



# Sound Measurement



# Summary

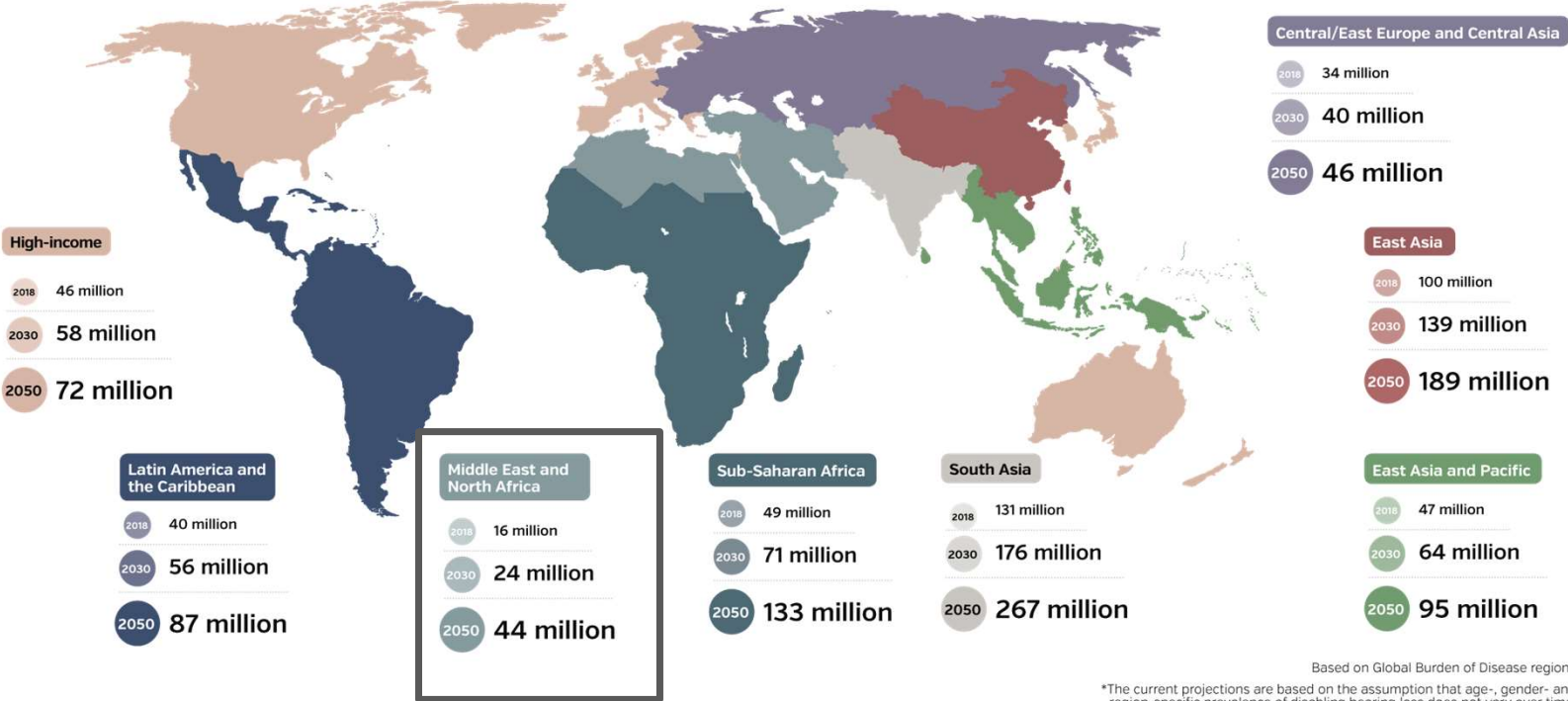
## WHO estimates that there are

- ✓ **466** million persons in the world live with disabling hearing loss\* -> **6.1%** of the world's population
- ✓ **432** million (**93%**) of these are adults -> **242** million males, **190** million females
- ✓ **34** million (**7%**) of these are children
- ✓ One-third of persons **65+** are affected by disabling hearing loss
- ✓ The number of people with disabling hearing loss will grow over the years -> up to **630** million by **2030** and over **900** million in **2050\*\***

\*Disabling hearing loss refers to **hearing loss greater than 40 dB** in the better hearing ear in adults (15 years or older) and greater than 30 dB in the better hearing ear in children (0 to 14 years).

