

ENERPAC 

**HOW TO DRIVE
EFFICIENCY
IN THE WIND
INDUSTRY
WITH HYDRAULIC TOOLS**



**THE RIGHT TOOL
MAKES ALL THE DIFFERENCE**

INTRODUCTION

In this document we explore the vital role of hydraulic technology within the wind energy sector, focusing on wind turbine manufacturing, transport, installation, and maintenance, showcasing how these tools significantly influence real-world applications.

Throughout this document, we'll provide detailed insights that highlight how these hydraulic tools significantly impact each phase – manufacturing, transport, installation, and maintenance.

Emphasizing their role in advancing efficiency and productivity within the wind energy sector, these examples underscore the transformative influence of hydraulic technology in the industry's various operational aspects.



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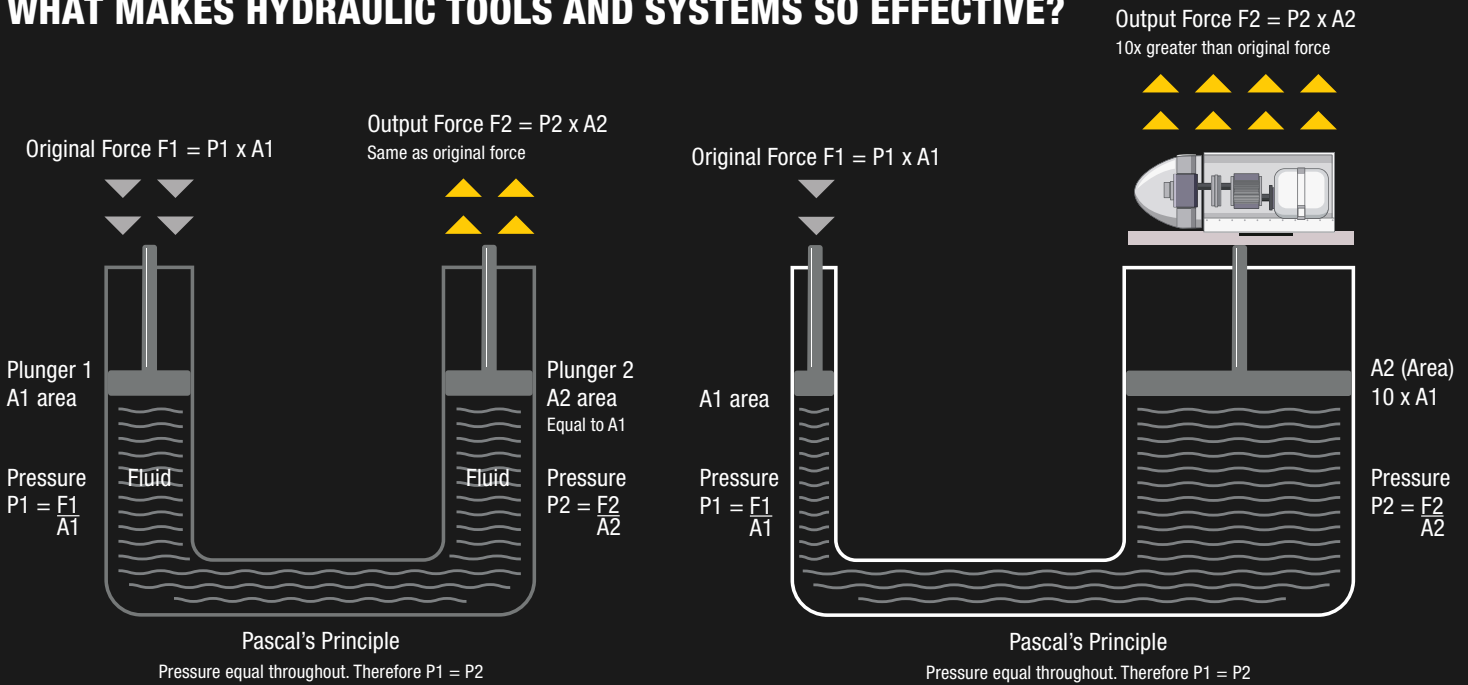
PART 1 **KEY BENEFITS** **OF HYDRAULIC** **TOOLS AND** **EQUIPMENT**



KEY BENEFITS OF HYDRAULIC TOOLS AND EQUIPMENT

PART 1

WHAT MAKES HYDRAULIC TOOLS AND SYSTEMS SO EFFECTIVE?



The inherent characteristics of hydraulics, rooted in fluid mechanics and engineering principles, contribute to their efficiency, reliability, and wide-ranging applicability in different industries, offering substantial advantages over alternative methods and systems.

