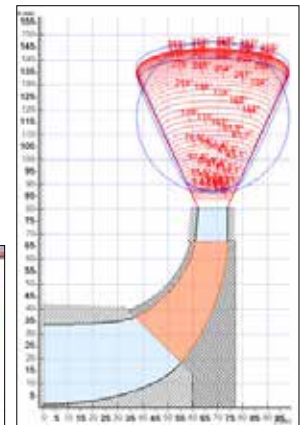
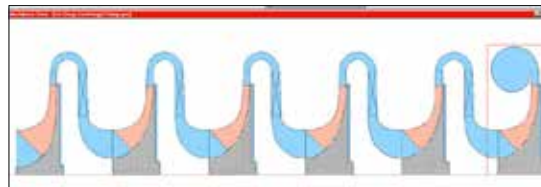




## Preliminary Design Module for Centrifugal, Mixed-Flow, and Axial Pumps

# PUMPAL<sup>®</sup>

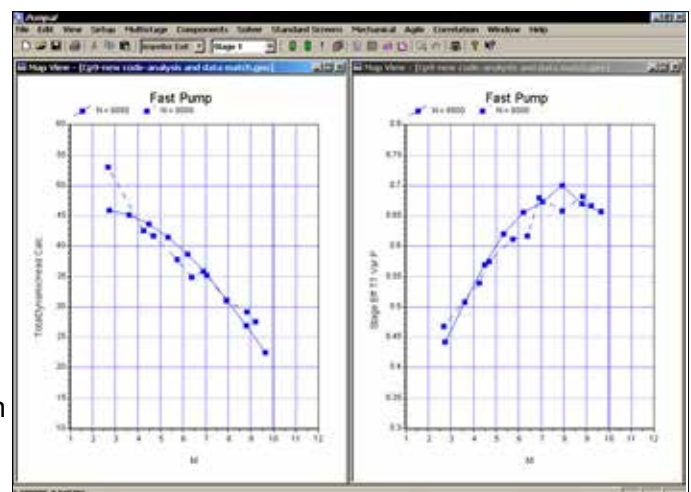
Perform meanline design optimization for centrifugal, mixed-flow, and axial pumps with single or multiple stages with PUMPAL Computer-Aided Engineering (CAE) software. PUMPAL can be used to design the stage, analyze performance, refine the parameters with data reduction, and model the machine according to several performance models. PUMPAL's unique Design Wizard leads the user through all the necessary steps for design, analysis, and data reduction. The meanline pump design can easily be sent to AxCent<sup>®</sup>, Concept NREC's detailed 3D geometric design and rapid 2D flow analysis program for further blade design and fluid dynamic analysis.



Single-stage and multistage pump design examples.

## Components Supported by PUMPAL

- Inlet guide vanes
- Open or closed impellers
- 2D or 3D impellers
- Front and rear seals
- Various leakage paths
- Multistage pumps
- Diffusers, including: Arbitrary Vaned; Vaneless; Wedge/ Channel; Cascade; Conical; 90/180-degree Bends
- Exit elements, including: Collector; Volute; Return Channel



Performance map overlay with data reduction.

## Modeling

PUMPAL supports Two-Elements-in-Series (TEIS) rotor diffusion modeling, two-zone loss modeling, radial and axial stator diffusion/losses, volutes, inlet cavitation, disk friction, exit mixing, cavity leakage, and more. PUMPAL uses the same model of stage performance for design, analysis, and data reduction modes.

## Easy Editing

View the pump stage in an active, true scale meridional view. Edit parameters by double clicking on the component or using a single text input/output file, which is especially useful for optimization.

## Integrated Performance Map Plotting

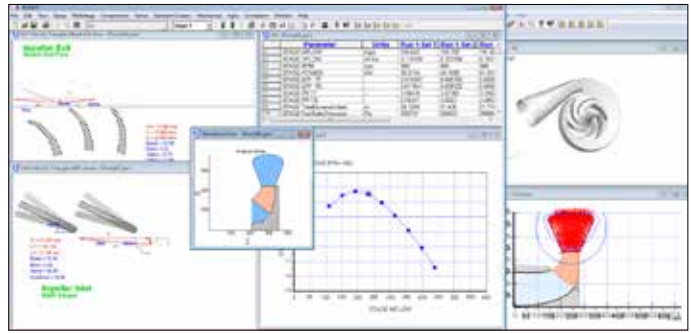
Review design performance, analysis, and test data with flexibly-plotted performance maps, updated automatically with each geometric change.

## Axial View with Inlet, Exit Velocity Triangles

Using the window view, you can view blades and velocity triangles at the impeller inlet and exit. View inlet velocity triangles for the hub, tip, or RMS radius, and exit velocity triangles for the primary and secondary zones, and mixed-out state.

## Preliminary Mechanical Analysis

PUMPAL provides the user with an initial calculation of mechanical properties of the design. Stress, vibration, and fatigue limit estimates are given and access a wide database of customizable material properties.



Seamless integration with AxCent.

## A Real Fluid Program

PUMPAL calculates real fluid properties using optional D.B. Robinson Real Fluid Properties, NIST, or ASME steam routines.

## Direct Integration with AxCent®

Users can start AxCent automatically from PUMPAL, with the initial meanline geometry transferred automatically. Changes in AxCent that affect the meanline analysis will cause the meanline analysis to be rerun and all performance maps to be regenerated.

Concepts NREC's Agile Engineering Design System®		Radial		Axial			
		Compressors	Pumps	Compressors	Pumps	Turbines	Turbines
<b>CAE Preliminary Design</b>							
Meanline Approach	AXIAL™					✓	✓
Meanline Approach	COMPAL®	✓					
Meanline Approach	FANPAL™		✓			✓	
Meanline Approach	PUMPAL®			✓		✓	
Meanline Approach	RITAL™			✓			
<b>CAE Detailed Design</b>							
3D Geometric Design	AxCent®	✓	✓	✓	✓	✓	✓
CFD Option for AxCent	FINE™/Turbo™*	✓	✓	✓	✓	✓	✓
Pre- & Post-Processor for AxCent	pbPost™	✓	✓	✓	✓	✓	✓
FEA Option for AxCent	Pushbutton FEA™	✓	✓	✓	✓	✓	✓
<b>CAE Specialized Design Software</b>							
Gas Turbine Blade Cooling	CTAADS™						✓
Optimization	TurboOPT II™	✓	✓	✓	✓	✓	✓
Rotor Dynamics	Dyrobex®	✓	✓	✓	✓	✓	✓
Gas Turbine Cycle Analysis	GasTurb®	✓	✓	✓	✓	✓	✓
<b>CAM Toolpaths</b>							
Base Platform	MAX-PAC™	✓	✓	✓	✓	✓	✓
Flank Milling Option	MAX-5™	✓	✓	✓	✓	✓	✓
Point Milling Option	MAX-AB™	✓	✓	✓	✓	✓	✓
Closed Impeller Option	MAX-SI™	✓	✓	✓	✓	✓	✓
Single Blade Option	MAX-SB™	✓	✓	✓	✓	✓	✓
3+2 Roughing Option	3+2 Roughing	✓	✓	✓	✓	✓	✓



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