

Yamaha Motor Monthly Newsletter



The "JWX-1" Electric Wheelchair

Spotlight: Electric Wheelchairs

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Electric Wheelchairs

Never giving up on what people can do



The "JW-I" electric wheelchair unit was followed by the "JW-II" electric power assist unit. These two Yamaha wheelchair electric power units drew much industry attention when introduced together at the 1996 International Home Care & Rehabilitation Exhibition.

Yamaha Motor has always sought to be a "Kando* Creating Company" that brings new excitement and a more fulfilling life for people all over the world through our *Monozukuri* (engineering, manufacturing and marketing) and a wide range of corporate activities. And, as a vehicle manufacturer, Yamaha has also focused on the wheelchair, an important vehicle in the health and welfare sector. While overcoming numerous challenges along the way, we have developed and marketed a number of wheelchair products using exclusive Yamaha technologies. These products are giving more people greater mobility with greater comfort that helps them live more active lives.

*Kando is a Japanese word for the simultaneous feelings of deep satisfaction and intense excitement that we experience when we encounter something of exceptional value.

Changing the "merits and demerits" mindset to getting "the best of both worlds"

Wheelchairs can be divided largely into two types: manual wheelchairs controlled by the user pushing/pulling on the hand-rims of the main wheels and electrically powered wheelchairs mounting electric motors that drive the wheels. The wheelchairs commonly used at hospitals and public facilities, etc. are manual wheelchairs of a standard design built to accommodate the majority of users. In Japan, wheelchairs for personal use are generally custom-made units designed to answer the specific needs of the individual's degree of disability and use conditions. When purchasing wheelchairs for personal use, the user must first choose between a manual or electrically powered wheelchair, and both types have their merits and demerits. The manual wheelchair has merits like being light and easy to carry around, and



Conventional electrically powered wheelchairs from other companies had the drawbacks of large, integrated motor and battery assemblies that limited design freedom even in custom-made models, and were heavy at about 80 kg

can be folded for easy loading into an automobile, but it also has the demerits of being difficult to go up inclines or over longer distances with. As for electrically powered wheelchairs, they greatly reduce the workload of the user but due to the fact that the electric power units are generally built into the chassis, they are heavy and not foldable, and therefore more difficult to transport. Another demerit is that electrically powered wheelchairs do not have a manual switchover and can only be run under motor power, so it is difficult to make small movements or slight adjustments in position.

Yamaha sought to combine the merits of both types of wheelchairs in one, and in 1995, the wishes of wheelchair users everywhere were answered with the release of the "JW-I," an electric power unit that could be after-fitted to a manual wheelchair to make it electrically powered.

The JW-I unit consists of right and left drive wheels with built-in electric motors, a battery and a control device, all designed to be mountable on most manual wheelchairs while providing features: 1) In most cases, the JW-I unit can be fitted on a wheelchair built to fit the specific needs of the user's degree of disability and use conditions without modification. 2) A wheelchair mounted with the JW-I unit only weighs around 25 kg (one-third the weight of a conventional electrically powered wheelchair). 3) It is possible to fold up a wheelchair mounted with the JW-I unit. 4) Forward and reverse motion, stopping and turning operations are all performed easily with a single joystick. 5) Switching between manual and electric modes is simple. 6) An optional rear control unit for operation by a care-giver can be fitted. These many features made the JW-I unit very well received by wheelchair users, care-givers and welfare workers.

Reducing stress and effort expands the realm of what people can do

Yamaha Motor first began development of electric wheelchairs at the end of the 1980s. In the search for viable new businesses, all kinds of ideas sprang up like mushrooms after a rain and disappeared just as quickly, as Yamaha engineers put together new combinations of various technologies to create new forms of products. The birth of Yamaha's electric wheelchair business was the result of the connection of the *Yaramaika* spirit (meaning "Let's give it a shot!" in the local dialect of western Shizuoka Prefecture where the company's headquarters is located), which has always been a strong part of the company's corporate culture, and the passion for Yamaha's *Monozukuri* ideals aimed at fulfilling our corporate mission as a "Kando Creating Company."

