

Phonak Insight

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Phonak rechargeable hearing aids

Every day, we rely upon countless rechargeable products such as mobile phones, toothbrushes, laptops or tablets. To make sure devices are working at a moment's notice, daily charging is something that has become part of our daily routine. However, despite an abundance of rechargeable devices, rechargeable batteries have not become a mainstay of the hearing aid industry. Phonak Audéo™ B-R is the first hearing aid from Phonak to use an innovative rechargeable battery technology with lithium-ion and offer 24 hours* of uninterrupted hearing.

*Expected results when fully charged, and up to 80 minutes wireless streaming time. Please refer to www.phonakpro.com/evidence

Background

Consumers utilize rechargeable batteries daily without a second thought. But when it comes to hearing aids, rechargeable technology is not commonly used even though solutions are available. In 1939 a patent was filed in the United States by Grant Wheat¹ detailing a "Storage battery for hearing aids". The patent describes that the hearing aid battery must be small while being able to provide a long battery life with great reliability. It should also be easy to recharge and durable enough to withstand occasional accidental dropping.

Consumer expectations and desires for a rechargeable hearing aid have not changed much over the past 75 years. The same essential principles and characteristics are necessary for a modern hearing aid with a rechargeable battery. The devices need to be able to provide battery life beyond the average wearing time, while being easy to manipulate and charge. They also need to offer a high level of reliability and durability so the wearer receives maximal benefit with minimal downtime. 43 years later, the first rechargeable hearing aid battery was developed. This battery was large and could only be used in over-the-ear hearing aids, took hours to recharge, and did not hold that charge for very long. At best they lasted for five to six hours, which was not suitable for the average ten to eleven hours² that the average wearer of hearing aids require.

The success of this rechargeable battery was very limited. Zinc-air batteries were still utilized despite the hassle of having to remove battery tabs, struggle to insert a battery or having to carry additional battery packs in order to replace an expired battery. Following the introduction of wireless hearing aids and the ability to stream music and phone calls, zinc-air batteries that lasted up to 2 weeks, now last around one week depending on the hearing loss, frequency of use and wireless accessory usage. This leads to a strong desire to have a rechargeable hearing aid or battery that can last a full day and can be fully charged overnight.

The 2015 MarkeTrak IX study³ by the Hearing Industries Association, showed that non-hearing aid wearers rated a "rechargeable hearing aid" and a "rechargeable batteries for hearing aids" as #2 and #4 in the top ten of features that would motivate them to buy a hearing aid. Advances in rechargeable hearing aid battery technology have improved. Today most rechargeable batteries for hearing aids are made of nickel and come in a variety of sizes with an increased length of battery life. These batteries are an alternative to the zinc-air batteries but are still not the popular choice for hearing aid batteries. There are several reasons why they have not been very successful in the market:

- Unable to meet the demands of wireless hearing aid technology with media streaming

- Battery charging stations can be difficult to operate
- Charging only works if placed in a very specific position⁴
- Long charging times
- Short battery lifetime

The ideal rechargeable hearing aid needs to:

- Hold a large capacity with no significant degradation after years of use
- Be small
- Be lightweight

Rechargeable hearing aid battery solutions

There are three types of rechargeable batteries for hearing aids that are available on the market today.

Nickel-metal hydride (Ni-MH)

Ni-MH batteries were the first rechargeable batteries to penetrate the market. However, they are unable to provide a hearing aid with sufficient battery life for listening and media streaming of up to 10 to 11 hours a day. Another limitation of the Ni-MH battery is the number of charging cycles that can be performed before the overall capacity decreases and the battery needs to be replaced. Every time the battery is charged, the capacity decreases to a level that is not useable for the wearer and thus needs to be replaced only after one or two years. This decrease in capacity also affects the performance of the hearing aid. The charging time for the batteries is up to six hours to fully charge. This may lead to inconvenience for the wearer if they find themselves in a situation without battery power.

Silver-Zinc (Ag-Zn)

Ag-Zn is another rechargeable battery technology that has been recently introduced in the hearing aid industry. It operates with a higher capacity and greater energy density than Ni-MH batteries resulting in a longer battery life. Charging time to reach full capacity is 4 hours and the battery life cycle is one year. This means that every year the Ag-Zn battery has to be changed. The voltage of Ag-Zn batteries is too high for most hearing aids so it has to be used in hearing aids that are specially designed to handle higher voltage levels. One way to do this is by fitting the battery door with a voltage regulator that will reduce the capacity without affecting the hearing aid electronics. A major limitation of the AgZn rechargeable hearing aid battery in the limited penetration in the market.

