VERTICAL TURBINE PUMPS: MOVING WATER EFFICIENTLY FROM DEEP SOURCES



When water must be lifted from a deep well, reservoir, intake structure, lake, river, or other below-grade source, pump selection becomes more than a question of flow rate. The equipment must be capable of developing the required head, operating reliably at depth, handling changing water levels, and delivering efficient hydraulic performance over years of service.

Vertical turbine pumps are designed specifically for these demanding applications. Their vertical configuration allows the pumping elements to be positioned below the water level while the driver and discharge arrangement remain at the surface—making them a practical solution for deep-source water movement.

Municipal Water Pumping Station

What Is a Vertical Turbine Pump?

A vertical turbine pump is a vertically oriented centrifugal pump typically consisting of a bowl assembly, vertical column, shafting, discharge head, and driver.

The pump bowls and impellers are installed below the water surface. As the impellers rotate, they impart energy to the water and progressively increase its pressure. In a multistage arrangement, multiple impellers can be used to generate the head required to lift water from significant depths.

The vertical arrangement is particularly useful where the available water source is below the pump installation level.

The Peerless Pump turbine range is suitable for applications including well water, water lifting from lakes and rivers, booster systems, cooling towers, industrial processes, and agriculture. Its published range extends to capacities of up to 100,000 gpm and heads of up to 2,500 ft, depending on configuration.



VERTICAL TURBINE FURE PUMP

Why Vertical Configuration Matters

One of the fundamental challenges in pumping from a deep source is maintaining an effective hydraulic connection between the pump and the water.

With a conventional surface-mounted pump, suction conditions can become limiting when the water level is significantly below the pump. A vertical turbine configuration addresses this by placing the pumping elements down in the water source.

This arrangement can provide several practical advantages:

1. Deep-source water extraction

Vertical turbine pumps are particularly suited to deep wells and below-grade water sources. The pump bowl assembly can be positioned at the appropriate depth to maintain the required submergence as operating water levels change.

2. High-head capability

Multiple stages can be incorporated where significant pressure or elevation difference must be overcome.

Peerless Pump's technical information lists deep-well vertical lineshaft turbine pumps with heads up to **2,500 ft (760 m)** and capacities up to **10,000 US gpm (2,273 m³/hr)** for that category.

3. Large-volume water movement

Vertical turbine technology isn't limited to deep wells. Different vertical pump configurations can be applied to municipal water intake, irrigation, industrial cooling, water distribution, and other high-flow applications.

4. Flexible drive arrangements

Depending on the application, vertical turbine pumps can be driven by electric motors, right-angle gear drives, combination drives, engines, or steam turbines.

How a Vertical Turbine Pump Works

The basic operating principle is straightforward:

Water source → Pump bowl → Impeller stages → Column → Discharge head → Delivery system

The engineering behind that process, however, is considerably more sophisticated.

Step 1: Water enters the pump

The pump's suction inlet or bell collects water from the well, wet pit, reservoir, or other source.

The pump must be positioned correctly relative to the water level to provide appropriate submergence and prevent undesirable hydraulic conditions.

Step 2: The impeller adds energy

The rotating impeller transfers mechanical energy from the driver into the water.

This increases the water's velocity and pressure.

Step 3: The bowl converts velocity into pressure

The bowl assembly surrounds the impeller and incorporates passages that guide the water toward the next stage while recovering velocity into pressure.

In a multistage pump, this process is repeated through successive bowl assemblies.

Step 4: Water travels upward

Once the water has gained sufficient energy, it moves upward through the vertical column.

The shafting running through the column transmits rotational power from the surface driver to the submerged pump components.

Step 5: The discharge head directs the flow

At the surface, the discharge head redirects the water into the delivery pipeline.

The result is a compact vertical pumping arrangement capable of moving water from substantial depths to the required delivery point.

The Major Components

Understanding the main components helps explain why vertical turbine pumps are suited to deep-source applications.

Pump Bowl Assembly

The bowl assembly contains the hydraulic components responsible for developing pressure.

Peerless Pump notes that its standard bowl construction incorporates integral vanes designed to guide flow between stages while minimising hydraulic losses. Its vertical turbine designs can also use different materials depending on the pumped liquid and operating environment.

Impellers

Impellers are the rotating hydraulic elements.

Their geometry is selected according to the required:

- Flow rate
- Total dynamic head
- Speed
- Efficiency
- Liquid characteristics

- Number of stages

Impeller selection is critical because even a mechanically robust pump can perform poorly if its hydraulic design doesn't match the actual operating point.

Vertical Shaft

The shaft transmits torque from the surface driver to the submerged impellers.

In deep-set installations, shaft design becomes particularly important because shaft length, alignment, lubrication, bearing conditions, and thermal/mechanical effects can influence reliability.