"We often heard complaints from owners that the electrically powered wheelchairs at the time were large, heavy, had a short running distance per charge and that dealers were slow to provide service when they broke down, etc. We thought that with our experience in building a wide range of vehicles like motorcycles to boats, we could apply the latest technologies and build ideal wheelchairs that were compact and light," says one of the members of the original development team.

"Even when wheelchair users want to go out, they often refrain from doing so because of the burden of knowing that they will have to depend on the help of others for things like getting over the curbs on the roads, going up and down stairs or when covering longer distances and periods of time, etc. Especially in the case of manual wheelchair users, there are many instances where they must depend on a care-giver and that increases their reluctance to get out and about even more. However, we believed that if they have access to an electric wheelchair that is lightweight and maneuverable, the users can do much more by themselves and it would surely encourage a more positive attitude and willingness to go out and be more active. We sought to develop and build that kind of product. The same ideal is in the 'JW' designation we gave the product, meaning 'Joy Wheel.'"

Since most of the product development engineers seldom had the opportunity to interact with wheelchair users, a series of interviews were arranged during the early stage of the wheelchair development project to enable them to get to know the users' actual needs and wishes. With the cooperation of a large rehabilitation center and professionals in the field, the Yamaha team was also able to arrange test-ride sessions for wheelchair users. Through these activities, the team was able to share knowledge of the issues and shortcomings of existing wheelchairs. All this led to the successful development of the light and compact JW-I electric power unit for manual wheelchairs. It was packed full of outstanding features never seen on wheelchairs before like the simple structure that merely involved replacing the main wheels of a manual wheelchair with its wheels with built-in electric motors and employing electronic control technology garnered from Yamaha's industrial



A manual wheelchair is quickly converted into an electric one by replacing the drive wheels and attaching a battery and control unit. In addition to being light and compact, the great operability and smooth ride made possible by exclusive Yamaha technology is another unique feature (JWX-1 pictured).

robot expertise to create smooth operation and running performance. Furthermore, a small but highly skilled staff of service people were assembled with the readiness to go anywhere in Japan to quickly respond to any product failure or problems that might arise.

"We handled this project aiming to satisfy each and every customer with a product created through an integrated approach to engineering, manufacturing and marketing. The result was a gradual spread of approval by word of mouth among users for the product's benefits, including the aftersales service. Even today, we continue to maintain a staff wing that will go to the home of any customer on request to offer test rides of the JW line of products. Our top priority is spreading understanding of the benefits these products offer to as many people as possible. This attitude has been handed down from the earliest days of the development project and lives on today," comments the team member.

"Powered assisted" wheelchairs that offer the joy of using one's physical capabilities

To expand sales and help Yamaha wheelchairs grow as a business, a broad lineup of models is essential. In 1996, the lineup got that additional breadth with the development of the "JW-II," an electric power assist unit for wheelchairs using exclusive Yamaha drive system technology and being the first of its kind in the world. Like the JW-I, the JW-II unit replaces the main wheels of a manual wheelchair with motor-fitted wheels, but the difference is that it doesn't have a joystick control unit because technology employed from Yamaha's PAS electrically power assisted bicycles enables operation just like a manual wheelchair by simply pushing or pulling on the hand-rims. The magical part of this new product however, was that the instant the user applied force to the hand-rims, the precisely controlled electric motors in the wheels produced a gentle but powerful assist to the user's effort that felt just like getting a helpful push from behind by a care-giver. This assist made the workload of pushing the wheelchair incredibly light and pleasant, even up inclines or over longer distances.