Lithium-ion (Li-ion)

The third rechargeable battery type that has also been recently introduced as a hearing aid battery solution is

lithium-ion (Li-ion). The lightest of all rechargeable batteries, it is used in countless rechargeable portable devices such as smart phones, cameras, power tools and cars. Li-ion batteries offer the fastest charging time and the longest lasting battery on the market today. The capacity of a Li-ion battery does not decrease with repeated short charging sessions, nor is the hearing performance affected over time. Li-ion devices can be charged often for short or long periods of time without the risk of harming the battery capacity or life cycle. And since Li-ion technology is used in many everyday devices, it is also available from a variety of sources. Like Ag-Zn, the high voltage capacity of Li-ion limits its use in hearing aids but it can also be specially adapted to be utilized in hearing aids. Table 1 is a comparison of the different rechargeable solutions that are available in the market today.

	Nickel-Metal Hydride (Ni-MH)	Silver-Zinc (Ag-Zn)	Lithium-ion (Li-ion)
Voltage (V)	1.2	1.6	3.6
Capacity (mAh)	30	40	42
Charge time (h)	5	6	3
Charging cycles	500	400	1500
Expected battery lifetime (years)	1	1	4
Self-discharge per month	<20%	<2.5%	1-2%

Table 1: Comparison between a 13 size battery consisting of Nickel-Metal Hydride, Lithium-ion or Silver-Zinc

Lithium-ion in Phonak rechargeable hearing aids

Li-ion was never considered as a rechargeable battery option for hearing aids because of the high voltage capacity which can destroy the hearing aid electronics. Thanks to a breakthrough in Phonak technology, . Audéo B-R (Figure 2) is the first rechargeable hearing on the Phonak Belong™ platform that uses a built-in Li-ion hearing aid battery. This solution meets the requirements of an ideal rechargeable hearing aid: (1) large capacity without degradation over time, (2) small in size and (3) lightweight.



Fig.2: Phonak Audéo B-R, the first rechargeable hearing aid from Phonak to use Li-ion in a hearing aid battery

The built-in Li-ion battery provides Phonak rechargeable hearing aids with enough power for 24 hours* of wearing time before recharging is required. With the fast charging of Li-ion, the hearing aid can be completely depleted and recharged in three hours (Table 2) without any effect on the battery degradation over time. When a wearer needs to have a quick charge of the battery, they are able to place their devices in the charger for 30 minutes and provide the hearing aids with at least six hours of battery life.

Charge	Time
0% to 100%	3 hours
0% to 80%	1.5 hours
Charging time for a 30 min. fitting session	10 minutes

Table 2: Charging times of Audéo B-R

An internal Phonak investigation showed Phonak Venture premium wireless hearing aids are worn on average ten to eleven hours a day² or longer. This means that wearers will require a hearing battery that can last as long as their day lasts. By using Li-ion as a rechargeable solution in hearing aids, wearers can enjoy a full day of continuous hearing including wireless streaming without any decrease in hearing performance or deterioration of the battery over time. This is a more viable solution for people who were not satisfied with the limitations of other rechargeable solutions.

*Expected results when fully charged, and up to 80 minutes wireless streaming time. Please refer to www.phonakpro.com/evidence

Since the expected life of Li-ion is four years, it makes sense to integrate the battery into the housing of the hearing aid. This helps to increase the durability of the hearing aids and reduce the corrosion of the battery contacts. The biocompatible titanium charging contacts on the hearing aids support the quick charge and are also resistant to corrosion.

One clear advantage of integrating the battery means that handling is also simple. Without the battery door, the wearer never needs to worry about opening a battery door and replacing the battery. Instead, the hearing aids are placed directly into the charger to automatically begin charging. The various charging options offers wearers a simple and effective user experience. To charge the hearing aids, there are two charging options available: the Phonak Charger Case and the Phonak Mini Charger. The Charger Case (Figure 3), resembles the standard Phonak hard case.



Fig.3: Audéo B-R in the Phonak Charger Case

In addition to protecting the hearing aids, it also charges and dries the hearing aids in a compact and stylish package. For charging-on-the-go, the optional Power Pack (Figure 4) for the Charger Case allows 7 full charges for a pair of Phonak rechargeable hearing aids. This means that wearers who are constantly on the move do not have to worry about always searching for a power supply.



Fig.4: The Phonak Charger Case with the Phonak Power Pack

The Mini Charger (Figure 5) is a smaller option for wearers who want a charger that takes up very little space on a desk or nightstand or as secondary charger. Both chargers fully charge a pair of hearing aids in three hours.



Fig.5: Audéo B-R in the Phonak Mini Charger

Conclusion

Multiple surveys have clearly defined consumers expectations and desires of rechargeable hearing aids. Phonak rechargeable hearing aids with a built-in Li-ion battery fulfills these expectations through the following: (1) full day battery life, including media streaming, (2) Depleted batteries can be fully recharged quickly within three hours, and (3) the built-in battery improves usability by increasing the durability and handling of the hearing aid.

The challenges and inconveniences of replacing batteries is now a thing of the past, thanks to Phonak rechargeable hearing aids. In combination with advanced Phonak technology, Audéo B-R is the first rechargeable hearing aid from Phonak to use Li-ion technology and provide wearers with 24 hours of uninterrupted hearing.

References

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Authors



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