INTERNATIONAL STANDARD 2151

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION · МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ · ORGANISATION INTERNATIONALE DE NORMALISATION

Measurement of airborne noise emitted by compressor/primemover-units intended for outdoor use

iTeh STANDARD PREVIEW
(standards.iteh.ai)

First edition — 1972-06-15

ISO 2151:1972
https://standards.iteh.ai/catalog/standards/sist/4ef4b214-f0f1-4056-a484-c5ea6ffde7c1/iso-2151-1972

UDC 621.51 : 534.61

Ref. No. ISO 2151-1972 (E)

Descriptors : acoustic measurement, compressors, engine noise, tests.

Price based on 6 pages

FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO Member Bodies). The work of developing International Standards is carried out through ISO Technical Committees. Every Member Body interested in a subject for which a Technical Committee has been set up has the right to be represented on that Committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the Technical Committees are circulated to the Member Bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 2151 was drawn up by Technical Committee ISO/TC 118, *Compressors, pneumatic tools and pneumatic machines.*

iTeh STANDARD PREVIEW
(standards.iteh.ai)

It was approved in June 1971 by the Member Bodies of the following countries:

ISO 2151:1972
https://standards.iteh.ai/catalog/standards/sist/4ef4b214-f0f1-4056-a484-c5ea6f0d8161/iso-2151-1972

Belgium	India	Sweden
Canada	Ireland	Switzerland
Czechoslovakia	Israel	United Kingdom
Egypt, Arab Rep. of	Japan	U.S.A.
France	Netherlands	U.S.S.R.
Germany	New Zealand	
Hungary	Romania	

The Member Body of the following country expressed disapproval of the document on technical grounds:

South Africa, Rep. of

© **International Organization for Standardization, 1972** •

Printed in Switzerland

Measurement of airborne noise emitted by compressor/primemover-units intended for outdoor use

0 INTRODUCTION

iTeh STANDARD PREVIEW
(standards.iteh.ai)

The purpose of this International Standard is to show how information on the acoustic properties of compressor/prime mover-units for outdoor use should be provided and presented.

ISO 2151:1972
https://standards.iteh.ai/catalog/standards/sist/...iso-2151-1972

Such information is valuable for the following purposes :

a) prediction of the disturbance in the neighbourhood of a machine working outdoors, for example on a building site;

b) assessment of the risk of hearing damage for people working close to the machine;

c) comparison of the acoustic properties of different makes of machines tested according to the methods described in this International Standard.

NOTE – The order of the above items is purely arbitrary and does not indicate any priority.

The information is obtained from measurements made over a reflecting plane and in an area where free field conditions exist.

Two sets of microphone locations are specified, one set situated at 1 m and the other at 7 m from the surface of the machine.

Prediction of the disturbance should be based on the information from the second set of microphone locations.

NOTE – Without a microphone location above the machine on test, it is not possible to predict accurately the sound level at any point above the machine.

An example of the recommended form of test report for the presentation of results is given in the Appendix.

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies a method of determining, for the purposes specified in the Introduction, the airborne sound emitted by compressor/primemover-units intended for outdoor use and gives precise instructions for conducting the tests and reporting the results.

2 REFERENCES

In this International Standard, the following reference pressure is used for the expression of sound pressure level :

$$2 \times 10^{-5} \text{ N/m}^2$$

Reference is made to the following publications :

– IEC Publication 179, *Precision sound level meters.*

– IEC Publication 225, *Octave, half-octave and third-octave band filters intended for the analysis of sound and vibrations.*

– ISO/R 131, *Expression of the physical and subjective magnitude of sound or noise.*

– ISO/R 362, *Measurement of noise emitted by vehicles.*

– ISO/R 495, *General requirements for the preparation of test codes for measuring noise emitted by machines.*

– ISO/R 1996, *Acoustics – Assessment of noise with respect to community response.*

– ISO/R 1999, *Acoustics – Assessment of occupational noise exposure for hearing conservation purposes.*

3 INSTRUMENTATION

The instrumentation required for carrying out the tests specified in this International Standard is as follows :

3.1 Sound level meter and microphone system, meeting the requirements of IEC Publication 179.

3.2 Octave band analyser, meeting the requirements of IEC Publication 225.

NOTE – The entire instrumentation system, including the microphone and cable, should be calibrated by means of an acoustic signal of convenient frequency before and after each test series. For this, a reciprocity calibrator or pistonphone is recommended. The frequency response of the system (with and without microphone and cable, should be calibrated by means of an acoustic instruments specified in 3.1 and 3.2 should be in accordance with IEC Publication 179 and IEC Publication 225 respectively.

