



# Intelligent Environmentally Friendly Cutting of High-pressure Waterjet The Entire Cutting Solution in the Wind Power Industry

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## 1. Company introduction (Who We Are )



Forplus waterjet brand originated in Sweden, Europe. With the spirit of scientific, rigorous and lean craftsmanship, it settled in Chongqing, the largest city in China, and continued to tell the classic story of water jet technology.

With a number of patents registered, ForPlus dedicates itself to the R&D, applications and manufacturing of extensive high-pressure waterjet machines, integrating with automation system, 5G communications, IoT, AI and other cutting-edge technologies and committed to be the full solution provider of waterjet oriented applications.



Benchmarking the world's leading waterjet companies, with the enterprise spirit -3I (Innovative, Improving, indomitable), ForPlus is determined to be world-class waterjet company.

**Forplus, Cheer for national industry!**



## 2. Advantages of Ultra-high Pressure

### Waterjet Cutting in the Wind Power Industry

The main components of the wind power industry are mainly made of fiberglass (glass fiber), including blades, fan covers, and fairings. Blades and other components are also made of other materials, including but not limited to balsa wood, structural adhesive, PVC, and a small amount of metal.

Traditional cutting methods in the industry are primarily mechanical, using equipment such as angle grinders, various-sized diamond saws, and wire saws. Operation is primarily manual, with some assistance from engineering equipment.

Mechanical cutting has a relatively high direct cutting efficiency and is easy to operate, but it also has several problems. The merit and demerit of ultra-high pressure waterjet cutting are as follows:

	Mechanical Cutting	High-pressure Waterjet Cutting
Dust generated by cutting	A large amount of glass fiber dust will be generated.	Dust-free
Pollutant recovery and treatment	Pollutants can be treated by using closed space + water flow + adsorption; There is no way to deal with the dust generated by cutting in the wild environment.	Water, abrasives(Confirm whether it is necessary according to different scenarios and cutting thickness.), debris need to be



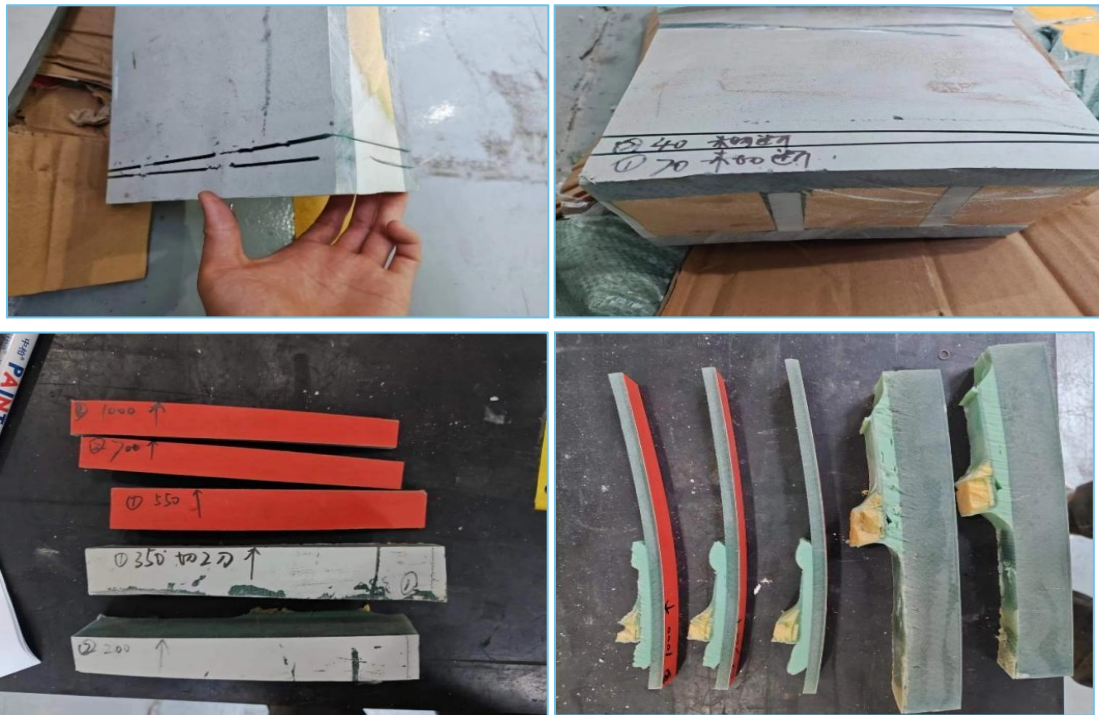
		<p>processed. We provide</p> <p>dedicated separation</p> <p>equipment without the risk of</p> <p>contamination.</p>
Artificial	<p>Manual operation requires a lot of</p> <p>physical strength and skills;</p> <p>Dust pollution and health impacts make it</p> <p>increasingly difficult to hire workers.</p>	<p>More automated operations,</p> <p>reducing manual labor and</p> <p>skill requirements;</p> <p>No dust and health impact;</p> <p>The requirements for the</p> <p>comprehensive quality of</p> <p>operator are improved.</p>
Cutting Speed	<p>In a direct comparison, mechanical</p> <p>cutting is faster.</p> <p>The larger the machine used for cutting,</p> <p>the faster it will be.</p>	<p>The cutting speed is slower</p> <p>than mechanical cutting.</p> <p>Cutting speed can be increased</p> <p>by increasing the</p> <p>high-pressure water flow, the</p> <p>abrasive ratio, or the number</p> <p>of cutting mechanisms.</p>



