SENNHEISER
defining sound

SENNHEISER-KOPFHÖRER
SENNHEISER HEADPHONES
CASQUES SENNHEISER
CUFFIE SENNHEISER
AURICULARES SENNHEISER
SENNHEISER-HOOFDTELEFOON

Was man über technische Daten wissen sollte
Some technical information you ought to know
Ce qu'il faut savoir sur les caractéristiques techniques
Che cosa si deve sapere sui dati tecnici
Todo lo que Vd. debe saber acerca de las características técnicas
Wat u over de technische gegevens moet weten

▶ PRESSURE FORCE

Whether or not a headphone is comfortable to wear is determined not only by its weight, but also by the amount of pressure which is exerted on the ear. This pressure is stated in Newtons (N), so that 1 N of pressure force means that a mass of about 100 g is exerted on a solid surface. DIN standard 45 500 Part 10 limits the permissible pressure force to 5 N. Usual levels are between 1.3 and 4 N, with lower levels for open headphones. Higher levels can be found in closed headphones, as a greater amount of pressure is necessary here in order to provide sufficient soundproofing - especially at lower frequencies - for the listener.

▶ CONTACT WITH THE EAR

You may choose between headphones which are placed on the outer ear (i.e. supraaural), or those which surround the outer ear (i.e. circumaural). Open headphones are fitted with a foamnet pad which is placed on the ear, or with allround padding which surrounds the ear. Closed headphones, on the other hand, are predominantly equipped with earsurrounding padding.

▶ CONNECTING CABLE

Terms such as "quality of sound" and "range of transmission" are often used with reference to headphones. Connecting cables, however, are rarely mentioned. Sennheiser Headphones are equipped with a special copper cable which is low in oxygen (OFC). So, in a wide frequency range, the headphone is always supplied with linear, low-loss transmission. Sennheiser Headphones also have a plug-in connection on the hearing unit, which greatly facilitates cable changes.

▶ dB

For the assessment of frequency response, directivity and sound pressure levels, it is important to know the ratio of one measured value to another. Therefore, the unit of measurement used in electroacoustics is the decibel (dB). The decibel is not an absolute mass such as a metre or a gramme - it simply indicates the ratio between numerical values.

With reference to the logarithmic hearing capacity of the human ear, the term "decibel" is derived from the common logarithm of a voltage or power ratio. So, for example, 20 dB equals a voltage ratio of 10:1, or a power ratio of 100:1.

▶ ELECTROSTATIC HEADPHONE

Unlike dynamic transducers whose diaphragm is driven from the center in ring waves by a moving coil, the diaphragm of the electrostatic headphone is driven over the entire surface area. This phenomenon is obtained by mounting a very thin conductive polymer film between two plate electrodes. This film responds to even the most minute of changes in the audio-frequency voltage.

A diaphragm moved in this way follows the sound frequency with excellent high fidelity. It offers such an excellent reaction velocity that the sound reproduction is nearly free from pulse distortions, phase errors and intermodulation products.

Moreover, the light weight of the diaphragm plays an important role for the exact and natural resolution. An electrostatic headphone offers a very impressive precision of the music reproduction.

▶ SENSITIVITY TO STRUCTURE-BORNE NOISE

The level at which the friction or scraping sounds ("structure-borne noise") of the cable are transmitted into the headphone, (heard during quiet passages as disturbing background noise) is determined to a large extent by the material of the cable. The copper conductor and insulation of Sennheiser's OFC connecting lead minimizes the unit's sensitivity to structure-borne noise.

▶ CORRECTION OF LOUDNESS DIFFUSION

In a dead or "anechoic" measurement chamber, a multitude of loudspeakers independently emit noise-signals. In the middle zone of the measurement chamber these different pieces of sound information meet and are superimposed in a "diffusion field", where it is no longer possible to tell from which direction each sound has come. These noises will be emitted one after the other at third-octave intervals, alternating over the loudspeakers, and then sent to the headphones. A large number of researchers are at present assessing the difference in volume between spatial noise and the sound in the headphones.

The aspired to ideal would be the same level of sound in the headphone as in the diffusion field. In practice, there is a greater atmospheric influence and an improved front-rear (external) detection system. To put it simply, the sound is actually occurring outside the head, is not limited to the space between the ears.

▶ DAMAGE TO THE HEARING

"The sound should be good, and it has to be loud!" Of course headphones should produce high-quality sound. But many people are not aware of the fact that continual use at a high volume can lead to permanent damage of the hearing. Loudness does not equal good quality of sound. Sennheiser Headphones give high-quality sound and at low volume too.

▶ IMPEDANCE

Impedance signifies the alternating current (AC) resistance of a set of headphones. This depends on the frequency and is indicated as so called rated input impedance at 1 kHz. The unit of measurement used here is the ohm (Ω). Over the past few years, an industrial standard has been established: headphone impedance is specified as 50, or 600 Ω. Sennheiser Headphones are manufactured according to this standard. Any problems with connection would therefore be an exception.