3.3 Recorders. If a tape recorder or graphic level recorder is used, its response shall be as specified in 3.1.

4 RANGE OF FREQUENCIES AND LEVELS

4.1 Frequencies

The range of frequencies generally considered is that of the octave bands whose centre frequencies lie between 63 Hz and 8 kHz.

NOTE – Measurements may be made at lower frequencies but it must be realised that measurement precision decreases with decreasing frequency.

4.2 Levels

Octave bands of interest are defined as those where the band pressure levels produced by the machine are within 50 dB of the highest measured octave band level. In no case are levels below 50 dB considered important.

5 PROCEDURE FOR SOUND LEVEL MEASUREMENT FOR INTEGRAL COMPRESSOR UNITS INTENDED FOR OUTDOOR USE

5.1 Operation of subject equipment

The machine shall have been warmed up and shall be operating in a stable condition as for continuous service and at its normal rated working pressure.

The measurements shall be made in the condition specified in 5.1.1 and also, if applicable, in that specified in 5.1.2.

5.1.1 *Full speed on load condition*

The machine shall be running at the design full speed with the compressor on load, delivering its rated output and pressure. The discharge shall be piped clear of the test area or fed into an effective silencer.

5.1.2 *Idling condition*

The machine shall be running in the idling condition with the discharge valves from the receiver closed.

5.2 Test environment

The machine on test is assumed to radiate sound into a free field over a reflecting plane.

This calls for an environment which can only be obtained on an open site above a hard reflecting plane. An example of a suitable test area would be a hard reflecting surface of such diameter that all microphone positions are within its perimeter. (See 5.4.2.) The hard reflecting surface shall be made of concrete or impervious asphalt.

NOTE – Consideration should be given to the noise induced by vibration of the hard reflecting plane; isolation to reduce this effect may be desirable and should be in the form of a break between the machine mounting pad and the rest of the plane.

The presence of large objects such as buildings and machines within a radius of 25 m from the machine on test is to be avoided; if this is impossible, their positions shall be reported.

No reflecting surfaces shall be near the microphone. Observers and measuring instruments shall be at least 1 m from the microphone and the machine under test. Care shall be taken to ensure that operating personnel are clear of the machine and the microphone while readings are being taken so as not to prejudice the validity of the measurements.

Care shall be also taken that gusts of wind do not distort the results of the measurements. A microphone windscreen shall be used if necessary; in this case, a special calibration correction may be required.

5.3 Background sound level

The background sound level when the machine on test is not running shall be determined at one of the microphone locations to be used when conducting the test.

The period of measurement shall be long in relation to any variation of the sound level observed so that a correct average reading can be obtained with the slow response setting of the meter.

The readings at each location with the machine running shall exceed the background sound levels by at least 10 dB in each octave band of interest. When the difference is less corrections shall be applied as shown in the following table :

Level increase due to the machine (dB)	Value to be subtracted from measured value (dB)
5	2
6 to 9	1

If the difference between the measured sound level and the background sound level in any octave band is less than 5 dB, a valid result cannot be obtained in that octave band.

iTeh STANDARD PREVIEW
(standards.iteh.ai)
ISO 2151:1972
https://standards.iteh.ai/catalog/standards/sist/4ef46214-f011-4056-a484-e9ea0fde7c1a/iso-2151-1972

5.4 Sound measurement

5.4.1 *Data to be recorded*

a) Sound level, using the "A" weighting network.

b) Octave band pressure levels, using the flat response network. (Marked C or Lin.)

The above data shall be recorded at each microphone location as specified in 5.4.2, with the machine on test running as specified in 5.1.

At one microphone location, the background sound level with the machine not running shall also be recorded and this location shall be indicated in the test report.