"However, a wheelchair is normally propelled forward by gripping and pushing the hand-rims forward and then moving the hands back to re-grip and push on the rims again. There are differences like the strength between a user's right and left arms and the timing of force applied and released, and if these differences were directly reflected in the power assist, the wheelchair's motion would be jerky. We had to figure out how to adjust the control to make the motion smooth and natural for the

user,” notes the Yamaha developer. “To solve this problem, we worked day in and day out, analyzing repeated small movements and forces to approach the ideal performance for the product. One of our specific targets was maneuverability fine-tuned enough so a user could wheel down an aisle in a supermarket precisely picking out products from the shelves. That was much harder than you’d think,” adds the development team member with his eyes gleaming. He then went on to explain that, “It is often the case that users of manual wheelchairs will have a care-giver pushing them from behind, and there are actually fewer users than you would expect propelling their wheelchairs under their own strength alone. But, with the JW-II unit at work, people can use their wheelchairs on their own without excessive strain. We believe that this is what defines a true ‘manual’ wheelchair. I will never forget the time when a former young gymnast who had sustained a spinal injury and was confined to a wheelchair told me that thanks to the JW-II unit on his wheelchair, it was now possible for him to go freely wherever he wanted. He has now left his hometown and has a job that has gotten him back into society as an independent person. Seeing the smiles of many people like him is truly the greatest reward for us product developers.”

The positive response to this product was not confined to Japan. Due to it being the world’s first product of its kind, when it was introduced at international health and welfare product exhibitions shortly after its release, inquiries and orders for the JW-II were received from Europe, the Americas and other countries with advanced health and welfare markets. This was followed by praise from abroad that not only did the product encourage users’ will to get out and around as well as increasing their range of activity, but also proved effective in helping to maintain and increase the physical capabilities of users with disabilities in the use (flexing) of their arms and upper body muscles. Then in 1999, OEM supply of the JW-II unit began to three companies in Europe for the first time. The JW-II also went on to win high recognition worldwide, receiving the “da Vinci Award”* of the Michigan Chapter of the U.S. National Multiple Sclerosis Society in 2008.

More recently, in 2013, Yamaha Motor released the new “JWX-2” electric power assist unit that uses a new type of motor and high-precision control functions. In order to make the unit mountable on an even wider range of manual wheelchair models, the motor is designed with a flatter shape and performance is greatly increased. Also, features like special software to customize the assist characteristics to specific user disabilities and use conditions and a choice of “Indoor” and “Outdoor” assist modes that can be selected with a simple switch operation result in major advances in ease of use and user comfort. In these ways, Yamaha’s JW products are making life better for wheelchair users in a wide range of situations today in Japan and around the world.



As successor to the JW-II unit released in 1996, the new “JWX-2” makes full use of Yamaha PAS technology to enable assist setting adjustments to fit individual user strength and/or preferences and achieve smoother, more natural performance, etc.

*da Vinci Award: A world-renowned award for revolutionary new technology or research that helps people with disabilities resulting from illness or injury live more active lives in society.

Message from the Editor



On September 17th, we had an event to introduce our electric wheelchairs to the press in Tokyo. There was a large attendance by members of the various media and it turned out to be a great opportunity to get them to experience the performance of our electric wheelchairs.

After the indoor presentation, everyone moved to the outdoor test-ride venue, for which a 3° paved slope was chosen to show what it's like going uphill for a wheelchair user. Looking at it at first, I thought it was pretty hard to even see the incline, and that 3° doesn't seem like much of a slope.

But when I tried to wheel up it with the wheelchair in manual (no assist) mode, I took my words right back. I could barely move the wheels forward, and I even started rolling backwards. I couldn't believe how hard even such a slight incline was to go up in a wheelchair.

We then switched to electric assist mode and tried the slope again. Timidly at first, I tried gently pushing on the rims and was answered with a smooth drive force in response. Then I tried giving the rims a serious push and felt a strong response. With a wheelchair like this, I felt like I'd be able to go up slopes or over bumps without someone pushing me from behind.

This experience brought back with new meaning the words of the development team member that said, "The JWX-2 is our definition of a true 'manual' wheelchair."

Going forward, Yamaha Motor will begin full-fledged marketing of its electric wheelchair units overseas. I hope you'll find the opportunity to try one yourself!

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