TRAINING ON ANTAM STANDARD CODE
For TESTING OF KNAPSACK MISTERS CUM DUSTERS

Theory 17: Noise Measurement Test

(Test Code Section IV(8) and D- 10 of Annex D)

2nd Training of Trainers on ANTAM Codes
16 - 28 October2016, Nanjing China

ANTAM
Asian and Pacific Network for Testing Agricultural Machinery

Fundamentals of noise measurement

$$I = \frac{p^2}{\rho c} W / m^2$$

- I=sound Intensity
- P=RMS value of acoustic pressure
- ρ = Density of air
- C= Velocity of sound in air

- MartyrA.J. and M.A. Plint 2007,Engine Testing Theory and Practice Third edition Published by Elsevier Ltd

$$dB = 10\log_{10}\left(\frac{I}{I_0}\right) = 20\log_{10}\left(\frac{p}{p_0}\right)$$

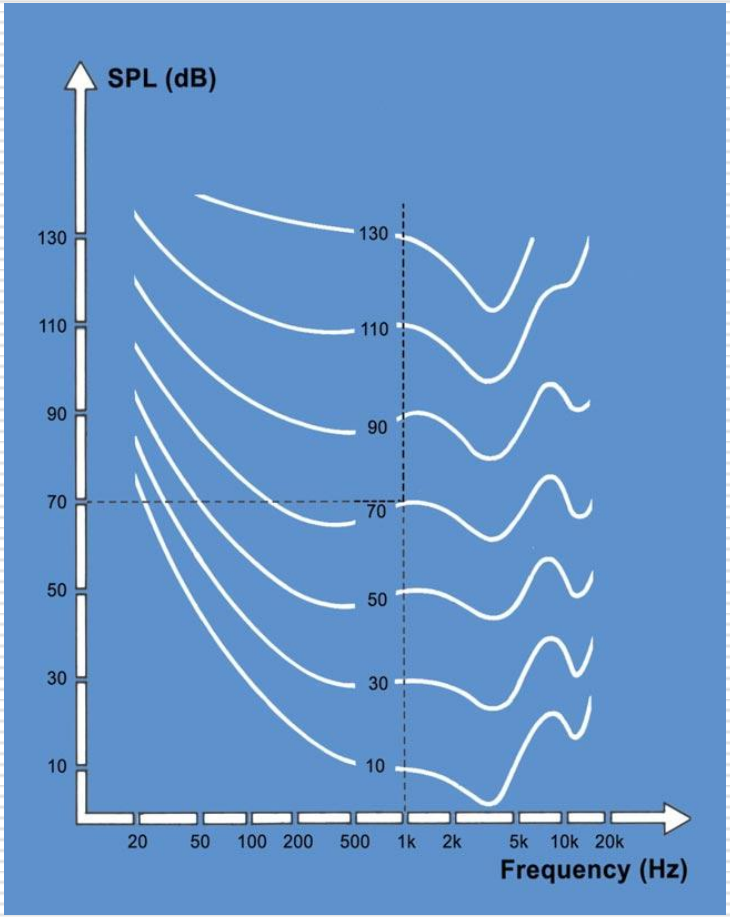
- where I_0 corresponds to the average lower threshold of audibility, taken by convention as $I_0 = 10^{-12}W/m^2$.

- $10 \log_{10} 2=3.01$ Hence 3dB means doubling of sound intensity
- The value on the decibel scale is often referred to as the sound pressure level (SPL).
- Sound is propagated spherically from its source and the inverse square law applies, and doubling the distance between the source of sound and point of measurement results in a reduction in Sound Pressure level (SPL) of about 6 dB ($\log_{10} 4=0.602$).

MartyrA.J. and M.A. Plint 2007,Engine Testing Theory and Practice Third edition Published by Elsevier

Sound frequency

- The human ear is sensitive to frequencies in the range from roughly 16 Hz to 20 kHz, but the perceived level of a sound depends heavily on its frequency structure.
- The well-known Fletcher–Munson curves which gives equal loudness contours on frequency- sound pressure level plane.



MartyrA.J. and M.A. Plint 2007,Engine Testing Theory and Practice Third edition Published by Elsevier Ltd

