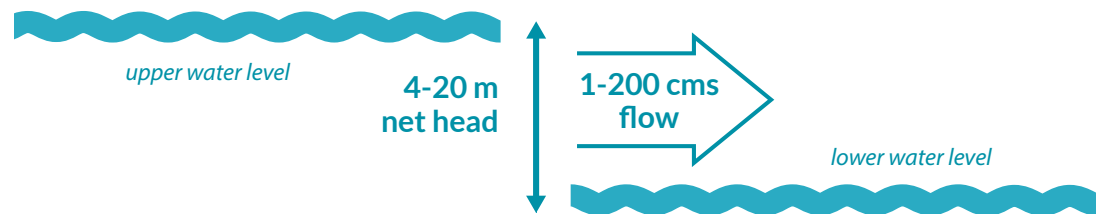


# hydroEngine<sup>®</sup>

a water-to-wire system for low head hydro applications

The hydroEngine is a hydroelectric turbine designed for high performance at low heads between 13 and 60 feet, or 4 and 20 meters. Single unit capacities range from 25 kW to 2000 kW. Civil works can be greatly simplified over legacy technologies, enabling much more cost-competitive projects from 25 kW to 25 MW or more.



## How it Works

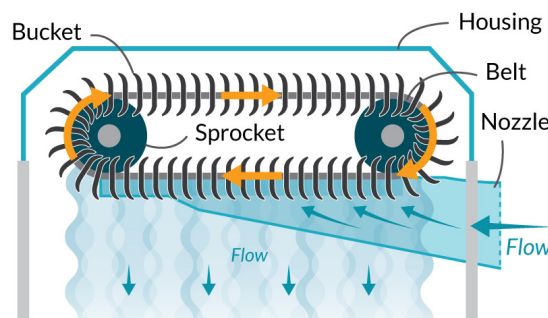
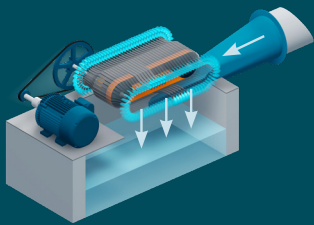
The Linear Pelton hydroEngine is the first-ever implementation of a Pelton-style linear turbine optimized for low heads. The technology utilizes the highly efficient fluid mechanics of a Pelton-style bucket on a linear powertrain, and removes the need for a draft tube, stators, wicket gates, or stay

vanes. The nozzle allows flow control over a wide range.

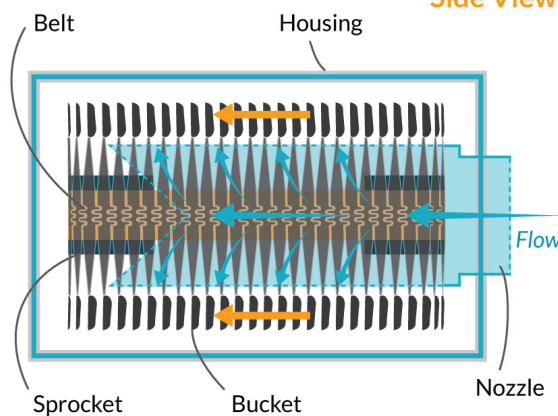
The Linear Pelton hydroEngine employs a unique linear drivetrain with two parallel shafts and carbon fiber belts between the shafts to make a horizontal loop. Cups analogous to Pelton turbine cups are mounted by cross bars on the belts so that the cups make two parallel rows outboard of the belt. A unique, flat nozzle projects flow from the center out to the two rows of cups. Flow is converted to force in the belts much like Pelton cups react with the water stream. This achieves Pelton performance profiles for low head, high flow sites as many Pelton-like cups are simultaneously impacted by the flow projected in the flat stream.

Either shaft drives a conventional generator. As with existing turbine technologies, water enters through a penstock, passes through the hydroEngine, and is returned to the water channel in a vertically downward discharge. Importantly, the hydroEngine sits above tailwater, greatly reducing civil cost considerations, and does not require a draft tube.

