



# INTEGRATED GEAR SOLUTIONS FOR HYDRO POWER

WATER TO WIRE | RENEWABLE ENERGY

# » A Legacy of Leadership

Growth through innovation, expertise and customer delight

Starting in the 1930's, the \$ 700+ million diversified Triveni Group today comprises two listed companies that occupy leadership function in a swathe of industries including Sugar, Fuel Ethanol, Water, Power Transmission. (Triveni Engineering and Industries Ltd.) and steam turbines (Triveni Turbine Ltd.)

The Group is pillared around a core set of principles that champion integrity in its people, product and business, is driven by efficiency, innovation and relationships, and is focused on building profitable, responsible and consistent value for its patrons, stakeholders and the industry.

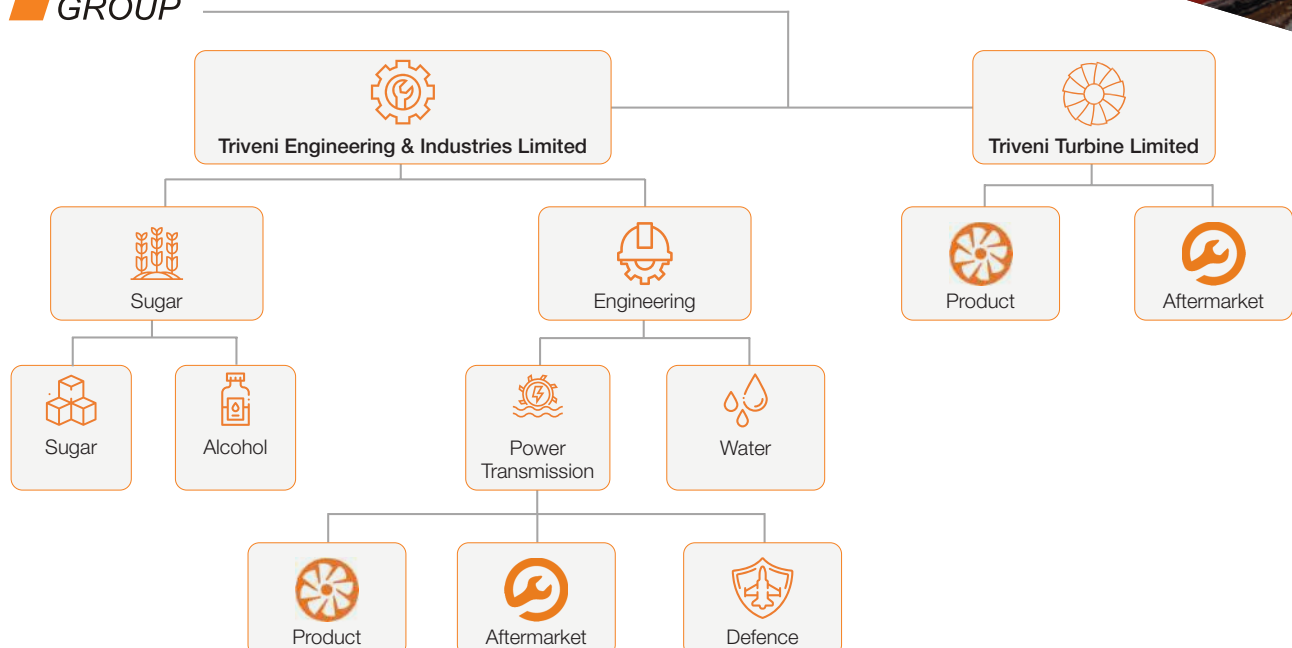
## TRIVENI ENGINEERING & INDUSTRIES LTD. (TEIL)

Triveni Engineering is one of the largest integrated sugar producers in the country, a market leader of engineered-to-order high-speed gears & gearboxes, and a leading player in water and wastewater management business. Our agile growth over the years is a testimony to our grip over sustainable business practices, value-first innovation and a passion to satisfy highly discerning patrons who demand nothing but the best.

## TRIVENI TURBINE LTD. (TTL)

Triveni Turbines is the largest manufacturer of industrial steam turbines in the >5 to 30MW range globally\*. Our commitment to customer service consistently goes above and beyond, leading to very high retention rates and satisfaction scores. Continuous R&D allows us to stay ahead of the curve, build a line of true industry redefining solutions, and get the nod from demanding global customers.

Triveni PTB stands for end-to-end solutions in high-speed gears and gearboxes, and is synonymous with cutting-edge expertise in transmission technology, globally.



# » Powered to Inspire

Engineered to perform

Triveni PTB - formerly known as Gears business - delivers innovative, value-engineered and highly reliable products and solutions in the areas of Gears and Defence.