\*\*Projections calculated based on the WHO 2008 prevalence estimates

# Projected number of people with hearing loss in different world regions until 2050



Based on Global Burden of Disease regions  
 \*The current projections are based on the assumption that age-, gender- and region-specific prevalence of disabling hearing loss does not vary over time.

The map shows the current and projected number of people with hearing loss in different regions. Projections show that the number of people with disabling hearing loss will increase in all regions.

# Prevalence of disabling hearing loss across the world

Selected Regions	*DHL All ages	
	Both sexes	
	millions	prevalence (%)
High-income	46.02	4.57
Central/Eastern Europe and Central Asia	34.57	8.36
Sub-Saharan Africa	49.66	4.55
Middle East and North Africa	16.55	3.17
South Asia	131.67	7.37
Asia Pacific	47.04	6.90
Latin America and Caribbean	40.19	6.18
East Asia	100.76	6.85
World	466.46	6.12



The table gives the prevalence of disabling hearing loss among all ages, in millions and as percentage of population, overall and according to regions.

# Prevalence of disabling hearing loss in adult males, adult females and children across the world

Selected Regions	*DHL in children		*DHL in adults			
	Both sexes		Males		Females	
	millions	prevalence (%)	millions	prevalence (%)	millions	prevalence (%)
High-income	0.8	0.5	24	5.8	21	4.8
Central/Eastern Europe and Central Asia						
Asia	1.2	1.5	16	10.2	17	9.5
Sub-Saharan Africa	8.9	1.9	23	7.4	18	5.6
Middle East and North Africa	1.4	0.9	9	4.7	6	3.3
South Asia	12.2	2.4	70	10.7	50	8.0
Asia Pacific	3.6	2.0	24	9.6	19	7.4
Latin America and Caribbean	2.6	1.6	20	8.3	17	6.8
East Asia	3.3	1.3	56	9.1	41	6.9
World	34.1	1.7	242	8.5	190	6.7

This table shows the prevalence of disabling hearing loss across the world for each population group separately– children, adult males and adult females. The prevalence trends are similar to the trends for the global population.

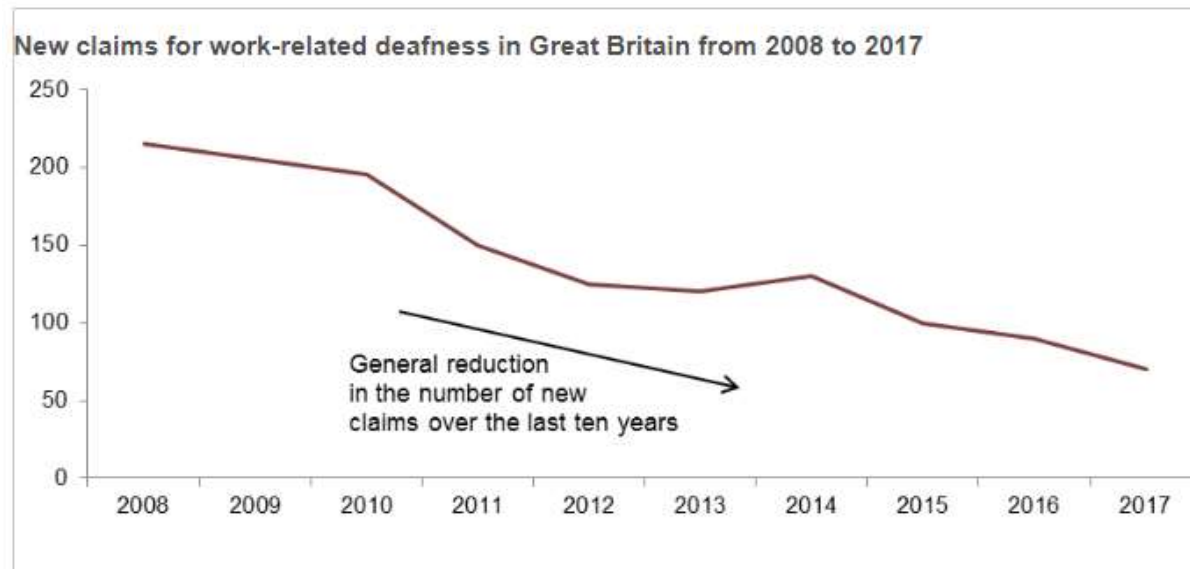
# Statistics – Europe

## + Switzerland

- In Switzerland, around 200,000 people are exposed to noise pollution above the occupational exposure limits during work. <https://www.suva.ch/de-ch/praevention/sachthemen/laerm-vibrationen>

