

NozzlePRO_{version14.2}

New Features Summary

Version 14.2 of NozzlePRO adds the following new or significantly reworked functionality to version 14.1 (which is covered below) to NozzlePRO:

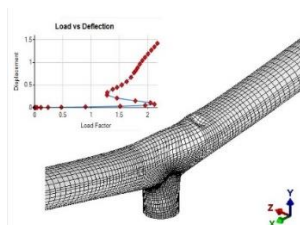
1. FULLY AUTOMATED PIPE SHOE SPECIFICATION CAPABILITY ADDED TO PIPE SHOE DESIGN WIZARD PROGRAM

- Pipe Shoe Wizard evaluates loads on all supports in CAESAR model automatically and gives PTP or PIP acceptable shoe size
- Pipe shoe modeling to include pipe shoes, flexibilities and centerline offsets automatically
- **AUTOMATED!** – Select/Specify the best pipe shoe (from a library of pre-defined Pipe Shoes) for every node in the Caesar II model that is likely to have a pipe shoe or vertical support. (Entire Caesar II model analyzed at once)

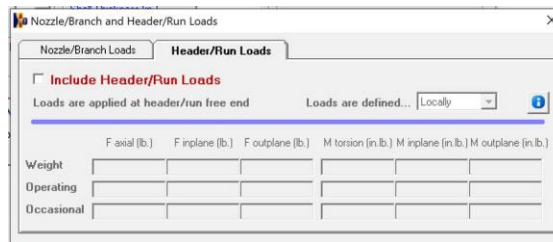
2. ENHANCED BUCKLING ANALYSIS CAPABILITY

- Contains enhanced capability to consider buckling related instabilities
- Stability Processor to Apply Rules of Thumb to Compressive Loads in PVP Geometries
- Multiple perturbation options to evaluate buckling sensitivity to fabrication imperfections
- Simultaneous load thru the Run(Vessel) and Branch (shown figures below)

Enhanced Buckling of Vessels and Large Diameter Pipe



Simultaneous Loads thru the Run and Branch (NozzlePRO)



Model Perturbation based on Patterns

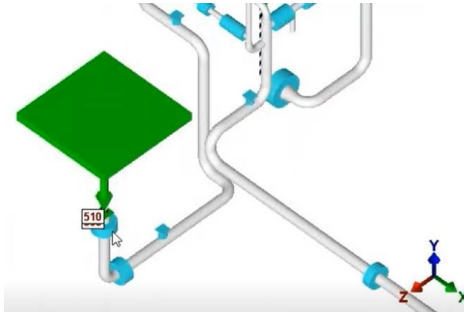


Stability Guidance – Provides basic calculations and cautions for compressive loads in the NozzlePRO geometry.



3. NEW FLANGE ANALYSIS CAPABILITY

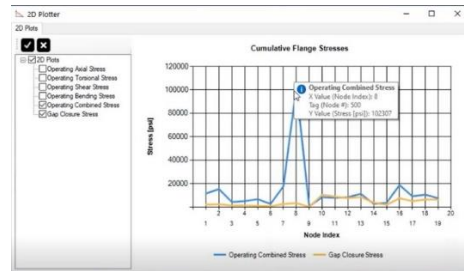
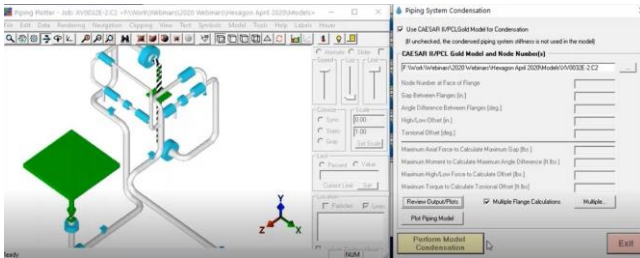
- Flange Tolerance Sensitivity Evaluation – Know where to put the flanges in the piping system and which flanges may be susceptible to leakage due to external loads or high forces due to fit-up tolerances



Multiple Node Condensation - Job: XV0032E-2.C2 <F:\Work\Webinars\2020 Webinars\Hexago...

