NozzlePRO v15.0

Released January 2021

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 an extensive knowledge of FEA modeling, analysis techniques or theory.

NozzlePRO v15.0 New Features

ASME 2019 Code Compliance

Automated Nonlinear SSI and Collapse Calculations for Heads, Branches or Saddles

Combination Loads Thru the Run

Multiple Load Cases in Load Case Editor

ASME Code Classification Update

Collapse Load Model Perturbation and Buckling for Heads, Cylinders and Branch Connections

WRC 107/537 Update Guidance for Spheres, Elliptical and Dished Heads

Recommended SCF for Pressure Stress on Welds

Interactive Local Thin Area Drawing & Analysis

+Y Simple Nonlinear Supports for Saddles, Pipe Shoes and Similar Geometries

Bar Supports & Local Thin Areas

Leak-Before-Break Linear and Nonlinear Pressure Fatigue of Thick Nozzles and Olets

Acoustic Induced Vibration (AIV) Update

Nozzles, Saddles, Pipe Shoes & Clips

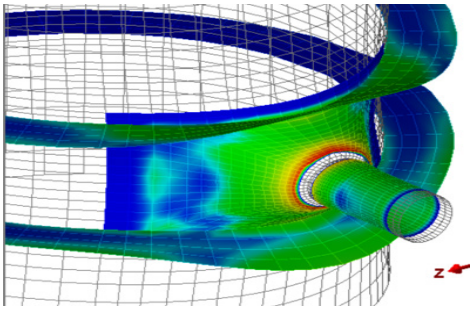
NozzlePRO is designed to quickly and easily evaluate nozzles, saddles, pipe shoes and clips on a variety of head types including spherical, elliptical, ASME, dished, cylindrical and conical. Within minutes you'll be able to generate the following:

- Nozzles through Blind Flanges in Axisymmetric and Brick Models
- Double Bed Support
- 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

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.

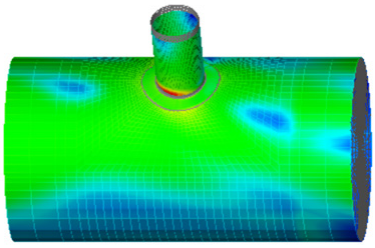
The **Pipe Shoe Wizard** creates an FEA model of a pipe shoe on a cylinder to calculate local stress within NozzlePRO.

The **Drawing Tools** allow the user to add gussets, rings, clips and other attachments to an existing NozzlePRO model.

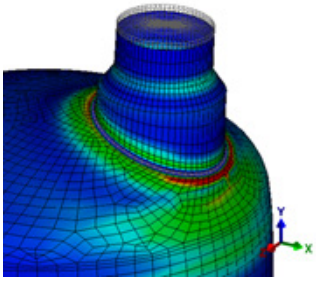


Model created with the Drawing Tools.

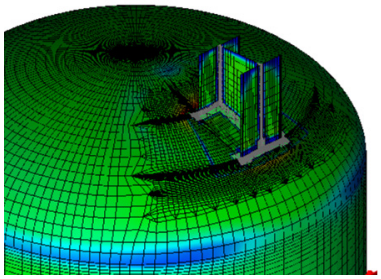
Which components are better analyzed with NozzlePRO?



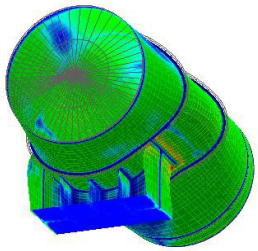
Nozzle on Cylinder



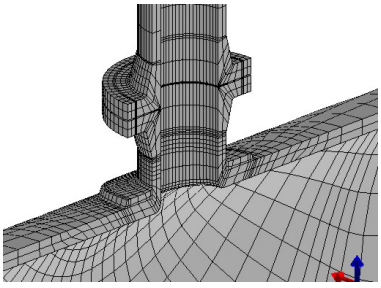
Nozzle on Head



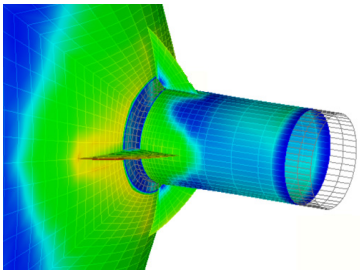
Structural Attachments/Lugs



Saddle Supports



Repads



Gussets
(via Drawing Tools)

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NozzlePRO v15.0

NozzlePRO v15.0 includes the following Programs...

