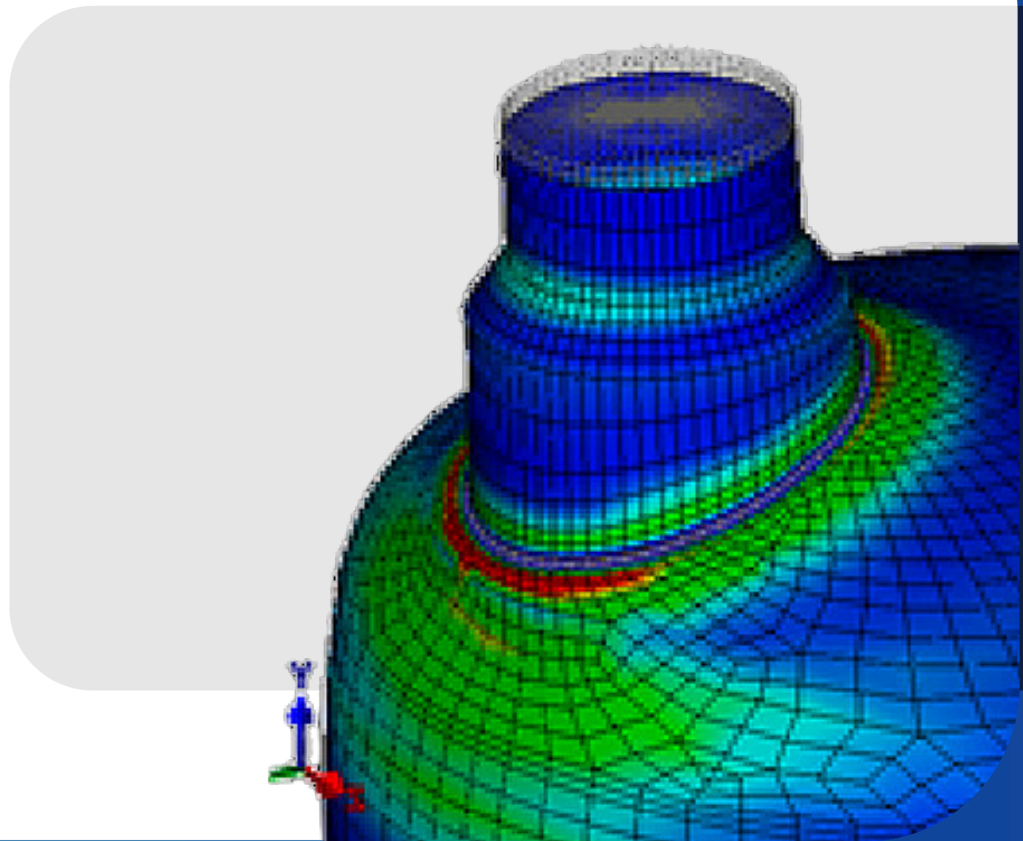


FEA Validation and Reporting.

NozzlePRO™

Perform Powerful FEA in Minutes

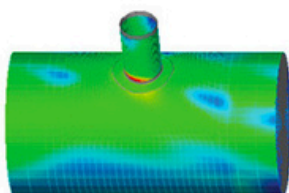


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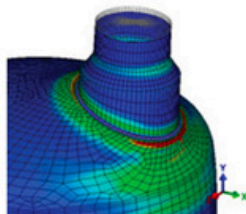
NozzlePRO™

What is NozzlePRO?

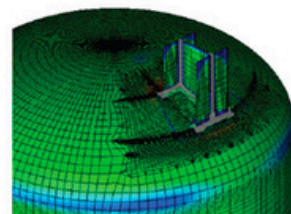
NozzlePRO is a standalone solution that enables users to quickly and easily perform **finite element analysis (FEA)** of individual pressure vessel and piping components, without extensive knowledge of **FEA modeling, analysis techniques or theory**. With capabilities designed to automate FEA validation and ASME code compliance reporting on pressure vessel and nozzle models, NozzlePRO is an efficient and accurate **Design By Analysis (DBA)** solution for pressure equipment designs.



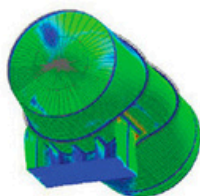
Nozzle on Cylinder



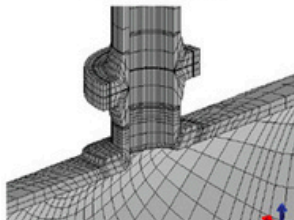
Nozzle on Head



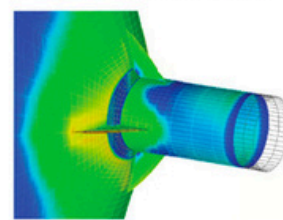
Structural Attachments/Lugs



Saddle Supports



Repads



Gussets
(via Drawing Tools)

What does NozzlePRO include?