HIGH POWER THROUGH FORCE MULTIPLICATION

Hydraulics use incompressible fluids to transmit force. Applying a relatively small force to a confined fluid generates a more substantial force at another point due to the principles of Pascal's law. (see fig 1 and fig 2 above). This force multiplication enables high power output, making hydraulics ideal for high force and heavy-duty applications.

WIDE RANGE OF APPLICATIONS

Hydraulic systems power a wide range of equipment and tools equipment such as cranes, forklifts, presses, and heavy machinery.

COMPACT AND LIGHTWEIGHT DESIGN

They often have a high power-to-weight ratio and a more compact design compared to other power transmission systems, making them more portable and easier to handle.

PRECISE CONTROL

Hydraulic systems provide precise control over speed and force, allowing for delicate and accurate operations. This level of control is essential in the various industries, especially the wind sector.

SAFETY

Hydraulic systems are designed with safety features that prevent sudden overloading and provide more controlled operations, reducing the risk of accidents. Hydraulic tools often provide a safer alternative to manual hammering, cutting, grinding, and torching.

DURABILITY AND LOW MAINTENANCE

Hydraulic systems are generally durable, reliable, and require less frequent maintenance compared to some alternatives. This robustness contributes to their long-term cost-effectiveness.

CONSTANT FORCE AND SPEED

Hydraulic tools offer constant force or speed even under varying loads, ensuring consistent performance regardless of the application's demands.

ADAPTABILITY TO AUTOMATION

Hydraulic systems can be easily integrated into automated processes, making them suitable for modern manufacturing and industrial automation. Examples include hydraulic cylinders designed to push, pull, lift, and lower.

DRIVING EFFICIENCY IN THE WIND INDUSTRY WITH HYDRAULIC TOOLS

1 MANUFACTURING

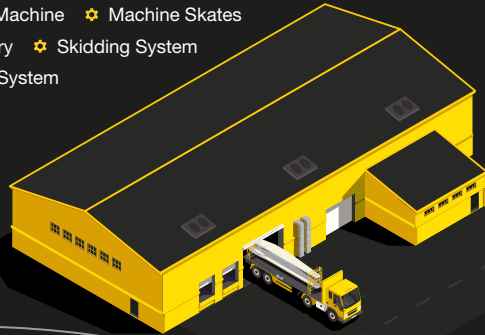


The world's longest wind turbine blade is **123m** LZ Blades China



Manufacturers use hydraulic equipment to gain a competitive edge when machining and handling wind turbine components.

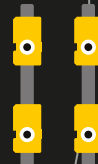
- ✦ Orbital Milling Machine ✦ Machine Skates
- ✦ Hydraulic Gantry ✦ Skidding System
- ✦ Cube Jack-up System
- ✦ Electric Trolley



2 TRANSPORT

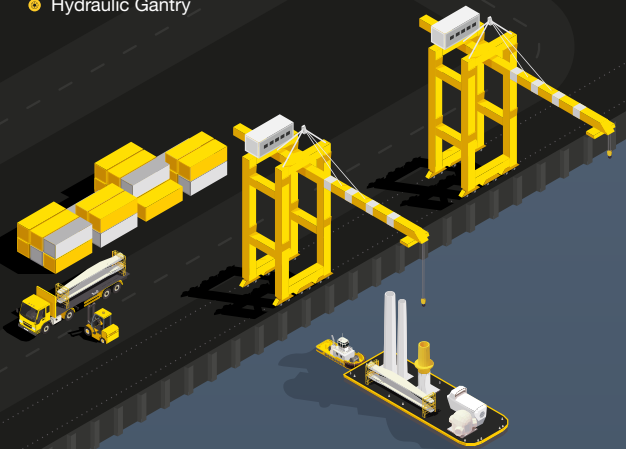


An offshore transition piece weighs approximately **500-tons**



Hydraulic lifting equipment streamlines the logistics process by enabling the safe efficient loading and offloading of turbine components.

- Electric Trolley System ● Skidding System
- Synchronous Hoist System
- Hydraulic Gantry



4 MAINTENANCE

62.9%

Of all turbine failure causes are **internal engineering related**

59%

The maximum efficiency of a turbine is around **59%**



Maintenance tools such as hydraulic torque wrenches keep wind technicians safe and productive, ensuring minimal downtime during servicing.

