



Process and Power Piping. Increase Productivity and Save your Time Twice with PASS/START-PROF 4.84

Dr. Alex Matveev,
START-PROF Product Owner



PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

PASS/START-PROF

Smart Pipe Stress Analysis & Optimal Sizing

Presenter:

Dr. Alex Matveev

START-PROF Product Owner

Development, Training, Support of
START-PROF Since 2005

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PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

Webinar Agenda – Part 1

- Quick introduction of PASS/START-PROF
- Supported codes for power and process piping
- Integration capabilities
- Object-oriented piping model creation principle
- Piping object types: pipe, tees, bends, reducers, etc.
- Equipment objects: Nozzle, Tank Nozzle, Pump, In-line Pump, Turbine, Compressor, Air cooler, Fired heater
- Expansion joint objects
- Databases, ASME B31J, Creep self-springing effect, wind, ice, snow, seismic loads



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Webinar Agenda – Part 2

- Minimum design metal temperature (MDMT) according to 323.2.2 (a)-(j) ASME B31.3
- Alternative occasional allowable stress 302.3.6 ASME B31.3
- Creep-Rupture usage factor, Appendix V ASME B31.3
- FRP/GRP/GRE piping analysis
- Pipe and fittings wall thickness calculation
- Operation mode editor. Load cases
- Analysis reports: Stress in piping, Stress in insulation, Seismic stress, Flaw stress, Restraint loads, Equipment loads, Displacements, Expansion joints check, variable spring selection, constant spring selection, buckling analysis, flange leakage
- Special features



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PASS/Start-Prof

Comprehensive pipe stress, flexibility, stability, and fatigue strength analysis with related sizing calculations



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Quick Pipe Stress Analysis & Optimal Sizing

- Broad Applicability
- Unsurpassed Usability
- Powerful Capabilities
- Extensive Databases
- Flexible Configurations
- Extensive Code Support
- Widely Used



PASS/Start-Prof | Broad Applicability

- Process Industry Piping
- Oil and Gas Pipelines
- Utility Network Pipelines
 - District Heating
 - Natural Gas
 - Water
- Power Generation Piping

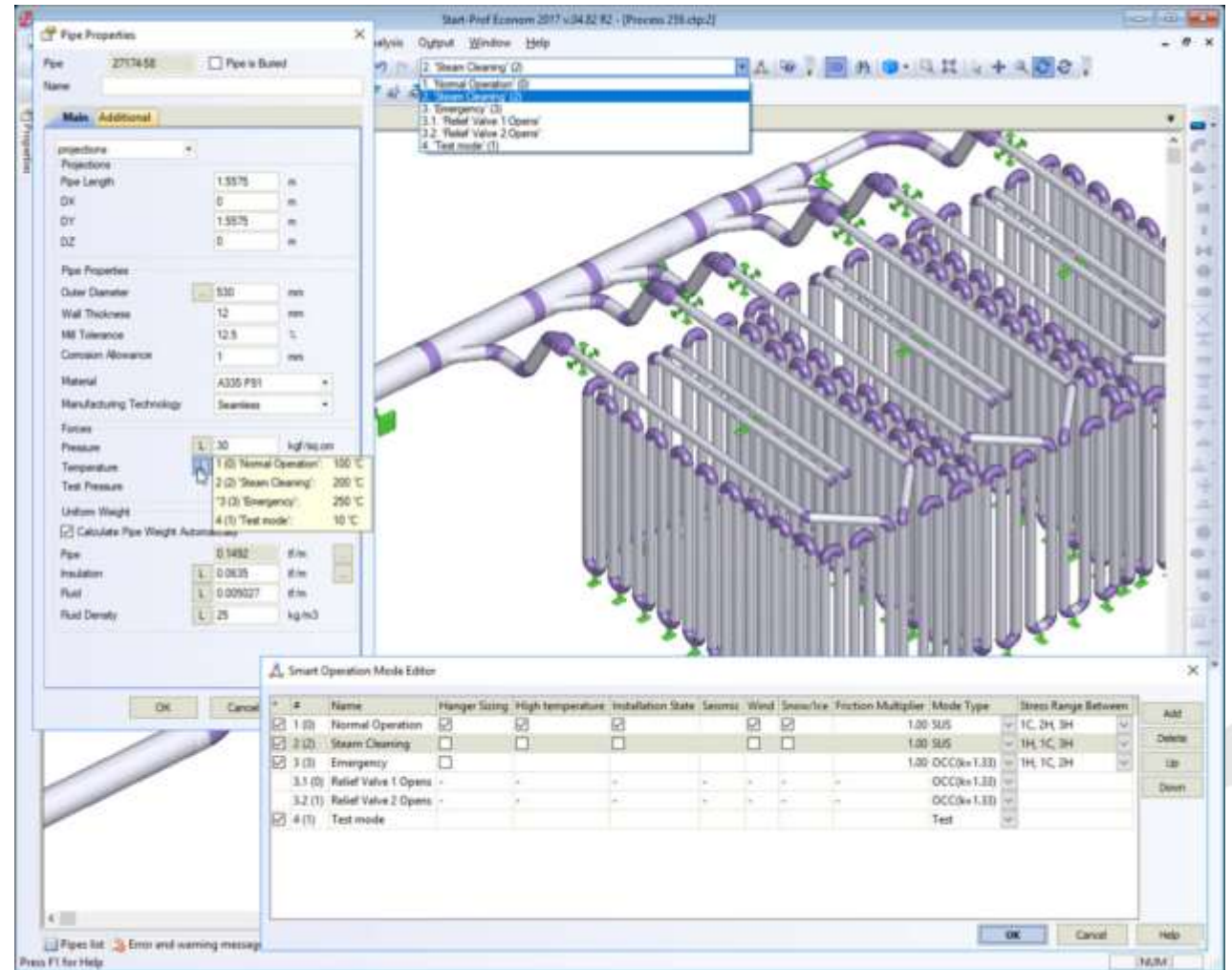


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PASS/Start-Prof | Features

- PASS/START-PROF for Process and Power Piping Stress Analysis
- Increase your Productivity and Save your Time
- Save your Money (we have a friendly pricing policy)
- Increase the Accuracy of Pipe Stress Analysis



PASS/Start-Prof | Broad Applicability

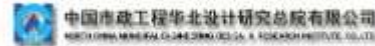
- Developed since 1965
- 2000+ Active users (companies). Licenses 8000+
- User interface and documentation languages: English, Chinese, Russian
- Piping codes: 32
- Wind, Seismic, Snow, Ice codes: 18



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PASS/Start-Prof | Our Customers



PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE



PASS/Start-Prof | Features

- First hand quick response from experienced piping engineers in UK, China, Mexico, Brazil, Australia, Egypt, Turkey and others
- Direct support from developers via e-mail is available
- Easy to learn, fast and simple to work with for a new pipe stress analyst
- Due to intuitive modern object-oriented user interface, you can start working immediately. Companies can put PASS/START-PROF into application immediately after purchase, significantly reducing costs and save the time without compromising on the quality of end results



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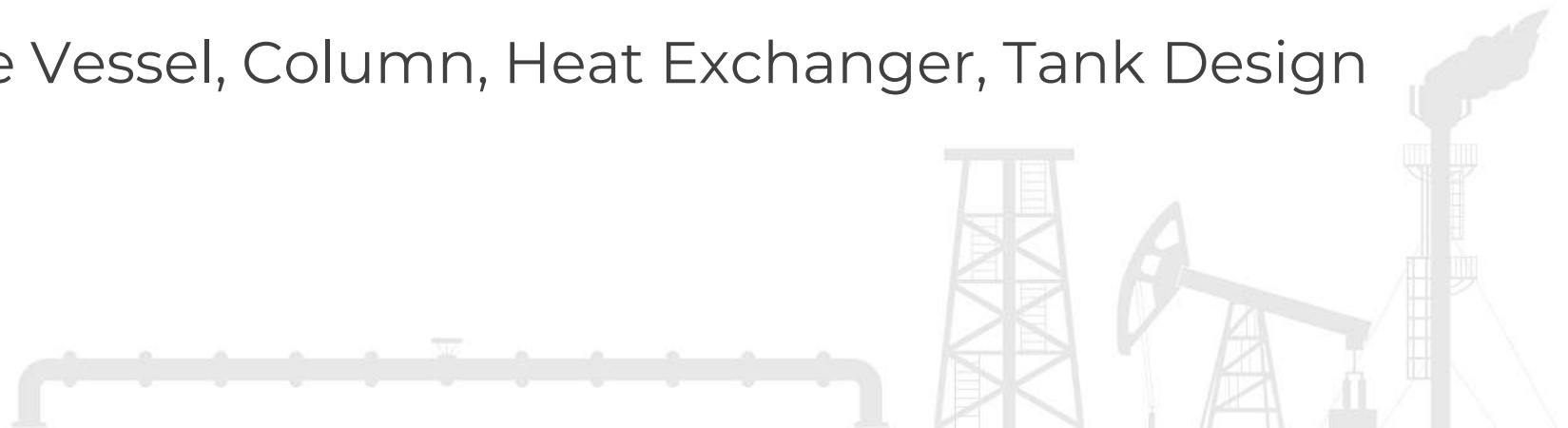
PASS/Start-Prof | Features

PASS/START-PROF is a part of PASS Suite:

- **PASS/START-PROF** – Pipe Stress Analysis Software
- **PASS/HYDROSYSTEM** – Piping hydraulic and Thermal Analysis Software
- **PASS/ NOZZLE-FEM** – Nozzle to Shell Junction Finite Element Analysis Software. Calculate SIF, k-factors, Nozzle Flexibility and Stress Analysis, etc.
- **PASS/EQUIP** – Pressure Vessel, Column, Heat Exchanger, Tank Design and Analysis Software



PIPING AND EQUIPMENT
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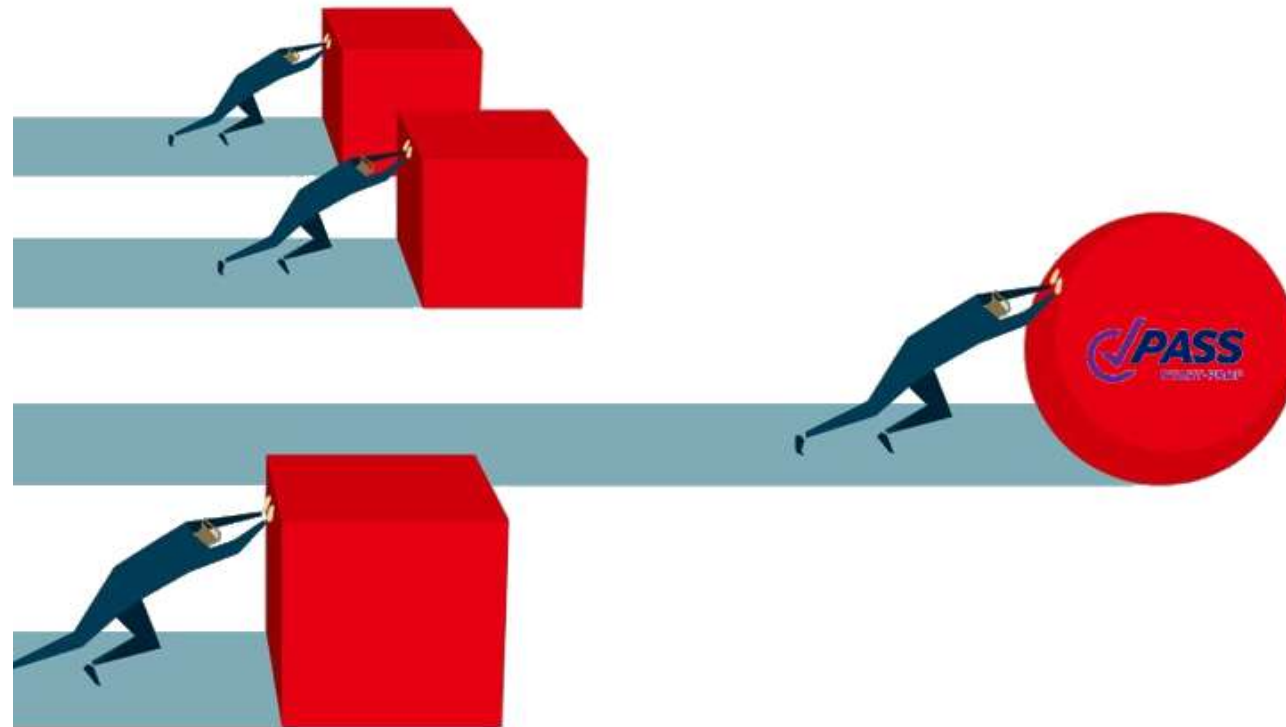


PASS/Start-Prof | Increase Productivity

PASS/START-PROF is a Professional Modern Pipe Stress Analysis Software

PASS/START-PROF Makes Complex Things Simple

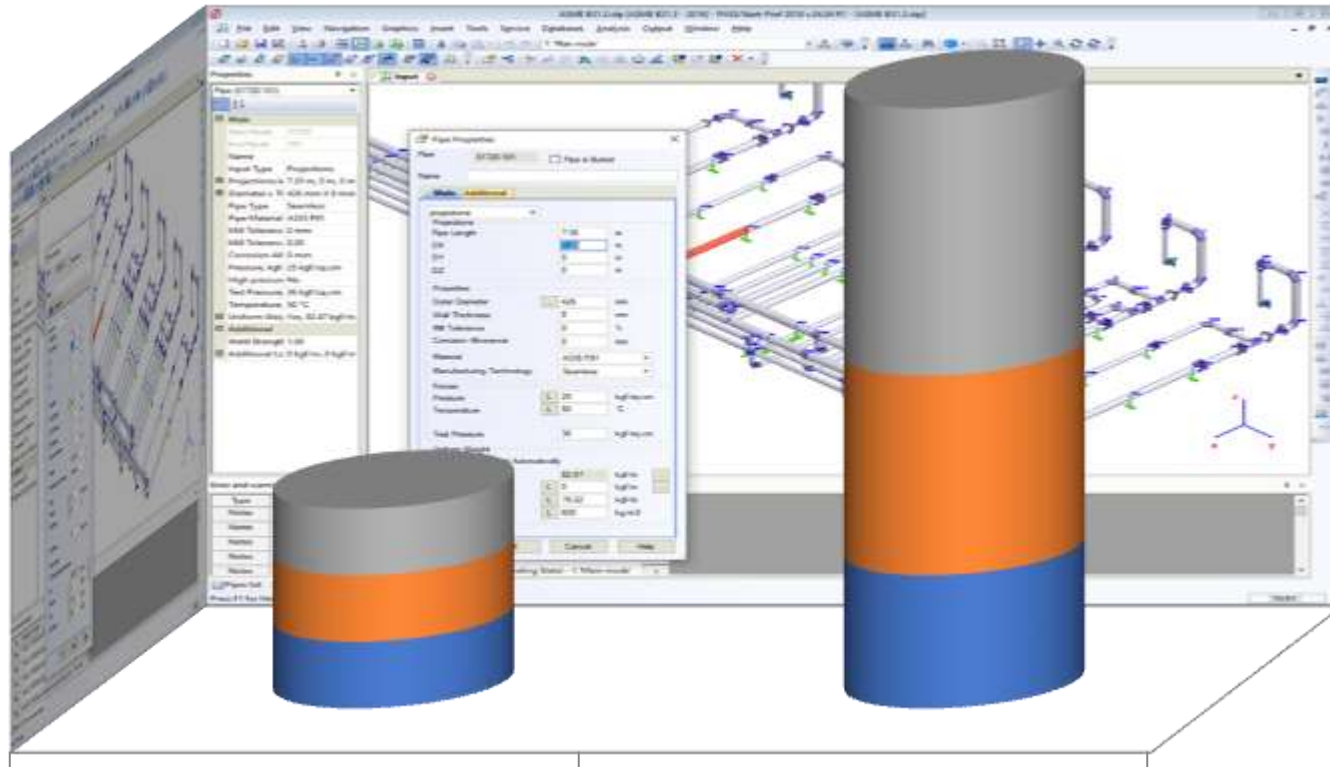
You will Get the Same Result, but Faster and Easier



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PASS/Start-Prof | How START-PROF Saves your Time



START-PROF

Other Pipe Stress Software

- Time to Create the Model
- Time to Analyze and Optimize the Model
- Time to Create the Report



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PASS/Start-Prof | Interfaces with Other Software

PASS/START-PROF can analyze piping according to 32 piping codes.
The software contains all needed and latest codes for Power and Process Industry:

- ASME B31.1
- ASME B31.3
- ASME B31.12
- EN 13480
- DL/T 5366 (China)
- GB 50316 (China)
- GB 20801 (China)
- RD 10-249-98 (Russia)
- GOST 32388 (Russia)
- ISO 14692 FRP/GRP/GRE
- Thermoplastic Piping (HDPE, PVC, PP, PVDF)



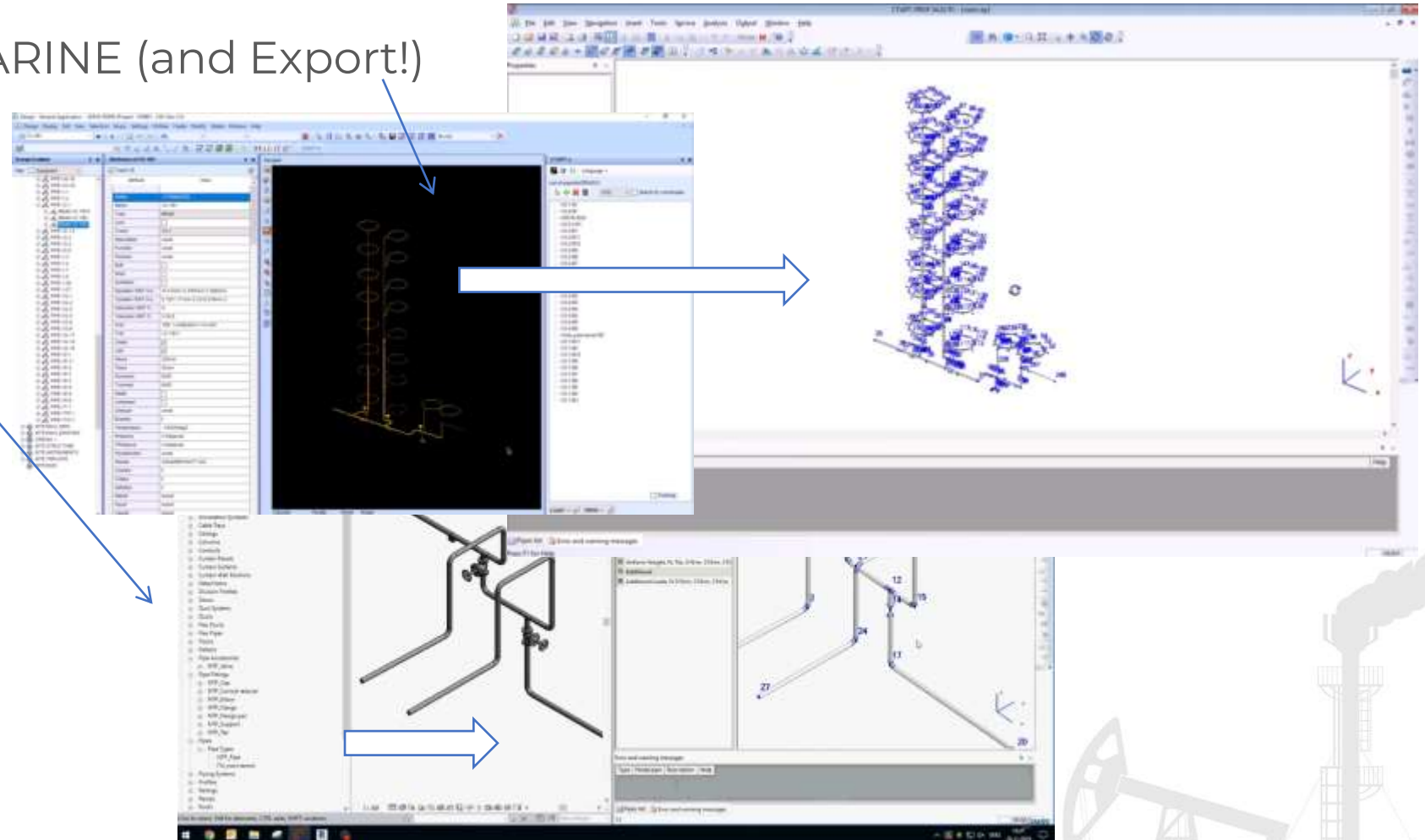
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PASS/Start-Prof | Interfaces with Other Software

PASS/START-PROF can Import the Piping Models from

- AVEVA PDMS, E3D, MARINE (and Export!)
- SmartPlant 3D
- Autodesk Revit
- OpenPlant
- AutoPlant
- CADWorx
- Smart 3D
- CAESAR II
- Autopipe
- PASS/HYDROSYSTEM
- PCF



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PASS/Start-Prof | Piping Model Creation

In PASS/START-PROF the piping model creation is simple and straightforward.
Even a beginner will understand what to do.

Create the Piping and Equipment Model by Combining the Objects
Like LEGO

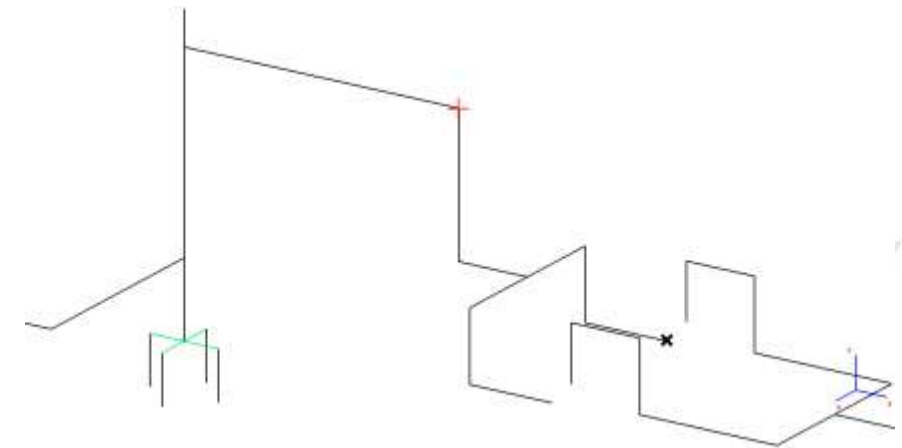
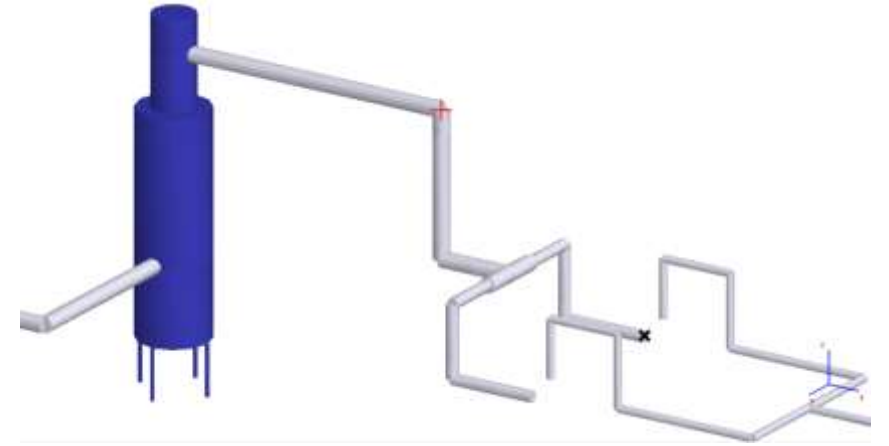
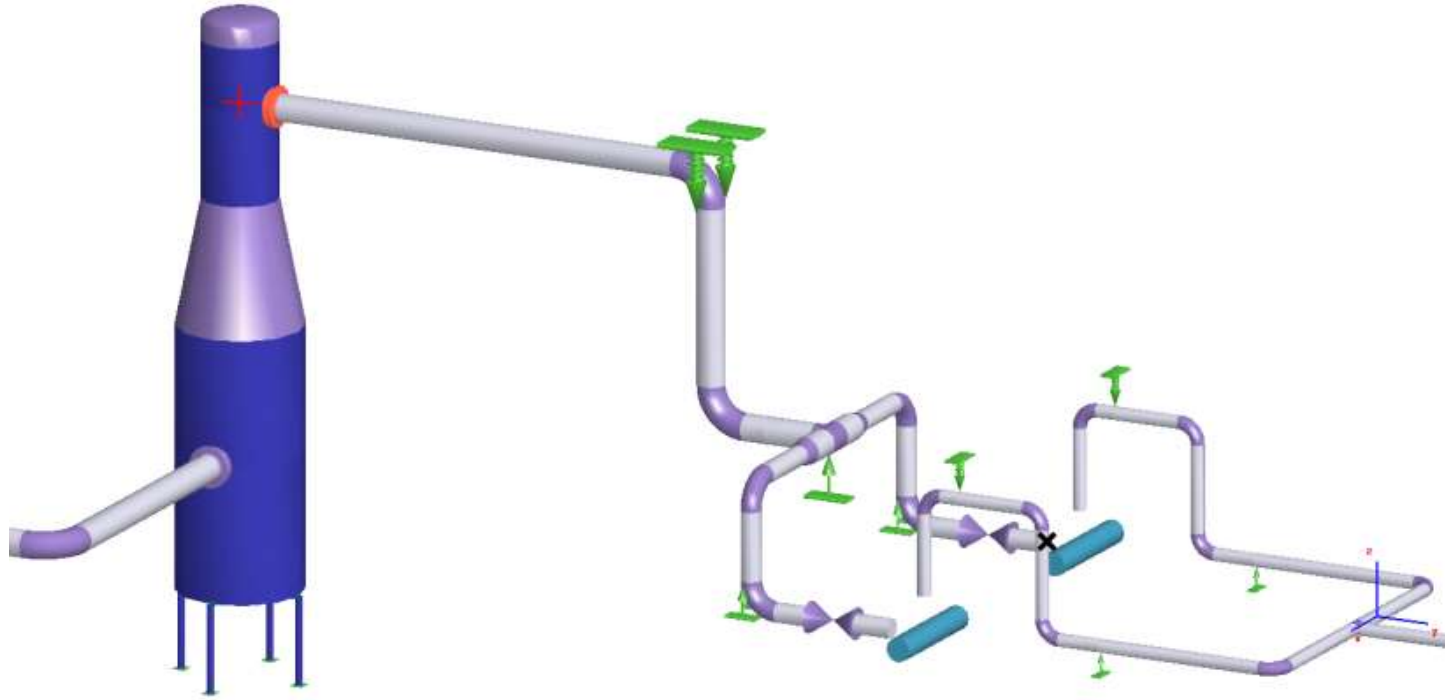
- Fast Model Creation
- Fast and Easy Existing Model Modification
- You can Add, Delete, Modify, Copy, Rotate, Mirror, Split Objects
- Work With Object Groups



PIPING AND EQUIPMENT
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PASS/Start-Prof | Piping Model Creation



PIPING AND EQUIPMENT
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PASS/Start-Prof | Piping Model Creation

The image displays the PASS software interface for piping model creation. It features a central 3D model of a piping system with various components. A toolbar at the top left contains the following options:

- Insert Pipe... F7
- Insert Rigid Element...
- Cylindrical Shell...