NozzlePRO Software Capabilities

NozzlePRO is designed to quickly and easily **evaluate nozzles, saddles, pipe shoes and clips** on a variety of head types including **spherical, elliptical, ASME, dished, cylindrical and conical**. Within minutes you'll be able to generate the following:

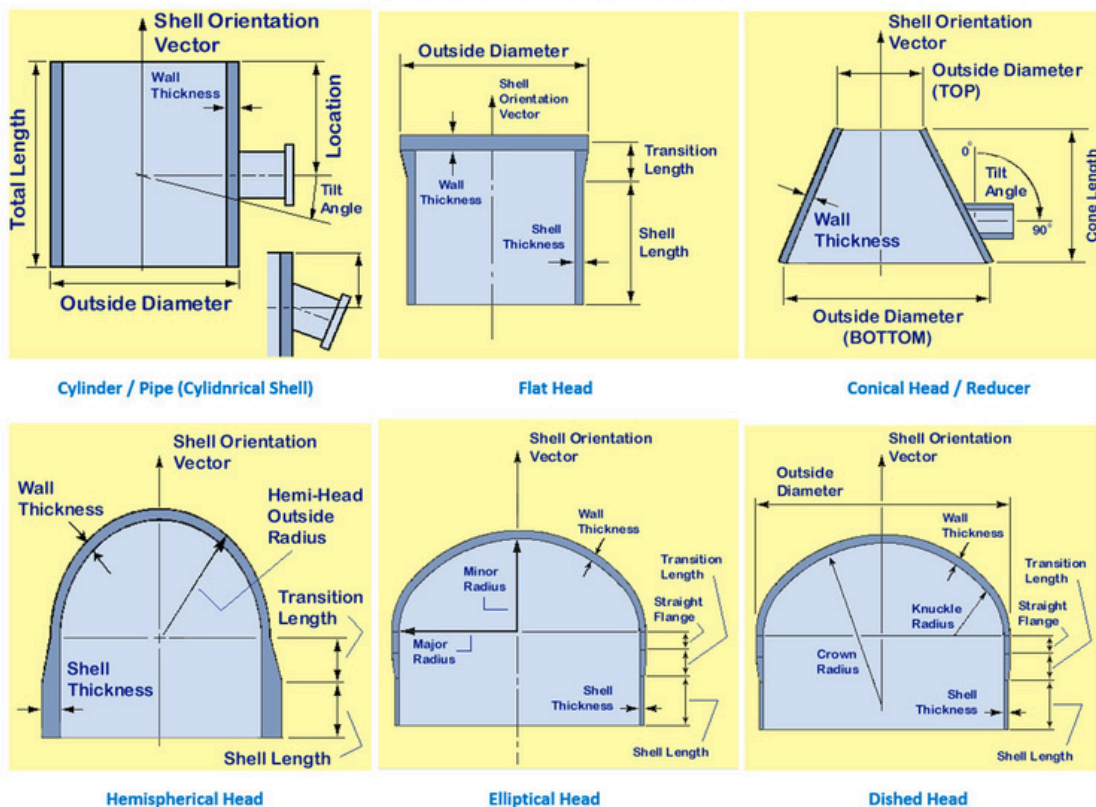
- Nozzles through Blind Flanges in Axisymmetric and Brick Models
- Double Bed Supports
- An Axisymmetric Horizontal Vessel with Saddles
- Steady State and Transient Heat Transfer for Axisymmetric 2D Elements
- Head Thickness Contours
- Blind or Matching Flange End Conditions for Axisymmetric or Brick Models
- Radiused Welds
- Overturning Moments on Skirts (Brick Models)
- Internal Ring Loads
- Integral and Non-Integral Repads