▶ CHARACTERISTIC SOUND PRESSURE LEVEL

(Sensitivity) The term "characteristic sound pressure level", also frequently known as sensitivity, indicates the level of sound pressure a headphone generates under particular measurement conditions.

According to DIN 45 500 Part 10, the sound pressure level of a hifi Headphone with a power input of 1 mW and sound frequency of 1 kHz should amount to at least 94 dB. This measurement is carried out with the aid of an "artifical ear" (a special microphone for this type of measuring). Now you will surely ask the question: How loud is a headphone with a sound pressure level of 94 dB?

First, some information: The unit of measurement used for sound pressure is the Pascal (Pa). The lowest sound pressure still perceptible to the human ear (threshold of hearing) is 0.00002 Pa. This figure is an internationally recognized sound pressure reference. The logarithmic ratio of the receiver's own sound pressure - measured with an "artificial ear" - to this sound pressure reference gives the characteristic sound pressure level in dB. The 94 dB value established in the DIN indicates that a hifi Headphone should generate a sound pressure that lies over the threshold of hearing by a factor of 50 000(!)

But, on the other hand, the characteristic sound pressure level does not tell us anything about the maximum volume a headphone is capable of giving without distortion! And nothing at all about quality of sound! So a headphone set with a high characteristic sound pressure level is not automatically better than others.

▶ TOTAL HARMONIC DISTORTION

This is a measurement for non-linear, harmonic distortions, and is given in %. But what is a non-linear, harmonic distortion? In general, this term describes the signals which are transmitted by the headphones, but which were not originally present before this transmission took place. The blame for the occurence of these unwanted signals lies with the membrane which, aroused by the electric signals, does not, however, move in time with them. Unfortunately, this is a feature of all electroacoustical transducers. It cannot be completely eliminated, although suitable steps can be taken to minimize it. However, the user is not interested in why this distortion takes place, but in how great the level of harmonic distortion must be to become perceptible. Results of various research projects state that a total harmonic distortion of 1 % in the frequency range of 100 to 2000 Hz is imperceptible. Below 100 Hz the perceptibility threshold lies at 10 %. The DIN Standards Committee made use of this data in the formulation of DIN 45 500 Part 10.

▶ LOAD RATING

Load rating signifies the input of electricity - indicated by the manufacturer - which can be supplied to a headphone set over a period of time without causing damage. According to DIN 45 500 Part 10, the load rating should amount to at least 100 mW. A test is carried out using a special noise signal, which is transmitted to the headphones over a period of 100 hours. And there's no need to worry about amplifiers: new models are equipped with a special output for headphones that eliminate all possibilities of overloading.

▶ THE TRANSDUCER PRINCIPLE

For the conversion of electrical energy into mechanical energy in headphones two transducer principles have been established: electrodynamic and electrostatic, whereby the latter, due to relatively high manufacturing costs, is only employed in the "high end zone". The electrodynamic transducer comprises a ring-shaped permanent magnet and an oscillation coil, which is fastened to the receiver membrane. When an audiofrequency alternating current is sent through the oscillation coil it - and therefore the membrane - vibrates in relation to this current.

▶ OPEN/CLOSED

In general, a choice has to be made between closed and open headphones. With closed headphones, the ear is completely sealed off from outside noise (pressure chamber principle). Typical features of closed headphones is the sealed frame which prevents sound leakage and the allround padding which completely surrounds the ear. The insulation around the ear has a significant influence on the soundtransmission characteristics of closed headphones. If it is insufficient, the quality of the bass sounds will deteriorate. For this reason, the pressure force of closed headphones is greater than that of open headphones. Closed headphones are often used by sound engineers in order that they may be able to concentrate fully on the music without the interference of outside noise.

The problem of pressure force on the head does not exist with open headphones. These are constructed so that the space behind and in front of the membrane lets through sound. Open headphones permit music to pass straight through the receiver membrane without sounding muffled, which obviously makes it sound a lot more natural. Distinguishing features of open headphones are the small size and minimal weight. These in turn make open headphones extremely comfortable to wear, and no discomfort or feelings of fatigue are evident even following prolongued listening.

▶ TRANSMISSION RANGE

The transmission range is the range of frequencies, specified by the manufacturer, that is used for the projection of sound. As a minimum requirement, according to DIN 45 500 Part 10, a transmission range from 50 ... 12,500 Hz is necessary. It may now be supposed that a set of headphones with a transmission of, say, 5 to 30,000 Hz will produce good sound. In fact, that is a long way from the truth! The standard does not specify to what extent a drop in sensitivity ("characteristic sound pressure level") may occur on the edge of the transmission range. In order to compare different headphones, the transmission range standard should only be used brought into play when the method of measurement and the drop in sensitivity on the transmission range border are already known. In the technical data provided with Sennheiser Headphones, the frequency range is given in a range of up to -3 dB, and sometimes also in a range of up to -10 dB.