	Use?	Flange Node Number	Axial Gap [in.]	Angle Difference [deg.]	High/Low Offset [in.]	Torsional Offset [deg.]	Axial Force [lbs.]	Overturn Moment [ft.lbs.]	High/Low Force [lbs.]	Torsional Moment [ft.lbs.]
1	<input checked="" type="checkbox"/>	5300								
2	<input checked="" type="checkbox"/>	5350								
3	<input checked="" type="checkbox"/>	528								
4	<input checked="" type="checkbox"/>									
5	<input checked="" type="checkbox"/>									
6	<input checked="" type="checkbox"/>									
7	<input checked="" type="checkbox"/>									
8	<input checked="" type="checkbox"/>									
9	<input checked="" type="checkbox"/>									

Plot Piping Model O.K.



Stresses at Flange Locations due to Operating Load Cases

NozzlePRO_{version14.1}

New Features Summary

New Module

Pipe Shoe Design Wizard designs shoe supports in a piping system by accessing the Piping Technology & Products catalog for every restraint in the model. Users can also create their own library of pipe shoes.

MatPRO Upgrades – Expanded Databases & Plotting Option

- ASME B31.1 expanded from 2008 to include 2010, 2012, 2014 and 2017.
- ASME B31.3 expanded from 2008 to include 2010, 2012, 2014 and 2017.
- ASME Section II-D expanded from 2010 to include 2013, 2015 and 2017.
- Code compliance for European Standard EN-13445 added to the ASME/EN panel.

Material property plots are now available within MatPRO

Nonlinear Analysis for Axisymmetric and Brick Geometries thru the Drawing Tools

J-Integral Calculations for Shells, Axisymmetric and Brick Models Automatically Performed Using Virtual Shift Method

Fitness for Service

- Linear elastic modelled local thin area compared to VIII-2 Part 5 allowables with RSF
- Nonlinear elastic plastic modelled thin area compared to VIII-2 Part 5 allowables with RSF
- **Linear Elastic or Nonlinear elastic-plastic J-integral** calculation with modelled flaws in **shell, axisymmetric or brick model geometries**. Results are evaluated using the 9G.5 Driving Force Method. J-integral is calculated by the easy-to-use virtual crack extension method.
- **Interactive modeling of local thinned areas in shells** and for cracks in shells, bricks, or axisymmetric geometries.

DrawFE Drawing Tools

MiMOut PDF Reporting for all PRG Products and CAESAR II.

Printing can be done through the PDF file. Multiple files loaded into MiMOut will create their own section of the report.

Stability Tools

The PRG Stability evaluator *helps the user identify piping and vessel components that may be subject to instability* due either to external pressure and/or applied forces and moments. Recommendations are made for ASME evaluation options and calculation methods.

- Interactive eigenvalue buckling capability with or without perturbation. If perturbation needs to be added, it has to be done through the DrawFE Drawing Tools.
- Coordinate perturbation can be introduced due to scaled static results or previously computed buckled mode shapes.
- Perturbed coordinate solutions can be used for buckling, linear elastic and nonlinear calculations to be sure that any unstable condition will not go unrecognized. If perturbation needs to be added, it has to be done through the DrawFE Drawing Tools.
- Quadratic arc-length solutions to detect geometric buckling prior to elastic-plastic buckling. (These are in the nonlinear solver.)

Analysis Features

Temperature dependent allowable stresses have been added. Allowable stresses are used instead of yield for primary and secondary stress allowables.

Eigenvalue buckling added.

ASME 07-10 Calculations added.

API 660 load are imported automatically into NozzlePRO.