## + Great Britain

- <http://www.hse.gov.uk/noise/statistics.htm>



# Measurement



UNDERSTANDING, ACCELERATED

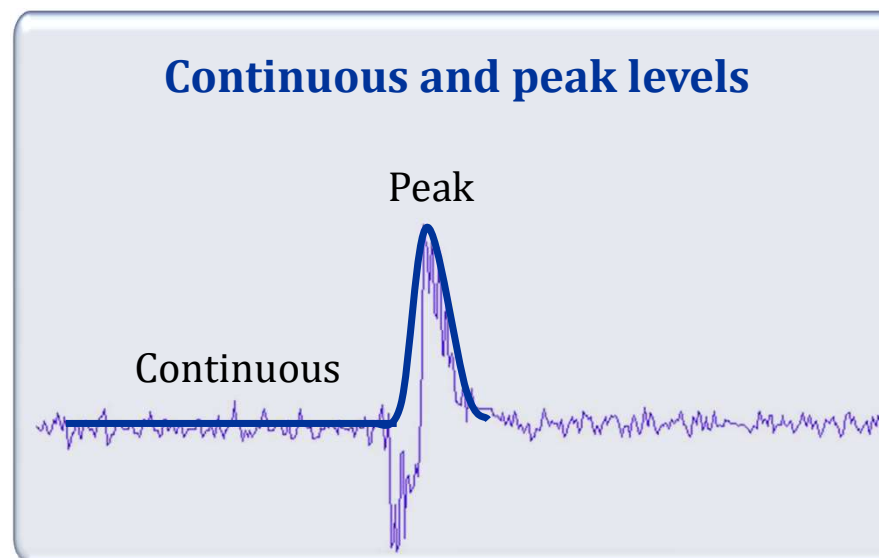
# Noise Legislation - EU

+ Physical Agents (Noise) Directive 2003/10/EC

**Exposure Limit  
Value**

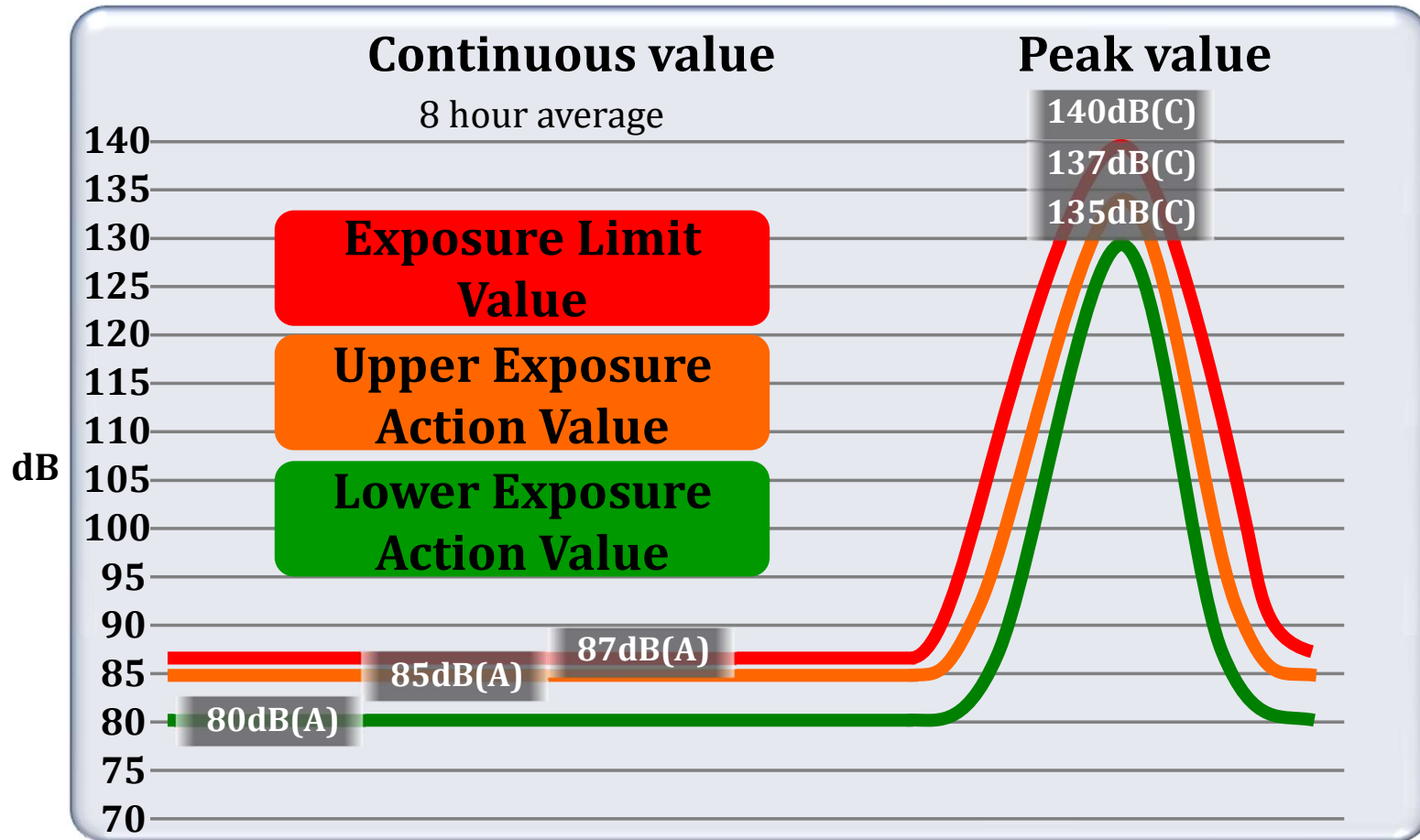
**Upper Exposure  
Action Value**

**Lower Exposure  
Action Value**

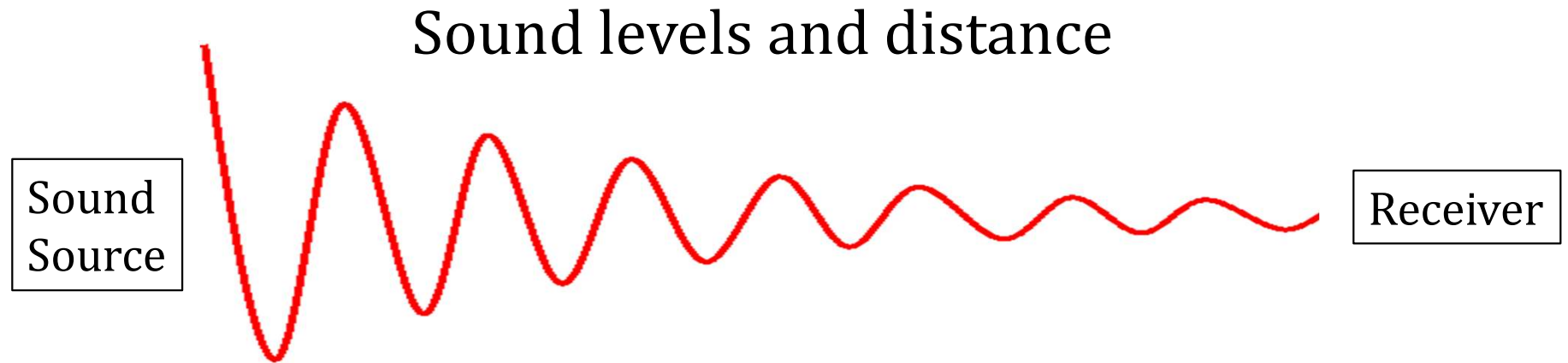




# Noise Legislation - EU



# Noise Measurement In The Workplace



- Sound Pressure wave is generated with a frequency and intensity
- Sound pressure levels decay over distance
- To measure sound as it effects workers, measure at the ear not the source

# Noise Dissipation

- + As a general rule of thumb, when the distance between a source and receiver doubles, the sound pressure level decreases by 6 dB.
- + Use this as a helpful guide for determining safe distances from noise sources:
  - Examples: Selecting the placement of an equipment control station  
Determining the location of designated walkways through a manufacturing site