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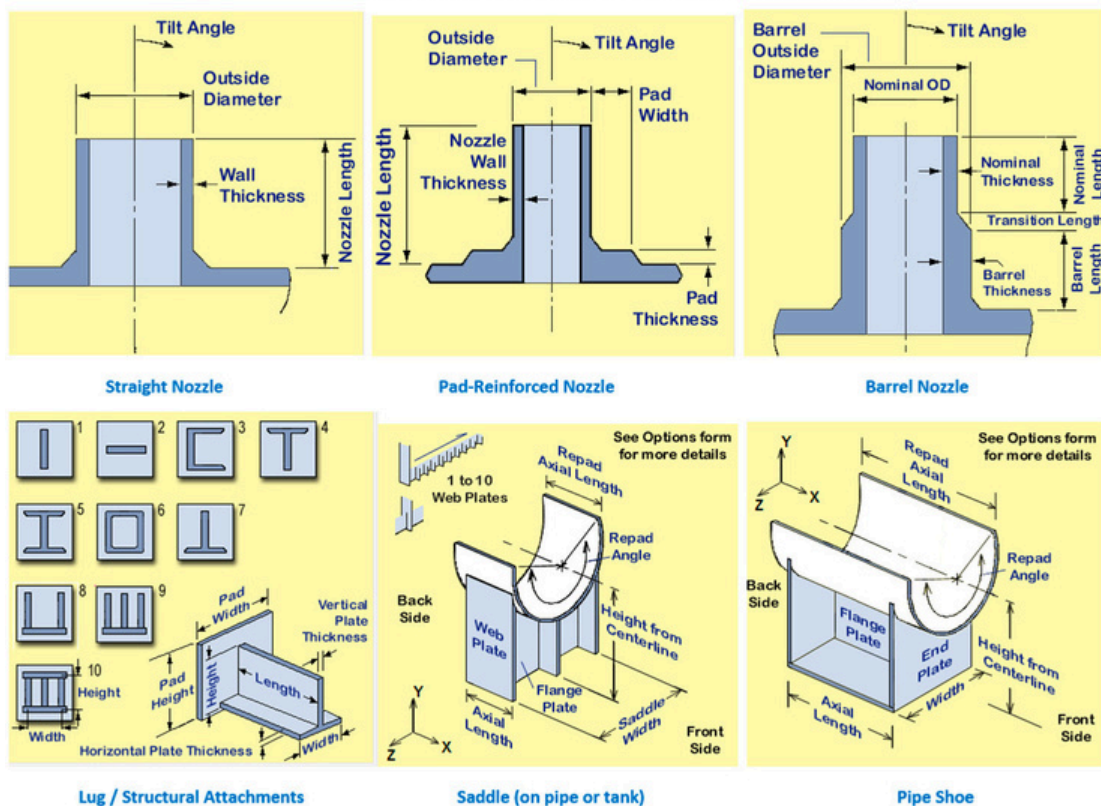
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Base/Shell Geometries Supported in NozzlePRO



Nozzle/Attachment Geometries Supported in NozzlePRO



Features in NozzlePRO

PRG's standalone FEA solution aims to support easy and accurate **Design By Analysis** functionalities, including:

Analysis

- Validates models against **ASME Section VIII Div 1 and Div 2** codes and provides stress classification options to address different interpretations of the code
- Uses **WRC 107/537** methods for spheres, elliptical and dished heads
- Analyzes **load model perturbation and buckling** for heads, cylinders and branch connections
- Evaluates **flaws or cracks in pressurized** or loaded components using a Level 3 -for-service analysis

Design

- Provides automatic **Stress Intensity Factors (SIF)**, nonlinear Sustained Stress Indexes (SSI) and flexibility factors for nozzles and branch connections
- Uses **elastic-plastic and non-linear FEA solvers** to determine the most accurate collapse loads and stresses
- Handles **multiple load cases at a time and loads on the nozzle** and header can be performed simultaneously.
- Provides guidance on the **Acoustic Induced Vibration (AIV) Update** for determining frequency ranges and stress results for high frequencies

Integration

- Includes a **native integration** with CEI's **DesignCalcs and Finglow** so that models can be imported and FEA can be performed along with **PD5500, EN13445 and ASME Section VIII Div 1 and 2 codes**
- **Supports XML and JSON files** so that models can be imported from **Codeware Compress** and **Hexagon** programs

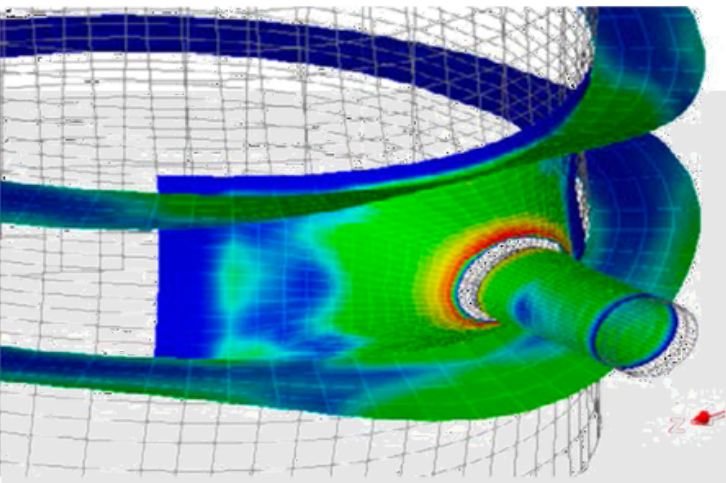
Hexagon and Codeware no longer support PRG software products. If you have any questions regarding NozzlePRO or FEATools licenses purchased through Hexagon or Codeware, please contact our sales group at sales@paulin.com.

