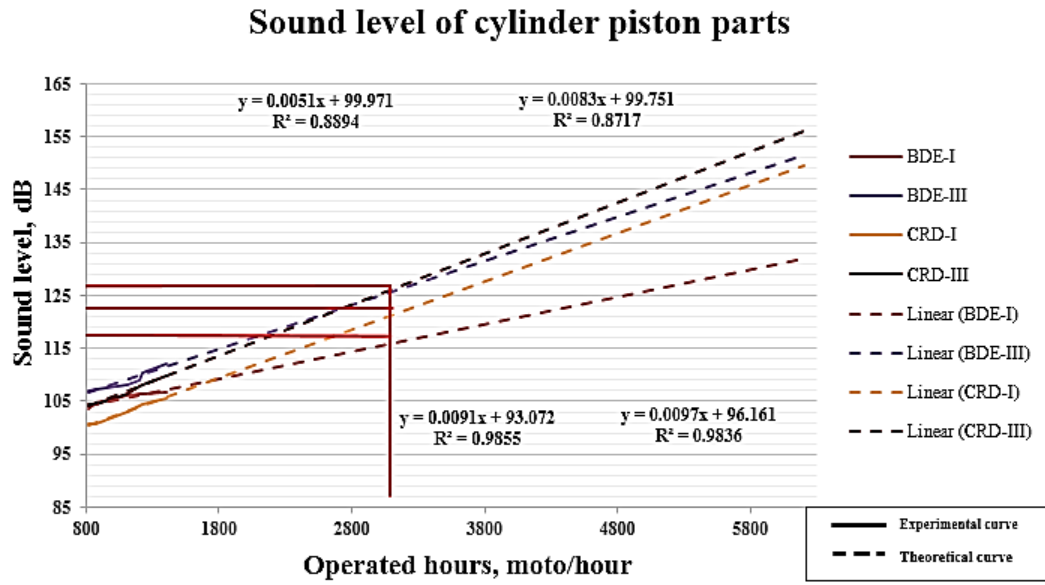
MULS researcher doctorate Zolboo, N and Hulan, B MSc have developed a theoretical model or nomogram that shows how engine oil pressure and soot will vary depending on operated years that demonstrates engine resource. We added a parameter of engine noise change to the engine oil pressure system and soot content, developing this nomogram (6).

**Figure 2.** Relationship between operated hours and sound level of power engine

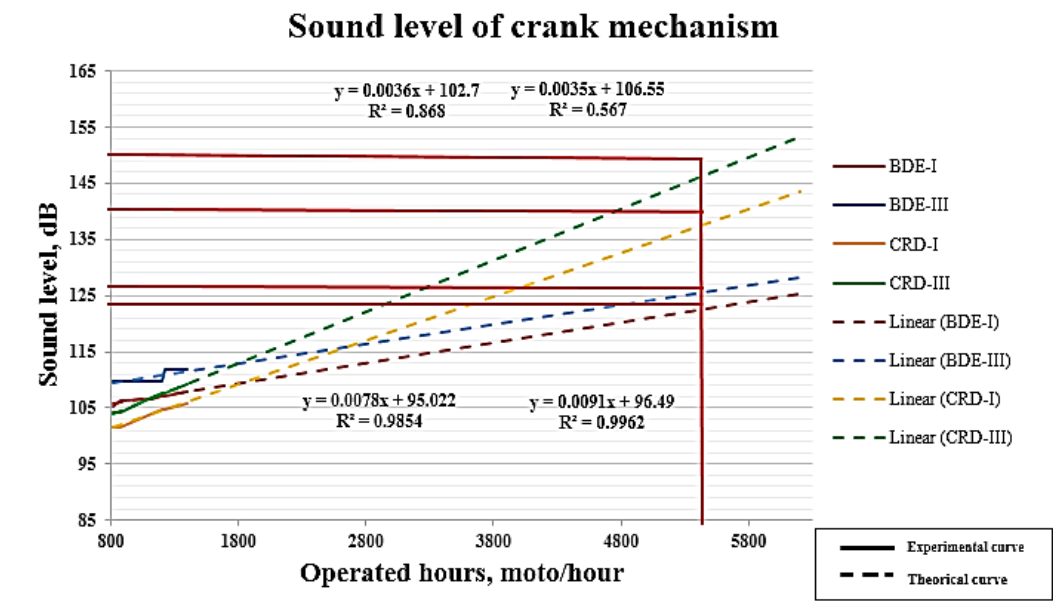
## Sound level of valve mechanism



**Figure 3.** The relationship between operated hours and sound level of power engine



**Figure 4.** Relationship between operated hours and sound level of power engine



## Conclusion

In the paper, we studied noise level change depending on the engine operated years and aimed to define technical condition and resource of AGCO SiSu Power engine and finally concluded below:

1. According to the comparison of measurement value and theoretical curve of basic diesel engine and CRD engine, it is proved that the sound level of basic diesel engine is 8% higher in the idle speed of engine, 7% higher in the rated speed of engine respectively than the CRD engine.

2. It is stated that operating repair is need to be done in 3000 moto-hours and overhaul is need to be done in 5800 moto-hours in condition of Mongolia. Hence, we determined corresponding sound levels to these hours of plan.

a. Operating repair:

• For aspiration diesel engine:

○ The sound level of valve timing parts is 113.09 Db in idle speed mode of engine and is 119.85 Db in rated speed of engine.

○ The sound level of cylinder and piston parts is 115.27 Db in idle speed mode of engine and is 124.65 Db in rated speed of engine.

• For CRD engine:

○ The sound level of valve timing parts is 127 Db in idle speed mode of engine and is 124.05 Db in rated speed of engine.

○ The sound level of cylinder and piston parts is 120.37 Db in idle speed mode of engine and is 125.26 Db in rated speed of engine.

b. Overhaul:

• For aspiration diesel engine: The sound level of crankshaft mechanism is 123.58 Db in idle speed mode of engine and is 126.85 Db in rated speed of engine

• For CRD engine: The sound level of crankshaft mechanism is 141.27 Db in idle speed mode of engine and is 149.27 Db in rated speed of engine

3. The importance of the research is that determining noise level by the times of doing operating repair and overhaul, developing the nomogram for determination a CRD engine residual resources.

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