Column Pipe

The column provides the structural and hydraulic connection between the submerged pump assembly and the surface discharge head.

It also houses the vertical shaft in lineshaft configurations.

Bearings

Bearings support the rotating assembly and help control shaft movement.

Peerless Pump's vertical turbine designs incorporate bowl and shaft bearing arrangements intended to support the rotating components and extend operating life.

Discharge Head

The discharge head supports the pump assembly and redirects the vertical flow into the horizontal discharge piping.

It also interfaces with the driver and provides an important structural connection between the pump and the installation foundation.

Lineshaft vs. Submersible Vertical Turbine Pumps

Vertical turbine systems can be configured in different ways.

Lineshaft configuration

In a traditional lineshaft vertical turbine pump, the driver is located above the water source and a vertical shaft extends down through the column to the submerged impellers.

This arrangement is widely used for deep wells and large water pumping systems.

Depending on the design, the lineshaft can use different lubrication arrangements, including product-lubricated open lineshaft or enclosed configurations using oil, grease, or fresh water.

Submersible configuration

A submersible vertical turbine pump places an electric submersible motor down in the water with the pump assembly.

Peerless Pump describes its submersible vertical turbine pumps as consisting of four basic elements:

1. Pump bowl assembly
2. Column pipe
3. Discharge elbow at grade level
4. Submersible electric motor

These pumps can be used for applications such as well water, irrigation, domestic water and mine dewatering.

Where Are Vertical Turbine Pumps Used?

The versatility of vertical turbine pumps makes them relevant across several industries.

Municipal Water Supply

Municipal systems may need to extract raw water from wells, rivers, lakes, reservoirs, or other sources and transfer it into treatment and distribution systems.

Peerless Pump identifies vertical pumps for raw water intake, municipal wells, water boosting and distribution, water treatment, and effluent applications.

Agriculture and Irrigation

Agricultural pumping frequently requires large volumes of water to be lifted from wells and delivered to irrigation systems.

Deep-set, short-set and submersible configurations can be selected depending on the source and installation requirements.

Industrial Processes

Industrial facilities often need reliable water movement for:

- Cooling systems
- Process water
- Water transfer
- Raw-water intake

- Manufacturing processes
- Utility systems

Vertical turbine pumps can be configured for different flow, head, temperature and material requirements.

Cooling Towers

Cooling-water systems can require substantial flow rates and reliable continuous operation. Vertical pump arrangements can be incorporated into water circulation and supply systems depending on the hydraulic design.

Mining and Dewatering

Water management is critical in mining operations. Depending on the application, vertical turbine, mixed-flow, axial-flow or submersible configurations may be appropriate.

Efficiency Starts With Correct Pump Selection

A common misconception is that pump efficiency is determined simply by the pump's rated horsepower.

In reality, efficient pumping begins with correctly understanding the entire hydraulic system.

Key design parameters include:

Flow rate

How much water must be moved?

For example:

Q = required flow rate

This may be expressed in gpm, m^3/h, L/s or another appropriate unit.

Total Dynamic Head

The pump must overcome the complete hydraulic head requirement—not simply the vertical elevation.

Total dynamic head can include:

Static elevation + pressure requirement + friction losses + other system losses

Water-level variation

For a well installation, the difference between static water level and pumping water level is particularly important.

The pump must be selected around the actual operating conditions rather than relying only on the static water level.

Pump efficiency

A pump operating close to its intended best-efficiency region can generally provide better hydraulic performance than one consistently operating far from its design point.

Motor efficiency

The driver is another major part of the system energy equation.

The goal isn't simply to select a sufficiently large motor. The complete pump-and-driver combination should be engineered around the expected operating envelope.

Why Operating Conditions Matter

Deep-well applications can be especially sensitive to changing conditions.

Water levels can fluctuate because of:

- Seasonal groundwater changes
- Drought
- Agricultural demand
- Municipal demand
- Aquifer characteristics
- Well drawdown
- Other nearby wells

As the water level changes, the pump's operating conditions can change as well.

That is why a proper pump specification should consider both static water level and working/drawdown conditions.

Peerless Pump's installation guidance specifically emphasises checking wells before installation and ensuring that well geometry is suitable for the pump assembly.

Installation: An Often-Overlooked Part of Pump Performance

Even a well-designed pump can experience operational problems if installation conditions are poor.

Important considerations include:

Well alignment

A crooked or improperly constructed well can interfere with the pump column or pump/motor assembly.

A recommendation is to inspect the well before installation and check well straightness where necessary.

Foundation

The foundation must provide sufficient rigidity and support for the pump, driver and fluid-containing components.

