

WaterResistant Versatility

Make a splash with the new WaterResistant portfolio!

Introduction

There has long been a wish to have hearing instruments that are resistant to water, sweat and dirt. Behind this wish lies the need to be able to wear hearing instruments in all situations without having to worry. This means not having to think about whether you can wear them in heavy rain, during sports or while swimming. Even if accidentally worn in the shower, there is peace of mind and security in knowing that the sensitive electronics of the hearing instruments are well protected. In a nutshell, there is the simple desire for a care-free life, hearing without limits in all situations.

Manufacturers have long pursued the development of hearing instruments that are resistant to water, sweat and dirt. In 2000, Phonak introduced the first product with special elastomer seals, which gave greater freedom and reliability, standing out from the crowd of hearing aids produced by other manufacturers. The next big step forward was the introduction of Naída in 2007 – the first water resistant Phonak hearing instrument. And now, in 2011, the Phonak Spice+ H2O hearing instruments set a new standard in water resistance and durability – they have been awarded a rating of IP67 on the IEC60529/ EN60529 ingress protection standard.



IP Certification

IP certification has long been used in the household appliance industry. IP stands for "Ingress Protection", i.e. "resistance to penetration" and rates the suitability of appliances under different environmental conditions. In order to be able to compare different products with one another, a range of standards was introduced for various industries. No uniform standard has been introduced for small electronics such as hearing instruments. Consequently, the hearing aid industry has adopted the standard IEC60529/EN60529 in order to demonstrate how water resistant hearing instruments are. This standard is designed to provide "protection by enclosures" and is applied in the case of appliances such as washing machines. Certification is performed by independent institutes that test and evaluate the products. The result indicates the state of the device after it was exposed to each test condition. The numbers in the IP code indicate the degree of protection the device achieved. The first number in the code indicates the level of protection against solid objects, such as dust, while the second number indicates the level of protection against liquids or moisture. Table 1 lists the numbers and explains what they mean.

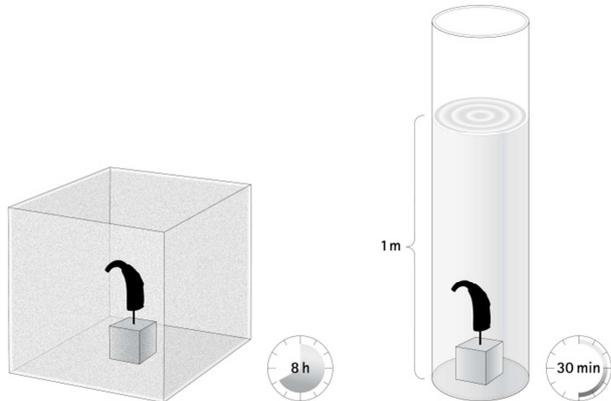
IEC/EN 60529 Code	Foreign objects	Water
0	No protection	No protection
1	Particles up to 50mm	Vertically dripping water
2	Particles up to 12.5mm	Dripping water, when tilted up to 15°
3	Particles up to 2.5mm	Spraying water at any angle up to 60°
4	Particles up to 1mm	Water splashing from any direction
5	Dust protected	Water jets (nozzle) from any angle
6	Dust tight	Powerful water jets
7	-	Temporary immersion
8	-	Continuous immersion

Table 1: Numbers of the IP certification

The new Spice+ H2O hearing instruments: Phonak Ambra M H2O, Solana M H2O, Cassia M H2O, Naída S CRT and Nios S H2O all achieved the IP67 rating. IP67 indicates that the hearing instrument was not damaged beyond repair after 8 hours in a dust chamber, or after being immersed in 1 meter (3 feet) of water for 30 minutes (as defined by IEC60529).

Figure 1: Dust chamber

Figure 2: Water tank



Figures 1 & 2: Graphic representation of the IP Certification test setup

This certification is a good indication of the dust and water tightness of a device. While IP67 accords these hearing instruments a high degree of protection, it must be kept in mind that these tests were not specifically designed for hearing instruments, and the way they were tested does not necessarily reflect real life situations. Such real life situations are discussed later in the "Everyday use" section.