5.4.2 *Microphone locations*

Surveys shall be made all around the machine at distances of 1 m and 7 m from the nearest major surface and at a height of 1.5 m to establish the direction of the maximum sound level ("A" scale) for the machine running on full load as specified in 5.1.1. The microphone locations shall be in this direction and in four other directions, two located at the centre of each end and two at the centres of the sides of the machine. Two sets of microphone locations shall be used (see Figure 1) :

a) 1 m distance from the nearest major surface of the machine and at a height of 1.5 m above the reflecting plane.

b) 7 m distance from the nearest major surface of the machine at a height of 1.5 m above the reflecting plane.

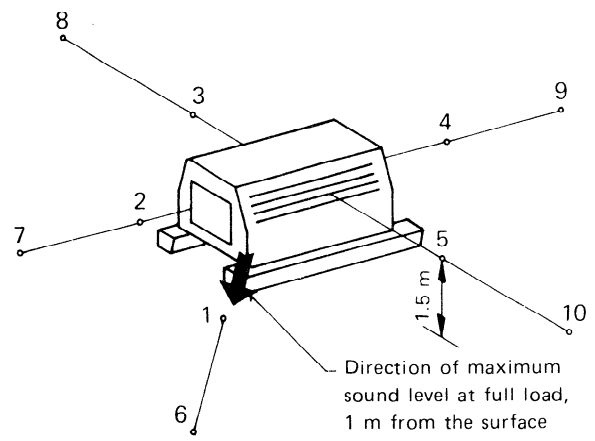


FIGURE 1 — **Microphone locations**

5.4.3 *Measuring technique*

With the microphone in each of the locations according to 5.4.2, the sound level shall be recorded as stated in 5.4.1.

The period of measurement shall be long in relation to any variation of the sound level observed so that a correct average reading can be obtained with the slow response setting of the meter.

The microphone shall be held in the position of grazing incidence or perpendicular incidence in which it was calibrated.

WARNING - If the sound from the machine on test contains strong audible discrete frequency components, errors in the measuring results may occur. When the discrete frequency components are of a high frequency, the errors can be reduced by slowly raising and lowering the microphone by approximately ± 0.3 m from each microphone location. During the movement, care must be taken to avoid the generation of noise, either mechanical or aerodynamic in origin, which could influence the measurements. If the moving microphone technique is used, this fact shall be reported.

6 EXPRESSION OF RESULTS

6.1 Application of corrections

Readings shall be corrected for the influence of background sound in accordance with the table in 5.3.

If required, calibration corrections shall be applied.

6.2 Calculation of the mean sound level and mean band pressure level

6.2.1 If the spread between the readings for one set of microphone locations in accordance with 5.4.2 does not exceed 5 dB, the mean level is obtained by taking an arithmetical average of the readings.

6.2.2 If the spread exceeds 5 dB, the mean level is calculated in accordance with the following equation :

$$L = 10 \log_{10} \frac{1}{n} \left[\text{antilog}_{10} \frac{L_1}{10} + \text{antilog}_{10} \frac{L_2}{10} + \ldots + \text{antilog}_{10} \frac{L_n}{10} \right]$$

where

L is the mean sound level or mean band pressure level in dB;

L_1 is the sound level or band pressure level in dB at microphone location No. 1;

L_n is the sound level or band pressure level in dB at microphone location n;

n is the number of microphone locations. (According to 5.4.2, $n = 5$.)

NOTE — An alternative method of establishing the mean is by using the chart shown in Figure 3.

To use this, proceed as follows :

1) Pair the readings to be averaged as shown in Figure 2.

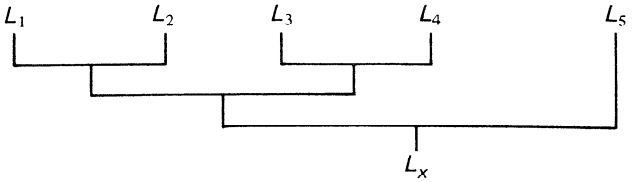


FIGURE 2

iTeh STANDARD PREVIEW
(standards.iteh.ai)
ISO 2151:1972
https://standards.iteh.ai/catalog/standards/sist/4ef4b214-f0ff-4056-a484-c5ea6ffde7c1/iso-2151-1972

2) Add these, using the chart shown in Figure 3.