Cutting Capacity	<p>The larger the size of the machine, the easier it is to cut and the faster it is, but it is more difficult to operate;</p> <p>The shell and the parts with relatively low thickness are relatively easy to cut; the parts with strong rigidity and thick thickness such as the blade root, web, main beam, etc. are not easy to cut or even impossible to cut;</p> <p>The composite multi-material layered structure will affect the mechanical cutting effect.</p>	<p>It can cut any material, no matter how thick or thin it is;</p> <p>Adjusting the cutting speed can cope with cutting of various parts, thicknesses, and composite layer structures.</p>
Cutting Process	<p>Mechanical cutting can basically only cut in straight lines;</p>	<p>Non-contact cutting, the trajectory can be planned arbitrarily</p>
Tool Wear	<p>Glass fiber material has high hardness and high tool wear</p> <p>The thicker the part, the greater the loss and the easier it is for the knife to get stuck.</p> <p>After the structural adhesive is</p>	<p>Non-contact cutting, no tool collision, tool jamming and other factors of loss;</p> <p>Only normal wear and tear from waterjet cutting.</p>



	<p>hot-melted, it is easy to stick to the cutting tool and cause damage;</p> <p>Feeding too fast or uneven material can easily cause the tool to get stuck.</p>	
Automation	<p>Only straight lines can be cut, not trajectory graphics.</p>	<p>Technologies such as 3D vision, robot vision, automated control, and robotics are becoming increasingly mature;</p> <p>Non-contact cutting makes it easier to integrate the above advanced metals and complete intelligent cutting.</p>
Costs	<p>Low equipment cost;</p> <p>The comprehensive labor cost is high;</p> <p>The operating cost is generally high and uncontrollable due to wear and tear, abnormal knife sticking, etc.</p>	<p>High equipment costs;</p> <p>Reduced overall labor costs;</p> <p>Operating costs are controllable and generally low.</p>



Combining the above characteristics, and comprehensively considering environmental protection, labor, safety, cost, efficiency and other aspects, the ultra-high pressure waterjet intelligent cutting solution is very suitable for the cutting needs of fiberglass workpieces in the wind power industry.