On the right, a 'Pipe Object' is shown as a 3D cylinder. Below it, the 'Pipe Properties' dialog box is open, showing the following settings:

Category	Property	Value
Main	Start Node	18
	End Node	3
	Name	
	Input Type	Projections
Projections/angles	0 m, 4 m, 0 m	
	Diameter x Thickness, m	219 mm X 6 mm
Pipe Type	Seamless	
	Pipe Material	A106 A
Mill Tolerance, %	10.00	
	Corrosion Allowance, m	0.9 mm
Pressure, kgf/sq.cm	16 kgf/sq.cm	
	High pressure	No
Test Pressure, kgf/sq.cm	20 kgf/sq.cm	
	Temperature, °C	150 °C
Uniform Weight, kg/m	Yes, 31.45 kgf/m, No, 24.8 kgf/m	
	Calculate Weight Aut	Yes
Input Insulation Prop	No	
	Uniform Insulation W	24.8 kgf/m
Uniform Fluid Weight	33.85 kgf/m	
	Fluid Density, kg/m3	1000 kg/m3
Additional	Weld Strength Factor, E	1.00
	Additional Loads, kgf/m	0 kgf/m, 0 kgf/m, 0 kgf/m, 0 kgf/m, 0 kgf/m
Weight Load, kgf/m	0 kgf/m	
	Load X, kgf/m	0 kgf/m
Load Y, kgf/m	0 kgf/m	
	Load Z, kgf/m	0 kgf/m

Below the 'Pipe Properties' dialog, the 'Insulation Properties' dialog box is open, showing the following settings:

Property	Value
Insulation Thickness, s	0 mm
Insulation Density	0 kg/m3
Cladding Thickness, tc	0 mm
Cladding Density	0 kg/m3
Lining Thickness, s	0 mm
Lining Density	0 kg/m3

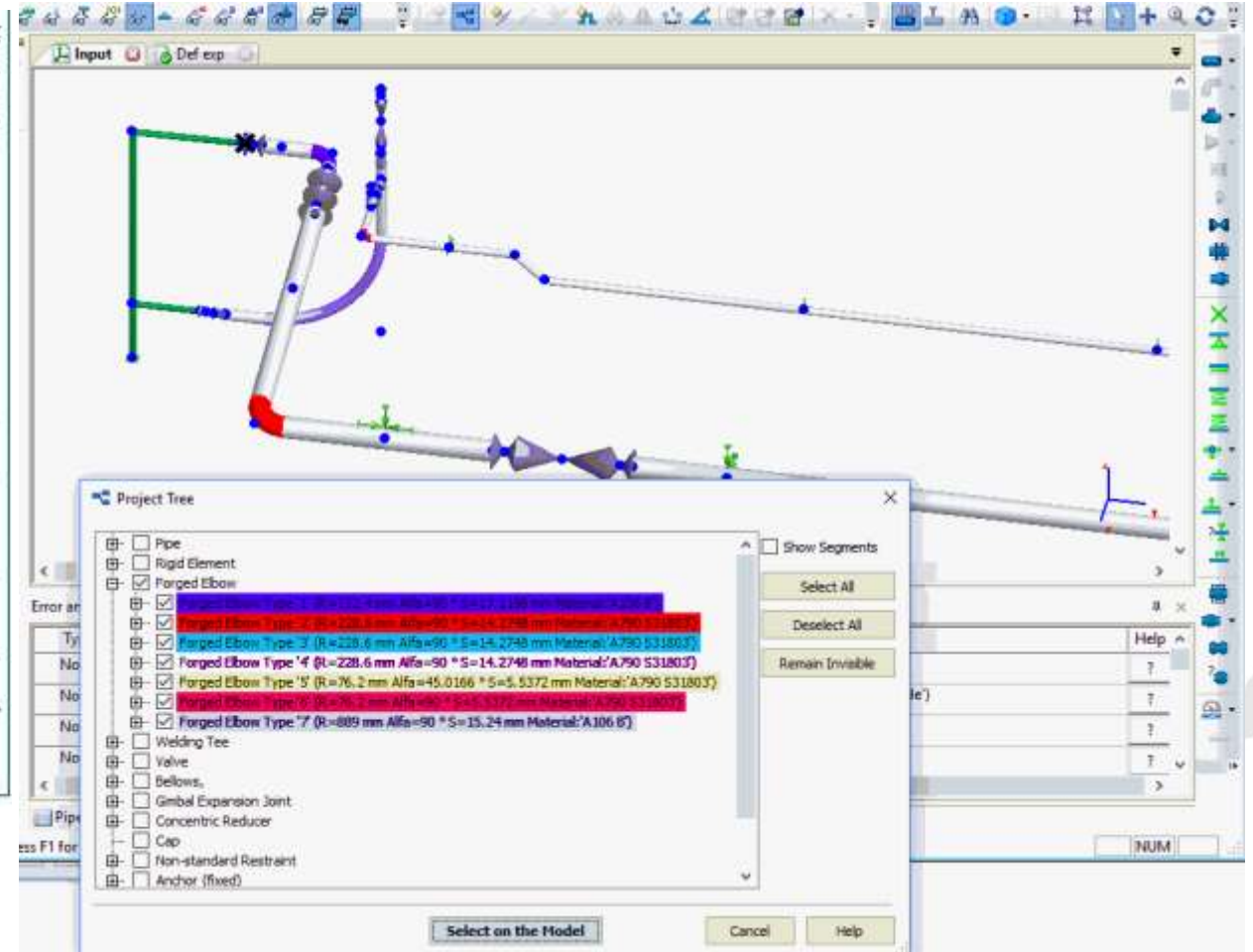
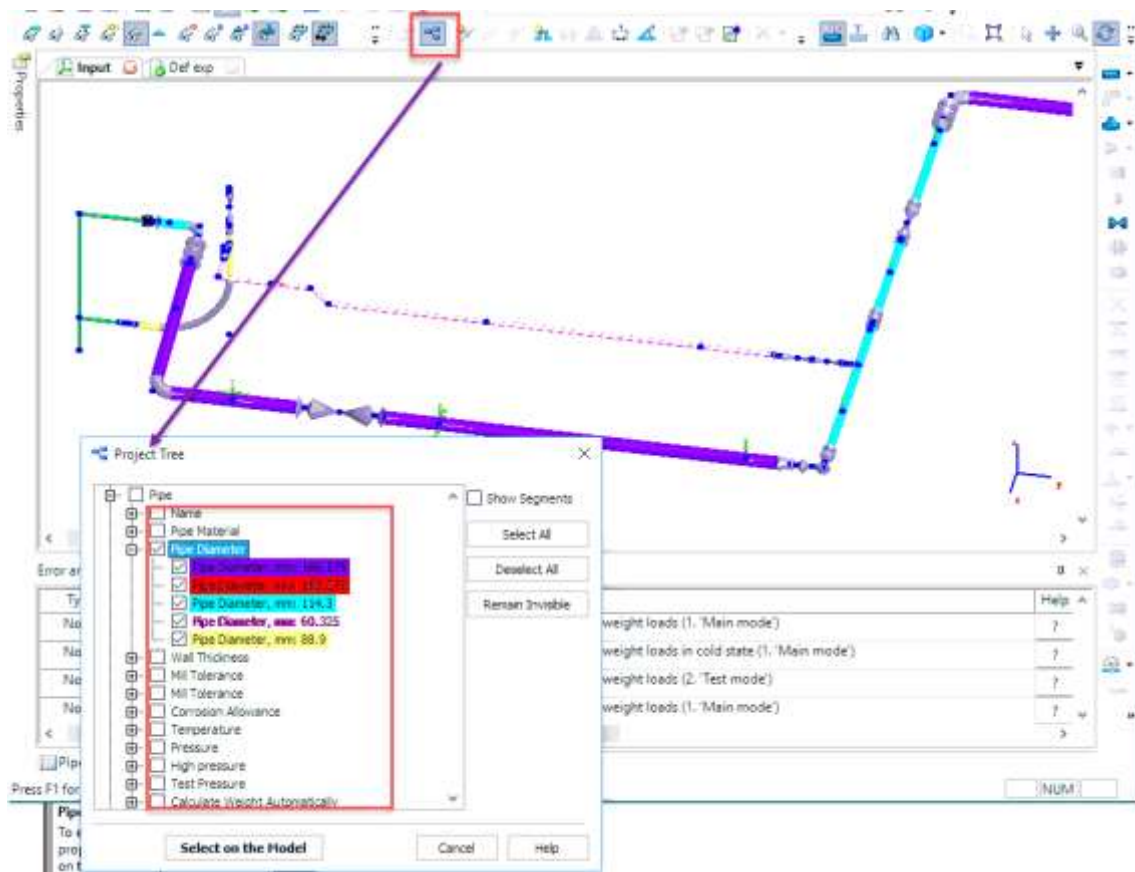
The 3D model includes several callouts:

- Cylindrical Shell Object**: Points to a vertical cylindrical vessel on the left.
- Rigid Element Object**: Points to a blue cylindrical component in the lower-left section of the piping.
- Pipe Object**: Points to a 3D cylinder model on the right.

The PASS logo is located in the bottom left corner.

PASS/Start-Prof | Piping Model Creation

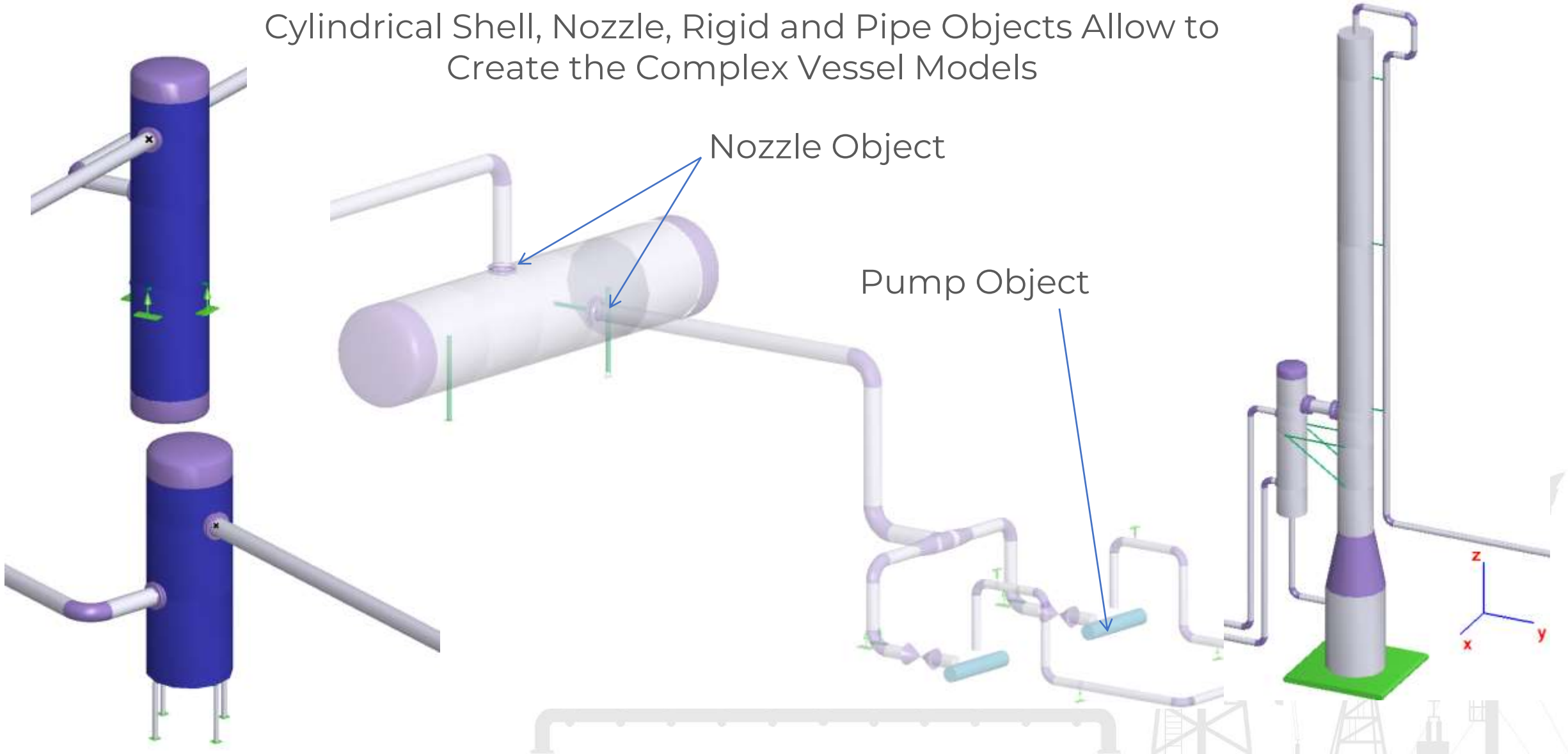
Color map for any properties of any objects: diameter, temperature, pressure, material...



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PASS/Start-Prof | Piping Model Creation

Cylindrical Shell, Nozzle, Rigid and Pipe Objects Allow to Create the Complex Vessel Models



PASS/Start-Prof | Piping Model Creation

Tee Object

Welding Tee...
 Fabricated (Reinforced/Unreinforced)...
 Stub-in...
 Extruded Outlet...
 Weldolet (Branch Welded-on Fitting)...
 Sweepolet (Welded-in Contour Insert)...
 Plastic Tee...
 Non-standard Tee...

Project Settings... - Ex4-Pump.ctp

General Additional Seismic Wind, Snow, Ice Other: Dynamics

Date: 15-10-2016 Description:

Piping Type: All

Stress Analysis Code: ASME B31.3-2010 Process Piping (USA)

Use Eth for Support Loads

Liberal Stress Allowable
 Stress Range from Operation to Cold

Use ASME B31J SIFs and k-factors

Use ASME B31.3
 Maximum f=1.2

Node Object Properties

Welded Stub-in (Fabricated Tee)

Flexibility (k): 0.155
 Run SIF: $i_0=3.116, i_1=2.587, i_2=1.000, i_3=1.000$
 Branch SIF: $i_0=3.116, i_1=2.587, i_2=1.000, i_3=1.000$

Weld Quality Factor, E: 1

6 mm

Node Object Properties

Welded Stub-in (Fabricated Tee)

Run SIF: $i_0=3.169, i_1=3.792, i_2=4.506, i_3=1.009$
 Branch SIF: $i_0=6.383, i_1=3.898, i_2=4.493, i_3=1.000$

Weld Quality Factor, E: 1

Pad
 Saddle

Wall Thickness, t: 0 mm

Table

Manufacturing Technology	Standard	Material	Size	Header Diameter, mm	Branch Diameter, mm	Header DN, mm	Branch DN, mm	Header SPC, in	Branch SPC, in	Schedule	Header Thickness, mm	Branch Thickness, mm	Header S11 Tolerance, mm	Branch S11 Tolerance, mm	Full Length, mm	Crotch Height, mm	Crotch Radius, mm	Weight, kg	Standard Group
Welded Tee	ASME B16.9-2012	Welded Tee	42.2-21.3	42.2	21.3	32	15	1 1/4	1/2	30	0	0	0	0	36	48	0	0	ASME
Welded Tee	ASME B16.9-2012	Welded Tee	42.2-21.3	42.2	21.3	32	15	1 1/4	1/2	30	0	0	0	0	36	48	0	0	ASME
Welded Tee	ASME B16.9-2012	Welded Tee	42.2-26.7	42.2	26.7	32	20	1 1/4	3/4	120	0	0	0	0	36	48	0	0	ASME
Welded Tee	ASME B16.9-2012	Welded Tee	42.2-26.7	42.2	26.7	32	20	1 1/4	3/4	100	0	0	0	0	36	48	0	0	ASME
Welded Tee	ASME B16.9-2012	Welded Tee	42.2-26.7	42.2	26.7	32	20	1 1/4	3/4	180	0	0	0	0	36	48	0	0	ASME
Welded Tee	ASME B16.9-2012	Welded Tee	42.2-26.7	42.2	26.7	32	20	1 1/4	3/4	140	0	0	0	0	36	48	0	0	ASME
Welded Tee	ASME B16.9-2012	Welded Tee	42.2-26.7	42.2	26.7	32	20	1 1/4	3/4	X95	0	0	0	0	36	48	0	1	ASME
Welded Tee	ASME B16.9-2012	Welded Tee	42.2-26.7	42.2	26.7	32	20	1 1/4	3/4	70	0	0	0	0	36	48	0	0	ASME
Welded Tee	ASME B16.9-2012	Welded Tee	42.2-26.7	42.2	26.7	32	20	1 1/4	3/4	70	0	0	0	0	36	48	0	0	ASME

Only first 200 rows are shown
 To see other rows please use filters

PASS

ASME B31J

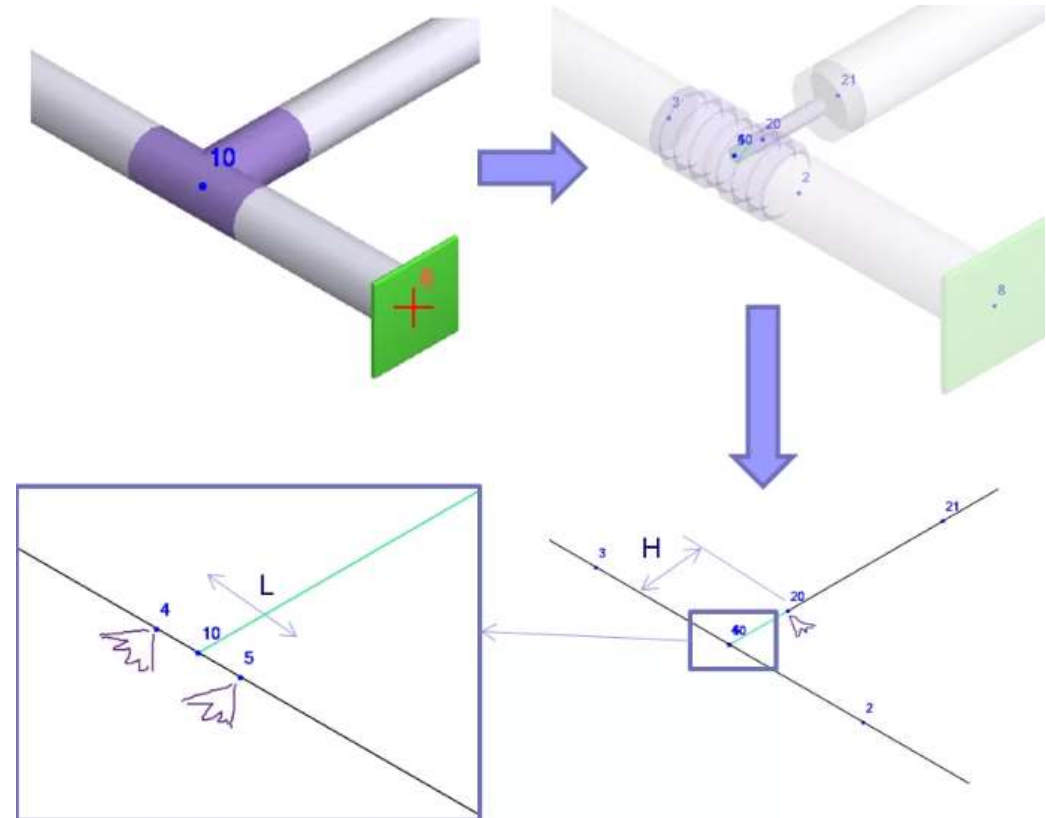
PASS/Start-Prof | Piping Model Creation

Automatic Detailed Tee Model

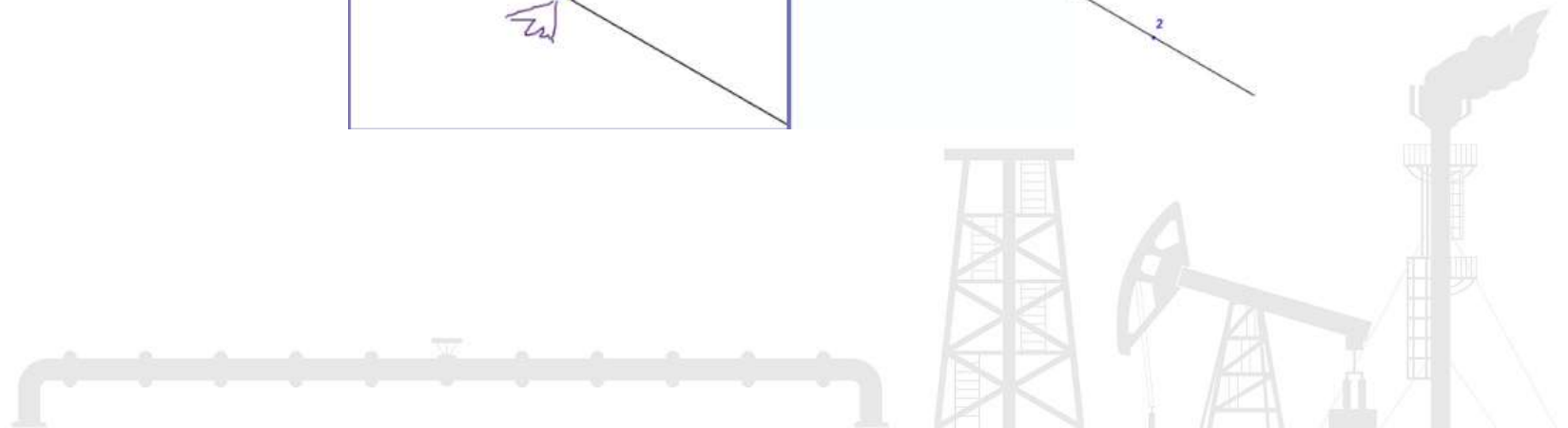
- Rigid Elements
- Flexibilities of Header and Branch
- Takes into Account the Wall thickness of Header and Branch

Consider SIF for Header and Branch

- According to the Code
- According to ASME B31J
- From FEA (Nozzle-FEM Software)