Insufficient foundation stiffness can contribute to:

- Misalignment
- Vibration
- Mechanical stress
- Premature component wear

Discharge piping

The discharge system should be designed to minimise unnecessary friction losses.

Peerless Pump's installation guidance recommends short, direct discharge piping with as few elbows and fittings as practical to minimise frictional head loss.

Shaft alignment and impeller setting

Correct shaft and impeller adjustment is especially important in deep-set pumps.

Peerless Pump's maintenance documentation notes that shaft elongation and accumulated shaft-joint tolerances can affect impeller-to-bowl clearance in deep-set and high-thrust applications.

Materials Matter

Water is not always simply "water."

The pumped liquid may contain characteristics that influence material selection, including:

- Corrosive constituents

- Abrasive particles
- Salinity
- Temperature
- Chemical contaminants
- Suspended solids

For this reason, vertical turbine pumps can be manufactured with different material combinations.

Material selection should therefore be considered part of the hydraulic and mechanical design—not as an afterthought.

Maintenance and Reliability

A major advantage of a properly engineered vertical turbine installation is the potential for long-term service.

But reliability depends on more than pump construction.

A maintenance programme should consider:

- Bearing condition
- Shaft alignment
- Vibration
- Lubrication
- Impeller clearance
- Motor condition
- Operating point
- Water quality
- Well condition
- Discharge pressure
- Flow rate
- Changes in pump performance

Unexpected changes in flow, pressure, vibration, power consumption or water quality can be valuable indicators that investigation is needed.

Vertical Turbine Pumps and Energy Efficiency

For large water systems, even small changes in efficiency can have significant consequences.

Consider a pump operating continuously for thousands of hours each year.

The energy requirement is influenced by:

Hydraulic power ≈ ρ × g × Q × H

where:

- **ρ** = fluid density
- **g** = gravitational acceleration
- **Q** = flow rate
- **H** = total head

The actual electrical or mechanical input is higher because no pump is 100% efficient.

This means that pump selection should consider lifecycle energy consumption, not simply initial purchase price.

A pump that is appropriately sized, hydraulically matched and maintained can help reduce unnecessary energy losses over the operating life of the installation.

Choosing the Right Vertical Turbine Pump

A successful application begins with accurate information.

Before selecting a pump, engineers should establish:

Water source

- Deep well
- Wet pit
- Lake
- River
- Reservoir
- Tank

Required flow

- Normal flow
- Minimum flow
- Maximum flow

Head

- Static elevation
- Water-level variation
- Discharge pressure
- Pipeline friction losses

Operating conditions

- Continuous or intermittent operation
- Ambient conditions
- Water temperature
- Available power supply

Water characteristics

- Clean or abrasive
- Fresh or saline
- Corrosive constituents
- Suspended solids

Installation

- Available space
- Well diameter
- Well depth
- Foundation arrangement
- Discharge piping

This information allows the pump, impeller configuration, shaft arrangement, materials and driver to be matched to the application.

The Bigger Picture: Pumping Is a System, Not Just a Pump

One of the most important principles in water pumping is that the pump cannot be considered in isolation.

The well, intake structure, pump, motor, controls, piping and discharge system all interact.

For example, increasing pipe friction can increase required head. A changing water level can alter the pump's duty point. An improperly sized pump can operate away from its intended efficiency range. Poor installation can introduce vibration or alignment problems.

The best pumping system therefore starts with understanding the complete hydraulic duty.

Peerless Pump Vertical Turbine Solutions

Peerless Pump offers vertical turbine configurations for commercial, agricultural, industrial and municipal applications.

Its published vertical turbine range includes applications from well water and surface-water lifting to booster systems, cooling towers, industrial processes and agriculture. The company also offers vertical mixed-flow, axial-flow and submersible pump technologies for applications requiring different combinations of flow and head.

Explore Peerless Pump Vertical Turbine Pumps

Final Thoughts

Moving water from deep sources is a demanding engineering task. The pump must overcome elevation, friction, pressure requirements and changing operating conditions while maintaining reliable mechanical and hydraulic performance.

Vertical turbine pumps provide a purpose-built solution for these challenges.

By positioning the pumping elements below the water level and using vertical shafting and column arrangements to deliver water to the surface, they can serve applications ranging from deep municipal wells and agricultural irrigation to industrial water systems and surface-water intake.

But the technology works best when the **pump is correctly selected, installed and maintained as part of the complete hydraulic system**.

For engineers, operators and water professionals, the key question isn't simply:

"How powerful does the pump need to be?"

It is:

"What combination of flow, head, water level, efficiency, materials, installation and operating conditions will deliver reliable water movement over the life of the system?"

That is where vertical turbine pump engineering becomes particularly valuable.

Learn more about vertical turbine pumping solutions from Peerless Pump: www.peerlesspump.com

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