## 3. Overview of application in the wind power industry

Based on our company's extensive industry communications, market research, and R&D testing over the past two years, we have analyzed various application scenarios of ultra-high pressure water jet cutting in the wind power industry, as follows:

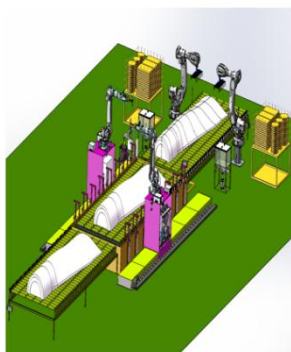
### 风电行业切割场景

#### 叶片循环利用



##### 塔下粗切割

撬装设备、现场粗切割，方便运输。并初步筛分叶根、腹板、主梁和壳体区域。



##### 工厂精细切割

工厂内自动化切割设备，根据需要实现自动化、无人化、黑灯工厂；基于3D视觉切割，完成条状、片状等指定尺寸切割。

#### 风电组件制造



**壳体、罩体裁边打孔**  
机舱罩、导流罩、风机罩等壳体结构的裁边、打孔



**叶片飞边一次性裁切**  
叶片压制后飞边的自动化、免打磨裁切

更多切割场景，有待持续开发、拓展

Recycling of wind turbine blades:

- 🔵 **Preliminary downsize cutting under tower:** Skid-mounted equipment and on-site **downsize** cutting facilitate transportation. Preliminary screening of blade roots, webs, main beams, and shell areas is also performed.
- 🔵 **Factory meticulous cutting:** The automated cutting equipment in the factory can realize automation, unmanned operation as needed; Based on 3D vision, it can complete the cutting of specified sizes such as strips and sheets.

**Component manufacturing of wind turbine blades:**

- 🔵 **Shell and cover trimming and punching:** Trimming and punching of shell



structures such as nacelle covers, deflectors, and fan covers.

- ④ Edge trimming of wind turbine blades: During the manufacturing process, the wind turbine blades are pressed layer by layer, and the flash and burrs on the edges are automatically trimmed using water jet cutting.



## 4. Products and Solutions

The following is an introduction to our current products and solutions according to various applications:

### 4.1 Preliminary downsize cutting

#### under tower

Version 2.0: Large skid-mounted blade cutting solution

Technical Features:

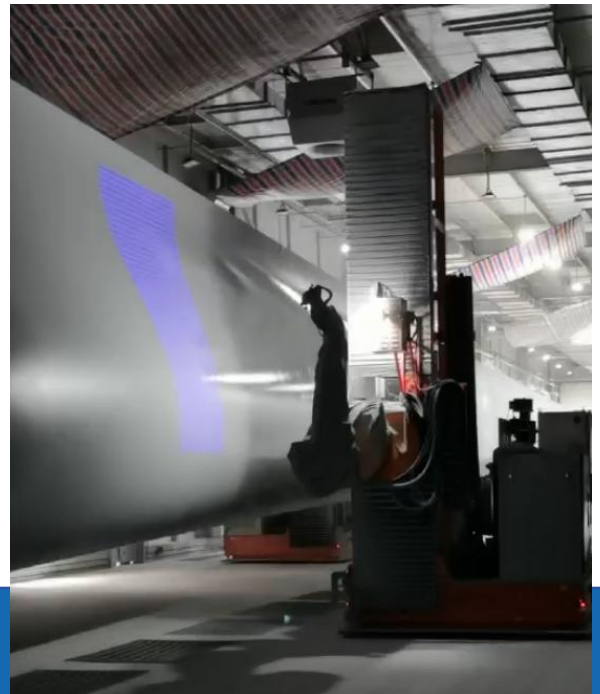
- Offline programming combined with robot programming to complete automatic cutting;
- Cutting is completed in the form of a skid-mounted and dual-station robot;
- Can work continuously for 8 hours;
- It only takes 6 hours to meticulous cut 1 piece of wind turbine blade (L\*W:500\*500).;



Version 3.0: A mobile, skid-mounted UHP, all-in-one waterjet cutting system

Technical Features:

- 3D machine vision scanning, automatic trajectory planning;
- Higher degree of integration, all equipment is integrated in one container;
- More in line with the actual needs of tower operations, self-integrated boom, self-transportation;
- Completed the downsize cutting of three blades under a tower within one day;