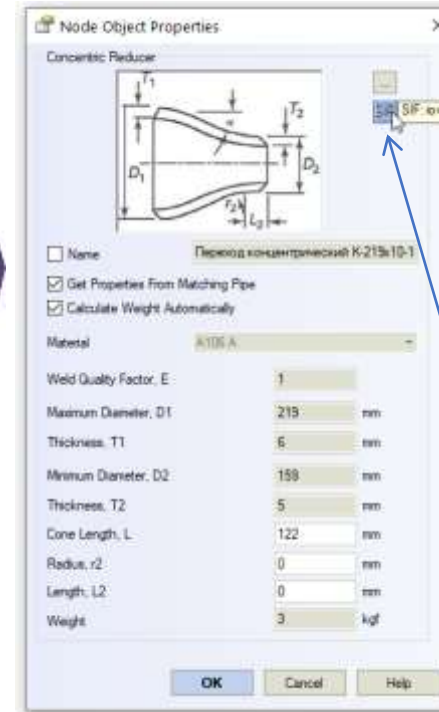
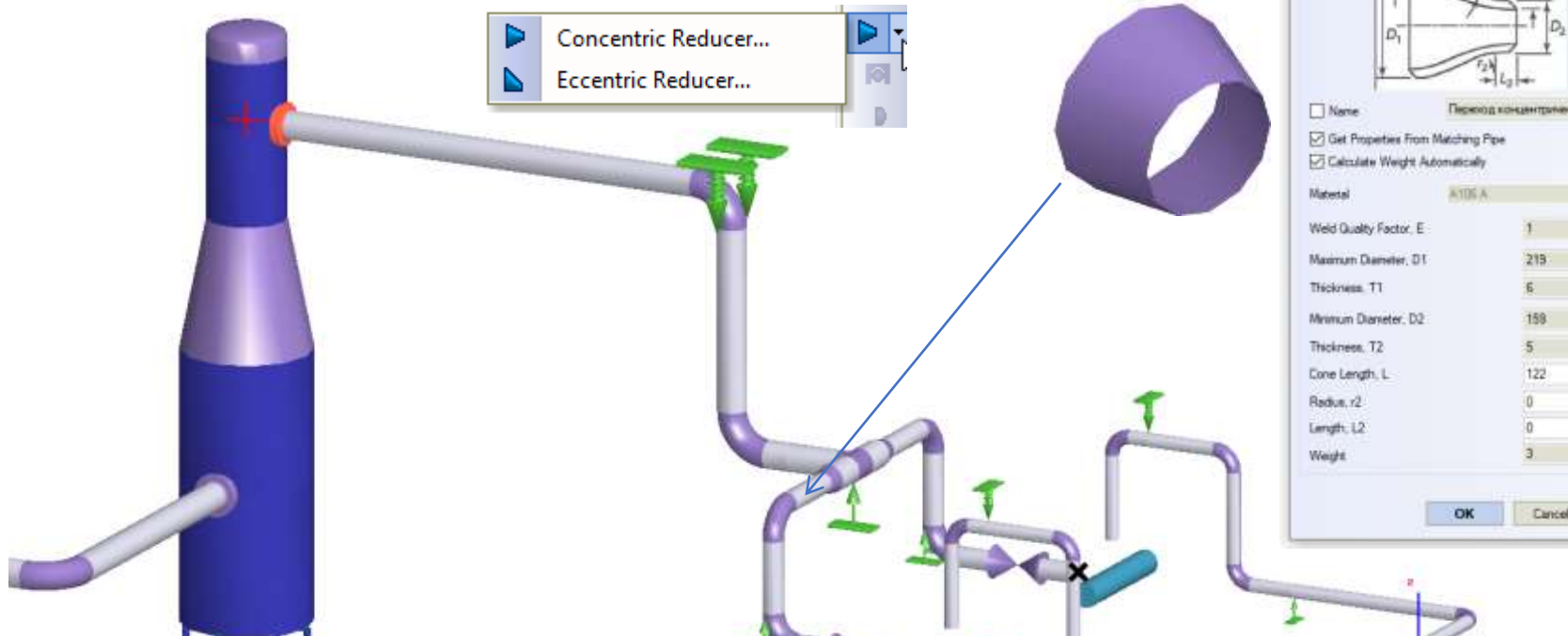


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ANALYSIS & SIZING SUITE

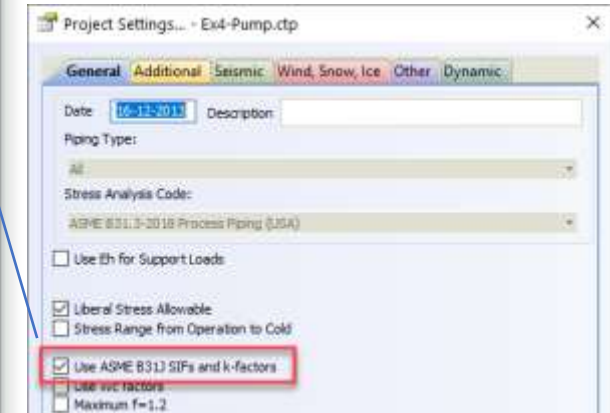


PASS/Start-Prof | Piping Model Creation

Reducer Object



ASME B31J



Reducers

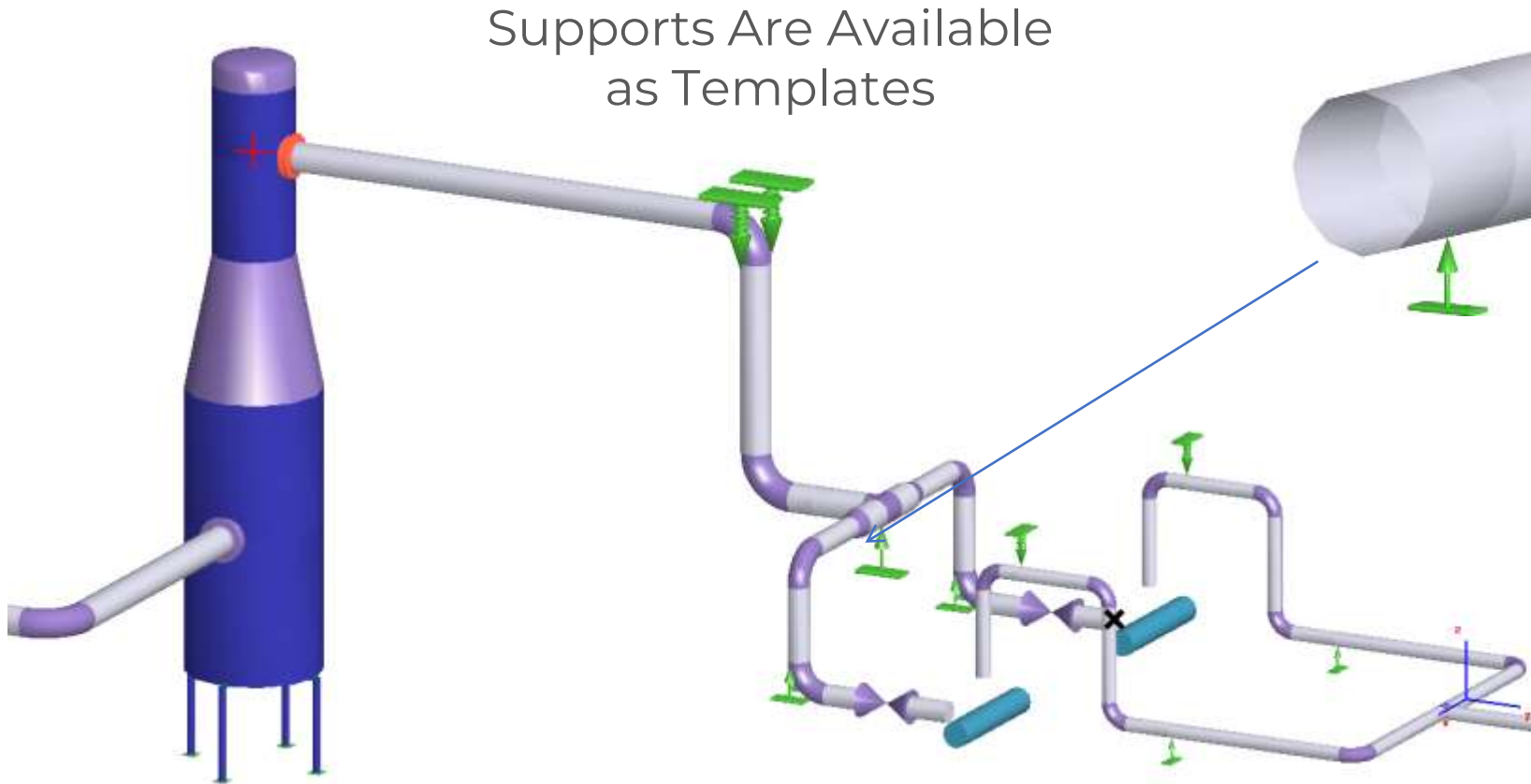
Type: concentric

Manufacturing Technology	Standard	Material	Size	Diameter min, mm	Diameter max, mm	Nominal Diameter min, mm	Nominal Diameter max, mm	NPS min, in	NPS max, in	Schedule	Thickness at Dmax, mm	Thickness at Dmin, mm	Min Thickness at Dmax, mm	Min Thickness at Dmin, mm	Full Length, mm	Cone Length, mm
<next set>	ASME B16.9-2012	<next set>	20-10	26.7	17.5	20	10	3/4	1/8	33	0	0	0	0	38	22.8
<next set>	ASME B16.9-2012	<next set>	20-10	26.7	17.5	20	10	3/4	1/8	33	0	0	0	0	38	22.8
<next set>	ASME B16.9-2012	<next set>	20-10	26.7	17.5	20	10	3/4	1/8	33	0	0	0	0	38	22.8
<next set>	ASME B16.9-2012	<next set>	20-10	26.7	17.5	20	10	3/4	1/8	33	0	0	0	0	38	22.8
<next set>	ASME B16.9-2012	<next set>	20-10	26.7	17.5	20	10	3/4	1/8	33	0	0	0	0	38	22.8
<next set>	ASME B16.9-2012	<next set>	20-10	26.7	17.5	20	10	3/4	1/8	33	0	0	0	0	38	22.8
<next set>	ASME B16.9-2012	<next set>	20-10	26.7	17.5	20	10	3/4	1/8	33	0	0	0	0	38	22.8
<next set>	ASME B16.9-2012	<next set>	20-10	26.7	17.5	20	10	3/4	1/8	33	0	0	0	0	38	22.8

Only first 300 rows are shown. To see other rows please use filters.

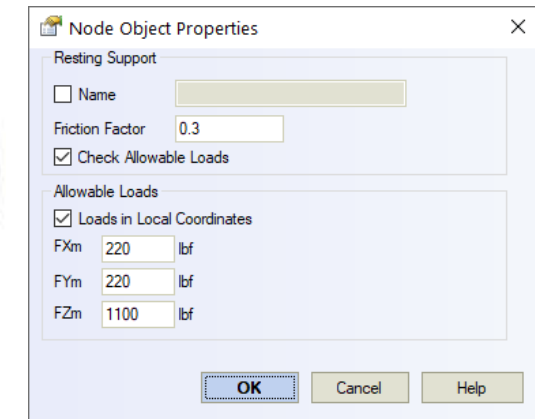


PASS/Start-Prof | Piping Model Creation



Supports Are Available as Templates

Resting Support Object



Automatically Checks:

- Allowable Loads
- Lift Off

Calculate Loads in Global and Local Coordinate Systems




PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

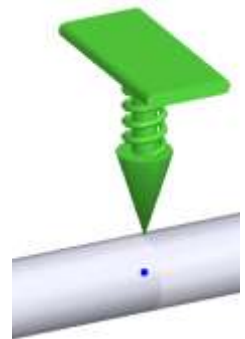


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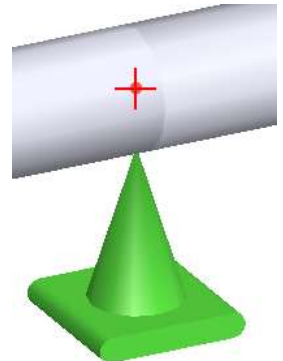
- Automatic Variable Spring Selection
- Automatic Constant Spring Selection



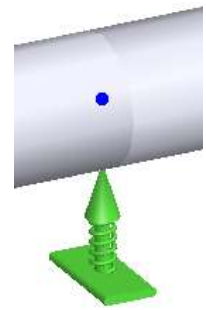
Anchor



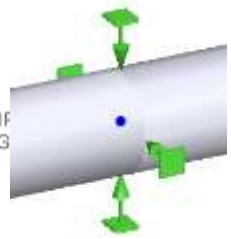
Spring Hanger



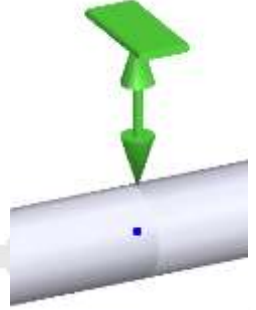
Hinged Anchor




Spring Support



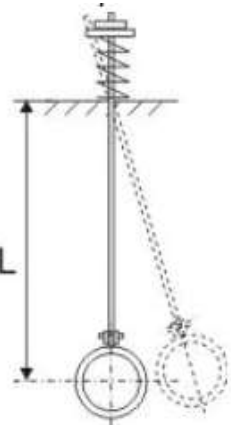
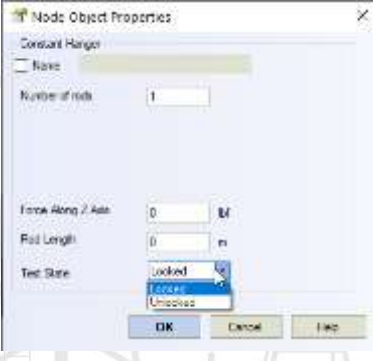
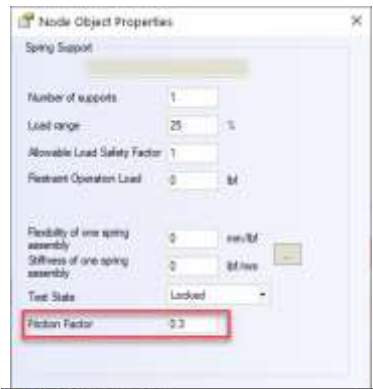
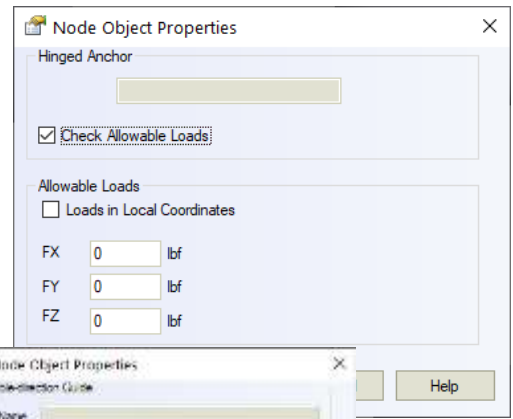
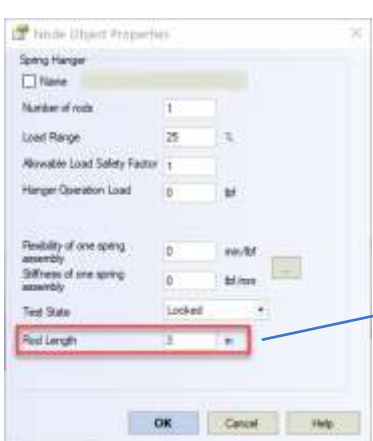
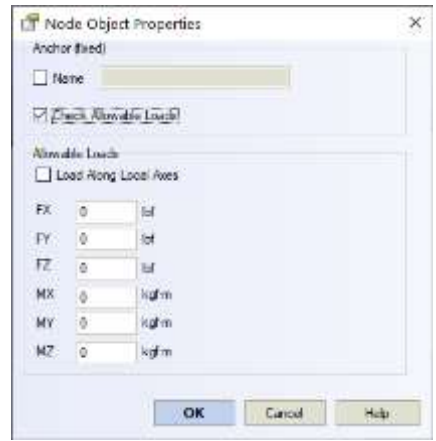
Guide Support



Constant Hanger

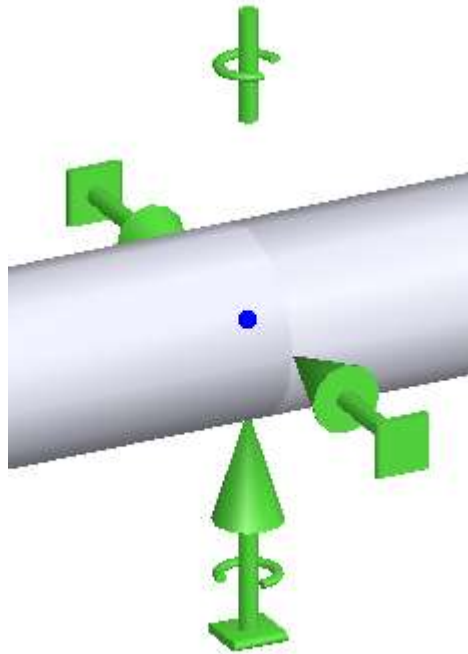


PIPING AND EQUIP
ANALYSIS & SIZING



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Custom Non-Standard Restraint Object



Non-standard Restraint

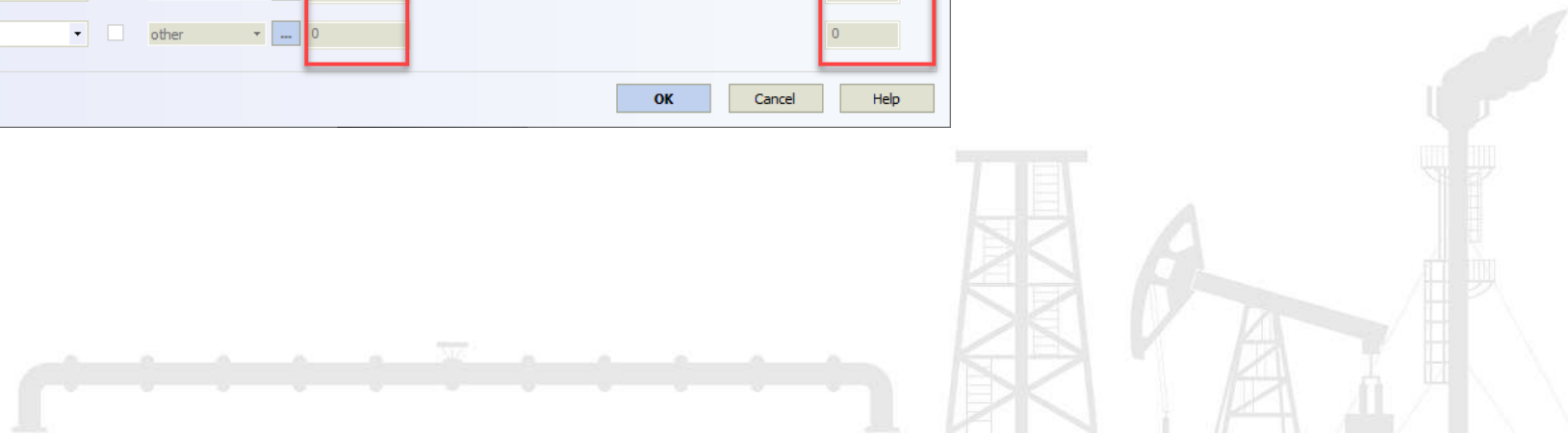
Name:

Support N 1 Precompression Spring, X: 0 lbf Test State: Unlocked Local Axes of the Pipe: Pipe 31-52
Precompression Spring, Y: 0 lbf Check Allowable Loads
Precompression Spring, Z: 0 lbf Use Gaps

Linear restraints								
	Local Axes	Restraint Direction	Flexibility, mm/lbf	Rod Length, m	Frict. Factor	Gap +, mm	Gap -, mm	Allowable Load, lbf
1.	<input type="checkbox"/>	+Ym Horizontal	0	0	0.3	0	0	0
2.	<input checked="" type="checkbox"/>	-Zm Ver/Horz	0	0	0.3	0	0	0
3.	<input type="checkbox"/>	other	0	0	0	0	0	0

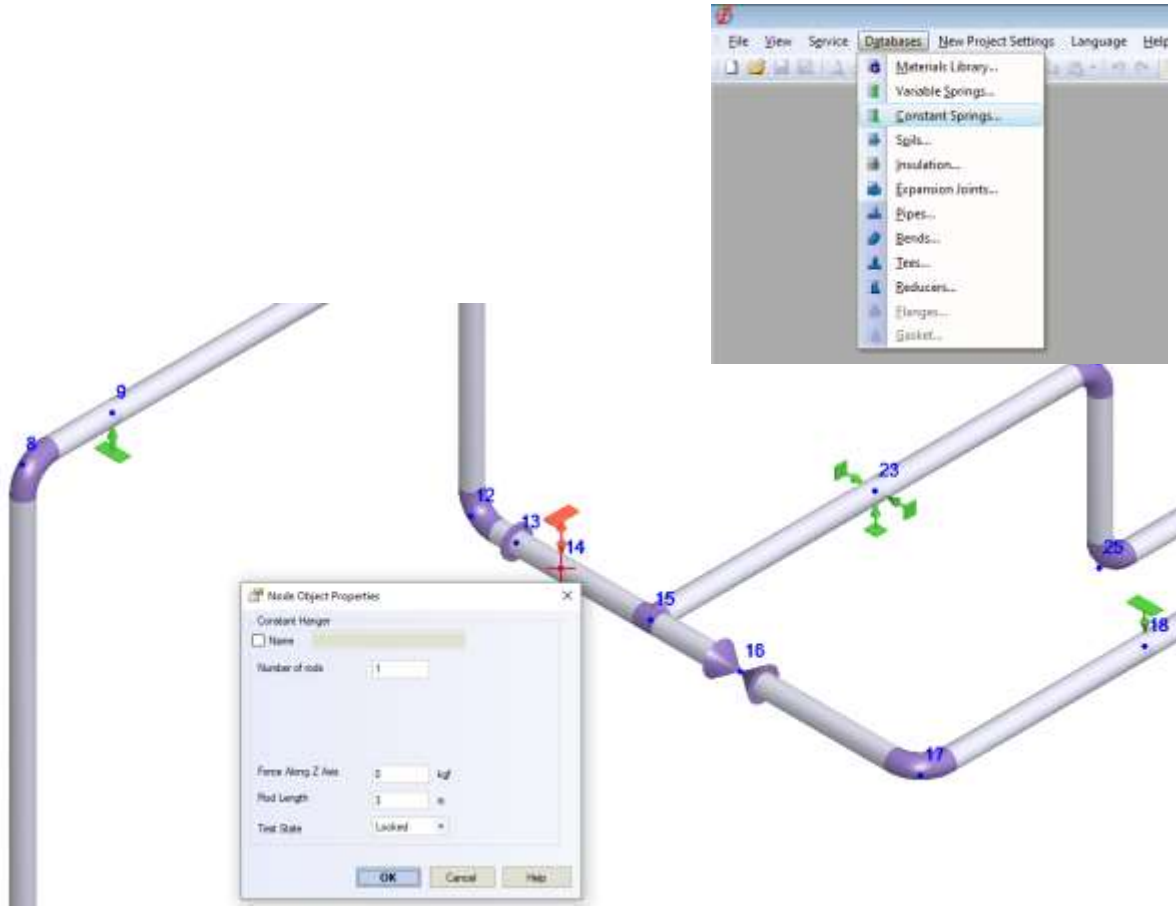
Rotational restraints				
	Local Axes	Restraint Direction Around Axis	Flexibility, °/kgf·m	Allowable Load, kgf·m
4.	<input type="checkbox"/>	+Z	0	0
5.	<input type="checkbox"/>	other	0	0
6.	<input type="checkbox"/>	other	0	0

OK Cancel Help



PASS/Start-Prof | Piping Model Creation

Automatic selection of constant effort hangers and supports



Constant Hangers and Supports

Standards: WITZEMANN

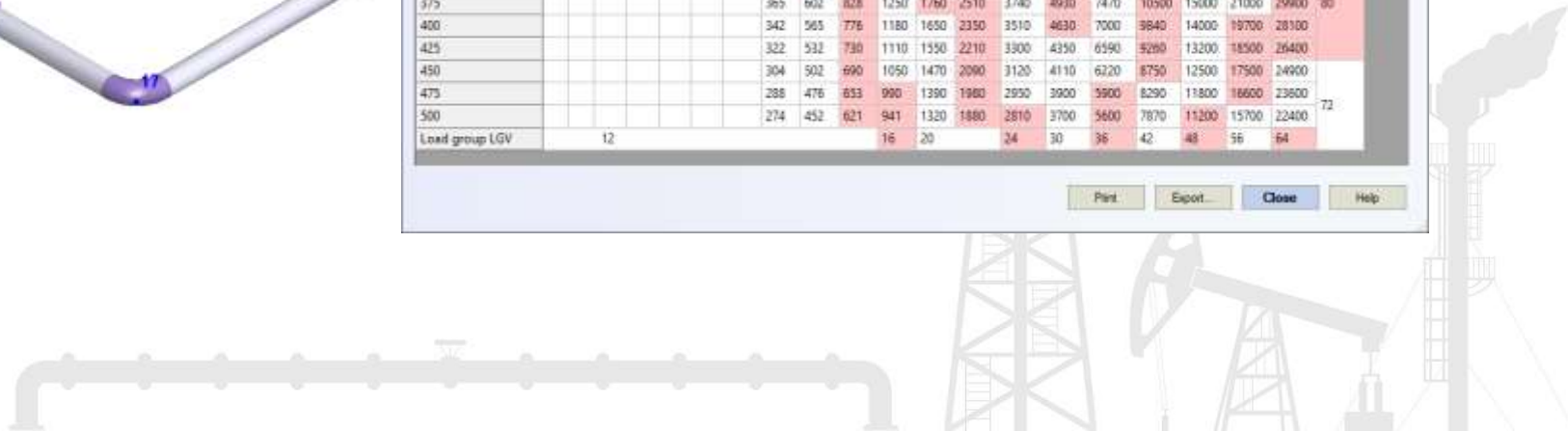
Restraint Type: Hanger

CH size

Nominal size	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Load group LGV				
Maximum required load, kgf																			
50																			
60	39	78	154	310	540	930	1540	2280	3770										
70	33	67	132	266	463	797	1320	1960	3230	4430	6100								
80	29	59	116	233	405	698	1150	1710	2820	3880	5880								
90	26	52	103	207	360	620	1030	1520	2510	3450	5230	7330	10500						
100	23	47	92	186	324	558	924	1370	2280	3100	4700	6600	9410	14000					
110	21	43	84	169	295	507	840	1250	2050	2820	4280	6000	8550	12800					
120	20	39	77	155	270	465	770	1140	1880	2590	3920	5500	7940	11700	15400				
130	18	36	71	143	249	429	710	1050	1740	2390	3620	5080	7240	10800	14200				
140	17	33	66	133	231	399	660	978	1610	2220	3360	4710	6720	10000	13200				
150	16	31	62	124	216	372	616	913	1510	2070	3140	4400	6270	9350	12300				
160	15	29	58	118	203	349	577	856	1410	1940	2940	4120	5880	8770	11800				
170	14	28	54	109	191	326	543	806	1330	1830	2770	3880	5530	8250	10900				
180	13	26	51	103	180	310	513	761	1260	1720	2610	3670	5230	7790	10300				
190	12	25	49	98	171	294	486	721	1190	1630	2480	3470	4950	7380	9740				
200	12	23	46	93	162	279	462	685	1130	1550	2350	3300	4700	7010	9250				
225	10	21	41	83	144	248	410	609	1000	1380	2090	2930	4180	6230	8220				
250	9	19	37	74	130	223	369	548	904	1240	1880	2640	3760	5610	7400				
275	9	17	34	68	118	203	336	498	821	1130	1710	2400	3420	5100	6730				
300	8	16	31	62	108	186	308	457	753	1030	1570	2200	3140	4680	6170				
325																			
350																			
375																			
400																			
425																			
450																			
475																			
500																			
Load group LGV	12									16	20		24	30	36	42	48	56	64