- 🔧 Controlled Bolting Tools 🔧 Bolting Accessories
- 🔧 Bolt Tensioners 🔧 Torque and Tension Pumps
- 🔧 Nut Splitters 🔧 Cutting Tools
- 🔧 Hydraulic Torque Wrenches



3 INSTALLATION AND ASSEMBLY



1,500 people are needed to construct a new offshore wind farm



25,000 Bolts (or more) in a typical wind turbine installation

When installing and assembling wind turbines, hydraulic lifting and bolting tools are used to reduce project timelines and costs.

- Synchronous Hoist System
- Tower Flange Alignment Tools
- Hydraulic Torque Wrenches
- TP Levelling and Fixation System
- Tensioners



Wind energy avoided

336,000,000 METRIC TONS

of CO2 emissions in 2022



The average height of offshore wind turbines is

150-200m

Time to construct an onshore wind farm between

4-8 YEARS

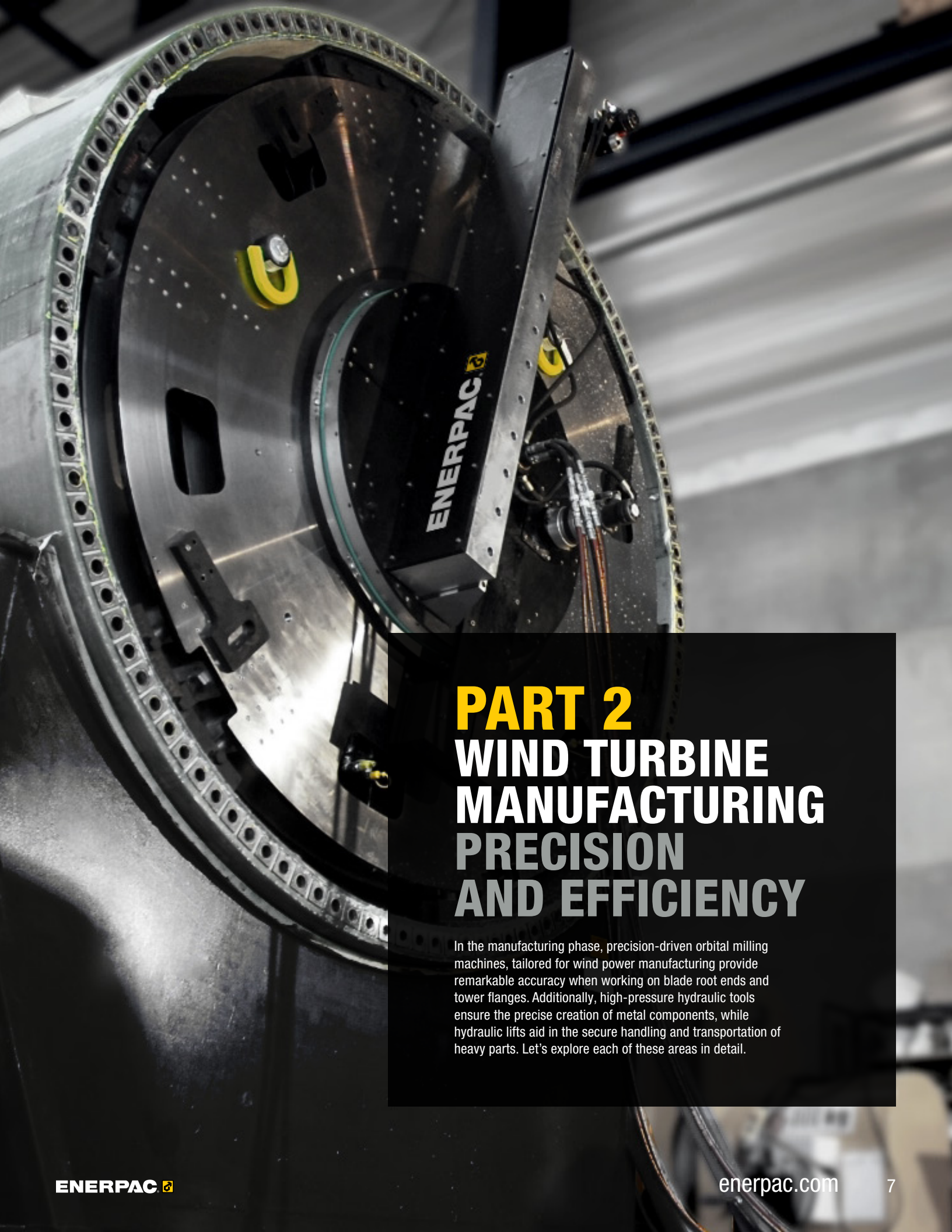


Time to construct an offshore wind farm between

7-11 YEARS

LEARN MORE. CONTACT A SPECIALIST.