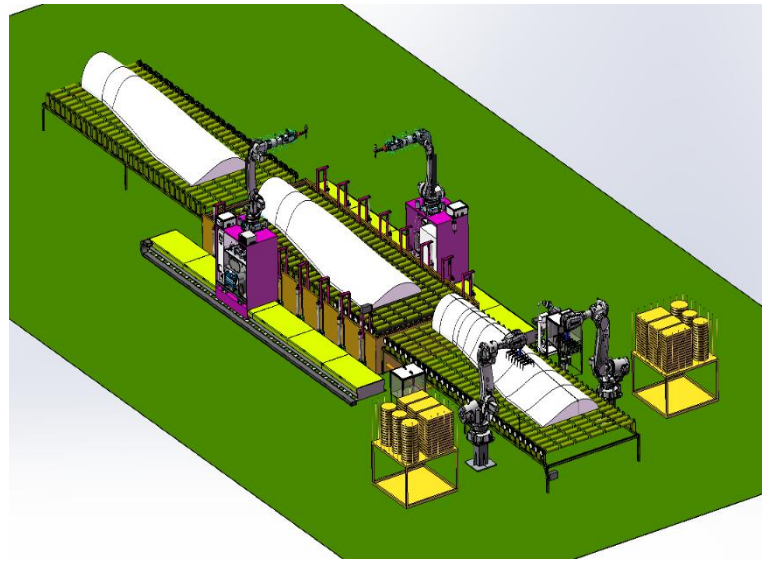
- ④ Rough cutting simultaneously completes the separation of high-strength, directly usable structural parts such as blade roots, webs, main beams, and shell areas;

## 4.2 Factory meticulous cutting

Customized solution: fully automatic blade fine cutting solution

Technical Features:

- ④ Recognition of the shape and position of the loading material based on the robot arm and 3D vision recognition;
- ④ Fully automatic operation without human intervention. Create a dark factory and fully automatic production line. Can be combined with its own post-processing recycling production line;
- ④ It can process and cut thicker and stronger blade parts such as blade roots, webs, and main beams, and directly use their rigid structures for recycling.。
- ④ Customized design and manufacturing are carried out according to customer needs and actual conditions.
- ④ Blades cutting of decommissioned wind turbine can be recycled. Not only can they be cut into strips, sheets, or blocks, but they can also be used directly to make pallets, fences, livestock poles, or split into pieces for crushing.





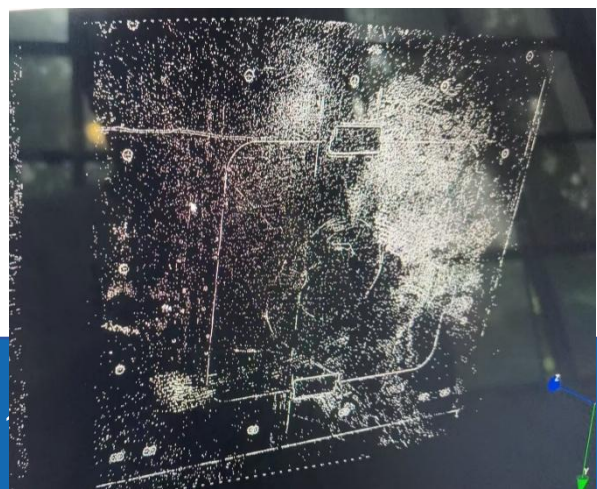
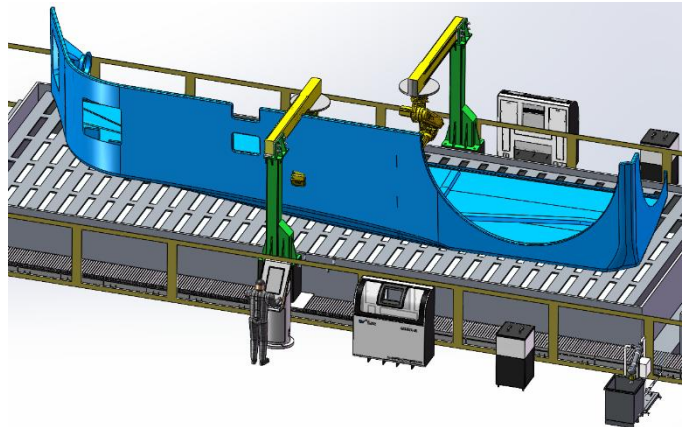


## 4.3 The shell and guide cover of the wind turbine blade are trimmed and punched

Comprehensive solutions for trimming and punching of intelligent flexible housings and cover components