WaterResistant Spice+ H2O hearing instruments

The demands on the new hearing instrument housings were very high, as the devices have to be extremely resistant to dust, dirt, sweat, water and moisture. These demands have been successfully met through the combination of three elements: The housing design, the materials used and nano-coating.

Figure 3a)

Figure 3b)

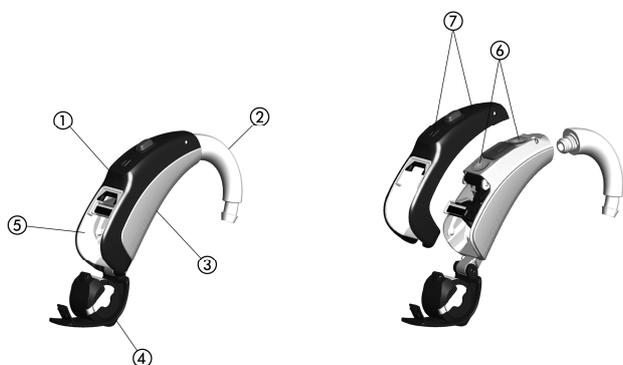


Figure 3: a) Spice+ H2O housing b) Explosion view of the Spice+ H2O housing

Legend for Figures 3a & 3b

- 1) Housing top shell
- 2) Acoustic coupling
- 3) Housing base
- 4) Protective membrane - battery compartment
- 5) Seals
- 6) Protective membrane - microphone
- 7) Microphone inlet with protective membrane

Figures 3a & 3b show the components of the housing. The Spice+ H2O housing is made up of two parts: the top shell (1) and the base (3). When both parts are put together, a double wall is formed which provides excellent stability. The double wall also averts the ingress of moisture, thus preventing any water from reaching the sensitive electronic parts of the device.

One effective way to obtain a completely sealed case is with injection molding processes used to produce the housing, so there are no edges or transitions. However, this is quite difficult to achieve in with micro hearing instrument housings. So joints on the housing must be kept to a minimum and properly sealed. The few edges of the Spice H2O products have an additional seal. Using two-component injection molding, the soft sealing material applied to the seams of the housing and the solid material of the housing are fused together, forming a single unit from the two layers. The material makes the critical edges very tight, thus protecting against the entry of any foreign substances. The seal is clearly visible within the battery housing (5), but is also used at the edges of the housing top shell. To ensure that the top shell and base stay together, they are fixed with pins. What is unique about this is that the pins neither penetrate the silicon layer nor come into contact with the interior of the device. This prevents water from entering the housing via the pins.

Three other parts of a hearing instrument also require a specific solution:

- acoustic coupling (tone hook, Slim Tube or external receivers)
- microphone protection
- battery compartment

The connection between the housing and the acoustic coupling (2) remains a screw connection, in the case of both the Phonak M H2O and Nios S H2O devices. In contrast to previous housings, the threads are embedded in the frame. This makes it possible to install additional sealing rings for a tightly-sealed surface. The Naída S CRT has a proven plug-in connector for the acoustic coupling of the external receiver. A special locking mechanism encloses the wire of the external receiver and prevents the ingress of water, sweat and dust.

One of the biggest challenges is ensuring microphone protection, as the microphone inlets must remain open to maintain the acoustic properties of the microphones. In the Spice+ H2O devices, this problem was solved by means of a triple-layer microphone cover. The first layer is part of the housing top shell and consists of two adjacent inlets (7), which are visible from the outside. The top shell with the two inlets is nano-coated. This combination of narrow inlets and nano-coating protects the microphones below from larger dust and dirt particles to which the hearing instrument is exposed in the air or through direct contact. This first layer also prevents scratching noises caused by fingernails or contact with hair.

The second layer consists of a special membrane that fits into the inside of the housing top shell directly below the inlets. The membrane is acoustically transparent and air-permeable. It protects against moisture and smaller dirt and dust particles. It consists of a tightly woven fabric which is both hydrophobic and lipophobic; i.e. it is both water- and grease-resistant. These properties make the membrane an effective protection against water and foreign bodies. The first and second layers are part of the top shell and, if necessary, can easily be replaced by hearing care professionals. The same protective fabric forms the third layer on the base of the housing above the microphone inlets (6). This ensures that no particles or water get into the microphone inlets. This layer cannot be replaced by a hearing care professional. This innovation in the field of microphone protection is acoustically stable.