PART 2

WIND TURBINE MANUFACTURING PRECISION AND EFFICIENCY

In the manufacturing phase, precision-driven orbital milling machines, tailored for wind power manufacturing provide remarkable accuracy when working on blade root ends and tower flanges. Additionally, high-pressure hydraulic tools ensure the precise creation of metal components, while hydraulic lifts aid in the secure handling and transportation of heavy parts. Let's explore each of these areas in detail.

COMPONENT FABRICATION

As the demand for wind turbines grows, manufacturers face the challenge of scaling up production while maintaining cost efficiency. Achieving economies of scale while preserving quality standards and cost-effectiveness is a constant balancing act in the industry.

Hydraulic tools and equipment can make a significant contribution to manufacturing operations due to their ability to exert considerable force while at the same time delivering remarkable precision.

One example is an orbital milling machine (sometimes referred to as radial or circular mill). These purpose-designed machines are used to machine the blade root ends and can achieve global industry flatness requirements of $\pm 0.15\text{mm}$ for across large diameters.

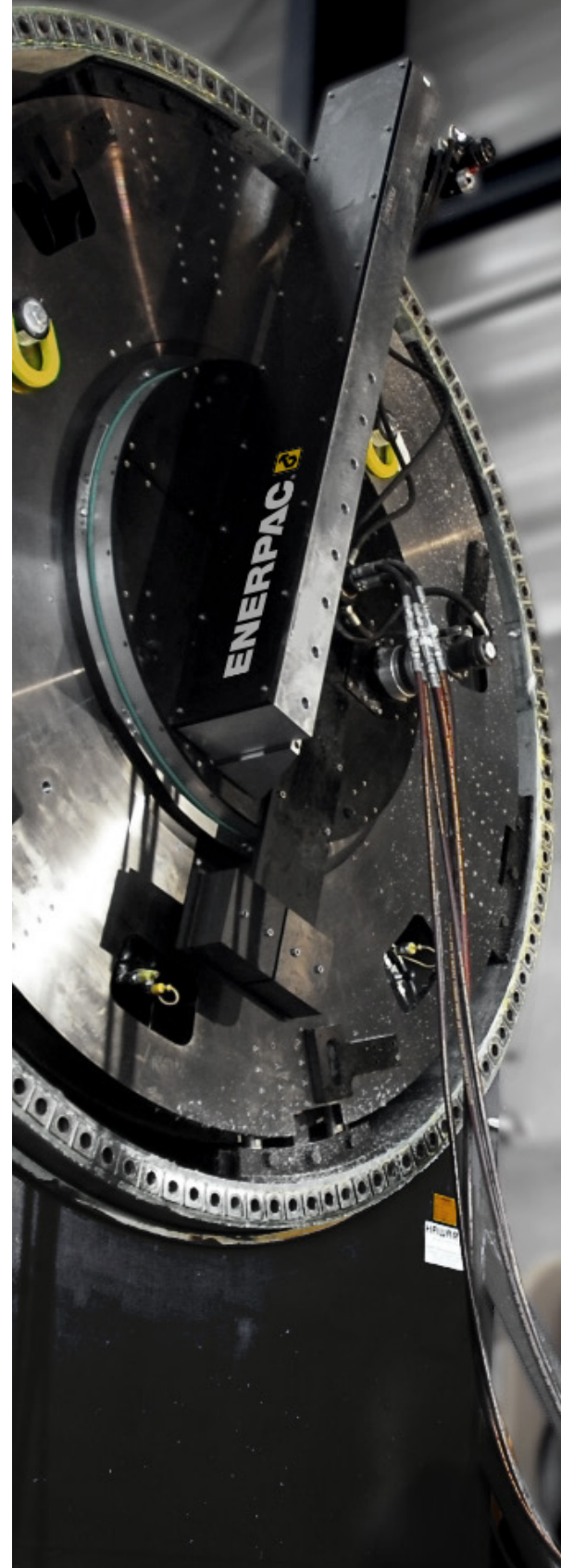
The root end of the blade is typically constructed from composite materials including fiberglass and threaded metal inserts that accept the fixing bolts or studs. Creating a smooth and level surface using alternative methods, such as grinding or using hand tools would be far too labor intensive, inaccurate, and time-consuming.