### Technical Features:

- ④ Use 3D machine vision for real-time scanning to overcome positioning deviation caused by shell structure deformation. The overall design is positioning-free and tooling-free.
- ④ Based on the visual processing platform, the proprietary algorithm independently developed is suitable for different cutting requirements of shells and covers, including but not limited to local position correction, regional seam docking, edge recognition and reverse calculation, and increasing correction angles for opening holes.
- ④ 2D/3D integrated intelligent vision hardware can confirm and filter (deep learning) based on the marked 2D features, and simultaneously locate the 3D spatial position to complete cutting based on the markings (cutting lines reserved during shell production, mark points and lines in the active identification area, etc.).
- ④ Create an extra-large working space to meet the needs of fan covers, main engine covers, and the processing of extra-large workpieces.。



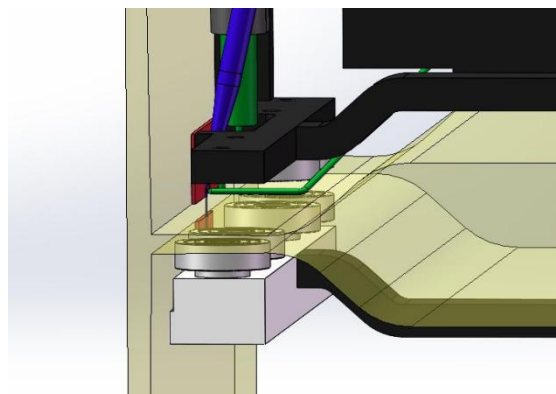
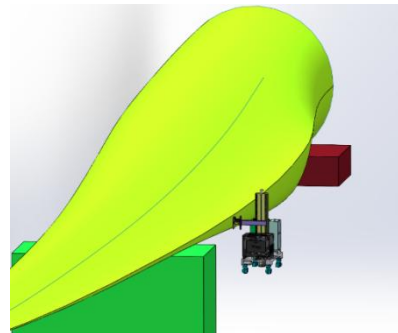
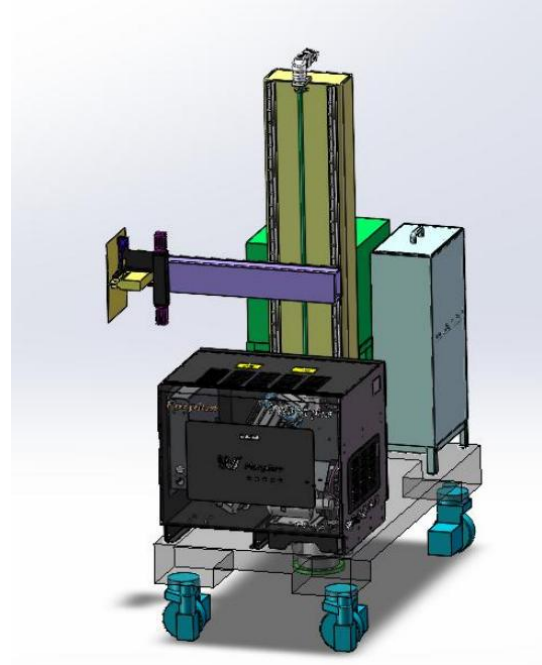


## 4.4 Edge trimming of wind turbine blades

Intelligent and automated edge trimming of wind turbine blades

Technical Features:

- ④ The integrated AGV trolley carries the entire cutting mechanism;
- ④ The edge structure of wind turbine blades and visual edge detection technology are used to locate the cutting position and achieve the goal of cutting as it moves;
- ④ Through the close cutting method, the residual after the flash cutting is no more than 1mm, and the overall dust-free solution of one-time cutting and reducing the grinding process is achieved. 。





## 5. Summarize

Forplus waterjet, deeply rooted in the high-pressure waterjet industry's diverse wind power applications, has gradually developed and iterated on its experience through continuous custom projects and practical experience, developing universal products. This product aims to address the long-standing challenges plaguing the wind power industry's cutting and crushing applications. This addresses numerous challenges, including labor shortages, severe pollution, high costs, and low levels of intelligent solutions, resulting in environmentally friendly, intelligent, and efficient technical solutions.