The battery compartment of a hearing aid also presents challenges. Nowadays, mostly zinc/air batteries are used in hearing instruments. They require a constant air supply in order to work. The battery compartment has a vent to ensure continuous air supply. At the same time, however, the vent increases the risk of the ingress of water. To prevent this, it is also covered with an air-permeable, water- and dirt-repellent membrane (4), with an even smaller pore size than the membrane for microphone protection. Together with its hydrophobic and lipophobic properties, this provides excellent protection. The battery compartment must be opened when the battery is changed, which represents a further risk factor. A seal (5) is incorporated using two-component injection molding and tightly seals the battery compartment. The sturdy locking mechanism of the battery compartment also ensures a tight seal.

All housing parts of the Spice+ H2O devices are nano-coated. This forms an additional repellent layer, so water and dirt just pearl off. Thanks to the combination of outstanding design, sealing elements and protective materials, the Spice+ H2O hearing instruments provide a new benchmark in dust and water protection.

In the development of a water resistant housing, the use of FM technology was also taken into consideration, as these hearing instruments are particularly suitable for children and power users. The ML15i FM receiver is integrated in the design and fits all Spice+ H2O devices and is also water resistant. The AS15 universal FM solution with audio shoe and universal FM receiver are not water resistant.

Everyday use

IP67 confirms that the hearing instrument is highly resistant to dust and water. But what does this actually mean for everyday life? Can an architect wear his hearing instruments, communicating at the dusty building site without needing to worry? Can hearing instruments withstand an unexpected rain shower? We will now look at these questions in more detail using selected examples.



The first digit of the IP certification indicates the level of protection against foreign objects. Common examples for this application are working environments such as construction sites, workshops or a farm. In these environments, hearing instruments are often exposed to dust and dirt of different particle sizes. Hearing instruments are also exposed to dust and dirt when working in the garden. As a precaution, many people tend to not use them when gardening. Spice+ H2O hearing instruments can be worn without worry in such dusty environments.



The second digit indicates the level of protection against water and moisture, as occurs, for example, in kitchens or bathrooms. Outdoor activities, such as taking the dog for a walk or jogging can often expose the devices to moisture, rain or sweat. Anyone who enjoys being active or doing sports will appreciate these devices, as they offer very high level of moisture protection. People typically do not shower while wearing their hearing instruments, as the sound of the water can be quite loud. However, there is no cause for concern, if someone takes a shower after doing sports and forgets to remove the hearing instruments. The sensitive electronics of the device are well protected. Even occasional submersion in water, as happens with children playing in the bath is no problem. Parents can play and splash, while still communicating with their child.

In fact, the devices are ideal for children who want to play, without their parents worrying about their hearing instruments. Children want to explore their surroundings and experience the fascination of water fountains, pools, puddles, as well as sandpits and playgrounds. Children do not want to miss out on anything at day care or on school outings. The Nios S H2O, in combination with the integrated FM receiver, provides care-free protection and security.

To maintain this level of protection, does require consistent care and maintenance. The more a device is used in wet and dusty environments, the higher the degree of maintenance that is required. It is recommended to gently rinse the instrument with fresh water after contact with dirt or moisture and then dry the outside and the battery compartment with a soft cloth.

There are also limits. Strong forces from contact with water such as during waterskiing or surfing, can damage the microphones. The hearing instruments are not suitable for diving, due to the rapidly increasing water pressure. The pressure damages the microphones, in particular, significantly impairing the functioning of the device. And, with the zinc/air battery being deprived of oxygen under water, the batteries soon fail. Fortunately, they can be easily replaced.

Validation subjects confirmed the consistent functioning of the device through exposure to water. But contact with soap should be avoided where possible. Soap can affect the hydrophobic and lipophobic properties of the membrane and compromise the protection. In addition, soap blocks the air circulation of the battery compartment.

Although a high standard was achieved with IP67, Spice+ H2O instruments are referred to as waterresistant, not waterproof. They offer hearing impaired people greater freedom. Wearers can confidently embrace all situations, communicating without restrictions.

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