MatPRO	PRG's materials database includes high temperature curves, allowable stress plots, NH reporting, creep-fatigue interaction diagrams, elastic-plastic stress strain curves and fatigue curves generated as a funtion 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.
High Frequency	Acoustic Induced Vibration calculation includes prediction of sound pressure levels measurable away from the surface of the vessel. Used mainly to estimate strength of branch connections when compared to straight pipe. PRG performs high frequency vibration tests to confirm surface integration and prediction of damaging SPL levels. Methods in IEC 60534-8-3 for gas flows are used to generate predicted SPL spectrum. Stresses in high frequency modes are scaled to match defined spectrum responses and predict expected cycle lives.
Flaw Detection	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.
Nonlinear Analysis	This capability computes burst pressures, sustained stress indices, twice elastic slope load levels, and a variety of load and unload conditions.
Drawing Tools	The Drawing Tools provide hundreds of small functions to modify, evaluate and document the model created.
FE107	FE107 replaces WRC 107 as a calculation tool that can be applied when WRC 107 or WRC 297 correlations or assumptions are limited. ASME Section VIII Division 2 allowables are printed along with flexibilities and allowable loads for forces, moments and pressure.
FESIF	Calculates SIFs and k-factors for standard B31 branch connection geometries.
FETee	FEA of contoured tees per user input, B16.9 or EN10253 is conducted. EN10253 types A and B tees can be defined and thickness profiles determined and appropriate finite element models constructed. Elastic models to produce SIFs and k-factors are generated automatically, along with nonlinear calculations (with or without pressure) for SSIs and loads thru the branch or run. Users may locally thin tees, define the crotch radius and/or the thickness profile around the branch to run penetration line.

When You Need to Use NozzlePRO

- When there are multiple thermal or operating loads acting on a nozzle.
- When the d/D ratio for a loaded nozzle is greater than 0.5 and WRC 107 or 297 is considered for use.
- When the t/T ratio for a loaded nozzle is less than 1.0 and WRC 107 or 297 is considered for use.
- When the nozzle is pad reinforced and WRC 107 or 297 is considered for use.
- When there are loads acting on a nozzle and run pipe simultaneously.
- When the number of full range pressure cycles is greater than 7000 and the nozzle is subject to external loads.
- When the D/T ratio is greater than 100 and SIFs or flexibilities are needed for a pipe stress program.
- When the D/T ratio is greater than 100 and a dynamic analysis including the nozzle is to be performed using a piping program.
- When a large lug is used in a heavily cyclic service.
- When pad reinforced lugs, clips or other support are placed on the knuckle radius of a dished head. WRT 107 simplifications for pad reinforced rectangular lug attachments are fraught with potentially gross errors.
- When seismic horizontal loads on vessel clips or box supports are to be evaluated.
- When pad reinforced hillside nozzles subject to pressure and external loads.
- When evaluating large run moments, but small branch moments in a piping system.
- When there are overturning moments on skirts.
- When the effect of integral vs. non-integral pad on nozzle in head should be studied.
- When there are different thermal expansion coefficients or temperatures between the header and branch.
- When the loads on nozzles are high because of the assumption that the nozzle connection at the vessel is a rigid anchor. Few connections at vessels are rigid. Even small rotations can significantly reduce the calculated moment and stress. Accurate flexibilities permit the actual moment on the vessel nozzle to be calculated and included in design.
- When there is heat transfer in an axisymmetric model geometry.
- When the effect of adding a radius to weld geometries on nozzles in heads should be investigated.
- When the anlayst needs to run various model types, comparing results to determine the stability and accuracy of the solution. To verify FEA calculations, NozzlePRO allows nozzles in heads to be analyzed with shell, axisymmetric, or brick finite elements.
- When horizontal vessels are saddle supported, with or without wear plates, and including 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. **Zick's methods do not consider either axial or transverse loads.**
- When designing pipe shoes for self-weight, liquid weight and axial loads.

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

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