ORBITAL MILLING MACHINES: WORKING PROCEDURE

- The orbital milling machine is mounted onto a purpose-designed trolley which is maneuvered to the blade
- The hydraulic clamping mechanism is actuated, which expands the jaws enabling the machine to clamp inside the root end of the blade
- The trolley is removed
- The flange high point is found to set the milling head starting position – this can be found manually or guided by laser
- The machine is powered by a hydraulic power pack and is controlled by a remote pendant
- The milling head works its way around the root end and takes the first rough cut
- Following this first rough cut, a second smooth and final cut is carried out
- The trolley returns to the machine and is reattached
- Hydraulic clamp released and the trolley moves into the next blade

BENEFITS OF AN ORBITAL MILLING MACHINE

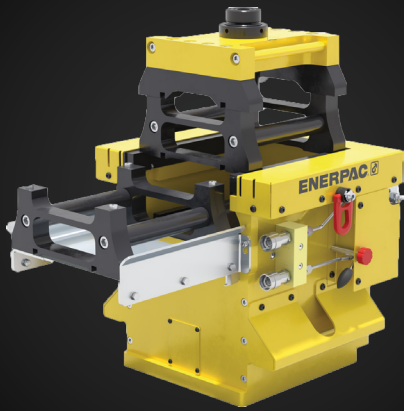
- Repeatable process times to suit a production environment
- Achieves current global industry flatness for root diameters of $\pm 0.15\text{mm}$ (Flatness requirements can fluctuate relative to the root diameter)
- In built flexibility to cope with new blade designs
- Mounting system options available to suit blades or tower flanges
- Fast-mount hydraulic clamping system works with minimal blade distortion
- Trolleys engineered to suit customer requirements – no need for cranes
- Optional dust extraction equipment available



HYDRAULIC LIFTING EQUIPMENT FOR MANUFACTURERS

Hydraulic systems, due to their capacity to deliver substantial force while maintaining precision and control, can play a vital part in handling wind turbine components. They assist in critical operations that demand both strength and accuracy, ensuring the quality and structural integrity of the components.

Throughout various stages of manufacturing, hydraulic equipment such as jacking systems, gantries and cranes can be employed to handle heavy components like tower sections, nacelles, and blades. These tools provide the necessary force to lift and move these massive elements precisely, allowing for safe and controlled transportation and assembly. Examples of hydraulic equipment useful for manufacturers and their applications are summarized below.



ENERPAC SELF-LOCKING CUBE JACKS

Jacks up from below at multiple lift points. Steel barrels are stacked to form lifting towers. Self-locking mechanism for safety. Available in either 50 or 100 ton capacity

CAPACITY PER CUBE JACK:
56 - 110 ton 500 - 1000 kN

MAXIMUM LIFTING HEIGHT:
81.4 - 118.3 inches 2067 - 3006 mm

ENERPAC LOW HEIGHT SKIDDING SYSTEM

Particularly useful for horizontal travel in low height areas. Includes low friction pads and hydraulic cylinders.

SKIDDING CAPACITY:
400 tons 3560 kN
WITH 2 PUSH-PULL UNITS

PUSH-PULL STROKE:
23.5 inches 600 mm



ENERPAC ELECTRIC TROLLEY SYSTEMS

Use for horizontal travel. Delivers a stable and continuous motion and includes integral hydraulics for lifting by small amounts.

CAPACITY PER TROLLEY UNIT:
110 tons 1000kN

TRAVEL SPEED (LOADED):
82 - 164 ft/hour 25 - 50 m/hr





ENERPAC TELESCOPIC GANTRIES

Lifts loads from above and can be used with slings under the load. Includes self-contained hydraulics and tracks.

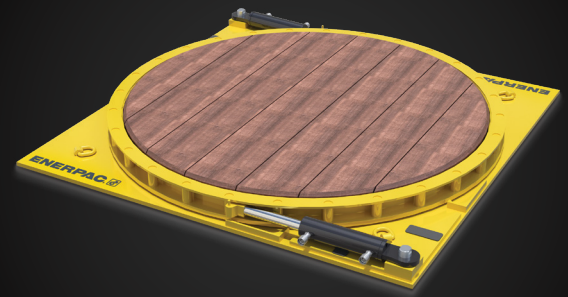
CAPACITY (4 LEGS)
45 – 1178 tons (400 – 10,484 kN)

MAXIMUM LIFTING HEIGHT:
11.7 – 39.38 ft (3.5 – 12 metre)

ENERPAC HYDRAULIC TURNTABLES

For safe and controlled rotation of heavy loads during, before or after a lifting or skidding operation.

CAPACITY
225 – 450 tons (2000 – 4000 kN)



ENERPAC BATTERY-POWERED LOAD SKATES

Use to lift and move materials and equipment. Manual and battery-powered options.