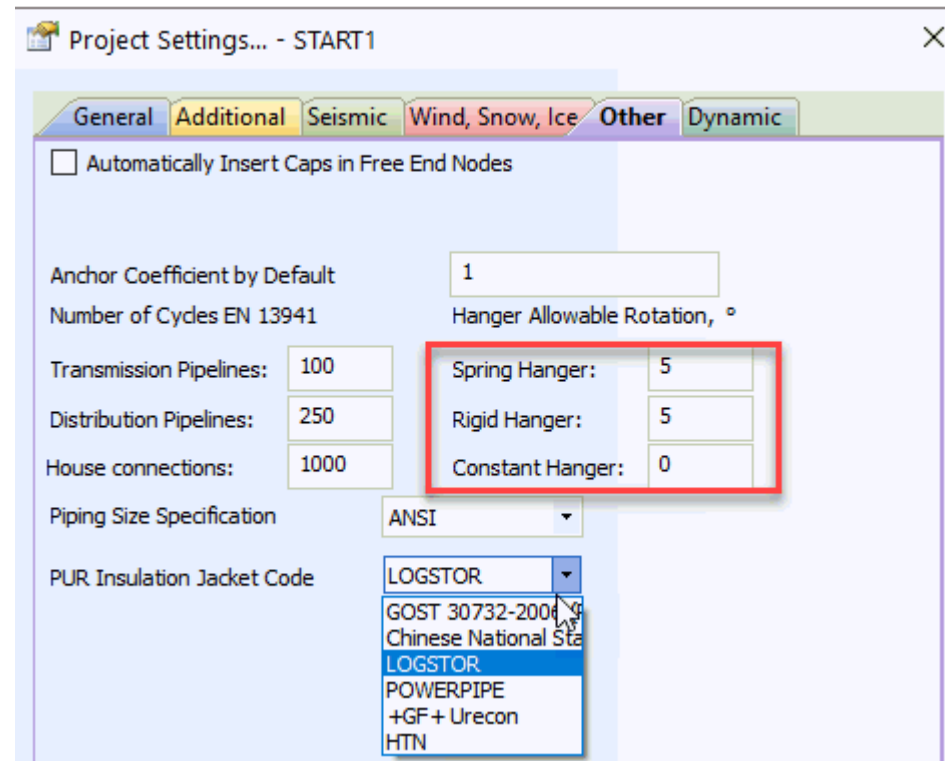


PIPING AND EQUIPMENT ANALYSIS & SIZING SUITE



PASS/Start-Prof | Piping Model Creation

User can enter the custom hanger allowable rotation angle for different types of hangers. START-PROF automatically check the hanger rotation angle and show the note message after analysis if restriction is violated.

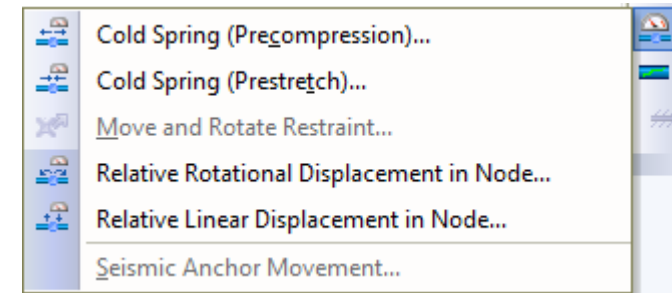
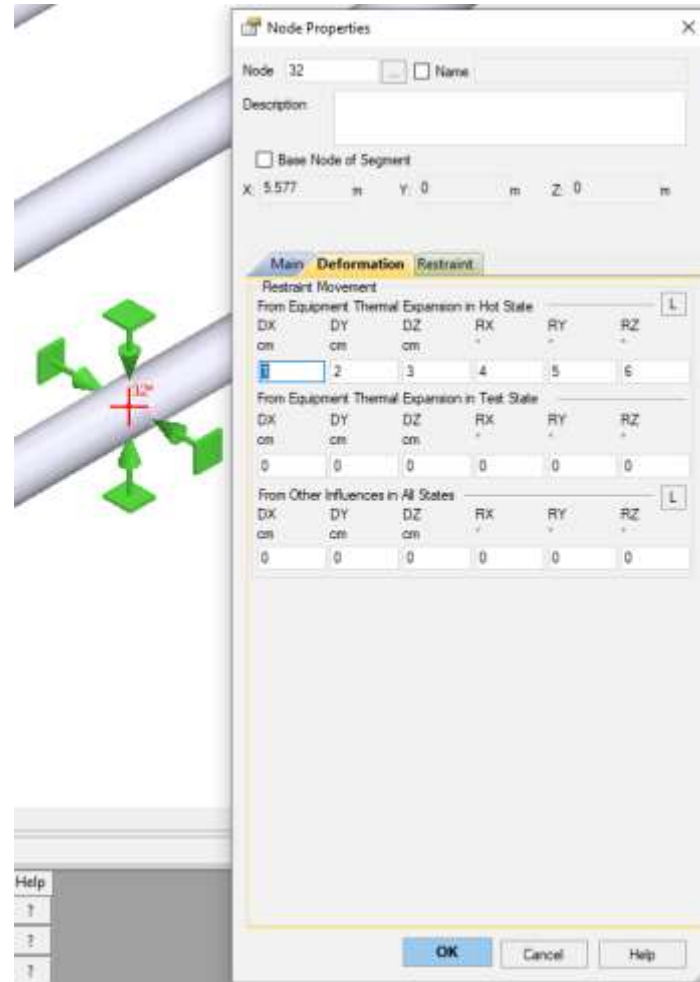


PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE



PASS/Start-Prof | Piping Model Creation

To specify support movement, just add displacement object to the support object

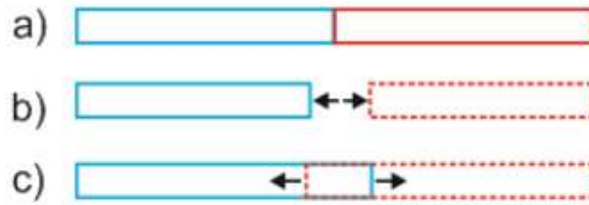
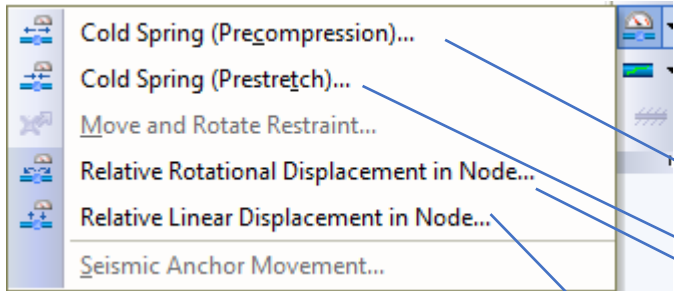


PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

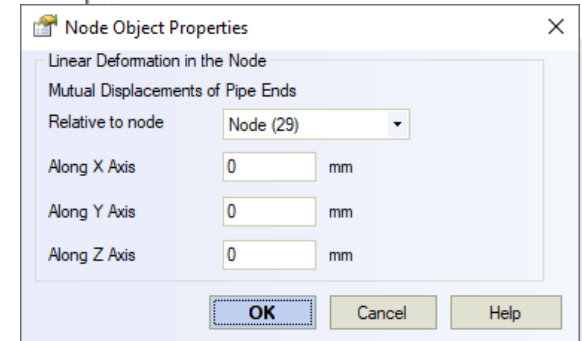
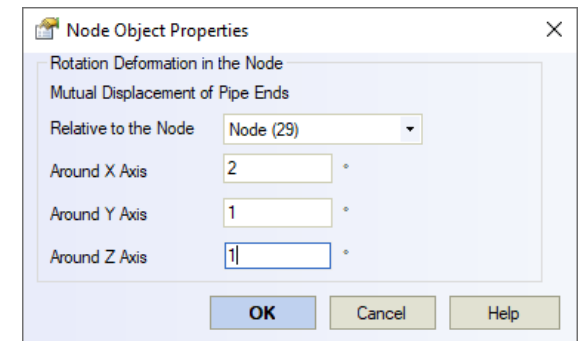
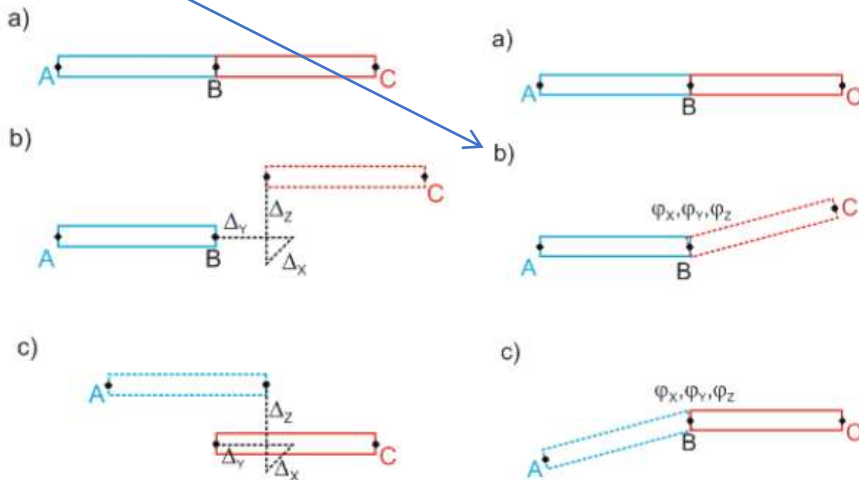
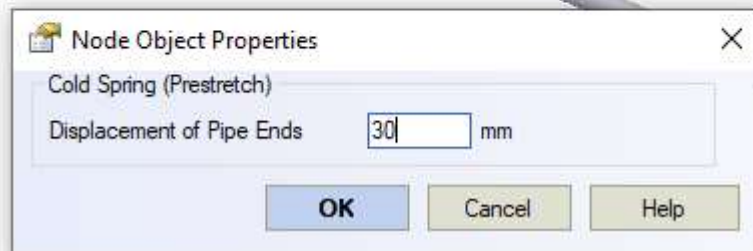


PASS/Start-Prof | Piping Model Creation

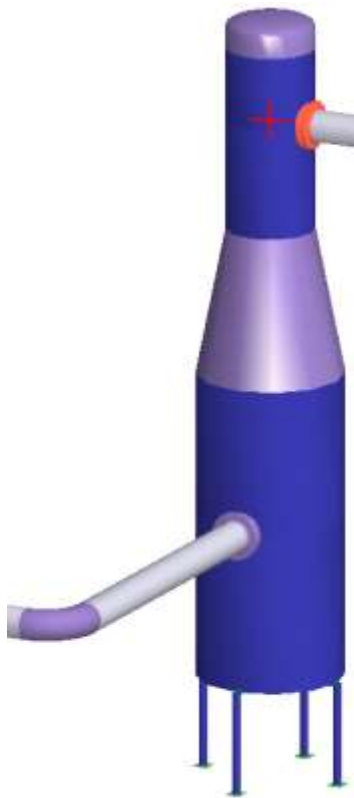
To specify the cold spring (cold pull, pre-stretch), just add the cold spring object in the node



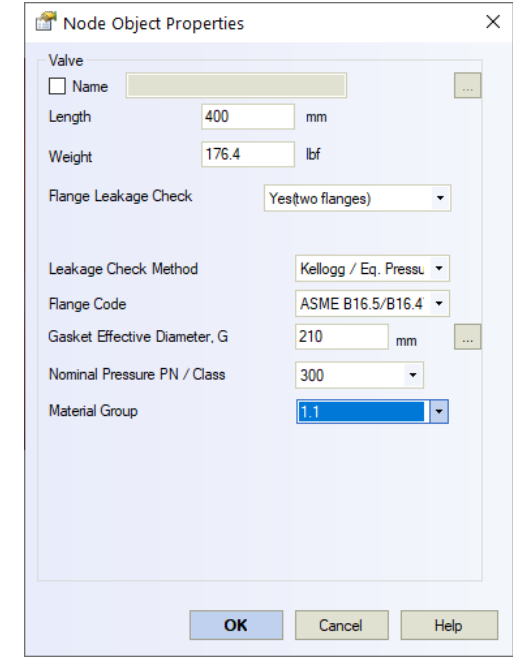
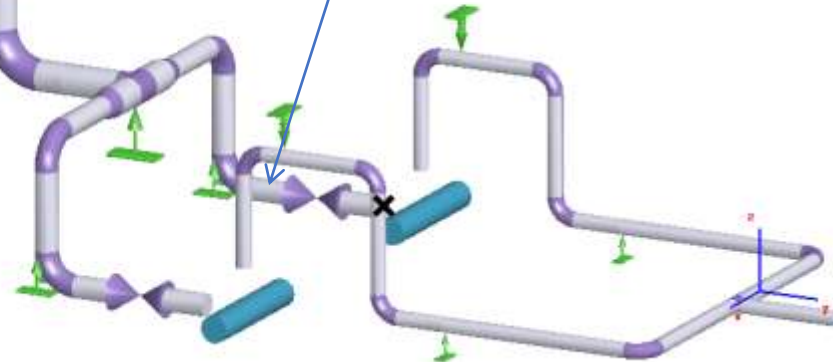
Also pre-compression, and relative rotational or linear displacements of the pipe ends



PASS/Start-Prof | Piping Model Creation



Valve Object



Automatic Flange Leakage Check

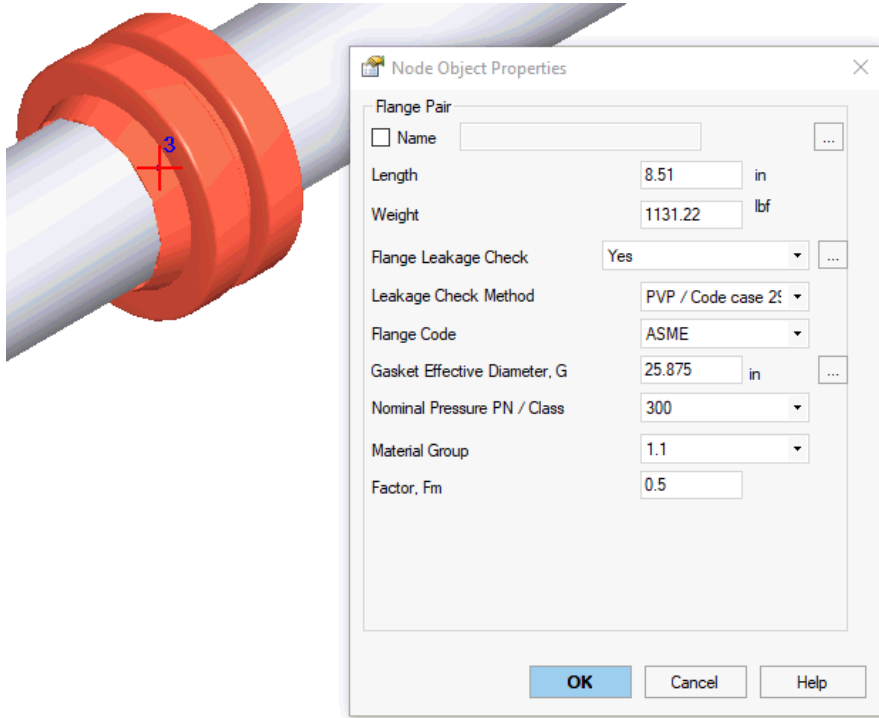


PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE



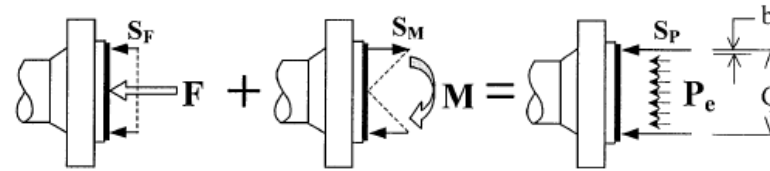
PASS/Start-Prof | Piping Model Creation

Flange Object



Automatic Flange Leakage Check:

- Equivalent pressure / Kellogg Method
- Code Case 2901 / PVP2013-97814 Method
- DNV Method
- NC 3658.3 Method



Input Flange leakage

Operating Mode: 1 'Operation mode' (0) Submode: Operation (all loads)

Node Number	Object	Flange on the side of node	Pipe outside diameter, (mm)	Temperature, (°C)	Axial Force, (kgf)	Bending Moment, (kgf-m)	Parameters	Condition, (MPa)			Notes
								calculated	allowable	%	
3	Flange Pair	-	219.08	400	-1000	1499.98	1.60 MPa	4.29 MPa	17.36 MPa	24.70	

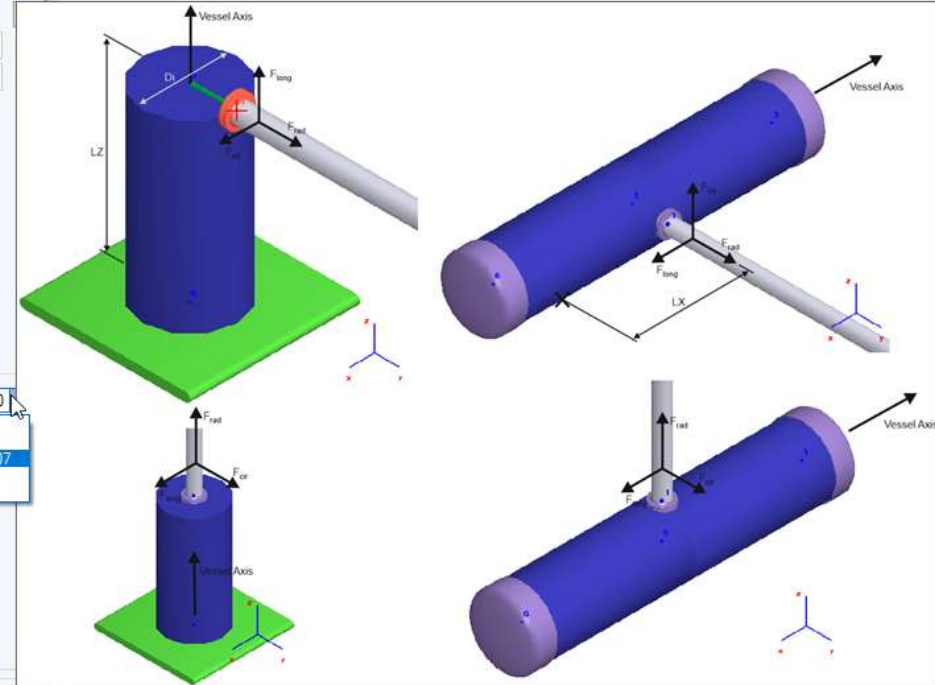
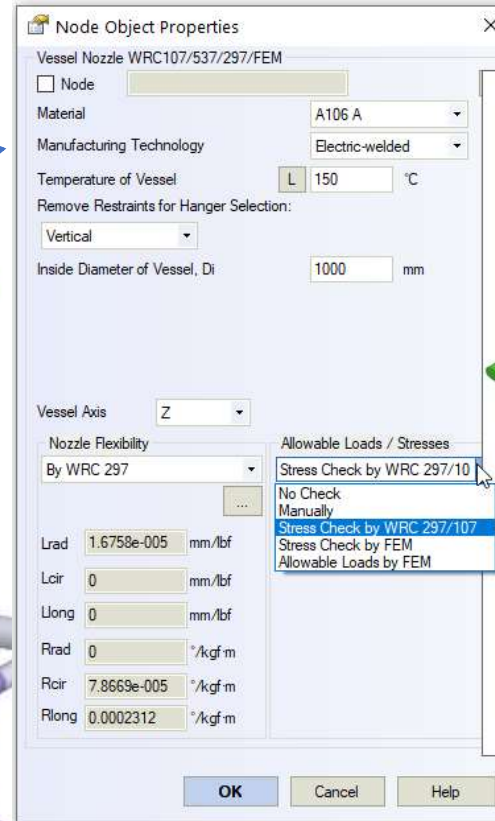


PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE



PASS/Start-Prof | Piping Model Creation

Vessel Nozzle Object

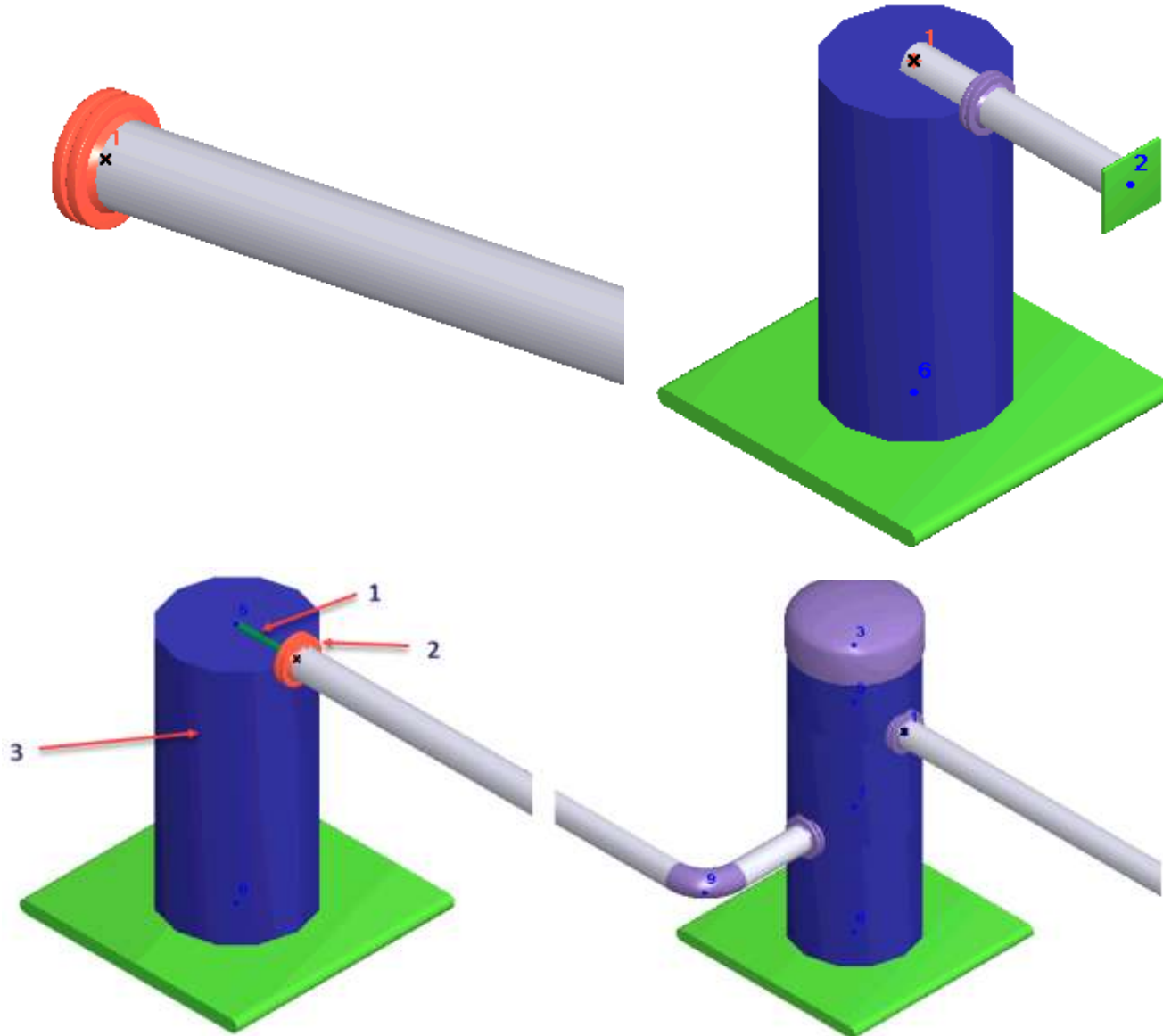


- Compute Flexibility (WRC 297, BS 5500, FEA)
- Check Allowable Loads
- Check Nozzle Stress (WRC 537/297, FEA using NOZZLE-FEM)



PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

PASS/Start-Prof | Piping Model Creation



Equipment - Operating Mode: 1 Padoseel paaser (0) - Operating W+P+T - Show Equations

Object	Start End node	Type	DN, mm	Prod, kgf	Fci, kgf	Flong, kgf	FR, kgf	Mrad, kgf-cm	Mcic, kgf-cm	Mlong, kgf-cm	MRL, kgf-cm	Sum
Vessel Nozzle WRC107/537/297/FEM	Node (1)	calculated allowable	219	-196.30 58.50								0.00

Nozzle-FEM 3.1.0.0 (c) 2006-2019 by NTP Truboprovod

STRESS ON CYLINDRICAL SHELL AS PER WRC 537(107)
(In the zone at the nozzle):

Location	AU	AL	BU	BL	CU	CL	DU	DL
Circ. PI-Pb	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Circ. PI-Pb-Q	2.9	-1.3	3.1	-1.4	3.9	-2.5	3.9	-2.5
Long. PI-Pb	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Long. PI-Pb-Q	3.9	-2.5	4.0	-2.0	3.0	-1.3	3.0	-1.3
Shear PI-Pb	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shear PI-Pb-Q	-0.0	-0.0	0.0	0.0	0.0	0.0	0.0	0.0
PI-Pb (TOTAL)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PI-Pb-Q (TOTAL)	3.9	2.5	4.0	2.0	3.9	2.5	3.9	2.5

CONCLUSION:
Stress Int., Max S1, Allowable, Result
MPa, MPa
PI-Pb (TOTAL), 0.0, 165.5, Passed
PI-Pb-Q (TOTAL), 4.0, 330.9, Passed

STRESS ON NOZZLE JUNCTION ZONE AS PER WRC 297

Location	AU	AL	BU	BL	CU	CL	DU	DL
Circ. PI-Pb	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Circ. PI-Pb-Q	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Long. PI-Pb	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Long. PI-Pb-Q	18.5	-17.6	19.2	-18.2	18.8	-17.9	18.8	-17.9
Shear PI-Pb	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shear PI-Pb-Q	-0.1	-0.1	0.1	0.1	0.0	0.0	0.0	0.0
PI-Pb (TOTAL)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PI-Pb-Q (TOTAL)	18.5	18.7	19.2	19.4	18.8	19.0	18.8	19.0

CONCLUSION:
Stress Int., Max S1, Allowable, Result
MPa, MPa
PI-Pb (TOTAL), 0.0, 165.5, Passed
PI-Pb-Q (TOTAL), 19.4, 330.9, Passed

RESUME:
Maximum utilization factor (per): 5.0%
Strength conditions are satisfied

Nozzle-FEM 3.1.0.0 (c) 2006-2019 by NTP Truboprovod

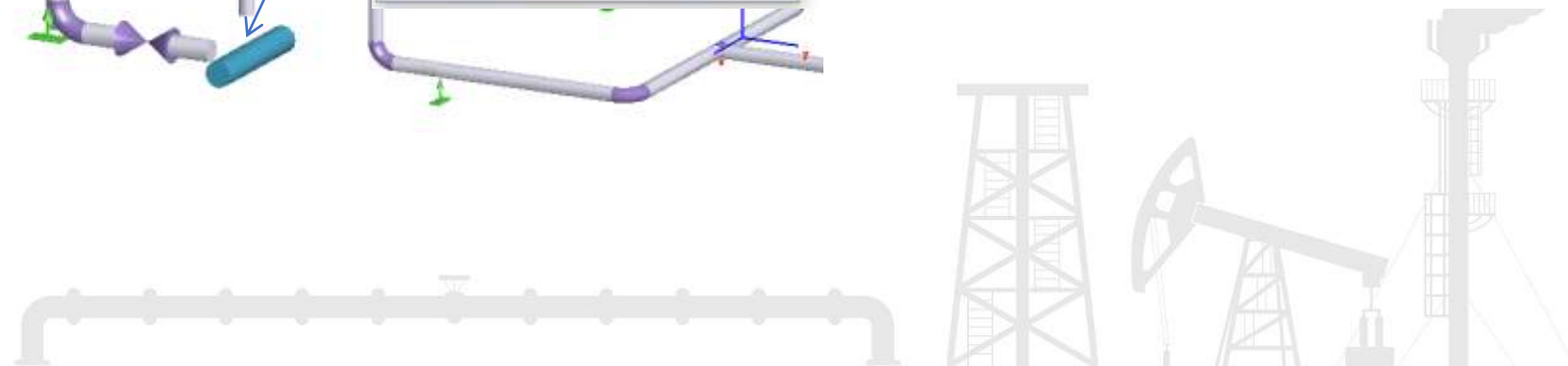
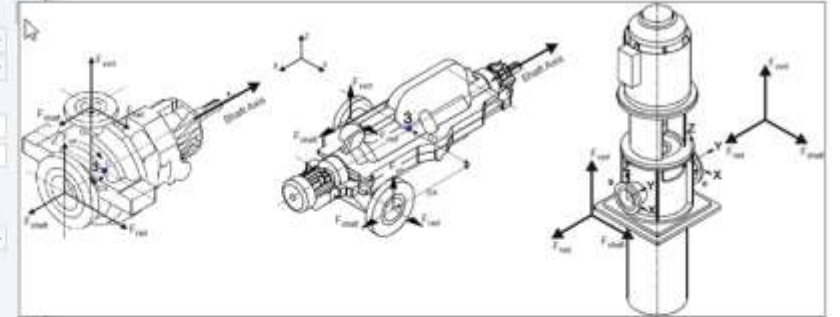
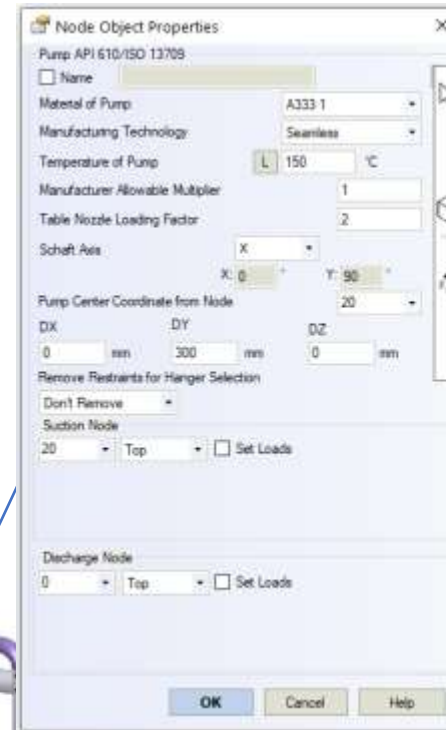


PASS/Start-Prof | Piping Model Creation

Pump Object

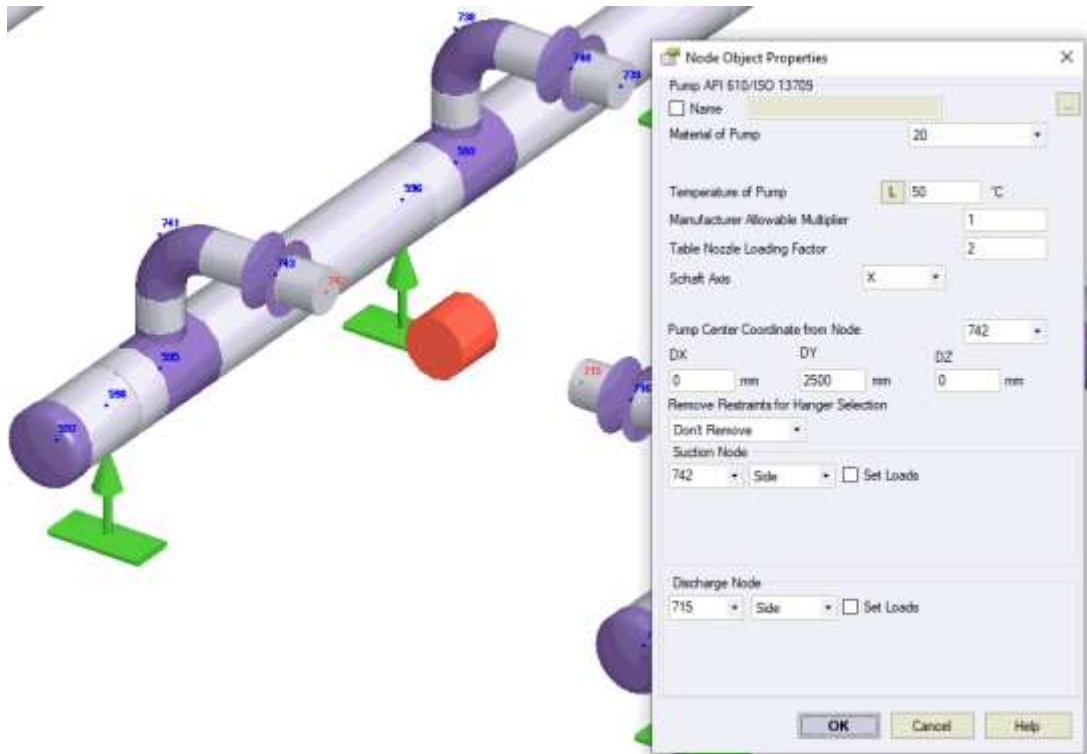


PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE



PASS/Start-Prof | Piping Model Creation

- Object "Pump API 610/ISO 13709", allows to automatically model the pumps, consider thermal movements of the nozzles, checks allowable loads using API 610 and ISO 13709
- Object "Pump ISO 9905"
- Object "Pump ISO 5199"



a) The individual component forces and moments acting on each pump nozzle flange shall not exceed the range specified in Table 5 (T4) by a factor of more than 2.

b) The resultant applied force (F_{RSA} , F_{RDA}) and the resultant applied moment (M_{RSA} , M_{RDA}) acting on each pump-nozzle flange shall satisfy the appropriate interaction equations as given in Equations (F.1) and (F.2):

$$[F_{RSA}/(1.5 \times F_{RST4})] + [M_{RSA}/(1.5 \times M_{RST4})] < 2 \quad (F.1)$$

$$[F_{RDA}/(1.5 \times F_{RDT4})] + [M_{RDA}/(1.5 \times M_{RDT4})] < 2 \quad (F.2)$$

c) The applied component forces and moments acting on each pump nozzle flange shall be translated to the centre of the pump. The magnitude of the resultant applied force, F_{RCA} , the resultant applied moment, M_{RCA} , and the applied moment shall be limited by Equations (F.3) to (F.5). (The sign convention shown in Figures 21 through 25 and the right-hand rule should be used in evaluating these equations.)

$$F_{RCA} < 1.5(F_{RST4} + F_{RDT4}) \quad (F.3)$$

$$M_{YCA} < 2.0(M_{YST4} + M_{YDT4}) \quad (F.4)$$

$$M_{RCA} < 1.5(M_{RST4} + M_{RDT4}) \quad (F.5)$$

where

$$F_{RCA} = [(F_{XCA})^2 + (F_{YCA})^2 + (F_{ZCA})^2]^{0.5}$$

where

$$F_{XCA} = F_{XSA} + F_{XDA}$$

$$F_{YCA} = F_{YSA} + F_{YDA}$$

$$F_{ZCA} = F_{ZSA} + F_{ZDA}$$

$$M_{RCA} = [(M_{XCA})^2 + (M_{YCA})^2 + (M_{ZCA})^2]^{0.5}$$

where

$$M_{XCA} = M_{XSA} + M_{XDA} - [(F_{YSA} \times z) + (F_{YDA} \times z) - (F_{ZSA} \times y) - (F_{ZDA} \times y)] / 1000$$

$$M_{YCA} = M_{YSA} + M_{YDA} + [(F_{XSA} \times z) + (F_{XDA} \times z) - (F_{ZSA} \times x) - (F_{ZDA} \times x)] / 1000$$

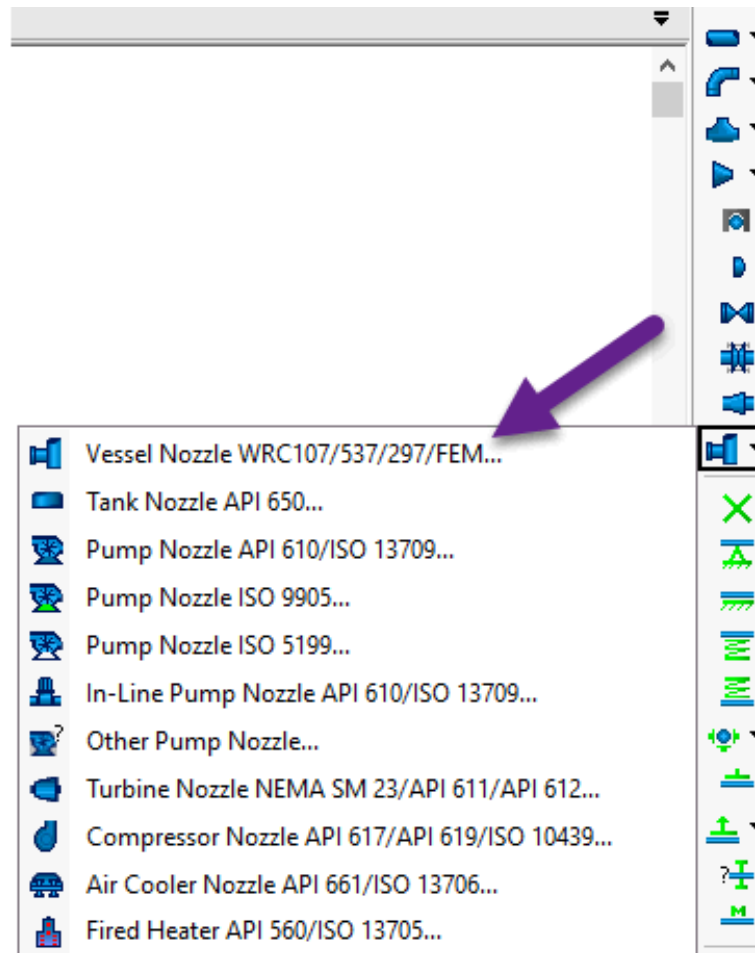
$$M_{ZCA} = M_{ZSA} + M_{ZDA} - [(F_{XSA} \times y) + (F_{XDA} \times y) - (F_{YSA} \times x) - (F_{YDA} \times x)] / 1000$$

Object	Start End node	Type	DN, mm	Frad, N	Fcir, N	Flong N	FR, N	Mrad, N-m	Mcir, N-m	Mlong, N-m	MR, N-m	Sum	Notes
Pump API 610/ISO 13709	Node (1)	Suction, Side	200	-7333	5887	-29592	31050	-2626.53	18306.88	4598.20	19057.39	2.84	1
				9780	6220	7560	6920	3520	5160	7060	4710		
	Node (3)	Discharge, Side	200	1440505	-173	0	1440505	0		28.89	28.89	69.39	1
				9780	6220	7560	6920	3520	5160	7060	4710		
		Summary Loads		1433173	5714	-29592	1433490	-2626.53	33102.90	7657.21	34078.35		1
						20760							

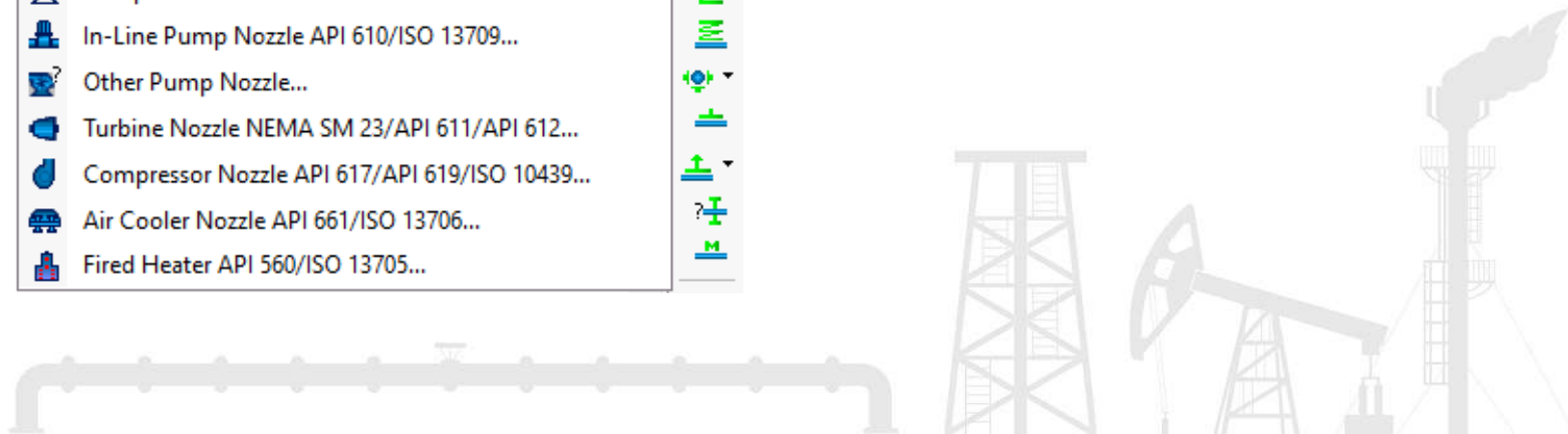
[My_sum]=2*([MradT1] + [MradT2])=2*(1760+1760)=7040 N-m

PASS/Start-Prof | Piping Model Creation

Full Scope of Equipment Objects for Power and Process Piping

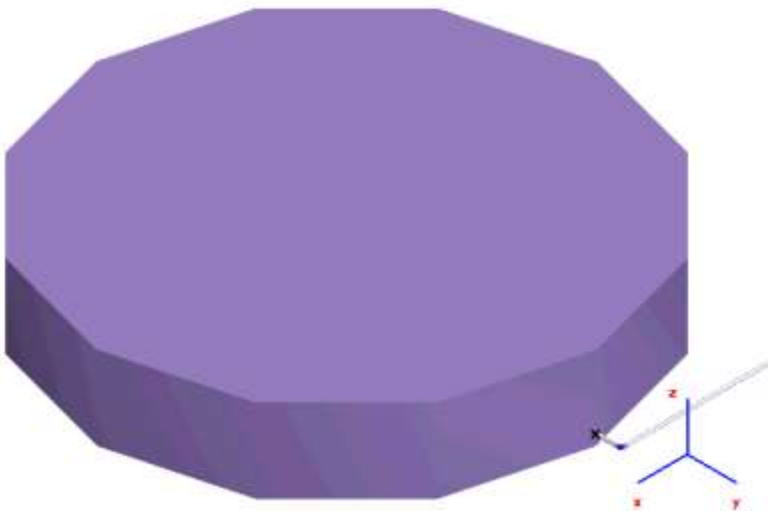
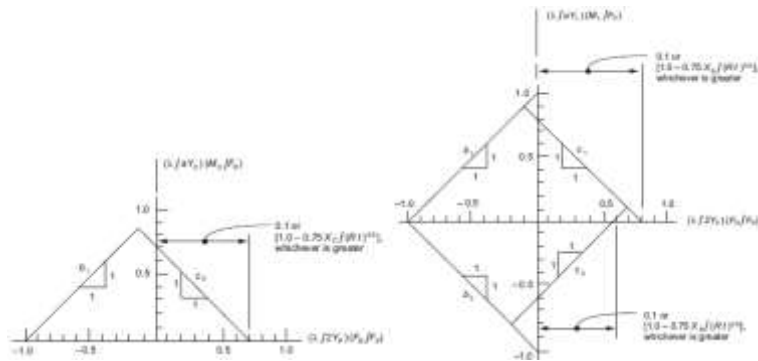


PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE



PASS/Start-Prof | Piping Model Creation

Object "Tank Nozzle API 650", allows to automatically model the storage tank nozzles. Automatically model flexibilities using API 650, thermal movements of the nozzle, movements and rotation due to tank bulging effect using API 650, tank settlement, automatically checks allowable loads using API 650 and STO-SA 03-002-2009.



Node Object Properties

Tank API 650

Name

Material of Tank: 20

Manufacturing Technology: Seamless

Temperature of Tank: L 40 °C

Remove Restraints for Hanger Selection

Vertical: X Y Z RX RY RZ

Radius of Tank, R: 40 m

Length from Bottom to Nozzle Axis, L: 0.63 m

Wall Thickness of Tank, t: 34 mm

Outer Diameter of Nozzle, 2a: 610 mm

Reinforcement: On Shell

Filling Height, H: L 5 m

Density of Product, G: 1000 kg/m³

Settlement of Tank, e: L 200 mm

Nozzle Flexibility: Allowable Loads

By API 650: Lrad 0.3042880744 mm/f

Lair 0 mm/f

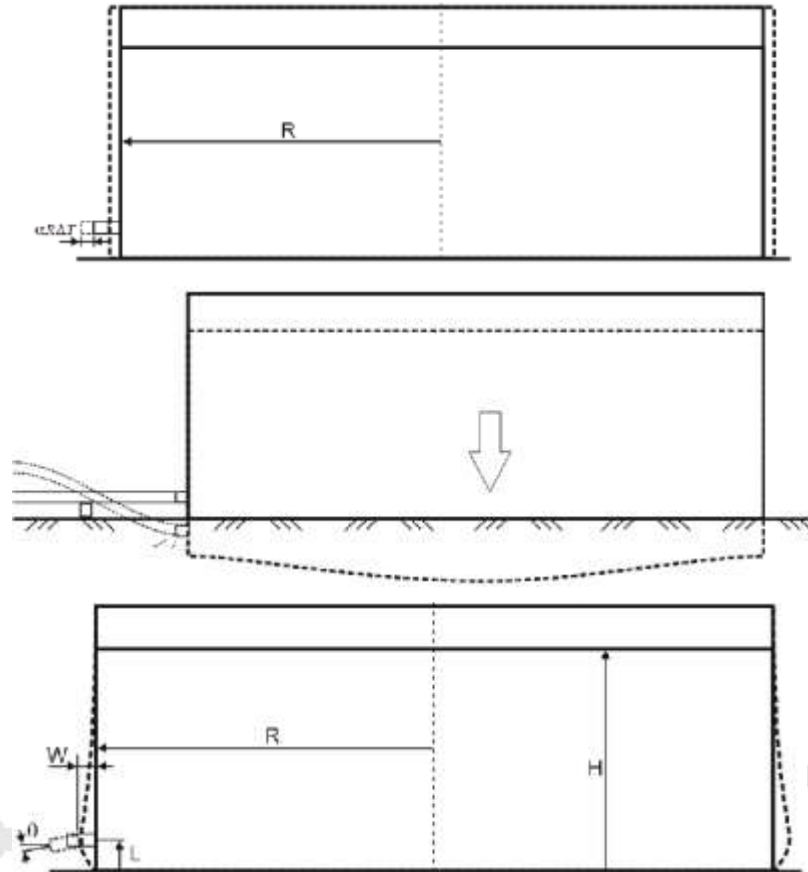
Llong 0 mm/f

Rrad 0 rad./f m

Rcir 0.00039594 rad./f m

Rlong 0.00062095 rad./f m

OK Cancel Help



PASS/Start-Prof | Piping Model Creation

Object "In-line Pump", allows to automatically model the vertical in-line pumps, consider thermal movements of the nozzles, checks allowable loads using API 610 and ISO 13709.

Node Object Properties

In-Line Pump API 610/ISO 13709

Code: API 610

Length: 400 m Weight: 50 N

Material of Pump: 20

Manufacturing Technology: Seamless

Temperature of Pump: L 100 °C

Factor for Temperature: 1

Nozzle Loading Factor: 2

Pump Center of Gravity Coordinate from Node: 3

DX: 0 mm DY: 500 mm DZ: 0 mm

Suction Node: 1

Discharge Node: 2

OK Cancel Help



For SI units, Equations (F.6) to (F.8) apply:

$$\sigma_p = (\sigma/2) + (\sigma^2/4 + r^2)^{0.5} < 41 \quad (F.6)$$

$$\alpha_1 = [1,27F_y/(D_o^2 - D_i^2)] + [10\,200D_o(M_x^2 + M_z^2)^{0.5}]/(D_o^4 - D_i^4) \quad (F.7)$$

$$r = [1,27(F_x^2 + F_z^2)^{0.5}]/(D_o^2 - D_i^2) + [5\,100D_o(M_y)]/(D_o^4 - D_i^4) \quad (F.8)$$

For USC units, Equations (F.9) to (F.11) apply:

$$\sigma_p = (\sigma/2) + (\sigma^2/4 + r^2)^{0.5} < 5\,950 \quad (F.9)$$

$$\alpha_1 = [1,27F_y/(D_o^2 - D_i^2)] + [122D_o(M_x^2 + M_z^2)^{0.5}]/(D_o^4 - D_i^4) \quad (F.10)$$

$$r = [1,27(F_x^2 + F_z^2)^{0.5}]/(D_o^2 - D_i^2) + [61D_o(M_y)]/(D_o^4 - D_i^4) \quad (F.11)$$

where

- σ_p is the principal stress, expressed in megapascals (pounds-force per square inch);
- α_1 is the longitudinal stress, expressed in megapascals (pounds-force per square inch);
- r is the shear stress, expressed in megapascals (pounds-force per square inch);
- F_x is the applied force on the X axis;
- F_y is the applied force on the Y axis;
- F_z is the applied force on the Z axis;

Input Equipment

Operating Mode: 1 'main mode' (0) Load Case: Operating W+P+T Show Equations ?