## LINEAR PELTON HYDROENGINE



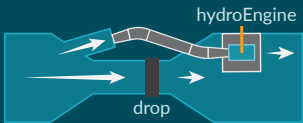
Side View



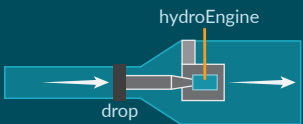
Top View

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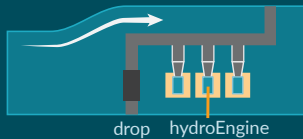
## TYPES OF INSTALLATION



### Conventional Penstock



### Headwall Intake



### Floating Powerhouse

## Technology Advantages

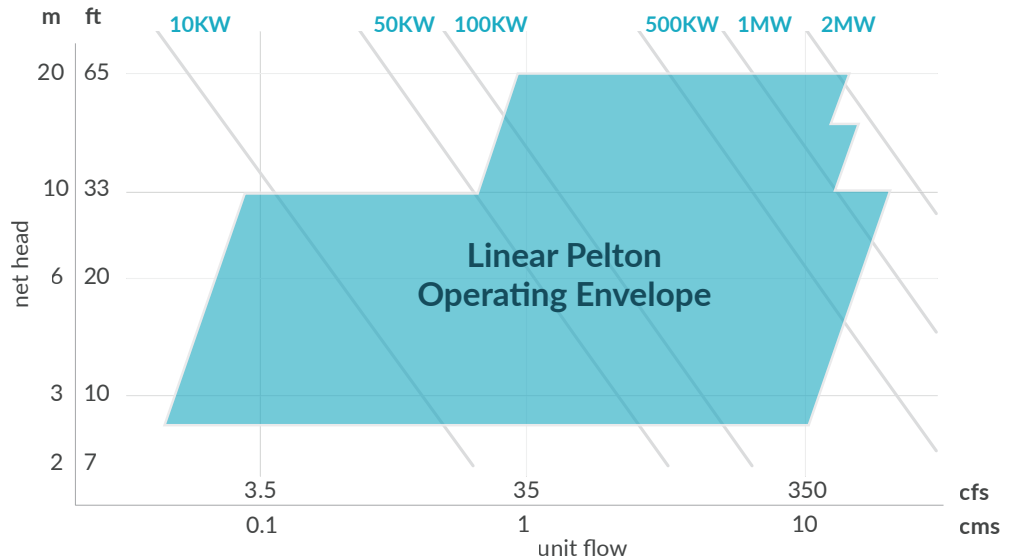
Natel's hydroEngine can be installed in a range of settings, including irrigation canals, existing dams, and run-of-river with a minimum of civil works. Additionally, the modular design of the hydroEngine ensures easy maintenance and repair: the hydroEngine's drivetrain is easily accessible by opening the "hood" of the casing for direct access to all major parts.

The hydroEngine is sold as a water-to-wire package, including power takeoff, generator and SCADA.

Key advantages include:

- No cavitation
- Fish-friendly due to order of magnitude lower pressure drops and impact velocities
- Quick and inexpensive maintenance
- High efficiency and flat performance curve like a conventional Pelton turbine

## Operating Envelope



## Operations

The hydroEngine has demonstrated greater than 80% hydraulic efficiency and has undergone extensive testing for reliability and performance over the past 5 years.

Several alternate configurations have been installed and grid-connected including:

- A 35 kW non-powered dam stream setting
- Irrigation canal drops at 25 and 250 kW

Natel Energy's extensive testing, design and manufacturing facility is 60,000 square feet located in the San Francisco Bay Area.

The Linear Pelton hydroEngine is a flexible, modular, easy-to-install hydroelectric turbine designed for low heads that enable reduced construction costs and defines a new class of sustainable, utility scale, distributed hydropower.

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