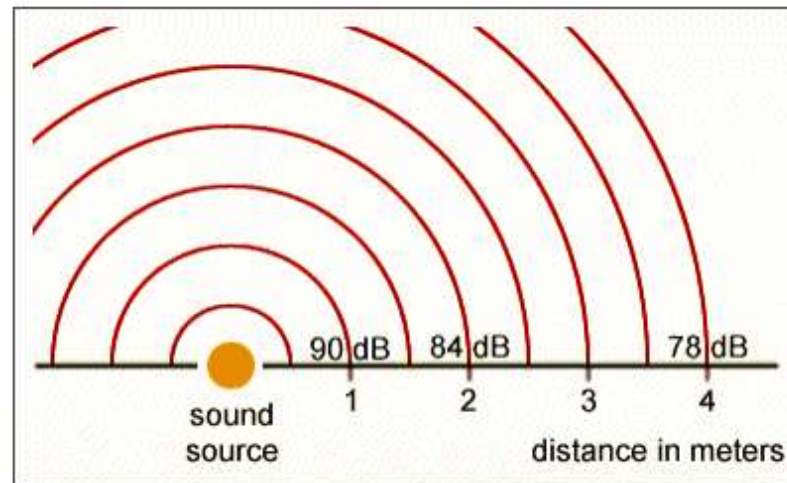


Figure 4: Inverse Square Law Concept in Free Field (OSHA, 2015)

# Frequency Weighting: A, C, Z

- + A is most commonly used around the world for occupational personal noise exposure measurements
- + When using sound level meters and noise dosimeters, you will need to select a frequency weighting, which is typically dictated by regulation