New Documentation

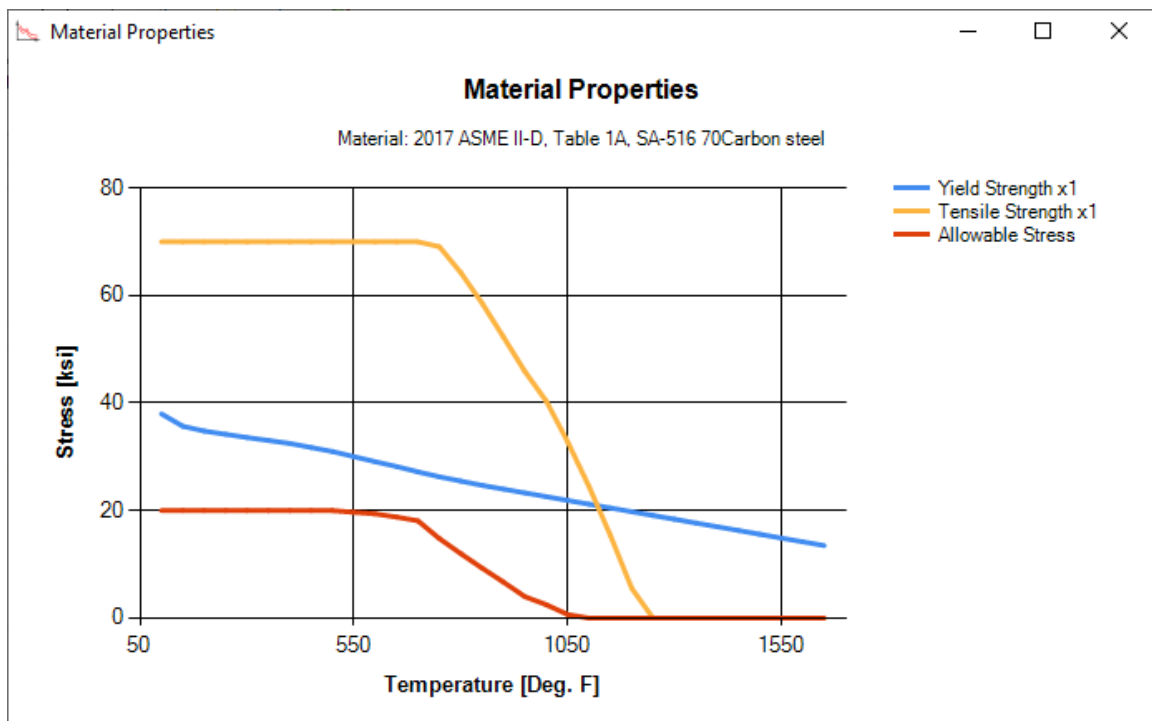
NozzlePRO version 14.1 New Features Details (by feature or program)

MatPRO Updates

Updated MatPRO Databases

- ASME B31.1 expanded from 2008 to include 2010, 2012, 2014 and 2017.
- ASME B31.3 expanded from 2008 to include 2010, 2012, 2014 and 2017.
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Material Properties Plot



Nonlinear Analysis for Axisymmetric and Brick Geometries thru the DrawFE Drawing Tools

- MITC8(H) nonlinear shell solver update. J-Integral Calculation, Nonlinear Compression-Only Contact elements, structural force output to compute nodal loads for each converged load step.
- Elastic-Plastic, Large Rotation Axisymmetric analysis with Unloading from Drawing Tools. Includes J-Integral calculation using nodal virtual crack extension.
- Elastic-Plastic, Large Rotation Brick (Volumetric, 8-noded) analysis with Unloading from Drawing Tools. Includes J-Integral calculation using nodal virtual crack extension.
- Automatic Flange plastic analysis of loading and unloading
- Automatic computation of SSI's required for sustained stress analysis in B31.3.
- Burst Pressure Test Simulation for shell models using multi-point elastic-plastic models with large rotation, large strain, and snap through.

- Automatic Calculation of Twice Elastic Slope and automatic selection of maximum displacement nodes and double angle load.

J-Integral Calculations for Shells, Axisymmetric & Brick Models Performed Automatically Using Virtual Shift Method

The linear and nonlinear J integral calculation of cracked geometries is the most effective way to determine the load capacity of cracked geometries in low or high load situations. When the material is tough, collapse occurs prior to crack extension. When the toughness of the material is low, then crack extension occurs and collapse is more likely to result. The nonlinear J integral solver in FEPipe and NozzlePRO makes the J calculation at each point along the crack edges and front for each converged solution. The loads are monotonically increased until collapse occurs or until JIC is exceeded.

Fitness for Service

Availability Varies per Feature

- Linear elastic modelled local thin area compared to VIII-2 Part 5 allowables with RSF. (*NozzlePRO*)
- Nonlinear elastic plastic modelled thin area compared to VIII-2 Part 5 allowables with RSF. (*NozzlePRO*)
- **Linear Elastic or Nonlinear elastic-plastic J-integral** calculation with modelled flaws in **shell, axisymmetric or brick model geometries**. Results are evaluated using the 9G.5 Driving Force Method. J-integral is calculated by the easy-to-use virtual crack extension method. (*NozzlePRO*)
- **Interactive modeling of local thinned areas in shells** and for cracks in shells, bricks, or axisymmetric geometries. (*DrawFE Drawing Tools*)