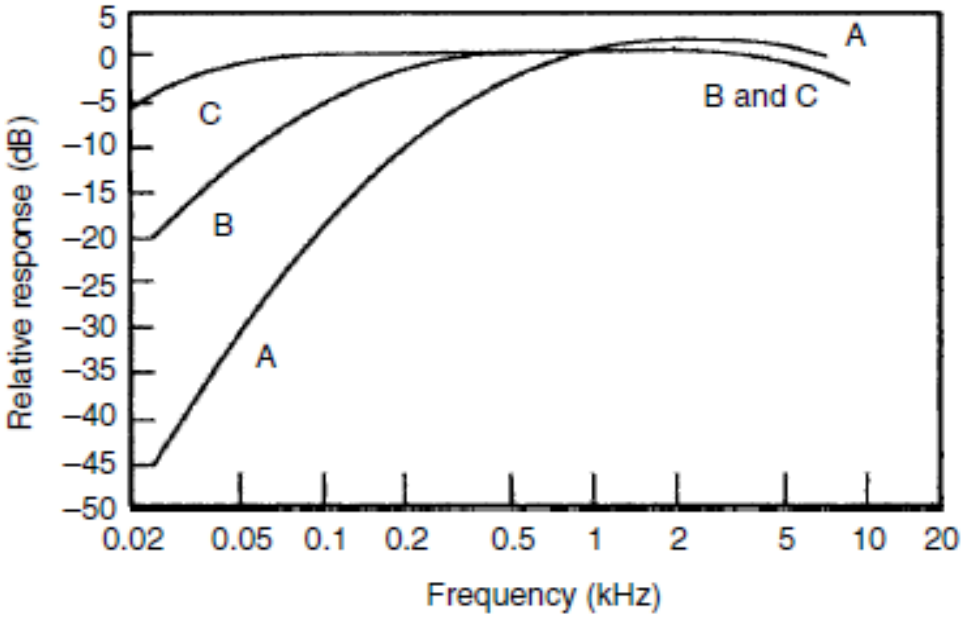
Octave Band

- An octave band is a frequency band where the highest frequency is twice the lowest frequency. An octave filter with a centre frequency of 1kHz has a lower frequency of 707Hz and an upper frequency of 1.414kHz. A third octave has a width of 1/3 of that of an octave band.

The weighing scale

- Most instruments for measuring sound contain weighted networks which give a response to frequency which approximates to the Fletcher–Munson curves.
- Their response to frequency is a reciprocal of the Fletcher–Munson relationship
- For most applications the A-weighting curve gives satisfactory results and the corresponding SPL readings are given in dBA. B- and C-weightings are sometimes used for high sound levels, while a special D-weighting is used primarily for aircraft noise measurements,

Noise weighing curve



Equipment- Location

(IS 12180 (Part 1): 2000)

- The noise measurement test shall be conducted at the operator's ear level during the drawbar pull test.
- Sound level meter which meets at least the requirements of IEC 651-1979 for a type 1 instrument shall be used.
- The noise shall be measured with instrument of A weighted expressed in decibels set on slow level.
- The test area shall be a flat open space and shall be within at least 20 m of the test machine. There shall be no obstacle likely to reflect significant sound, such as building, solid fence, tree or other vehicle.

Procedure

(IS 12180 (Part 1): 2000)

- The test shall be conducted at different drawbar loads in different forward speed gears. The drawbar loads shall be applied by the loading device remotely positioned to eliminate interference with the sound fields caused by the power tiller.

- During the measurement, the microphone shall be horizontal and facing forward. It shall be 5 cm to the side of the operator's forehead and in line with his eyebrows. It shall be mounted on an open frame helmet.

- The sound level measurements shall be made in all forward speed gears under safety test condition. The results shall be reported in the gear giving the nearest forward speed of 2km/h and also under any gear for which a sound level of at least 1 dB (A) above that of the above mentioned gear was recorded.

Calibration

IS : 12180 - 1987

The calibration of the equipment at the time of the measurements shall be in accordance in all respect with IS : 9779-1981*. Calibration shall be carried out at appropriate intervals and at least before and after each measurement session using an acoustical calibrator with an accuracy of ± 0.5 dB at a known frequency in the range 250 to 1 000 Hz. **The calibrator shall be checked annually to verify its output** and its initial calibration shall be traceable to a national standards laboratory.

Environment

IS : 12180 - 1987

The wind velocity at microphone height shall not exceed 3 m/s. Care shall be taken to ensure that wind effect does not distort the results.

Background Noise — The level of the background noise including wind noise shall be at least 10 dB below the level measured during the test. Where spectral analysis is required, the level of the background noise shall be at least 10 dB below the corresponding level in each frequency band as measured during the test.

Mounting the microphone

IS 12180 (P8rt 1) : 2000 ISO 5131: 1998

For standing and pedestrian operators, the microphone

shall be mounted on an open-frame helmet worn on the operator's head or on a shoulder harness. in such a way that the microphone axis is horizontal and its diaphragm is 250 mm ± 20 mm to the side of the centre plane of the operator's head, in the same vertical plane as his eyebrows and facing forwards.

The side of the head chosen for the microphone shall be that for which the higher sound pressure level is encountered. The operator shall continue to face forwards during the noise measurement.

Measuring procedure

IS 12180 (P8rt 1) : 2000 ISO 5131: 1998

Make at least three measurements at each microphone position, as defined in clause 8. and for each operating condition. If the spread of results of the A-weighted sound pressure level obtained under the measuring conditions exceeds 3 dB. make further measurements until the readings of three successive measurements fall within 3 dB. Take the arithmetic mean value of these three readings as the test result

Averaging readings

IS 12180 (P8rt 1) : 2000 ISO 5131: 1998

Measure the level of the noise obtained with the tractor or machine operating as specified in the appropriate annex. State the frequency weighting A and the time weighting S settings of the meter clearly in reports of the measurements.