Object	Start End node	Type	DN, mm	Frad, N	Fcir, N	Flong N	FR, N	Mrad, N·m	Mcir, N·m	Mlong, N·m	MR, N·m	Sum	Notes
In-Line Pump API 610/ISO 13709	Node (1)	Suction, Side	219	-1200421		-28			47.98			0.00	1
				7560	9780	6220		7060	3520	5160			
	Node (2)	Discharge, Side	219	-1200421		-27			47.98			0.00	1
					7560	9780	6220		7060	3520	5160		

PASS/Start-Prof | Piping Model Creation

Object "Compressor API 617/API 619/ISO 10439", allows to automatically model the compressors, consider thermal movements of the nozzles, checks allowable loads using API 617 and ISO 10439.

Node Object Properties

Compressor API 617/ISO 10439

Name

Material of Compressor: 20

Manufacturing Technology: Seamless

Temperature of Compressor: L 100 °C

Factor for Allowable Loads: 1

Shaft Axis: X

Center of Compressor Coordinate from Node: 3

DX 0 mm DY 500 mm DZ 0 mm

Remove Restraints for Hanger Selection: Don't Remove

Suction Nozzle: 1 Set Manual Loads

Discharge Node: 3 Set Manual Loads

Additional Nozzle 1: 0 Set Manual Loads

Additional Nozzle 2: 0 Set Manual Loads

OK Cancel Help

In SI units:
 $F_r = 1.09 M_y \leq 54.1 D_o$

In U.S. customary (USC) units:
 $3 F_r + M_y \leq 927 D_o$

F_r is the resultant force, Newtons (N) (see Figure F.1);
 M_y resultant moment, in Newton-meters (N-m) from Figure F.1;

$F_r = \sqrt{F_x^2 + F_z^2}$

$M_y = \sqrt{M_x^2 + M_z^2}$

For sizes greater than 200 mm (8 in.), use the following values.

In SI units:
 $D_o = \frac{(400 + D_{mm})}{3}$ (mm)

In USC units:
 $D_o = \frac{(16 + D_{in})}{3}$ (in.)

In SI units:
 $F_r + 1.64 M_y \leq 40.4 D_o$

In USC units:
 $2 F_r + M_y \leq 462 D_o$



In SI units:
 $F_r + 1.64 M_y \leq 40.4 D_o$ (F.5a)

In USC units:
 $2 F_r + M_y \leq 462 D_o$ (F.5b)

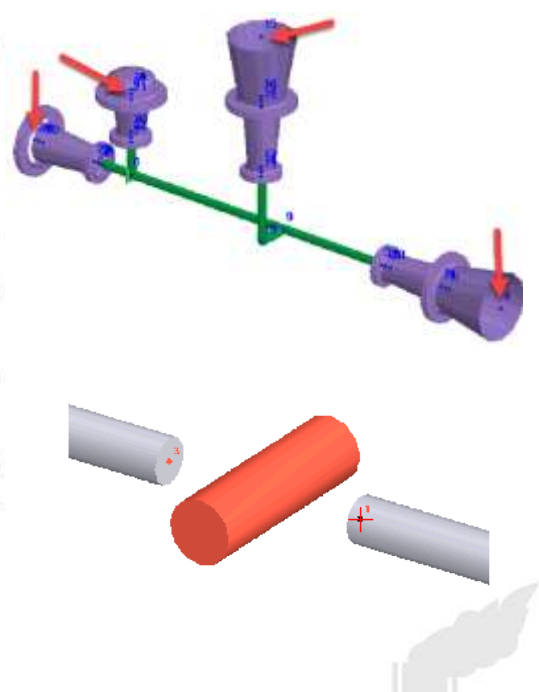
where:
 F_r is the combined resultant of inlet, sidestream, and discharge forces, Newtons (N);
 M_y is the combined resultant of inlet, sidestream, and discharge moments, and moments resulting from forces, Newton-meters (N-m);
 D_o is the diameter [mm (in.)] of one circular opening equal to the total areas of the inlet, sidestream, and discharge openings. If the equivalent nozzle diameter is greater than 230 mm (9 in.), use a value of D_o equal to the following.

In SI units:
 $D_o = \frac{(460 + \text{Equivalent Diameter})}{3}$ (mm) (F.6a)

In USC units:
 $D_o = \frac{(18 + \text{Equivalent Diameter})}{3}$ (in.) (F.6b)

The absolute value of the individual components (Figure F.1) of these resultants should not exceed the following.

In SI units:
 $F_x = 16 D_o$ $M_x = 34 D_o$ (F.5a)
 $F_z = 40.5 D_o$ $M_z = 12.3 D_o$
 $F_y = 32.4 D_o$ $M_y = 12.3 D_o$



Input Equipment

Operating Mode: Load Case: 1 "Рабочий режим" (0) Operating W+P+T

Show Equations

Object	Start End node	Type	DN, mm	Frad, N	Fcir, N	Flong, N	FR, N	Mrad, N-m	Mcir, N-m	Mlong, N-m	MR, N-m	Sum	Notes
Compressor API 617/API 619/ISO 10439	Node (1)	Suction, Top	200	-15918	12907	-23209	30962	-2577.83	11010.28	8677.81	14253.98	4.30	1
	Node (3)	Discharge, Top	200	1440505	-173	0	1440505	0		28.89	28.89	133.14	1
	est1												
	est2												
Summary Loads			250.91	1404587	12734	-23209	1424833	-2577.83	22615.01	15246.83	27396.16	144.99	
			8130						886.24	6172.48			

Dc=250.9141 mm
[Fcir]=k1*40.5Dc=1.00*10162.02=10162.02 N

PASS/Start-Prof | Piping Model Creation

Object "Turbine NEMA SM23/API 611/API 612", allows to automatically model the steam turbines, consider thermal movements of the nozzles, checks allowable loads using NEMA SM23, API 611, API 612, ISO 10437.

Node Object Properties

Turbine NEMA SM 23

Name

Material of Compressor: 20

Manufacturing Technology: Seamless

Temperature of Compressor: L 100 °C

Factor for Allowable Loads: 1

Shaft Axis: X

Center of Compressor Coordinate from Node: 3

DX: 0 mm DY: 500 mm DZ: 0 mm

Remove Restraints for Hanger Selection: Don't Remove

Suction Nozzle: 1 Set Manual Loads

Discharge Node: 3 Set Manual Loads

Additional Nozzle 1: 0 Set Manual Loads

Additional Nozzle 2: 0 Set Manual Loads

OK Cancel Help



PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE



PASS/Start-Prof | Piping Model Creation

Object "Other Pump", allows to automatically model the pumps, consider thermal movements of the nozzles, checks allowable loads.

Node Object Properties

Other Pump

Name

Material of Pump: 20

Manufacturing Technology: Seamless

Temperature of Pump: L 100 °C

Shaft Axis: X: 0 ° Y: 90 °

Pump Center Coordinates from Node: 3

DX: 0 mm DY: 500 mm DZ: 0 mm

Remove Restraints for Hanger Selection

Vertical X Y Z RX RY RZ

Suction Node

3	FR	MR			
	N	N-m			
	1	1			
FX	FY	FZ	MX	MY	MZ
N	N	N	N-m	N-m	N-m
1	1	1	1	1	1

Discharge Node

1	FR	MR			
	N	N-m			
	1	1			
FX	FY	FZ	MX	MY	MZ
N	N	N	N-m	N-m	N-m
1	1	1	1	1	1

OK Cancel Help

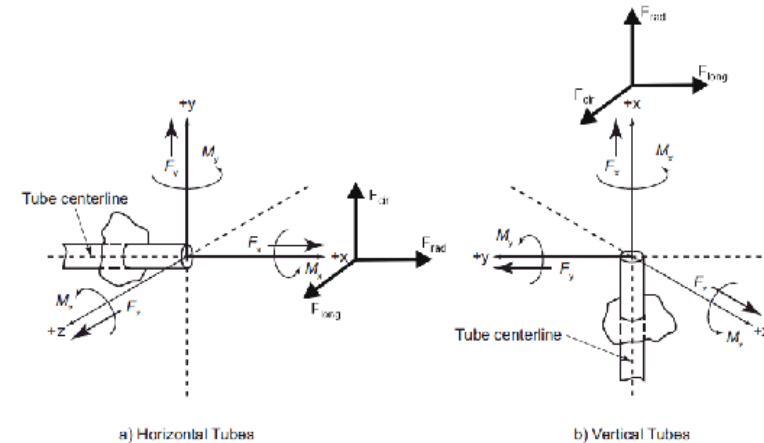
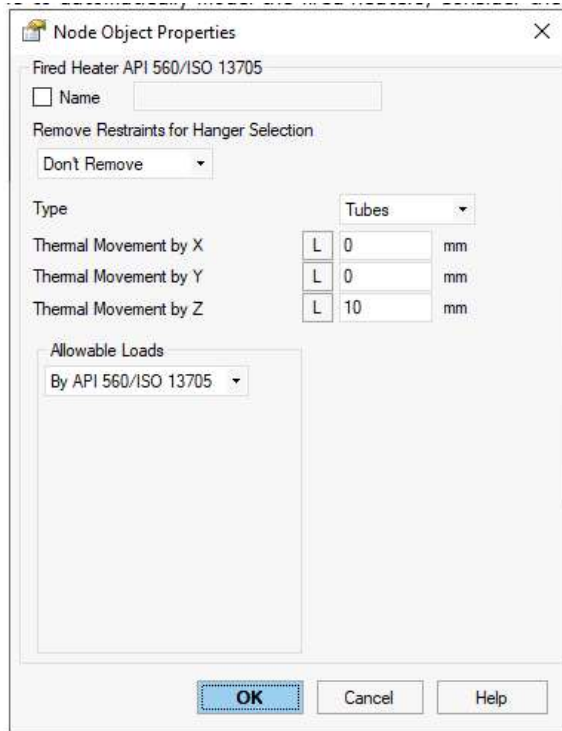


PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE



PASS/Start-Prof | Piping Model Creation

Object "Fired Heater API 560/ISO 13705", allows to automatically model the fired heaters, consider thermal movements of the nozzles, checks allowable loads using API 560 and ISO 13705.



displayed. In the second row the allowable values are displayed.

Object		Start End node	Type	DN, mm	Frad, kgf	Fcir, kgf	Flong, kgf	FR, kgf	Mrad, kgf-cm	Mcir, kgf-cm	Mlong, kgf-cm	MR, kgf-cm	Sum	Notes
Fired Heater API 560/ISO 13705		Node (1)	calculated	219	-96033.70		40605.70			-2029708.86				1
			allowable		133.40	266.90	266.90		11660	8810	8810			



PASS/Start-Prof | Piping Model Creation

Object "Air cooled Heat Exchanger API 661/ISO 13706", allows to automatically model the air cooled heat exchangers, consider thermal movements of the nozzles, checks allowable loads using API 661 and ISO 13706.

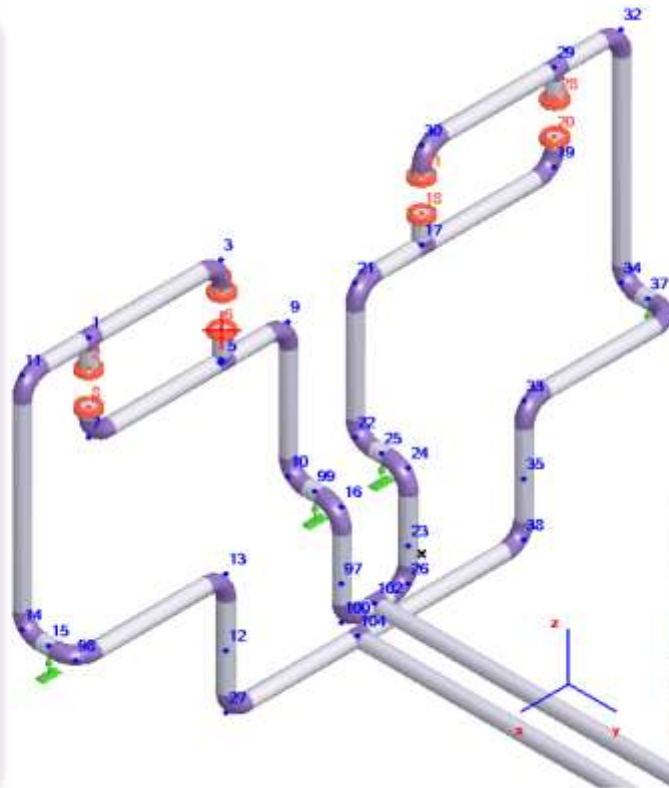
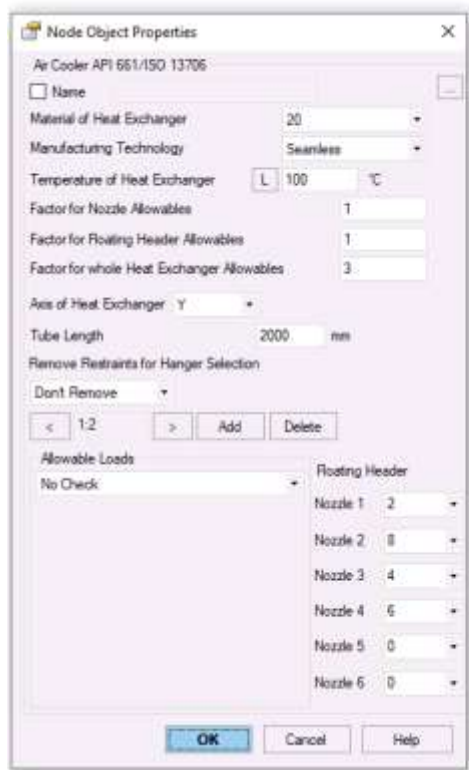


Table 4 — Maximum Allowable Nozzle Loads

Nozzle Size DN (NPS)	Moments N m (ft.lbf)			Forces N (lbf)		
	M_x	M_y	M_z	F_x	F_y	F_z
40 (1 1/2)	110 (80)	150 (110)	110 (80)	670 (150)	1020 (230)	670 (150)
50 (2)	150 (110)	240 (180)	150 (110)	1020 (230)	1330 (300)	1020 (230)
80 (3)	410 (300)	610 (450)	410 (300)	2000 (450)	1690 (380)	2000 (450)
100 (4)	610 (600)	1220 (900)	610 (600)	3340 (750)	2670 (600)	3340 (750)
150 (6)	2140 (1580)	3050 (2250)	1630 (1200)	4000 (900)	5030 (1130)	5030 (1130)
200 (8)	3050 (2250)	6100 (4500)	2240 (1650)	5690 (1280)	13,340 (3000)	8010 (1800)
250 (10)	4070 (3000)	6100 (4500)	2950 (1680)	6670 (1500)	13,340 (3000)	10,010 (2250)
300 (12)	5000 (3750)	6100 (4500)	3050 (2250)	8360 (1880)	13,340 (3000)	13,340 (3000)
350 (14)	6100 (4500)	7120 (5250)	3570 (2630)	10,010 (2250)	16,680 (3750)	16,680 (3750)

values from 7.1.10.2

7.1.10.2 The design of each fixed or floating header, the design of the connections of fixed headers to side frames, and the design of other support members shall ensure that the simultaneous application (sum) of all nozzle loadings on a single header does not cause any damage. The components of the nozzle loadings on a single header shall not exceed the following values:

- M_x 6100 N m (4500 ft.lbf)
- M_y 8130 N m (6000 ft.lbf)
- M_z 4070 N m (3000 ft.lbf)
- F_x 10,010 N (2250 lbf)
- F_y 20,020 (4500 lbf)
- F_z 16,680 (3750 lbf)

values from 7.1.10.2 multiplied by 3

7.1.10.3 The total of all nozzle loads on one multi-bundle bay shall not exceed three times that allowed for a single header.



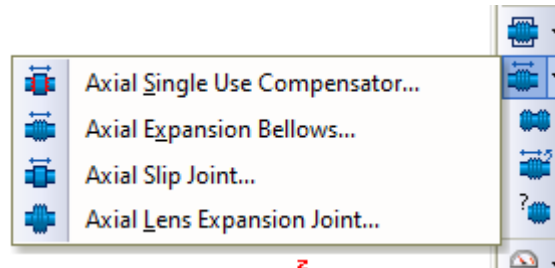
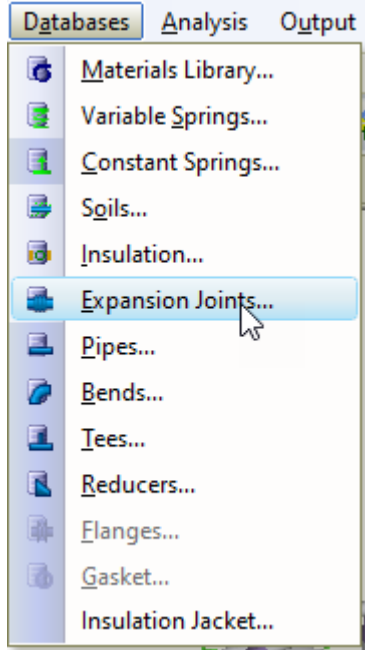
PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE



PASS/Start-Prof | Piping Model Creation

Expansion Joint Objects + Database

PASS/START-PROF has several expansion joint types and database. Expansion joint deformations are checked automatically.

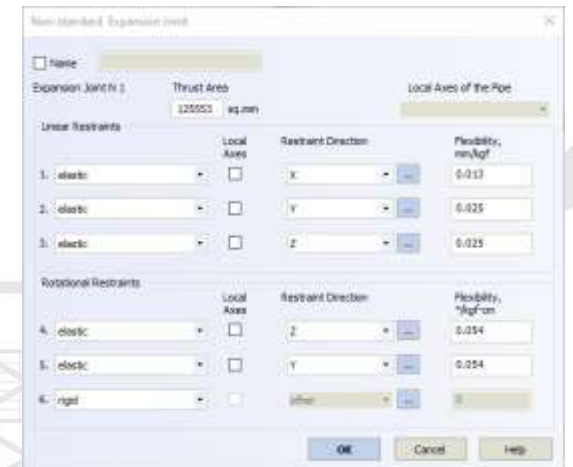
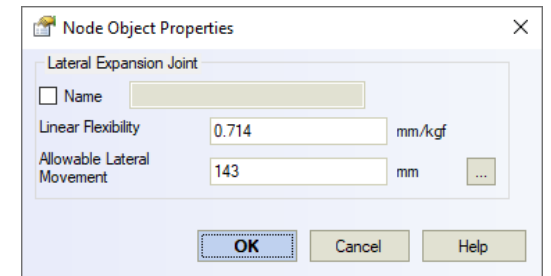
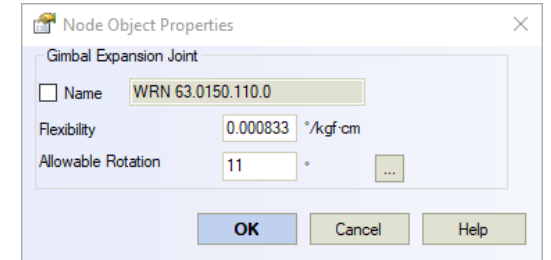


Expansion Joints

Type: Rotation expansion joint

Type	Supplier	Code	Description	Nominal Diameter mm	Friction Moment, N-m	Flexibility %/N-m	Thrust / sq.m
Gimbal expansion joint	Witzenmann	TU 3695-006-15294711	WBK 10.0200.320.0	200	0	0.04	0
Gimbal expansion joint	Witzenmann	TU 3695-006-15294711	WBK 16.0200.220.0	200	0	0.018182	0
Gimbal expansion joint	Witzenmann	TU 3695-006-15294711	WBK 16.0200.310.0	200	0	0.029412	0
Gimbal expansion joint	Witzenmann	TU 3695-006-15294711	WBK 25.0200.140.0	200	0	0.012821	0
Gimbal expansion joint	Witzenmann	TU 3695-006-15294711	WBK 25.0200.220.0	200	0	0.018182	0
Gimbal expansion joint	Witzenmann	TU 3695-006-15294711	WBN 06.0200.230.0	200	0	0.052632	0
Gimbal expansion joint	Witzenmann	TU 3695-006-15294711	WBN 10.0200.220.0	200	0	0.030303	0
Gimbal expansion joint	Witzenmann	TU 3695-006-15294711	WBN 10.0200.320.0	200	0	0.04	0
Gimbal expansion joint	Witzenmann	TU 3695-006-15294711	WBN 16.0200.220.0	200	0	0.018182	0

Buttons: Add, Delete, Import, Save, Close, Help



PASS/Start-Prof | Piping Model Creation

Object Untied Expansion Joint and database of Untied Expansion Joints, allows to specify the axial, rotational, shear and torsion flexibility and automatically checks the individual and combined allowable deformations. No need to manually model it using nonstandard expansion joint any more.

no need to manually model it using nonstandard expansion joint any more



$$\frac{|\lambda_p|}{[\lambda_p]} + \frac{|\lambda_\theta|}{[\lambda_\theta]} + \frac{|\lambda_\Delta|}{[\lambda_\Delta]} \leq 1.$$

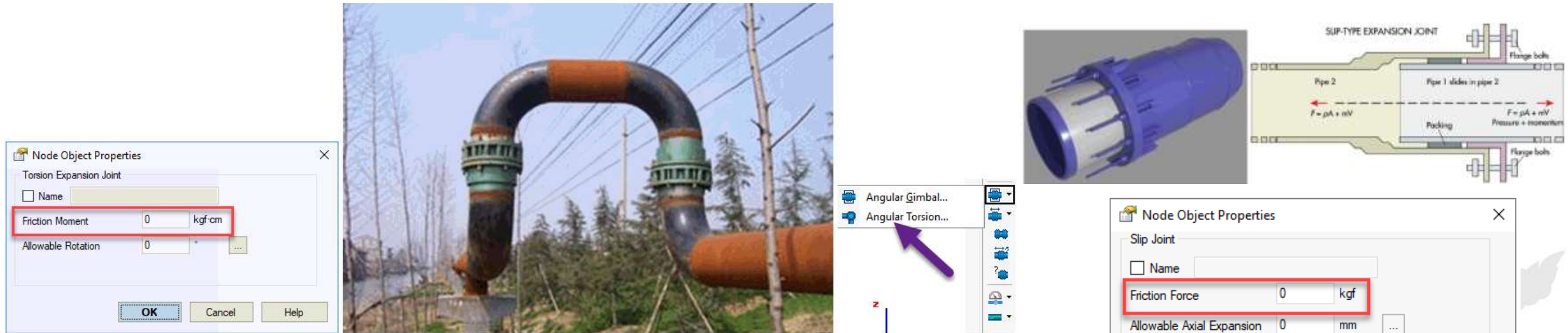
Node Number	Type	Local axis	Axial, (mm)	Allowable, (mm)	Shear, (mm)	Allowable, (mm)	Angular, (°)	Allowable, (°)	Torsion, (°)	Allowable, (°)	Summary	Notes
12	Untied Expansion Joint	Pipe 3 - 12	2,41	50	1,22	15	9,59131	10	-2,05119	No	1.09	1
13	Torsion Expansion Joint	Pipe 5 - 13	0	No	0	No	0	No	13,9229	51,5662	0,27	
15	Torsion Expansion Joint	Pipe 7 - 15	0	No	0	No	0	No	10,1299	51,5662	0,20	
21	Torsion Expansion Joint	Pipe 19 - 21	0	No	0	No	0	No	-4,36021	51,5662	0,08	



PIPING AND EQUIPMENT
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PASS/Start-Prof | Piping Model Creation

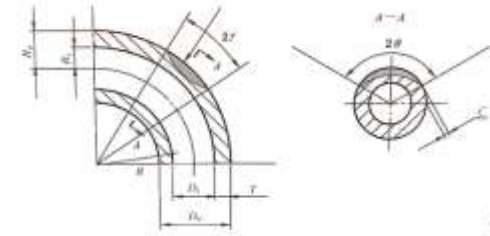
- Object Torsion Expansion Joint and database of torsion expansion joints, automatically model torsion friction (friction moment) and checks allowable rotation angle.
- Object Slip Joint and database of slip joints, automatically model axial friction and checks allowable deformation.