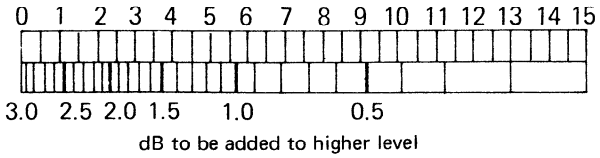


FIGURE 3

3) Subtract from the result 10 log n

($L = L_x - 10 \log n$)

i.e for 4 positions ... 6 dB
5 positions ... 7 dB

4) Record the result in the average column.

6.3 Test report

The test report shall give at least the following information :

a) reference to this International Standard;

b) description (including make, model and serial number) and major dimensions of the machine and its operating conditions (including ambient temperature);

c) a sketch showing the test layout and the microphone locations (direction and distance to larger objects within 25 m of the machine on test should be indicated);

d) make, model and serial number of the acoustical instrumentation used, including windscreen if required,

e) the background sound level in dB(A) and the octave band pressure level of the background sound at one microphone location (this location to be indicated in the sketch);

f) the sound level in dB(A) and the octave band pressure levels at each microphone location at 1 m, reported as shown in Table 1 in the Appendix, and those for 7 m, reported as shown in Table 2 in the Appendix (corrections having been made for background sound level and for a windscreen, if this was used);

g) graphs for both microphone distances to show

1) the mean sound level and the mean octave band level,

2) the octave band pressure levels in the microphone locations situated in the direction in which the maximum sound level "A" is found.

The format recommended for the report is shown in the Appendix.

iTeh STANDARD PREVIEW
(standards.iteh.ai)
ISO 2151:1972
https://standards.iteh.ai/catalog/standards/sist/4ef4b214-f0f1-4056-a484-c5ea6ffde7c1/iso-2151-1972

APPENDIX : **FORMAT FOR COMPRESSOR TEST REPORT**

COMPRESSOR TEST REPORT (NOISE)

The following test has been made in accordance with ISO 2151.

1 SUBJECT

Manufacturer : . . . . . .

Model : . . . . . Serial No. . . . . .

Rated speed and capacity : . . . . . .

Major dimensions : . . . . . .

Description : . . . . . .

2 OPERATING CONDITIONS

2.1 On load

Speed : . . . . . Delivered air pressure : . . . . . .

2.2 Idling

Speed : . . . . . Receiver air pressure : . . . . . .

2.3 Type of discharge silencer used : . . . . . .

3 TEST CONDITIONS

Barometric pressure : . . . . . Ambient temperature : . . . . . .

Reflecting plane condition and dimensions : . . . . . .

Remarks : . . . . . .

iTeh STANDARD PREVIEW
(standards.iteh.ai)

4 INSTRUMENTATION

Microphone : . . . . . Serial No. . . . . .

Sound level meter : . . . . . Serial No. . . . . .

Octave band analyser : . . . . . Serial No. . . . . .

Calibrator : . . . . . Serial No. . . . . .

Other, for example, windscreen or recorder : . . . Serial No. . . . . .

ISO 2151:1972
https://standards.iteh.ai/catalog/standards/sist/4e6fb214-f0f1-4056-a484-c5ea6ffde7c1/iso-2151-1972

5 Sketch showing microphone locations, orientation of compressor, direction of exhaust, direction and distance to large objects within 25 m of machine on test

Maximum sound level measured in position 1 . . . . . .

Background sound measured in microphone location No . . . . . .

The test result is given in the tables and diagrams on the two following pages.