CAPACITY
11 – 55 tons (100 – 500kN)

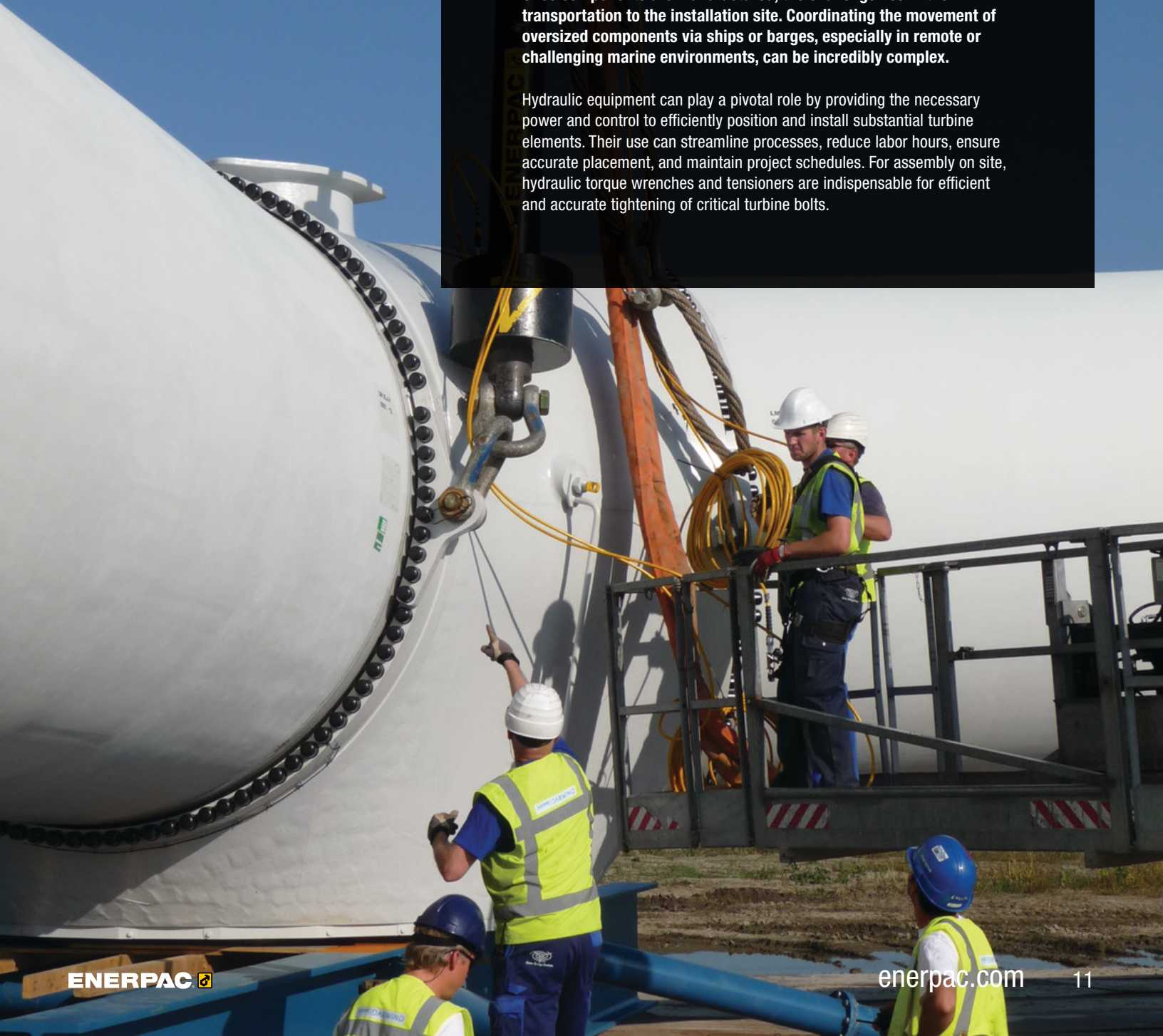


PART 3

TRANSPORT AND INSTALLATION STREAMLINING PROCESS

Once components are manufactured, the challenge lies in their transportation to the installation site. Coordinating the movement of oversized components via ships or barges, especially in remote or challenging marine environments, can be incredibly complex.

Hydraulic equipment can play a pivotal role by providing the necessary power and control to efficiently position and install substantial turbine elements. Their use can streamline processes, reduce labor hours, ensure accurate placement, and maintain project schedules. For assembly on site, hydraulic torque wrenches and tensioners are indispensable for efficient and accurate tightening of critical turbine bolts.



5 WAYS HYDRAULIC EQUIPMENT CAN STREAMLINE TRANSPORT AND INSTALLATION

HEAVY LIFTING AND HANDLING

Reliable hydraulic equipment and systems are critical for handling massive parts such as the Hub and Nacelle Assembly. They assist in lifting, positioning, and securing these heavy components, ensuring accurate placement and alignment while managing the considerable weight and intricacies of these parts.