PASS/Start-Prof | Piping Model Creation

Plane flaw and volumetric flaw objects for fitness-for-service calculations

The screenshot displays the PASS software interface for creating piping model objects. On the left, a 'Node Object Properties' dialog box is open, showing settings for a 'Volumetric Flaw'. The 'Flaw Type' is set to 'Inner'. Parameters include: Half Of Axial Length (A) = 0 mm, Circumferential Half Length Of Defect (B) = 0 mm, Measured Depth with Corrosion Allowance (C) = 0 mm, Measured Wall Thickness nearby Flaw (T) = 0 mm, and Tensile strength at Operating Temperature, σ_b = 0 kgf/sq. The dialog also features 'OK', 'Cancel', and 'Help' buttons. In the center, technical diagrams illustrate the geometry of a pipe with a flaw, showing axial and circumferential dimensions. On the right, the 'Output' menu is open, listing various analysis options such as 'Piping Stress', 'Insulation Stress', 'Seismic Stress (Aboveground)', 'Flaw Stress', 'MDMT, Impact Test', 'Load and Displacement in Restraints', 'Restraint Loads', 'Nozzle and Equipment Loads', 'Displacements', 'Expansion Joint Deformations', 'Internal Forces & Moments', 'Selected Springs', 'Selected Constant Effort Springs', 'Buckling Check of Pipe Wall', 'Flange Leakage Check', 'Output 3D View' (Ctrl+H), and 'Error & Warning Messages'. At the bottom, a toolbar contains icons for 'Plane Flaw' and 'Volumetric Flaw', with a blue arrow pointing to the 'Volumetric Flaw' icon.



PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE



PASS/Start-Prof | Material Database

Individual Material database for each piping code.

ASME B31.3

- Contain data for Creep Rupture Factor calculation, and alternative occasional stress calculation
- Contain data for minimum design temperature calculation
- Contain flag to use $f=1.2$ or $f=1.0$

(d) Allowable Displacement Stress Range, S_A . The computed displacement stress range, S_E , in a piping system [see para. 319.4.4] shall not exceed the allowable displacement stress range, S_A [see paras. 319.2.3 and 319.3.4], calculated by eq. (1a)

$$S_A = f(1.25S_L + 0.25S_h) \quad (1a)$$

When S_h is greater than S_L , the difference between them may be added to the term $0.25S_h$ in eq. (1a). In that case, the allowable stress range is calculated by eq. (1b)

$$S_A = f[1.25(S_L + S_h) - S_L] \quad (1b)$$

For eqs. (1a) and (1b)

f = stress range factor,³ calculated by eq. (1c)[‡]

$$f \text{ (see Fig. 302.3.5)} = 6.0(N)^{-0.2} \leq f_m \quad (1c)$$

f_m = maximum value of stress range factor: 1.2 for ferrous materials with specified minimum tensile strengths ≤ 517 MPa (75 ksi) and at metal temperatures $\leq 371^\circ\text{C}$ (700°F); otherwise $f_m = 1.0$

Material: A182 F310 Class: Austenitic Steel

Database can only be edited if database files are open for editing and if stress units are set as MPa (for ASME - ksi)

Data source: ASME B31.3-2018 Austenitic

Density: 8027.172363 kg/m3 Maximum f=1.2

Larson-Miller constant C: 15

Min. Temperature: -325 F Mn. Temperature: [dropdown]

Creep Factors: Austenitic Steel [dropdown]

Temperature F	Allowable Stress (S), ksi	Yield Stress (Sy), ksi	Elastic Modulus ksi	Expansion Coeff. 1/F	Poisson's Ratio (v)	WI
800.006	17.400	19.400	24100	9.4e-006	0.292	1.0
849.992	17.200	19.100	23800	9.45e-006	0.292	1.0
899.996	16.900	18.800	23499.999	9.5e-006	0.292	1.0
950	15.900	18.500	23150	9.55e-006	0.292	1.0
1000.004	9.900	18.200	22799.999	9.6e-006	0.292	0.95
1050.008	7.100	0	22400	9.65e-006	0.292	0.91
1099.994	5	0	22000	9.7e-006	0.292	0.86
1149.998	3.600	0	21600.001	9.75e-006	0.292	0.82
1200.002	2.500	0	21200	9.8e-006	0.292	0.77
1250.006	1.500	0	20750	9.85e-006	0.292	0.73

Buttons: Add, Delete, Print, Export..., Save, OK, Cancel, Help

PASS/Start-Prof | Material Database

Individual Material database for each piping code

For example EN 13480/EN 13941 database

- Can automatically select material properties depending on the wall thickness and seamless/welding option
- Contain properties for creep analysis

Material: 1.0345/P235GH Class: Carbon or Low Alloy Steel

Data source: EN 10216-2-2013

Density: 7850 kg/m³

Factor A, %: 23

Th, cm	Yield Stress (Rp), ksi	Tensile Strength (Rm), ksi
1.6	34.084	52.214
4	32.633	52.214
6	31.183	52.214

Temperature F	Yield Stress (Rp), ksi	Tensile Strength (Rm), ksi	Elastic Modulus, ksi	Expansion Coeff. 1/F	Poisson's Ratio (ν)	SRTt 10 000 h, ksi	SRTt 100 000 h, ksi	SRTt 200 000 h, ksi	SRTt 250 000 h, ksi
68	0	0	30714.787	6.277e-006	0.3	0	0	0	0
212	28.717	52.214	29887.637	6.611e-006	0.3	0	0	0	0
302	27.122	52.214	29353.463	6.804e-006	0.3	0	0	0	0
392	24.656	52.214	28805.946	6.986e-006	0.3	0	0	0	0
482	21.756	52.214	28245.375	7.155e-006	0.3	0	0	0	0
572	19.145	52.214	27671.460	7.313e-006	0.3	0	0	0	0
662	17.405	52.214	27084.493	7.458e-006	0.3	0	0	0	0
752	16.244	52.214	26484.181	7.592e-006	0.3	26.397	20.450	18.565	17.695
770	16.128	52.214	26362.495	7.617e-006	0.3	24.076	18.565	16.679	15.809
788	16.012	52.214	26240.228	7.642e-006	0.3	21.901	16.534	14.794	14.069
806	15.896	52.214	26117.526	7.667e-006	0.3	20.015	14.504	12.908	12.473
824	15.780	52.214	25994.389	7.691e-006	0.3	18.130	12.763	11.168	10.733
842	15.664	52.214	25870.527	7.714e-006	0.3	16.244	11.168	9.572	9.282



PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

PASS/Start-Prof | Material Database

Individual Material database for each piping code

ISO 14692 database

- Contains fc factor
- Contains Gxx factor
- And everything to perform accurate professional analysis, just need ask the manufacturer to provide the data for this table

The screenshot displays the 'Materials' window in the PASS software. The main window shows the material 'Wavistrong 55' selected from the 'ISO 14692 (GRP piping systems, International)' code. The material properties table is as follows:

Temperature F	al(0:1), ksi	al(1:1), ksi	hl(1:1), ksi	al(2:1), ksi	hl(2:1), ksi	qc bend, reducer, ksi	qs tee, nozzle, ksi	Ea, ksi	Fh, ksi	G, ksi	Expansion Coeff. 1/F	Poisson factor Vh/a	Gxx
68	4.714	0	0	9.065	18.130	11.603	9.282	1522.896	2973.274	1667.934	0.0000111111	0.65	0.045
104	4.714	0	0	9.065	18.130	11.603	9.282	1416.294	2824.610	1584.537	0.0000111111	0.65	0.054
140	4.714	0	0	9.065	18.130	11.603	9.282	1324.920	2675.946	1501.141	0.0000111111	0.65	0.063
149	4.714	0	0	9.065	18.130	11.603	9.282	1328.691	2623.878	1471.988	0.0000111111	0.65	0.065
176	4.250	0	0	8.166	16.317	10.443	8.354	1340.149	2467.817	1384.385	0.0000111111	0.65	0.078

The secondary window shows the 'Material' dropdown menu with the following options: Wavistrong 55, Bondstrand 2000, Bondstrand 55, Bondstrand 7000, Fiberbond 20FR20-20year, Fiberbond 20FR20-25year, Fiberbond 20FR20-30year, Fiberbond 20FR20-50year, Sapplast 55, Wavistrong 55, and Wavistrong 63.

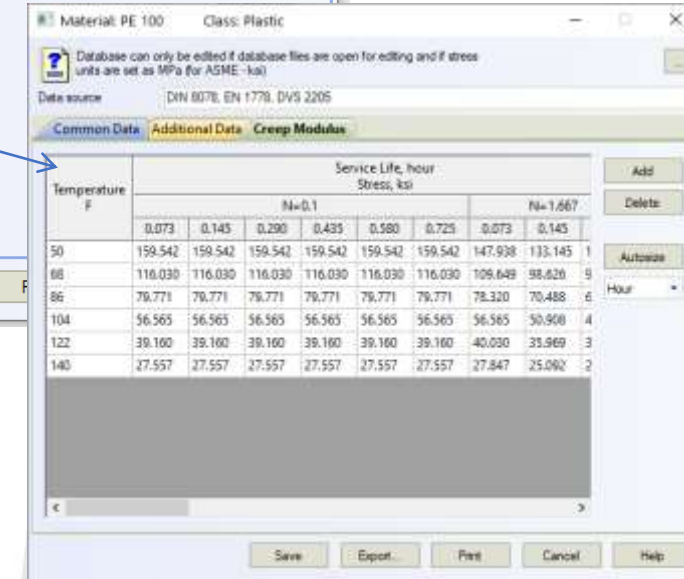
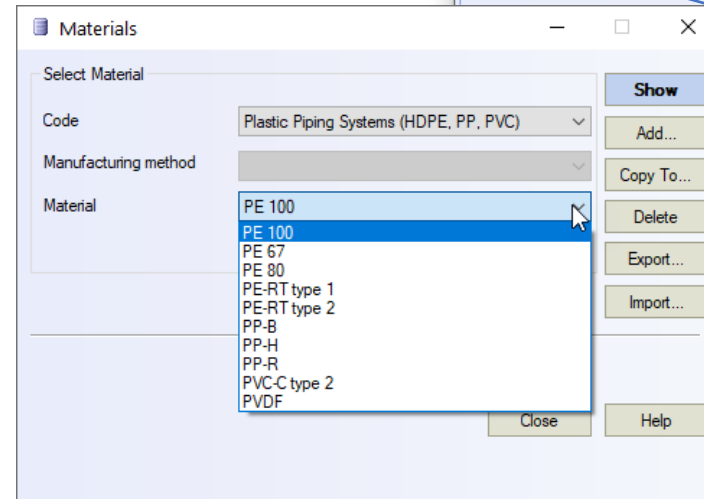
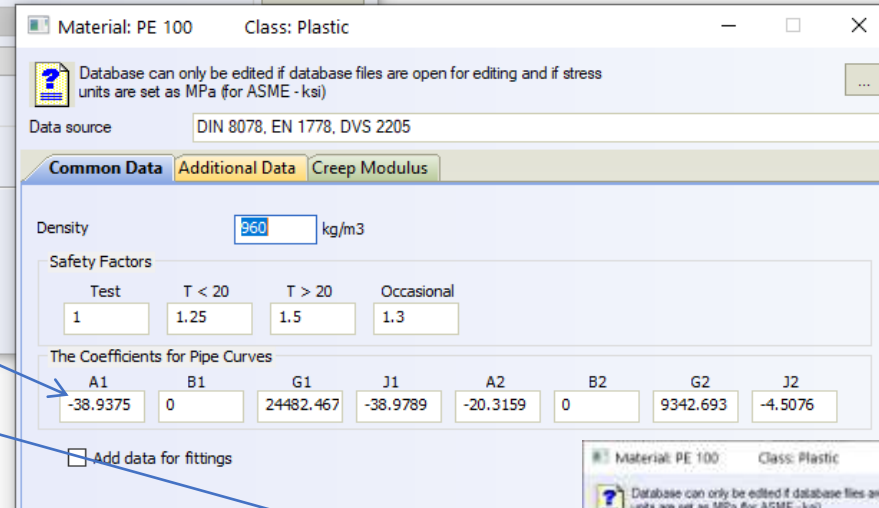
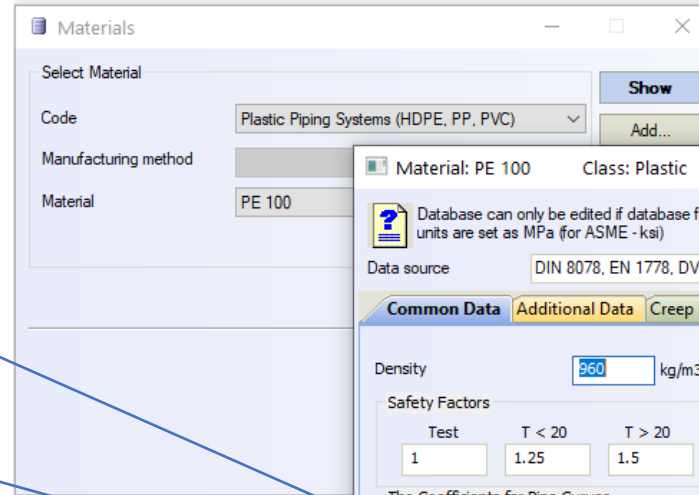


PASS/Start-Prof | Material Database

Individual Material database for each piping code

Thermoplastic (HDPE) Piping Database

- Contain factors to calculate allowable stress depending on time and temperature
- Contain creep modulus depending on temperature, time, and stress



PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

PASS/Start-Prof | Analysis Capabilities

PASS/START-PROF has professional analysis abilities needed for Process and Power Piping Stress Analysis:

- Nonlinear analysis of gaps, friction, one-way restraints, rotating rods, etc.
- Special algorithm that improves the nonlinear model convergence on-the-fly without manual tuning (gaps and one-way restraints cycling, friction force cycling etc.). We receive from users the models that didn't converge, put it into our collection and continuously improve that algorithm for past 55 years. It allow to achieve convergence in 99.9% models
- Nozzle, tee, bend flexibilities and SIF (Code, ASME B31J, WRC 537/297, PD 5500, FEA)
- Nozzle, pump and other equipment automatic checks (API, ISO, NEMA standards)
- Optimal automatic variable and constant spring selection using manufacturers catalogue

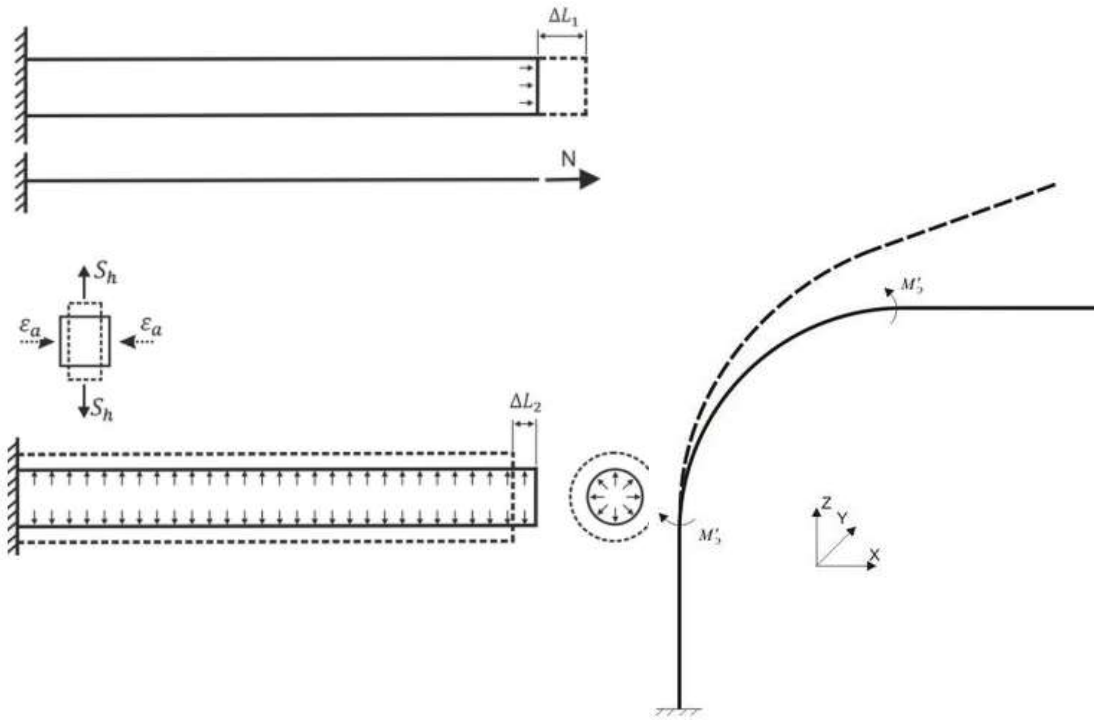


PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE



PASS/Start-Prof | Analysis Capabilities

Bourdon Effect (translation & bend rotation)



	Unrestrained pipe $k = 0$	Restrained pipe $k = \infty$	Partially restrained pipe with flexible spring k
Support Load	$R = 0$	$R = \alpha \Delta T E A + (1 - 2\nu) A \frac{P(D - 2t)^2}{D^2 - (D - 2t)^2} \approx \alpha \Delta T E A + (0.5 - \nu) S_h \cdot A$	$R = \frac{\alpha \Delta T E A + (1 - 2\nu) A \frac{P(D - 2t)^2}{D^2 - (D - 2t)^2}}{\frac{EA}{kL} + 1} \approx \frac{\alpha \Delta T E A + (0.5 - \nu) S_h \cdot A}{\frac{EA}{kL} + 1}$
Axial Force	$N = P \frac{\pi(D - 2t)^2}{4} \approx 0.5 S_h \cdot A$	$N = -\alpha \Delta T E A + 2\nu \frac{P \pi(D - 2t)^2}{4} \approx -\alpha \Delta T E A + \nu S_h \cdot A$	$N = \frac{-\alpha \Delta T E A - 2\nu \frac{P \pi(D - 2t)^2}{4}}{\frac{EA}{kL} + 1} + \frac{P \pi(D - 2t)^2}{4} \approx \frac{-\alpha \Delta T E A - (0.5 - \nu) S_h \cdot A}{\frac{EA}{kL} + 1} + 0.5 S_h \cdot A$
Axial Stress	$S_a = \frac{P(D - 2t)^2}{D^2 - (D - 2t)^2} \approx 0.5 S_h$	$S_a = -\alpha \Delta T E + 2\nu \frac{P(D - 2t)^2}{D^2 - (D - 2t)^2} \approx -\alpha \Delta T E + \nu S_h$	$S_a = \frac{-\alpha \Delta T E - 2\nu \frac{P(D - 2t)^2}{D^2 - (D - 2t)^2}}{\frac{EA}{kL} + 1} + \frac{P(D - 2t)^2}{D^2 - (D - 2t)^2} \approx \frac{-\alpha \Delta T E - (0.5 - \nu) S_h}{\frac{EA}{kL} + 1} + 0.5 S_h$
Elongation	$\Delta L = \alpha \Delta T L + (1 - 2\nu) \frac{P(D - 2t)^2}{D^2 - (D - 2t)^2} \frac{L}{E} \approx \alpha \Delta T L + (0.5 - \nu) S_h \frac{L}{E}$	$\Delta L = 0$	$\Delta L = \left(\alpha \Delta T L + (1 - 2\nu) \frac{P(D - 2t)^2}{D^2 - (D - 2t)^2} \frac{L}{E} \right) \left(\frac{1}{\frac{EA}{kL} + 1} \right) \approx \left(\alpha \Delta T L + (0.5 - \nu) S_h \frac{L}{E} \right) \left(\frac{1}{\frac{EA}{kL} + 1} \right)$



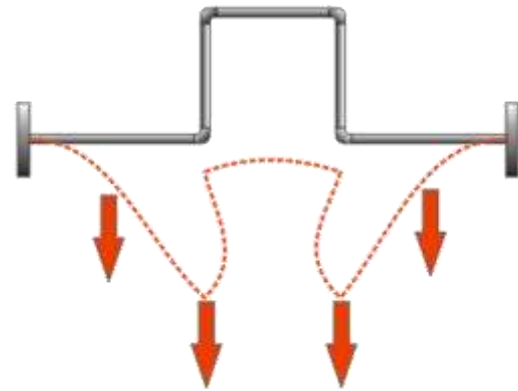
PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE



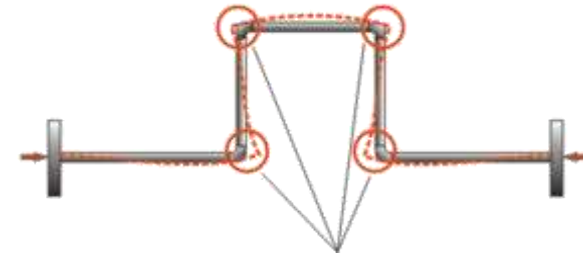
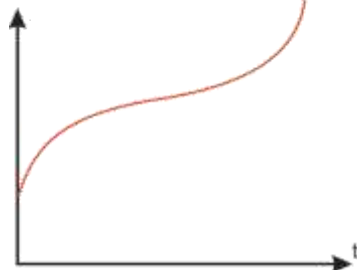
PASS/Start-Prof | Analysis Capabilities

Calculate creep stresses in operating state and after cooling down (relaxation)

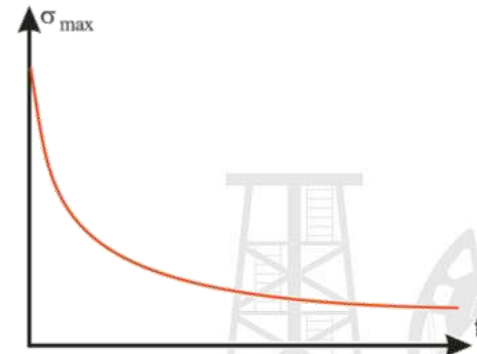
Calculate support loads with creep effect after cooling down with creep self-springing effect
(ASME B31.3 319.2.3 a)



Creep lead to increasing the deformations from the weight loads



Creep lead to expansion stress and support loads relaxation (reduction) with time



PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

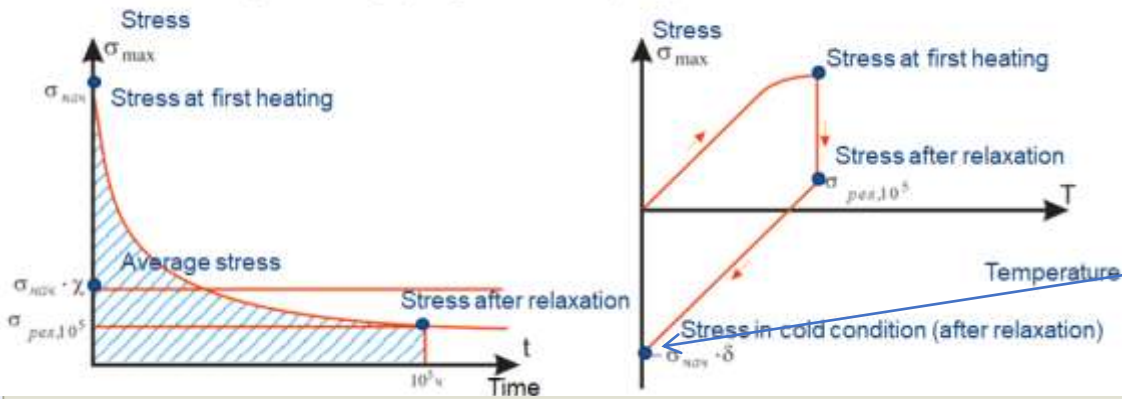


PASS/Start-Prof | Analysis Capabilities

Calculate creep stresses in operating state and after cooling down (relaxation)

Calculate support loads with creep effect after cooling down with creep self-springing effect (ASME B31.3 319.2.3 a)

Creep lead to piping self cold-spring in cold condition



319.2.3 Displacement Stress Range

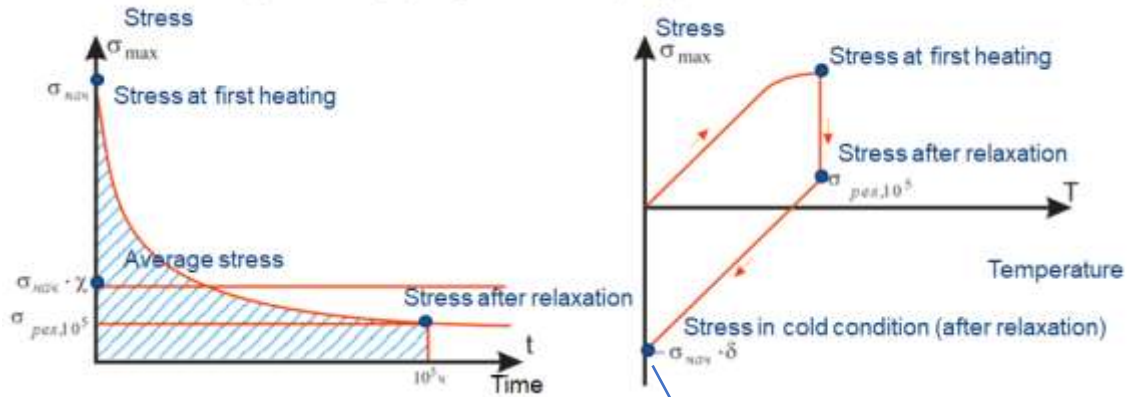
(a) In contrast with stresses from sustained loads, such as internal pressure or weight, displacement stresses may be permitted to attain sufficient magnitude to cause local yielding in various portions of a piping system. When the system is initially operated at the condition of greatest displacement (highest or lowest temperature, or greatest imposed movement) from its installed condition, any yielding or creep brings about a reduction or relaxation of stress. When the system is later returned to its original condition (or a condition of opposite displacement), a reversal and redistribution of stresses occurs that is referred to as self-springing. It is similar to cold springing in its effects.