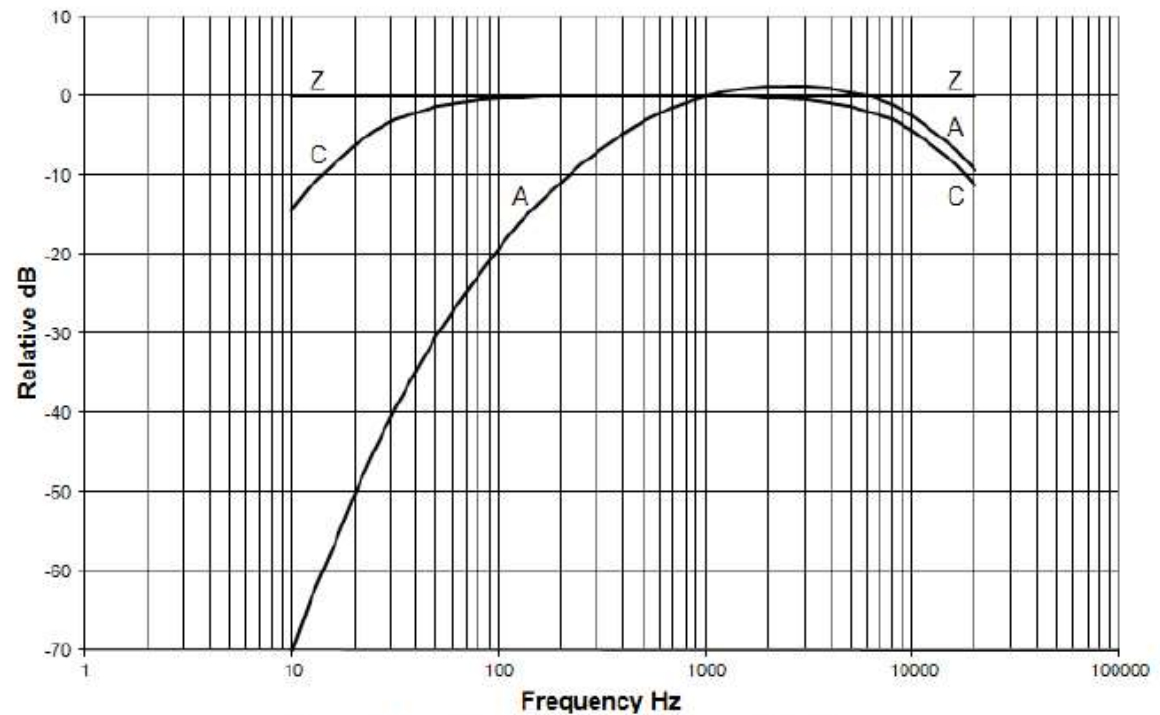


Figure B-3: All frequency weightings plotted together



Schallquelle und Situation (Entfernung)	Schalldruck (Effektivwert) (in Pascal)	Schalldruck- pegel $L_p$ dB re 20 $\mu$ Pa
<a href="#">M1 Garand</a> -Gewehr (1 m)	5000	168
<a href="#">Strahlflugzeug</a> (30 m)	600	150
<a href="#">Schmerzschwelle</a>	100	134
Gehörschäden bei kurzfristiger Einwirkung	20	ab 120
<a href="#">Strahlflugzeug</a> (100 m)	6 ... 200	110 ... 140
<a href="#">Presslufthammer</a> (1 m); Diskothek	2	100
Gehörschäden bei langfristiger Einwirkung mehr als 8 Stunden täglich	0,6	ab 90
Hauptverkehrsstraße (10 m)	0,2 ... 0,6	80 ... 90
<a href="#">Pkw</a> (10 m)	0,02 ... 0,2	60 ... 80
<a href="#">Fernseher</a> in <a href="#">Zimmerlautstärke</a> (1 m)	0,02	ca. 60
normale Unterhaltung (1 m)	$2 \dots 6 \cdot 10^{-3}$	40 ... 50
sehr ruhiges Zimmer	$2 \dots 6 \cdot 10^{-4}$	20 ... 30
Blätterrauschen, ruhiges Atmen	$6 \cdot 10^{-5}$	10
<a href="#">Hörschwelle</a> bei 1 kHz	$2 \cdot 10^{-5}$	0



# The Microphone is key



# DOSE

- + Dose is a percentage of allowable exposure.
- + Dose is directly related to the **Criterion Level and Exchange Rate**
  - 100% Dose is = to maximum Criterion Level
- + For OSHA, 100% dose occurs for an average sound level of 90 dB over an 8 hour period (or any equivalent exposure).
- + The dose will double (or halve) every time the TWA increases (decreases) by the **Exchange Rate (typically 3 or 5 dB)**.
  - For OSHA 95dB would be 200% dose



# Calculating Dose Exposure

$$\% \text{ Dose} = 100 \times (C_1/T_1 + C_2/T_2 + \dots + C_N/T_N)$$

Where C is the actual time exposed at a sound level in hours

- and -

T is the allowable time for that sound level

Reference Durations, in Hours, for given Noise Levels

Noise Level, L	Reference Duration, T
80	32.0
81	27.9
82	24.3
83	21.1
84	18.4
85	16.0
86	13.9
87	12.1
88	10.6
89	9.2
90	8.0
91	7.0
92	6.1
93	5.3
94	4.6
95	4.0
96	3.5
97	3.0
98	2.6
99	2.3
100	2.0
101	1.7
102	1.5
103	1.3
104	1.1
105	1.0

Noise Level, L	Reference Duration, T
106	0.87
107	0.76
108	0.66
109	0.57
110	0.50
111	0.44
112	0.38
113	0.33
114	0.29
115	0.25
116	0.22
117	0.19
118	0.16
119	0.14
120	0.13
121	0.11
122	0.095
123	0.082
124	0.072
125	0.063
126	0.054
127	0.047
128	0.041
129	0.036
130	0.031
131	0.027





# QUEST Monitoring Solutions

## Noise and Sound

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# Noise Measuring Product Solutions

## AREA MONITORING: *Sound Level Meter*

- If employers suspect noise levels 80 dBA or higher, a screening or walk-around SURVEY should be conducted.



## PERSONAL NOISE MONITORING: *Noise Dosimeter*

- If screening survey confirms levels are 80 dBA or higher, more in-depth measurements should be completed to CAPTURE FULL DAY EXPOSURE.



# Hearing Regulations

## OSHA HC (Hearing Conservation)

- "A" Weighting
- Slow response
- 5 dB ER
- 90 dB CL
- 80 dB Threshold

## OSHA PEL (Permissible Exposure Level)

- "A" Weighting
- Slow response
- 5 dB ER
- 90 dB CL
- 90 dB Threshold

## MSHA HC (Hearing Conservation)

- "A" Weighting
- Slow response
- 5 dB ER
- 90 dB CL
- 80 dB Threshold

## MSHA PEL (Permissible Exposure Level)

- "A" Weighting
- Slow response
- 5 dB ER
- 90 dB CL
- 90 dB Threshold

## ACGIH

- "A" Weighting
- Slow response
- 3 dB ER
- 85 dB CL
- 80 dB Threshold

## 200310EC (EU Directive)

- "A" Weighting
- Slow response
- 3 dB ER
- 85 dB CL
- No Threshold

# Noise Dosimeter Applications

- + Evaluate workers daily exposure noise levels.
- + Help to establish or evaluate compliance against a Hearing Conservation Program
- + Measured against government regulations or company's hearing conservation program.
- + Typically used measurements for decision making are:
  - Average exposure ( $L_{AVG}$ ), Time Weighted Average ( $L_{TWA}$ ), and Dose (%)