Programs in NozzlePRO

Along with a variety of features, NozzlePRO utilizes several programs to provide the ultimate FEA solution for pressure equipment designs. A few include:

- The **Saddle Wizard** is a step-by-step interactive modeler that allows the user to design their horizontal vessel and saddle for any loading conditions.
- The **Pipe Shoe Wizard** creates an FEA model of a pipe shoe on a cylinder to calculate local stress.
- **Vessel Link** allows the user to import models **of any file type** from **DesignCalcs, Finglow, Codeware Compress** and other pressure vessel design software to perform FEA.
- **FE107** replaces **WRC 107** as a calculation tool that can be applied when **WRC 107 or WRC 297 calculations or assumptions are limited**. ASME Section VIII Div 2 allowables are printed along with flexibilities and allowable loads for forces, moments, and pressure.

[Optional Upgrade] The Drawing Tools allow the user to add gussets, rings, clips and other attachments to an existing model. NozzlePRO uses the Drawing Tools feature to provide an interactive CAD feature to edit the model or apply local thinning and cracks.



Additional Programs

Program	Program Summary
MatPRO	MatPRO is PRG's materials database that includes high temperature curves, allowable stress plots, NH reporting, creep-fatigue interaction diagrams, elastic-plastic stress strain curves and fatigue curves generated as a function of creep temperature.
SIF/SSI/k (PRGiK)	Compares SIFs and k-factors from B31 and other codes for branch connections and elbows. Hyper Degree of Freedom (HyperDOF) calculations can be performed for elbows with and without supports with refractory.

Additional Programs (continued)

Program	Program Summary
High Frequency	<p>Provides AIV calculation predictions of pressure levels from the surface of the vessel. This program is mainly used to:</p> <ul style="list-style-type: none"> • Determine virtually any number of natural frequencies and their respective shell mode shapes • Perform high frequency vibration tests to confirm surface integration and prediction of damaging SPL levels • Generate the predicted SPL spectrum by using methods in IEC 60534-8-3 for gas flows • Scale stresses in high frequency modes to match defined spectrum responses and predict expected cycle lives
Flaw Detection	<p>Predicts crack growth for given stress states in components to know when the crack will reach half wall and/or thru wall for leaks. This is a quick calculation based on observed crack growth in tested low carbon steel components.</p>
Nonlinear Analysis [Optional Upgrade]	<p>Computes burst pressures, sustained stress indices, twice elastic slope load levels b, and a variety of load and unload conditions.</p>
Degree of Conservatism	<p>This tool aids in determining the degree of conservatism on models.</p>
FESIF	<p>Calculates SIFs and k-factors for standard B31 branch connection geometries.</p>
FETee	<p>Along with performing FEA of contoured tees per user input, B16.9, or EN10253, this program mainly:</p> <ul style="list-style-type: none"> • Defines EN10253 types A and B tees • Determinees thickness profiles • Constructs appropriate finite element models • Automatically generates elastic models to produce SIFs and k-factors, along with nonlinear calculations (with or without pressure) for SSIs and loads thru the branch or run • Defines local thin tees, the crotch radius, and/or the thickness profile around the branch to run penetration line

Why Choose NozzlePRO?

Ensuring your model or component is ASME code compliant can take time and knowledge. With NozzlePRO's extensive capabilities and programs, performing FEA in minutes against ASME codes helps ensure your models are always designed for safety.

When to Use NozzlePRO

- When there are **multiple thermal or operating loads** acting on a nozzle.
- When WRC limits, proper boundary conditions, and weld models should be accurately addressed.
- When the **nozzle pad is reinforced and WRC 107 or 297** is considered for use.
- When **there are loads acting on a nozzle and pipe** simultaneously.
- When **pad-reinforced lugs, clips, or other support are placed on the knuckle radius of a dished head** and WRT 107 methods are fraught with potential errors.
- When **seismic horizontal loads on vessel clips** or box supports are to be evaluated.
- When the analyst needs to run various model types, comparing results to determine the stability and accuracy of the solution.
- When there are **overturning moments on skirts**.
- When there are **different thermal expansion coefficients** or temperatures between the header and branch.
- When horizontal vessels are saddle supported, with or without wear plates, as well as tapered saddles with many design options.
- When evaluating the effects of axial or transverse loads due to internal sloshing, wind loads, seismic loads, or general external loads and when the **Zick method does not consider either axial or transverse loads**.
- When designing **pipe shoes** for self-weight, liquid weight and axial loads
- **& many more**

NozzlePRO accounts for **thermal, weight, operating, occasional, pressure, wind and earthquake loads** so that compliance requirement needs in the **O&G, Chemical, Pharma** and many other industries can be easily determined and met.

With any DBA program, **NozzlePRO is highly configurable and can be tailored to fit almost any need.**

Want to learn more? **Schedule a discovery call with us today by emailing sales@paulin.com.**

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