DrawFE v2.1 Drawing Tools

- Calculates perturbed coordinate solutions for buckling worst case estimates.
- Linear or non-linear J-Integral calculations for shells, axisymmetric or brick geometries.
- Interactive drawing of local thin areas for FFS evaluations
- Interactive Eigenvalue Buckling Calculation
- Shell, axisymmetric, and brick (volumetric) nonlinear FEA analysis.
- Ability to apply scaled mode or static displacements to create model perturbation
- Interactive node-by-node, or element-by-element specification of wall thickness
- Specification of temperatures by curve or by element
- Nonlinear gaps between shell models and/or between shell models and boundary conditions
- Pinned End coupling between two shell model ends, or between shell and beam ends
- Linear and Nonlinear J-Integral Calculations with interactive crack specifications
- Ability to edit ascii FEA Database files
- Nodes may be moved around the model interactively to get nodes in correct locations
- Interactive node merging when needed
- Thermal loads included in structural stress and force calculations
- Graphical specification of pressure
- New “full view” help processor
- Ability to interactively change load cases or apply pressure to elements
- Ability to go from exaggerated to scaled displacement solutions

- Duplicate, move or rotate selected parts of the model (lugs for example)
- Build and include structural steel cross sections
- Updated unstructured closed path “mesher”

MiMOut

All Programs except FE107, FESIF

MiMOut is a general-purpose output processor using XML. It includes input, output and point cloud manipulation of any number of models and model types, i.e., piping, axisymmetric, shell, etc.

- Supports 50+ nonlinear analysis load types
- Point clouds may be read in and manipulated with the corresponding beam or finite element model.
- Supports pdf output, multiple output panes, and 2/3D graphical representation of results.

Documentation Update

- DrawFE Drawing Tools extensive help and example problems
- Fitness for Service detail description (Cumulative Damage)
- Summary Pamphlets that include key information in compressed format:
 - B31J branch connection stiffness modeling in a pipe stress program
 - Interactively described cracked geometries in shells, axisymmetric geometries and bricks
 - Evaluating J-Integrals
 - DrawFE Drawing Tools Miscellaneous Command

Stability Tools

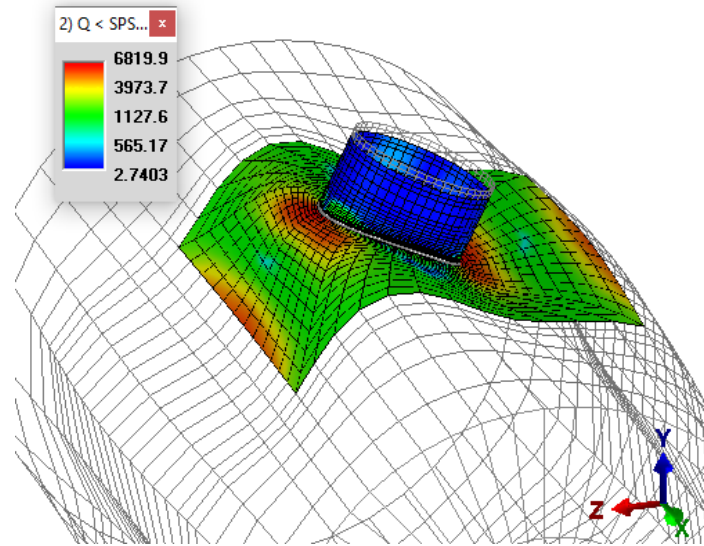
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Eigenvalue Buckling

Added to NozzlePRO

Includes interactive eigenvalue and large rotation, elastic plastic, and arc length buckling.



Out-of-plane mode shape from buckling calculation using initial perturbation from preliminary buckling analysis

ASME 07-10 Calculations and API 660 Loads

Added to NozzlePRO

API 660 loads automatically imported into NozzlePRO

PRGiK

SIF Suite results detailing interaction of pressure with other stresses at branch connections. PRGiK also includes SSI calculations, and SIF, k, and SSI calculations for trunnion supported bends with or without refractory.

FESIF_{version2.7}

No version changes.

FE107_{version2.7}

No version changes.

NozzlePRO – Included Module Summary

NozzlePRO v14.1 Program Description / Included Modules

NozzlePRO offers component analysis capabilities of nozzles, supports or saddles on piping and pressure vessels.

NozzlePRO v14.1 Modules:

- NozzlePRO
- MatPRO
- MiMOut – Advanced Graphical Reporting
- SIF/SSI/k
- High Frequency
- Flaw Detection
- Nonlinear Analysis
- DrawFE v2.1 Drawing Tools
- Fitness for Service & NH Reporting
- Pipe Shoe Design Wizard
- FE107
- FESIF
- FETee