Take measurements after a 10s period of stabilized running.

When sound pressure levels fluctuate widely because of the characteristics of the machine type and the 3 dB requirement for successive readings, specified above, cannot be met, the number of separate measurements shall be greater than the fluctuation range in decibels. Take the arithmetic mean as the test result.

Specification of sound level meter

Electroacoustics IS 15575 (Part 1) :2005 IEC 61672-1 (2002)
confirms to IEC 651- 1979 for a type 1 instrument (ANTAM 001-2016)

Measurement of sound

Power tiller test Code Is 9935:2002 Vs ANTAM-2016

- Noise at By-Stander Position
- Noise at Operator's Ear Level
  - Power tiller test Code **Is 9935:2002**
- Only Noise at Operator's Ear Level
  - ANTAM 001-2016

Noise Measurement

ANTAM-001-2016(IS 12180 (Part 1): 2000)

- The noise measurement test shall be conducted at the
  - Operator's ear level
  - During the drawbar pull test.
- Sound level meter
  - IEC 651- 1979 for a type 1 instrument
- The noise shall be measured with
  - Instrument of A weighted
  - Expressed in decibels
  - Set on slow level.

Conditions

ANTAM-001-2016

- The test area shall be
- A flat open space
- There shall be no obstacle within at least 20 m.
- The air temperature
- From -5 °C to 35 °C
- Wind velocity shall not exceed 5 m/s at the operator's position

Location of Microphone

ANTAM-001-2016

- For seated operators, the microphone shall be located 250 mm ± 20 mm to the side of the center plane of the seat.
- The side being that on which the higher sound pressure level is encountered.
- The axis of the microphone shall be horizontal and the diaphragm shall face forwards.
- The centre of the microphone shall be 700 mm ± 20 mm above the seat index point and 100 mm ±20 mm forward of that point.
- Excessive vibration of the microphone shall be avoided.
- The seat index point shall be determined in accordance with ISO 5353: 1995.

Location of Microphone

Procedure

ANTAM-001-2016

The test shall be conducted at:
Different drawbar loads
In different forward speed gears.
The drawbar loads shall be applied by the loading device remotely positioned.

The microphone shall be horizontal ,Facing forward.
It shall be 5 cm to the side of the operator’s forehead and in line with his eyebrows.
It shall be mounted on an open frame helmet.

Measurement-Reporting

ANTAM-001-2016

The sound level measurements shall be made in **all** forward speed gears under safety test condition.

The results shall be reported in the gear giving the nearest forward speed of 2km/h and

Under any gear for which a sound level of at least 1 dB (A) above that of the above mentioned gear was recorded.

The data shall be recorded in Annex D-10.

D-10.1 AT OPERATOR'S EAR LEVEL						
D-10.1.1 Brief Description of the Silencing System						
D-10.1.2 Background Noise Level, dB (A)						
D-10.3 Sound Level Meter Sound Level Meter 1) Type: 2) Make: 3) Model:						
D-10.4 Date of Test						
D-10.5 Atmospheric Conditions a) Temperature, ^{0}C b) Pressure, kPa c) Relative humidity, %						
D-10.6 Test Data						
No	*Gear Used*	*Travelling Speed (km/h)*	Engine Speed (rpm)	*Slip (%)*	*Drawbar Pull (kN)*	*Sound Level dB (A)*
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
1						
2						
3						
4						
5						
6						

Permitted exposure levels

IEC60804

Duration per Day - hours	Sound level dB (A)
24	80
16	82
8	85
4	88
2	91
1	94

Sl.No	Code	Number
1	ANTAM Standard Code For Testing of Power Tillers	001-2016
2	Power tiller - Test Code- (2nd Revision)	IS 9935:2002
3	Method For Noise Measurement of Agricultural Tractors	IS : 12180 – 1987- Reaffirmed 1995
4	OECD standard Code for the official measurement of noise at the driving position(s) on Agricultural and Forestry Tractors	Code 5 July 2012
5	OECD Standard Code For The Official Testing Of Agricultural And Forestry Tractor Performance	Code 2 July 2012
6	Tractors and machinery for agriculture And forestry - noise measurement method Of test Part 1 noise at the operator1s position - survey method	IS 12180 (Part 1) : 2000 ISO 5131 : 1996
7	Tractors and machinery for agriculture And forestry - noise measurement method Of test Part 2 noise emitted when in motion *(first revision)*	IS 12180 (Part 2) : 2000 ISO7216 : 1992
8	*Indian standard* electroacoustics — level meters Part 1 specifications	IS 15575 (Part 1) :2005 IEC 61672-1 (2002) (Superseding IS 9779: 1981)