PRECISION AND CONTROL

Hydraulic systems provide precise control over the movement and positioning of the equipment. During the transportation of these oversized components, especially in the delicate process of loading and unloading onto ships or installation vessels, the precision of hydraulic systems is essential for ensuring safe and accurate placement without causing damage to the components or vessels.

ADAPTABILITY AND VERSATILITY

Hydraulic systems are adaptable to various equipment and loading mechanisms, making them versatile for different types of vessels and handling setups. Their compatibility with diverse machinery and control systems allows for seamless integration into the specific requirements of offshore wind turbine component transportation.

DURABILITY AND MAINTENANCE

Having reliable hydraulic equipment minimizes the risk of breakdowns or malfunctions during critical operations. Properly maintained hydraulic systems contribute to the durability and long-term performance of the equipment, reducing the likelihood of unexpected failures during transportation.

STABILITY AND SAFETY

Conditions when loading onto a barge dockside and at the offshore wind farm can be incredibly. Reliable hydraulic systems help to ensure the heavy components remain properly balanced, reducing the risk of tilting or instability during transport, therefore reducing the risk of accidents or damage.



EQUIPMENT OVERVIEW FOR TRANSPORT AND INSTALLATION

The assembly and integration of these large components on-site are critical stages. Challenges involve precise coordination, ensuring alignment, and handling complex lifting and installation procedures. The integration of electrical systems, the nacelle, the tower, and the blades requires skill and adherence to strict safety measures. Examples of hydraulic equipment useful for transport, installation, and assembly are shown below.

ENERPAC

OFFSHORE LEVELLING & FIXATION SYSTEM

A system including hydraulic cylinders pre-installed within the transition piece used to align on the monopile.

Used with a no-spill hydraulic hose disconnecter.

ENERPAC

LIFTING YOKES

Custom designed equipment to assist in the precise lifting of hubs and nacelles during installation.





ENERPAC ELECTRIC TROLLEY SYSTEMS

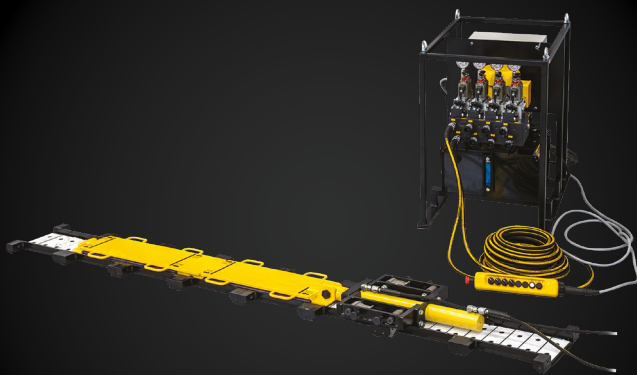
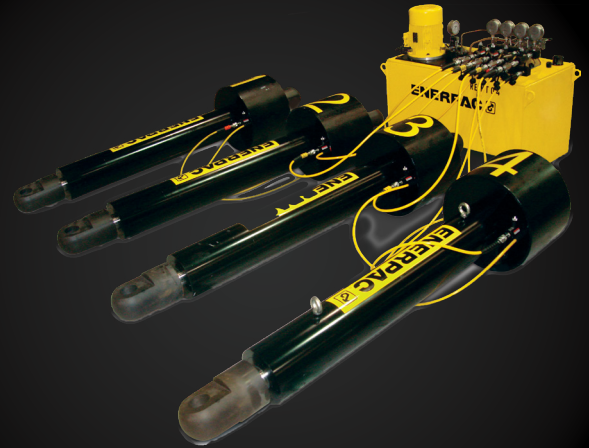
Use for horizontal travel. Delivers a stable and continuous motion and includes integral hydraulics for lifting by small amounts.

CAPACITY PER TROLLEY UNIT:
110 tons 1000kN

TRAVEL SPEED (LOADED):
82 - 164 ft/hour 25 - 50 m/hr

ENERPAC SYNCHRONOUS HOIST SYSTEMS

Attaches below the hook on a crane. Enables precise monitoring and adjustment of each lifting point independently. Can precisely position heavy and unbalanced loads.



ENERPAC LOW HEIGHT SKIDDING SYSTEM

Particularly useful for horizontal travel in low height areas. Includes low friction pads and hydraulic cylinders.

ENERPAC SEA LOAD FASTENING & ASSEMBLY TOOLS

Includes hydraulic torque wrenches, hydraulic tensioners, tower flange alignment tools, torque pumps and tensioner pumps.