# Noise Dosimeters: Edge 4/4+/5

	Edge 4 Noise Dosimeter	Edge 4+ Noise Dosimeter	Edge 5 Noise Dosimeter
Product No.	EG4	EG4P	EG5
Data Logging	+	+	+
Battery Life	60	40+	40
Number of Independent Dosimeters	2	2	3 (third dosimeter enabled through DMS software)
Lock Out Security Function	+	+	+
LED Dose Indicator	+	+	+
Bluetooth Model Available		+	
Color Screen		+	
Intrinsic Safe Approval			+



# Sound Detector: SD-200

- + Compact, lightweight, entry-level sound level meter designed for industrial professionals for the measurement of workplace and area noise levels.
- + Class 2 microphone
- + Provides safety professionals accurate, reliable data versus cell phone apps



# Key points about the SD-200

- + Displays data. Is not data logging.
- + The SD-200 measurement range is 40 to 130 dBA.
- + Very easy to use, navigate settings, and provides accurate results.
- + Economy product with a professional class 2 microphone
- + The SD-200 does not include the calibrator adaptor as a standard accessory. If a user chooses to buy an AC300 to use with the SD-200 they should also purchase the calibrator adapter part number 056-990.



# SD-200 Results Summary

## **SPL (no screen indicator)**

- A-weighted Slow Sound Pressure Level

## **Leq/Lavg**

- Average SPL that is measured over run-time

## **LED Alert screen**

- Average SPL with activated LEDs and indicator.


## **Max (MAX)**

- Maximum SPL the instrument measured during test

## **Min (MIN)**

- Minimum SPL the instrument measured during test

## **Run-Time**

- Time elapsed from the start of the run mode that calculates:  $L_{EQ}/L_{AVG}$ , LED Alert , MAX, and MIN





# Sound Examiner SE-400 Series Products

The Sound Examiner Data Logging Sound Level Meter is a mid-tier product available in Class 1 (SE-401) and Class 2 (SE-402). **There is an intrinsically safe version approved for certain hazardous location environments.**

TSI currently offers five different models:

- SE-402
- SE-402-R: Removable preamp
- SE-401
- **SE-402-IS**
- **SE-401-IS**



# SE-400 Series Products

- + Real-Time Integrating / Data logging sound level meter
- + Class 1 (SE-401) , Class 2 (SE-402), Mid-Tier SLM
- + Intrinsically Safe models SE-401-IS and SE-402-IS
- + Removable preamp option for cabling the microphone

- Aero dynamic shape for minimal disturbance to sound fields being measured.