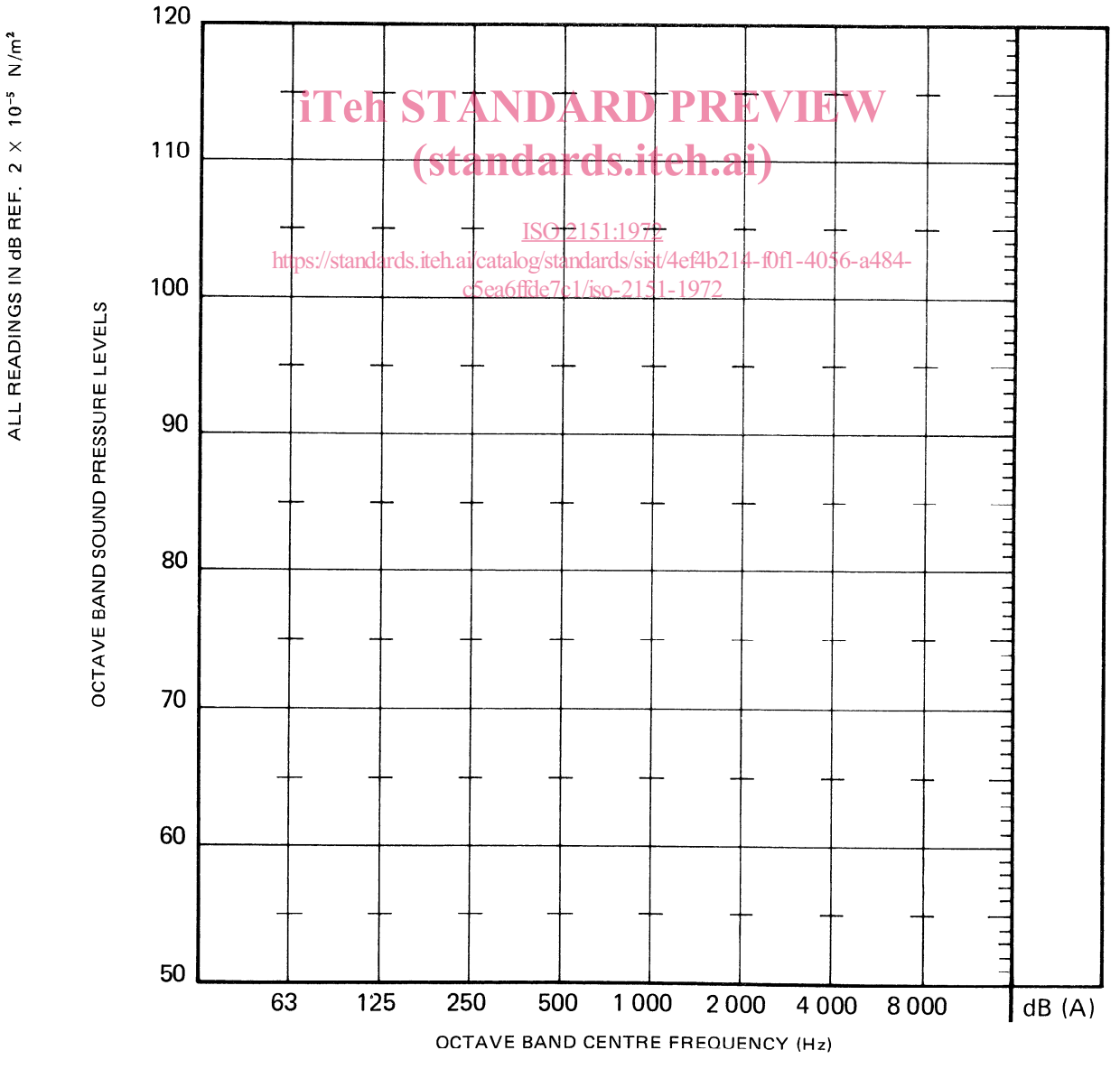
REPORTED BY : . . . . . DATE : . . . . . .

APPROVED BY : . . . . . DATE : . . . . . .

TABLE 1 – **CORRECTED SOUND LEVELS AT 1 m DISTANCE AND 1.5 m HEIGHT**

TEST CONDITION	MICROPHONE POSITION	dB(A)	BAND CENTRE FREQUENCY (Hz)								
				63	125	250	500	1 000	2 000	4 000	8 000
BACKGROUND											
ON LOAD CONDITION	1										
	2										
	3										
	4										
	5										
	MEAN										
IDLING CONDITION	1										
	2										
	3										
	4										
	5										
	MEAN										

NOTE – Readings that needed background correction must be in brackets.