Our offerings encompass quality New Products, Built-to-print high technology and quality gearing, Replacement Solutions, Diagnostic studies and

Aftersales service - a comprehensive range where we deploy the latest technologies to deliver world-class and future-ready solutions.

An unerring eye for detail and sustainable business excellence makes Triveni PTB the largest manufacturer of high-speed gears and gearboxes in India, South Asia & South-East Asia, and the preferred partner for domestic and international customers. We are the leading name in turbo gears, with a growing market share.



# » Reliable Engineered Gearbox for Hydro Power

Small Hydro Power sector, a major contributor of Renewable energy generates demand for highly reliable speed increasers. Hydro turbine requirements are unique in design with higher thrust loads, with design conditions for runaway speeds and committed product performance.

Gearboxes for hydro turbines are generally used in low heads with turbine speeds as low as 60 rpm and generator speeds based on country-specific grid frequency.

Triveni PTB offers Gears and Gearboxes for Micro, Mini and Small Hydro applications Spanning all Turbine configurations such as

- Vertical Kaplan - Full / Semi
- Horizontal Kaplan - Full / Semi
  - » S-Type
  - » Pit type
  - » Bulb Type
- Horizontal Francis

Triveni PTB's expertise in adapting to global standards, with CE marking

and specific project requirements, have enriched capabilities to supply speed increasers for small hydro applications, partnering with various OEMs like Andritz Hydro, Boom Systems, Mecamidi HPP, B Fouress, Kirloskar Brothers Ltd., etc.

Gearboxes supplied by Triveni PTB undergoes stringent quality checks at all levels until commissioning, so that the designed and the guaranteed parameters are delivered.

## Design philosophy

Hydro Turbines undergo various operational cycles and gearboxes are mandatory to be designed for run away speed conditions. Hence design requirements are unique and critical to each Hydro application. Depending on the speed ratios, the gearboxes are designed with single or double state.

Gearboxes are designed with fully integrated Lube oil system with necessary instruments and controls.

Lube oil system components include instruments and controls to measure flow, temperature, pressure and oil level for maximum reliability of equipment. Lube oil system is offered either skid mounted or integrated with the gearbox.

Integration of Steel Backed white metal lined bearings and antifriction bearings for maximum bearing life and to overcome runaway speeds as high as 3 times of the normal operating speeds.

All Gearboxes for Hydro applications follow Solid Modeling, and analysis through Pro-E software ensuring no assembly error.

The robust steel casing design ensures low noise and vibration signatures under full load conditions.



# » Proven Engineering and Robust Supply Chain

## Design edge

Our design superiority is a result of several influences such as technical thought leadership, a proactive Research & Development (R&D) culture, a highly skilled technology team (that supports our Engineering, NPD, and R&D programmes), reliability ensured through the best engineering practices and proximity to facilitate our ETO business.

- Conforming to the industry standards: API, AGMA, DIN, ISO
- Skilled and experienced design resource
- Highly efficient designs
- Customized software for gear tooth design optimization
- More than 50 Design workstations with CREO 3D software for modelling & drafting
- Windchill software for product data management
- XL Rotor software for Rotor Dynamic Analysis
- ANSYS software for Structural and modal analysis
- Triveni Gear Suite and KISSsoft software for gear rating
- HydroDyn software for Journal Bearing design

## Supply chain process

Triveni PTB has a dedicated supply chain with long term partnerships spanning over decades, quality benchmarked to global standards including robust process capability to meet stringent demands of customer and product reliability.

A well established metallurgical laboratory with the latest state-of-the-art equipment ensures stringent and comprehensive control on the quality of input raw materials and at the same time help Triveni PTB to provide constructive and specific feedback to supply chain partners to improve and control their process parameters for the sustenance of the same.

MS Fabricated Casings suiting to the gearbox configuration are sourced through approved suppliers.

Other bought outs like bearings, RTD's and lube oil systems are sourced from well-established supply chain partners.