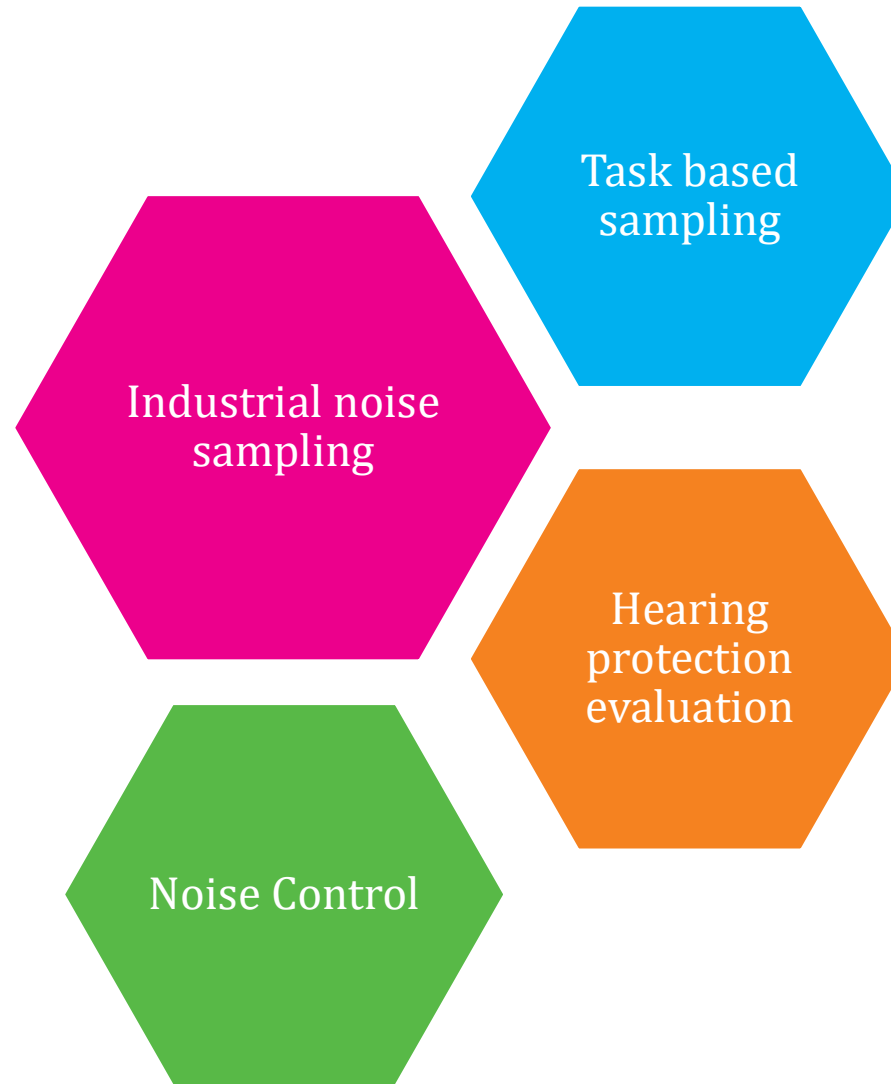
- Large graphical display allows easy instantaneous measurements.

- Single 110 dB dynamic range (30 dB – 140 dB)

- Data is stored for post processing and analysis.



# When to use the SE-400 meter?



# Sound Examiner, SE-400 Components

## ***Major components:***

- Microphone
- Preamplifier
- Graphics display
- Rubberized keypad
- Rechargeable Li+ ion Battery
- Bottom connection panel



# Viewing measurements

## SLM Measurements available

SPL ( $L_{AS}$ )

A weighted Slow Sound Pressure Level

Max ( $L_{ASMx}$ )

Maximum SPL the instrument measured during test

Min ( $L_{ASMn}$ )

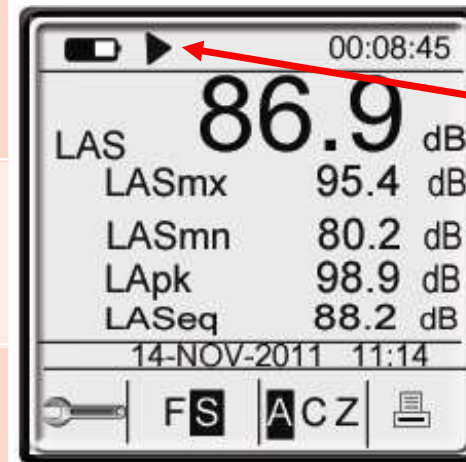
Minimum SPL the instrument measured during test

Peak ( $LA_{PK}$ )

Absolute Peak of the pressure wave, A weighted.

Leq ( $L_{ASeq}$ )

Average 'A' weighted Slow SPL during the sample period



Run-time clock

Run icon

Multi-measurement screen

# SoundPro SE/DL

- + The SoundPro SE/DL is a high performance technically advanced **Real-Time Integrating** sound level meter available in Class 1 and Class 2 models.
- + Large graphical display for easy on-screen analysis.
- + Data is stored on a Secure Digital memory card.
- + Powered by 4 “AA” alkaline batteries, optional rechargeable AA batteries or external power (AC or DC).
- + Optional 1/1 or 1/3 octave band filter options.
- + Optional Sound Curves feature and / or Reverberation Time options (requires 1/1 or 1/3 filter).
- + Outdoor long-term exposure monitoring kit available.



# SoundPro SE/DL Components

## Major components include:

- Microphone
- Preamplifier - removable
- Graphics display
- Membrane keypad
- "AA" battery compartment
- Bottom connection panel



# Applications for SE-400 and SoundPro meter?