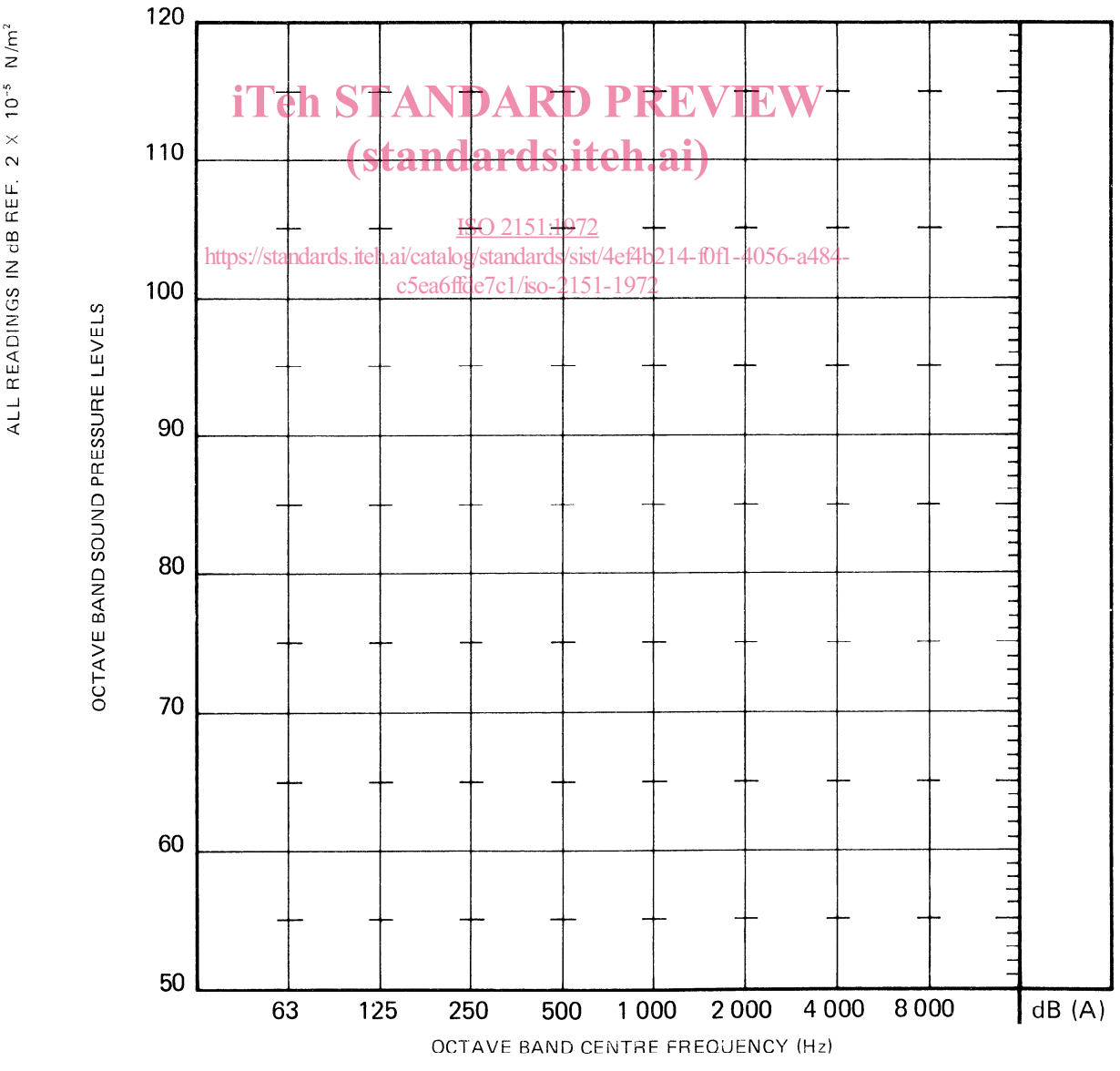


iTeh STANDARD PREVIEW
(standards.iteh.ai)
ISO 2151:1972
https://standards.iteh.ai/catalog/standards/sist/4ef4b214-f0f1-4056-a484-c5ea6ffde7c1/iso-2151-1972

TABLE 2 – **CORRECTED SOUND LEVELS AT 7 m DISTANCE AND 1.5 m HEIGHT**

TEST CONDITION	MICROPHONE POSITION	dB(A)	BAND CENTRE FREQUENCY (Hz)							
			63	125	250	500	1 000	2 000	4 000	8 000
BACKGROUND										
ON LOAD CONDITION	6									
	7									
	8									
	9									
	10									
	MEAN									
IDLING CONDITION	6									
	7									
	8									
	9									
	10									
	MEAN									

NOTE – Readings that needed background correction must be in brackets.



iTeh STANDARD PREVIEW
(standards.iteh.ai)
ISO 2151:1972
https://standards.iteh.ai/catalog/standards/sist/4ef4b214-f0f1-4056-a484-c5ea6ffde7c1/iso-2151-1972