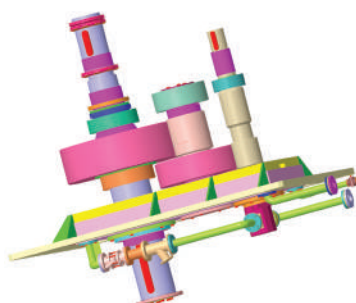
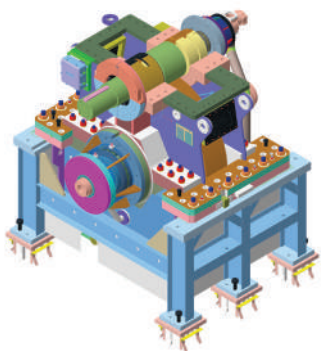
## Triveni excellence chain

All raw materials like forgings and castings developed to required quality standards

Materials for forgings are restricted to approved steel mills meeting AMS 2304

Product delivery cycle ranging from a few weeks to 6 months for full gearboxes

Our low-cost high-quality supply base has given us a powerful strategic edge in ensuring long-term relationships across the supply chain



# » Infrastructure

## Manufacturing

Triveni PTB has a fully integrated, world-class manufacturing set-up with well-established process flows and plant layouts for optimum cycle time. High precision multi-axis CNC European and other international makes of machines for hobbing, surface & teeth profile grinding, horizontal and vertical turning and housing machining along with highly skilled manpower ensure a superior and reliable product.

## Quality

All our products and processes are benchmarked to global quality practices and 5S principles.

Every Triveni PTB product passes through a series of stringent quality checks - from raw material to Final Run - to ensure that the product not only meets but exceeds, the expectations of our demanding clients. Fuelling our leadership in quality is an in-house metallurgical laboratory with state-of-the-art equipment to inspect raw material properties such as chemical composition, grain size, inclusions, banding and microstructure, including hardness gradient, case and core hardness. Chemical composition and carbon percentage in heat-treated teeth are tightly controlled through sophisticated optical spectrometer. Magnetic particle testing and surface etch inspection as well as Barkhausen noise testing ensures defect-free gear teeth that last long.

All equipment, machine tools and quality infrastructure undergoes predetermined calibration regime - which includes heat treatment furnaces and quenching station – ensuring consistent high gear quality.

## Assembly and Testing bay for Hydro Gearboxes

- Fully integrated test bench (10 MW & 90 MW) with sophisticated instrumentation and test data acquisition system
- All assembly technicians have highly experienced product and application knowledge
- Testing of **Hydro Turbine gearboxes** follow stringent processes simulating site conditions like
  - » Full speed test
  - » Test for Runaway speed conditions which are sometimes 3 times the operating speed
  - » Performance check of the lube oil system instrumentations and controls to check interlocks for machine safety
  - » Leak tests and oil operating parameters



# » Replacement Solutions

## Any Brand, Any Application, Anywhere.

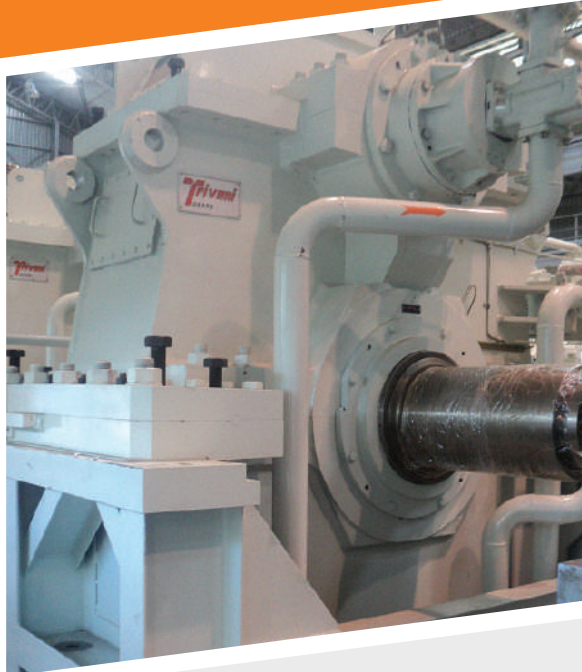
In the life cycle of any gearbox, there inevitably comes a point where replacements or upgradations have to be made to ensure optimum performance according to the ever-changing demands of the industry. Highly skilled and experienced engineering and service resources enable Triveni PTB to undertake repair and refurbishment of predominantly world-renowned brands in addition to the domestic brands with inherent issues.

A two-pronged strategy is adopted in the event of failure – Short term & Long-term solutions. Short term solutions include minor repairs with least lead time to maximise the up time of the equipment whereas long term solutions are aimed at creating higher order of reliability which includes major repair and replacement of parts.

Triveni PTB's replacement solutions provided to industries across the globe is a testament of high-reliability and low product life cycle costs. Strategic creation of dedicated dimensioning assets facilitates setting up of a large pool of dimension ready sites (DRS) at

no cost to the customer helps in developing parts during distress, and in a significantly lower lead time as compared to global OEMs.

Triveni PTB's reverse engineering technology revolves around deep understanding of application dynamics and know-how which influences and enhances overall train performance. Triveni PTB's capability to diagnose is key to providing long-lasting solutions to chronic problems and providing comprehensive solutions with enhanced value proposition.





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