PART 4

WIND TURBINE MAINTENANCE ENSURING RELIABILITY

Wind turbine Maintenance challenges include the remote locations of many wind farms, making access and logistics difficult for servicing and repairs. The complex structure and height of the turbines amplify these challenges, requiring specialized equipment and skilled technicians for maintenance. Additionally, the harsh environmental conditions, such as exposure to high winds, extreme temperatures, and corrosive elements, increase wear and tear on components, necessitating regular inspection and upkeep.

Given these challenges, maintenance teams need access to quality tools and equipment they can rely on to get the job right first time, while working efficiently and safely. Examples include a selection of tools relating to bolted connections such as hydraulic torque wrenches, tensioners, nut splitters, and tower flange alignment tools.



HYDRAULIC TOOLS FOR WIND TURBINE MAINTENANCE

In the wind turbine industry, where structural integrity is paramount for safety and operational efficiency, hydraulic tools like torque wrenches and tensioners are instrumental in achieving the necessary precision and consistency in fastening critical components. Their use contributes significantly to the overall reliability and structural integrity of wind turbines.

Proper and precise torque application is vital to ensure that these components are securely fastened without being over-tightened or under-tightened, thus maintaining the structural integrity of the wind turbine. Over-tightening can cause damage, while under-tightening can lead to loosening and potential failure. Further down the line, if a fastener is seized it can be removed easily using a hydraulic nut splitter, which works without the need for dangerous torching or hammering practices.

Typical applications for these tools include hub and blade maintenance, tower flange connections, foundation bolting (onshore), gearbox and nacelle maintenance, and pitch and yaw system maintenance.



HYDRAULIC TORQUE WRENCHES

Tightens nuts individually to a chosen torque value. Can be square drive, or hex cassette when clearance is tight.



HYDRAULIC TENSIONERS

Stretches multiple bolts simultaneously with hydraulic flow provided by a single hydraulic pump.



BOLTING ACCESSORIES

Includes Safe T™ Torque Lock attachments to create a hands-free torque wrench solution. Torque Calibration Checkers, and tethered tools.



NUT SPLITTERS

For removing seized fasteners without causing damage to surrounding components. Available with a single blade or as a two-blade type that splits from two sides in one action.



HYDRAULIC PUMPS

Pumps used to power hydraulic tools on site. Now available in highly portable battery-powered types.



CONCLUSION

Hydraulic tools and systems have emerged as a cornerstone in various industries, owing to their inherent characteristics deeply rooted in fluid mechanics and engineering principles. These properties contribute to their efficiency, reliability, and broad applicability across different sectors, offering substantial advantages over alternative methods and systems.

The force amplification through the principles of Pascal's law is a key driving force behind hydraulic systems. Leveraging incompressible fluids to transmit force, these systems apply a small force to generate a substantial force elsewhere, making them ideal for high-force and heavy-duty applications.

Moreover, hydraulic systems offer precise control over speed, ensuring delicate and accurate operations—vital in sectors like wind energy. They maintain a constant force and speed, remain compact and lightweight, and demand lower maintenance, enhancing their appeal across various industries.

The safety measures ingrained in hydraulic systems prevent overloading, ensuring controlled operations and minimizing the risk of accidents, setting them apart as a safer alternative in numerous industrial operations.

Hydraulic systems power a diverse range of equipment, making their adaptability to automation and their wide applicability advantageous in modern manufacturing and industrial processes. They streamline wind turbine manufacturing and maintenance by providing precision in blade machining and facilitating secure handling and transportation of heavy components.

Overall, the efficiency, precision, adaptability, and safety features encapsulate the effectiveness of hydraulic tools and systems, making them indispensable across industries, from manufacturing to transport, installation, and maintenance in the wind energy sector and beyond.





ABOUT ENERPAC

Enerpac Tools offer ultra-reliable quality, safety, and precision. As a global market leader in precision hydraulic tools, our products are trusted to perform in the most challenging and extreme conditions worldwide.

In the realm of manufacturing, we believe that our tools can significantly boost productivity, facilitating the profitable production of wind components on a large scale. Our equipment also serves as an asset for streamlining the transport and installation of wind turbines, reducing installation times, and enhancing the safety of your teams.

For wind turbine maintenance teams, Enerpac maintenance tools and solutions stand as the cornerstone for ensuring the safety and productivity of your technicians. Specifically designed to support even the tallest and most advanced wind turbines globally, our products provide the essential capabilities to lift, move, secure, disassemble, and maintain the world's largest wind turbines with absolute safety and precision.



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