Object	Start End node	Primary Loads Stress in Hot State, (ksi)			Expansion Stress Range, (ksi)			Creep Stress (Operating State), (ksi)			Creep Stress (Cold State), (ksi)			Notes
		SI	Sh*Wc/E	%	Se	Sa	%	Slcreep	Sh, creep	%	Slcreep	Sc, creep	%	
Above ground pipe	14	4.733	15.215	31.1	4.795	45.535	10.5	4.762	12.172	39.1	7.364	30	24.5	
	29,2 Flange	6.244	15.215	41.0	4.127	44.025	9.4	6.103	12.172	50.1	8.580	30	28.6	
Forged Elbow	29,2 Flange	7.270	15.215	47.8	7.012	43.060	16.3	7.033	12.172	57.8	10.611	30	35.4	
Above ground pipe	29,2 Flange	6.491	15.215	42.7	4.542	43.778	10.4	6.254	12.172	51.4	9.429	30	31.4	
	15	3.422	15.215	22.5	5.656	46.847	12.1	3.989	12.172	32.8	7.435	30	24.8	
Above ground pipe	14	4.923	15.215	32.4	16.859	45.346	37.2	5.603	12.172	46.0	20.829	30	69.4	
	16	5.016	15.215	33.0	13.674	45.252	30.2	5.687	12.172	46.7	16.348	30	54.5	
Weldolet (branch welded-on fitting)	16	10.051	15.215	66.1	75.640	41.251	183.4	13.462	12.172	110.6	60.670	30	202.2	33,13,14,333
Above ground pipe	16	4.204	15.215	27.6	8.415	46.065	18.3	5.036	12.172	41.4	9.884	30	32.9	

Often the greatest stresses and support loads are in cold state after creep relaxation due to self-springing!

PASS/Start-Prof | Analysis Capabilities

Creep lead to piping self cold-spring in cold condition



Often the greatest stresses and support loads are in cold state after creep relaxation due to self-springing!

Operating Mode		Load Case			Axis			Support Type	
1 'CTAPT1'		Cold Creep (W+P)-T*d			Global axis			Anchor (fixed), Resting...	
Node Number	Type	Forces along coordinate axis, (kgf)			Moments around coordinate axis, (kgf.cm)				
		X	Y	Z	X	Y	Z		
5,Bend	Anchor (fixed)	-4821.20	-741.20	-516.80	-7516.52	-164260.46	310608.63		
7,Bend	Anchor (fixed)	-15296.50	6107.60	-508.40	-134784.76	68006.50	1955982.59		
9	Anchor (fixed)	4594.90	-2450.80	-474.70	25199.76	149356.38	-211296.82		
11	Anchor (fixed)	738.80	282	-1175.80	98675.08	-172333.62	-52396.02		
13	Resting Support	0	0.10	39.20	0	0	0		
15	Anchor (fixed)	143.70	-102.60	-850.80	-63010.91	33497.13	-33351.85		
17	Anchor (fixed)	25.40	-259.90	-742.60	-125347.83	66853.35	-23842.90		
19	Anchor (fixed)	182.20	-481.60	-881	-210262.61	17410.30	-13870.44		
21	Anchor (fixed)	14432.80	-2353.50	15.30	-27776.98	425.14	-456489.75		



PASS/Start-Prof | Analysis Capabilities

EN 13480 creep stresses are calculated automatically without any user's manual efforts

e) For the combination of sustained loads and restrained thermal expansion loads

$$\sigma_4 = \frac{p_c D_o}{4e_n} + 0,75i \frac{M_A}{Z} + i \frac{M_C}{Z} + \sigma_{MT} + \frac{\sigma_{PT}}{2} \leq f_h + f_a, \text{ and } 0,75i \geq 1,0 \quad (11.6-5)$$

EN 13480 database contains all needed information for creep analysis

The screenshot displays the 'Material' database window in the PASS software. The material selected is 1.0345/P235GH, Class: Carbon or Low Alloy Steel. The data source is EN 10216-2-2013. The density is 7850 kg/m³ and Factor A is 23. The window contains two tables: one for yield and tensile strength vs. thickness (Th) and another for material properties vs. temperature.

Th, mm	Yield Stress (Rp), kgf/sq.cm	Tensile Strength (Rm), kgf/sq.cm
16	2350	3600
40	2250	3600
60	2150	3600

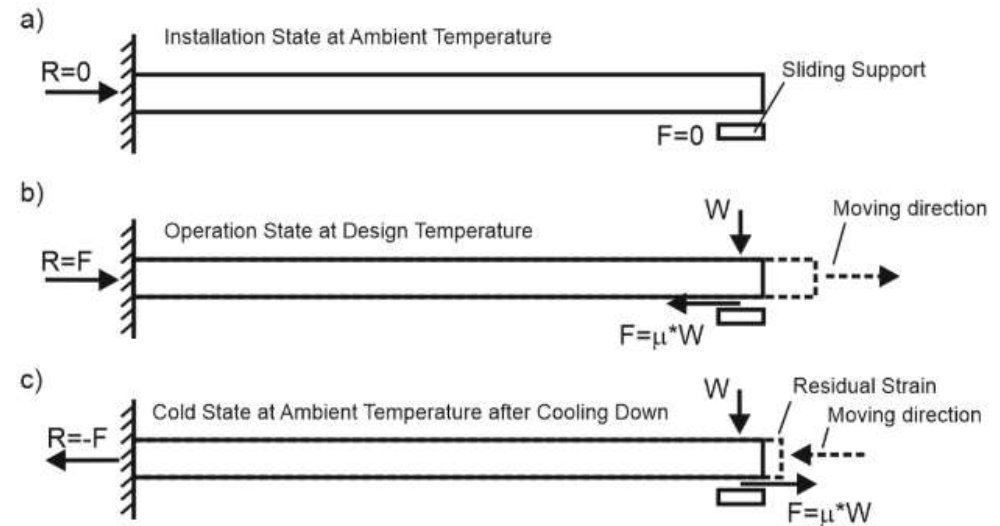
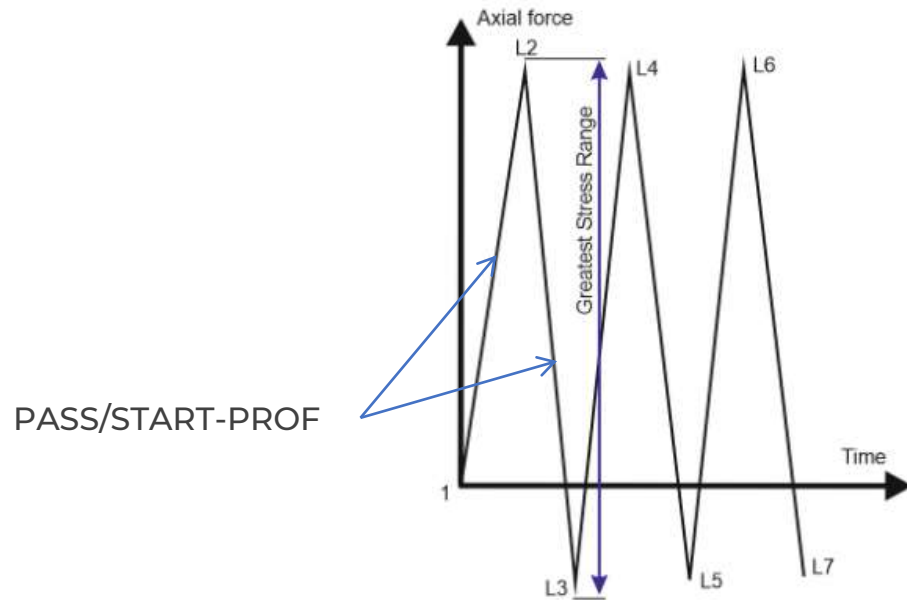
Temperature °C	Yield Stress (Rp), kgf/sq.cm	Tensile Strength (Rm), kgf/sq.cm	Elastic Modulus, kgf/sq.cm	Expansion Coeff., 1/°C	Poisson's Ratio (ν)	SRt 10 000 h, kgf/sq.cm	SRt 100 000 h, kgf/sq.cm	SRt 200 000 h, kgf/sq.cm	SRt 250 000 h, kgf/sq.cm
20	0	0	2117710	1,1296e-005	0,3	0	0	0	0
100	1980	3600	2090680	1,19e-005	0,3	0	0	0	0
150	1870	3600	2023850	1,2248e-005	0,3	0	0	0	0
200	1700	3600	1986100	1,2574e-005	0,3	0	0	0	0
250	1500	3600	1947450	1,2879e-005	0,3	0	0	0	0
300	1320	3600	1907880	1,3163e-005	0,3	0	0	0	0
350	1200	3600	1867410	1,3425e-005	0,3	0	0	0	0
400	1120	3600	1826020	1,3666e-005	0,3	1520	1410	1280	1220
410	1112	3600	1817630	1,3711e-005	0,3	1660	1280	1150	1090
420	1104	3600	1809200	1,3756e-005	0,3	1510	1140	1020	970
430	1096	3600	1800740	1,38e-005	0,3	1380	1000	890	860



PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

PASS/Start-Prof | Analysis Capabilities

START-PROF calculates the cold state after cooling down from the hot state. It allows to get more realistic expansion stress range



PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE



PASS/Start-Prof | Analysis Capabilities

Minimum Design Metal Temperature (MDMT) calculation according to 323.2.2 (a), (b), (d), (e), (f), (g), (h), (i), (j) of ASME B31.3-2018.

Material database contains all needed data.

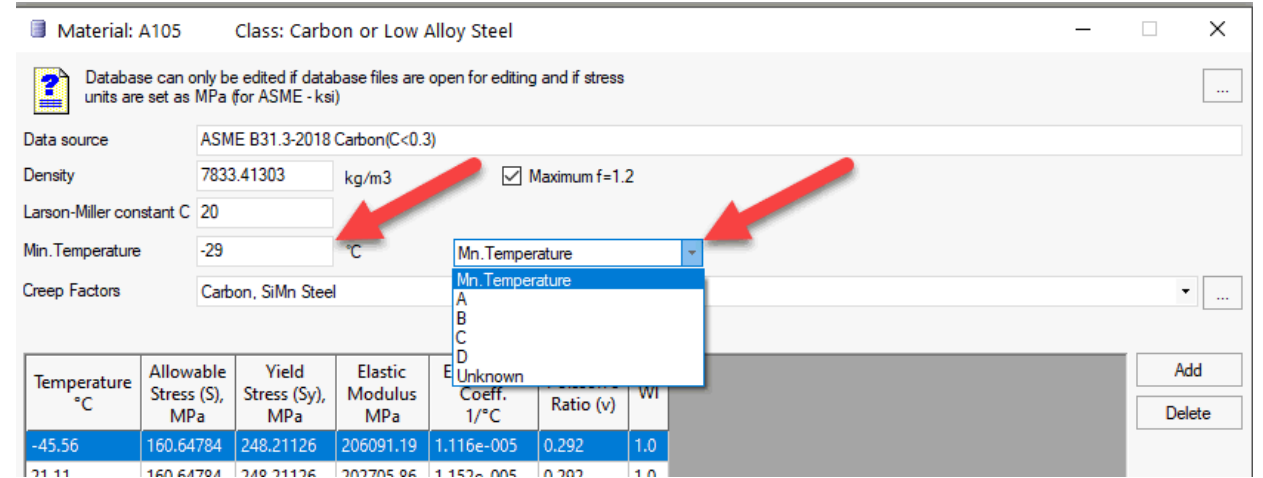
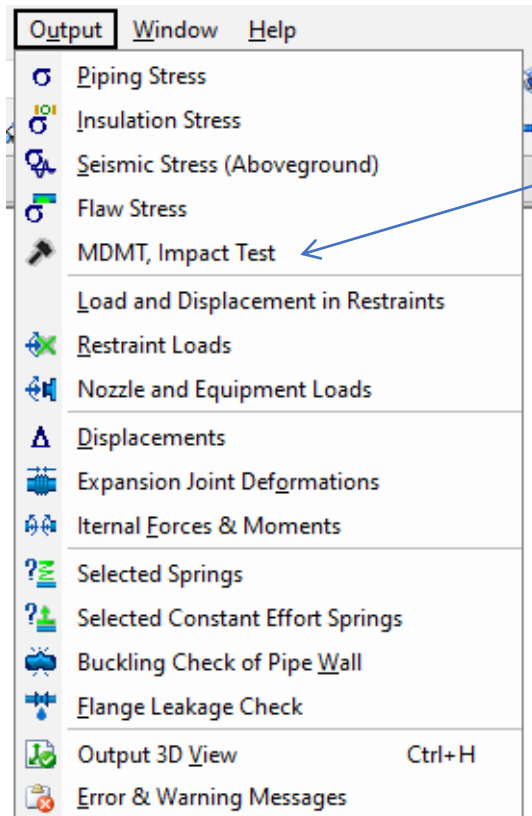


Table A-1 Basic Allowable Stresses in Tension for Metals (Cont'd)
 Numbers in Parentheses Refer to Notes for Appendix A Tables: Specifications Are ASTM Unless Otherwise Indicated

Material	Spec. No.	Type/Grade	UNS No.	Class/Condition/Temp	Size, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi		Basic Allowable Stress, S, ksi, at Metal Temperature, °F [Note (1)]		
									Tensile	Yield	100	200	300
Carbon Steel — Pipes and Tubes													
A285 Gr. A	A134	...	...	...	...	1	(8b)(57)	B	45	24	15.0	14.7	14.2
A285 Gr. A	A672	A45	K01700	...	...	1	(57)(59)(67)	B	45	24	15.0	14.7	14.2
Butt weld	API 5L	A25	...	...	...	1	(8a)(77)	-20	45	25	15.0	15.0	14.7



PASS/Start-Prof | Analysis Capabilities

PASS/START-PROF calculates the MDMT according to figure 323.2.2A and figure 323.2.2B depending on the calculated stress ratio if user select appropriate option in project settings, taking into account the code requirements 323.2.2 (g), (h), (i).

After analysis the output report table is provided. For each pipe START-PROF show if the impact test is needed or not

Object	Start End node	Thickness, cm	Material	Stress Ratio, r	Tmin, °C	MDMT, °C	Output
Above ground pipe	3,Restrained	0.600	A106 B	0.294	-40	-48	OK
Above ground pipe	23	0.600	A106 B	0.395	-40	-48	OK
	5,Bend	0.600	A106 B	0.840	-40	-37.869	Impact Test
Above ground pipe	6,0 Flange	0.600	A106 B	0.436	-40	-48	OK
	24	0.600	A106 B	0.400	-40	-48	OK
Above ground pipe	6,0 Flange	0.600	A106 B	0.342	-40	-48	OK
	8	0.600	A106 B	0.373	-40	-48	OK
Above ground pipe	8	0.600	A106 B	0.317	-40	-48	OK
	25	0.600	A106 B	0.283	-40	-48	OK
Above ground pipe	27	0.600	A106 B	0.430	-40	-48	OK
	9	0.600	A106 B	0.951	-40	-31.783	Impact Test
Above ground pipe	8	0.600	A106 B	0.330	-40	-48	OK

Figure 323.2.2A Minimum Temperatures Without Impact Testing for Carbon Steel Materials (See Table A-1 or Table A-1M for Designated Curve for a Listed Material; see Table 323.2.2A for Tabular Values)

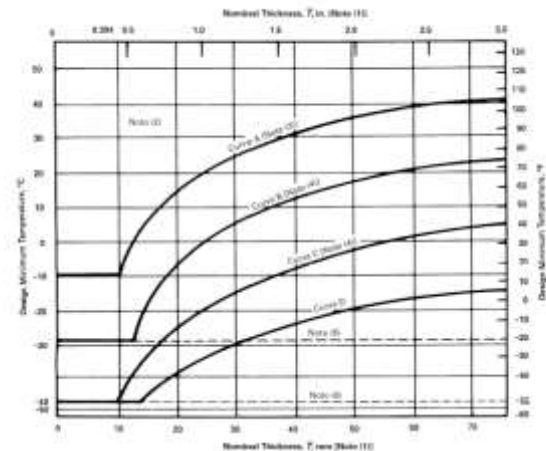
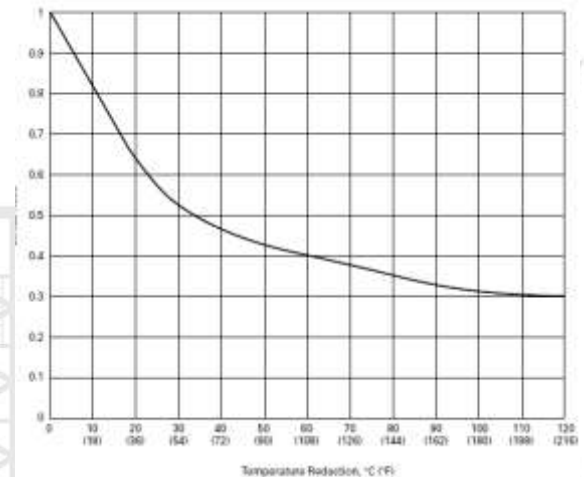


Figure 323.2.2B Reduction in Lowest Exemption Temperature for Steels Without Impact Testing (See Table 323.2.2B for Tabular Values)



PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE



PASS/Start-Prof | Analysis Capabilities

Alternative occasional allowable calculation for elevated temperature fluid service 302.3.6 (2) ASME B31.3-2018, added appendix V.

"Time duration", "Alternative Occasional" options in operating mode editor.

Larson-Miller constant "C" in ASME B31.3 material database.

Operating Mode: 1.1 'occ1.1'

Object	Start End node	Primary Loads Stress, (ksi)			Notes
		Sl_Alt	k*Sh	%	
Above ground pipe	14	5.012	5.960	84.1	
29,2 Flange		7.181	5.960	120.5	1
Forged Elbow	29,2 Flange	8.444	Sh, 4.684 ksi		
Above ground pipe	29,2 Flange	7.805	Sy, 18.616 ksi		
	15	4.266	ti=5000 hour		
Above ground pipe	14	5.172	C=20		
	16	5.325	Te, 481.384305068139 °C		
Weldolet (branch welded-on fitting)	16	12.256	S02, 5.960 ksi		
Above ground pipe	16	3.967	min(4Sh, 0.8*0.9Sy, S02), 5.960 ksi		

include same or like material, weld metal composition, and welding process under equivalent, or more severe, sustained operating conditions.

302.3.6 Limits of Calculated Stresses Due to Occasional Loads

(a) Operation. Stresses due to occasional loads may be calculated using the equations for stress due to sustained loads in para. 320.2.

(1) Subject to the limits of para. 302.2.4, the sum of the stresses due to sustained loads, such as pressure and weight, S_s , and of the stresses produced by occasional loads, such as wind and earthquake, may be as much as 1.33 times the basic allowable stress provided in Table A-1 or Table A-1M at the metal temperature for

(-a) the weld strength reduction factor times 90% of the yield strength at the metal temperature for the occasional condition being considered

(-b) four times the basic allowable stress provided in Appendix A

(-c) for occasional loads that exceed 10 h over the life of the piping system, the stress resulting in a 20% creep usage factor in accordance with Appendix V

For (-a), the yield strength shall be as listed in ASME BPVC, Section II, Part D, Table Y-1 or determined in accordance with para. 302.3.2. The strength reduction factor represents the reduction in yield strength with long-term exposure of the material to elevated temperatures and, in the absence of more-applicable data, shall be taken as 1.0 for austenitic stainless steel and 0.8 for other mate-

basic allowable stress for castings shall be multiplied by the casting quality factor, E_c . Where the stress value exceeds two-thirds of yield strength at the metal temperature, the allowable stress value shall be as specified in para. 302.3.2(e). Stresses due to test conditions are not subject to the limits of para. 302.3. It is not necessary to apply the strength reduction factor to occasional loads, e.g., wind and earthquake, currently with test loads.

Material: A106 A Class: Carbon or Low Alloy Steel

Database can only be edited if database files are open for editing and if stress units are set as MPa (for ASME - ksi)

Data source: ASME B31.3-2018 Carbon(C=20)

Density: 7833.41303 Maximum f=1.2

Larson-Miller constant C: 20

Creep Factors: Carbon, SiMn Steel

Temperature F	Allowable Stress (S), ksi	Yield Stress (Sy), ksi	Elastic Modulus ksi	Expansion Coeff. 1/F	Poisson's Ratio (v)	WI
-325	16	30	31400	5.5e-006	0.292	1.0
-200	16	30	30800	5.79e-006	0.292	1.0
-150	16	30	30300	5.9e-006	0.292	1.0
-50	16	30	29891	6.2e-006	0.292	1.0
70	16	30	29400	6.4e-006	0.292	1.0
100	16	30	29262	6.47e-006	0.292	1.0
200	16	27.500	28800	6.7e-006	0.292	1.0

Smart Operation Mode Editor

#	Name	Hanger Sizing	High temperature	Low temperature	Creep	Weight	Time duration	Mode type	Stress range between	Help
1 (0)	OPE	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	1.00	1.00	0.00 SUS	1-1A	?
1.1 (0)	occ1.1	-	-	-	-	-	-	OCC Std		?
2 (2)	occ	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	1.00	1.00	0.00 OCC Std	2-1A	?
3 (1)	Test mode							SUS		?

PASS/Start-Prof | Analysis Capabilities

Automatic Creep-Rupture Usage Factor calculation according to ASME B31.3-2018 Appendix V (V303.1-V303.3)

V303.2 Determine Creep-Rupture Usage Factor

The usage factor, u , is the summation of individual usage factors, t_i / t_{ri} , for all service conditions considered in para. V303.1. See eq. (V4).

$$u = \sum (t_i / t_{ri}) \quad (V4)$$

where

- i = as a subscript, 1 for the prevalent operating condition; $i = 2, 3$, etc., for each of the other service conditions considered
- t_i = total duration, h, associated with any service condition, i , at pressure, P_i , and temperature, T_i
- t_{ri} = as defined in para. V303.1.4

V303.3 Evaluation

The calculated value of u indicates the nominal amount of creep-rupture life expended during the service life of the piping system. If $u \leq 1.0$, the usage factor is acceptable including excursions. If $u > 1.0$, the designer shall either increase the design conditions (selecting piping system components of a higher allowable working pressure if necessary) or reduce the number and/or severity of excursions until the usage factor is acceptable.

Material: A106 A Class: Carbon or Low Alloy Steel

Database can only be edited if database files are open for editing and if stress units are set as MPa (for ASME - ksi)

Data source: ASME B31.3-2018 Carbon(C_{0.3})

Density: 7833.41303 Maximum f=1.2

Larson-Miller constant C: 20

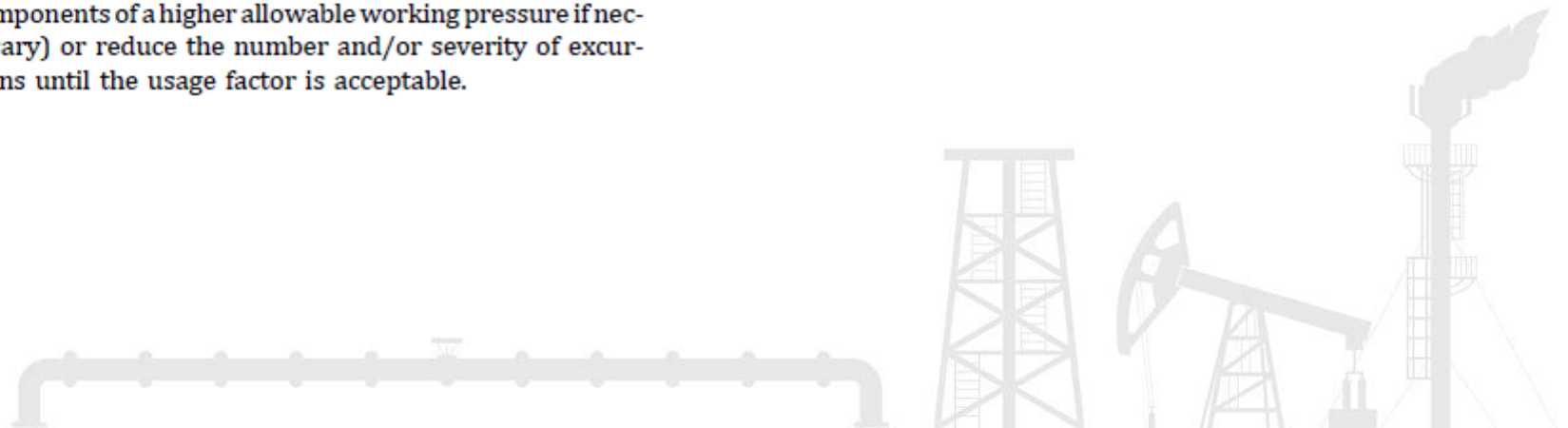
Creep Factors: Carbon, SiMn Steel

Temperature F	Allowable Stress (S), ksi	Yield Stress (Sy), ksi	Elastic Modulus ksi	Expansion Coeff. 1/F	Poisson's Ratio (ν)	WI
-325	16	30	31400	5.5e-006	0.292	1.0
-200	16	30	30800	5.79e-006	0.292	1.0
-150	16	30	30300	5.9e-006	0.292	1.0
-50	16	30	29891	6.2e-006	0.292	1.0
70	16	30	29400	6.4e-006	0.292	1.0
100	16	30	29262	6.47e-006	0.292	1.0
200	16	27.500	28800	6.7e-006	0.292	1.0

Buttons: Add, Delete, Print, Export..., Save, OK, Cancel, Help

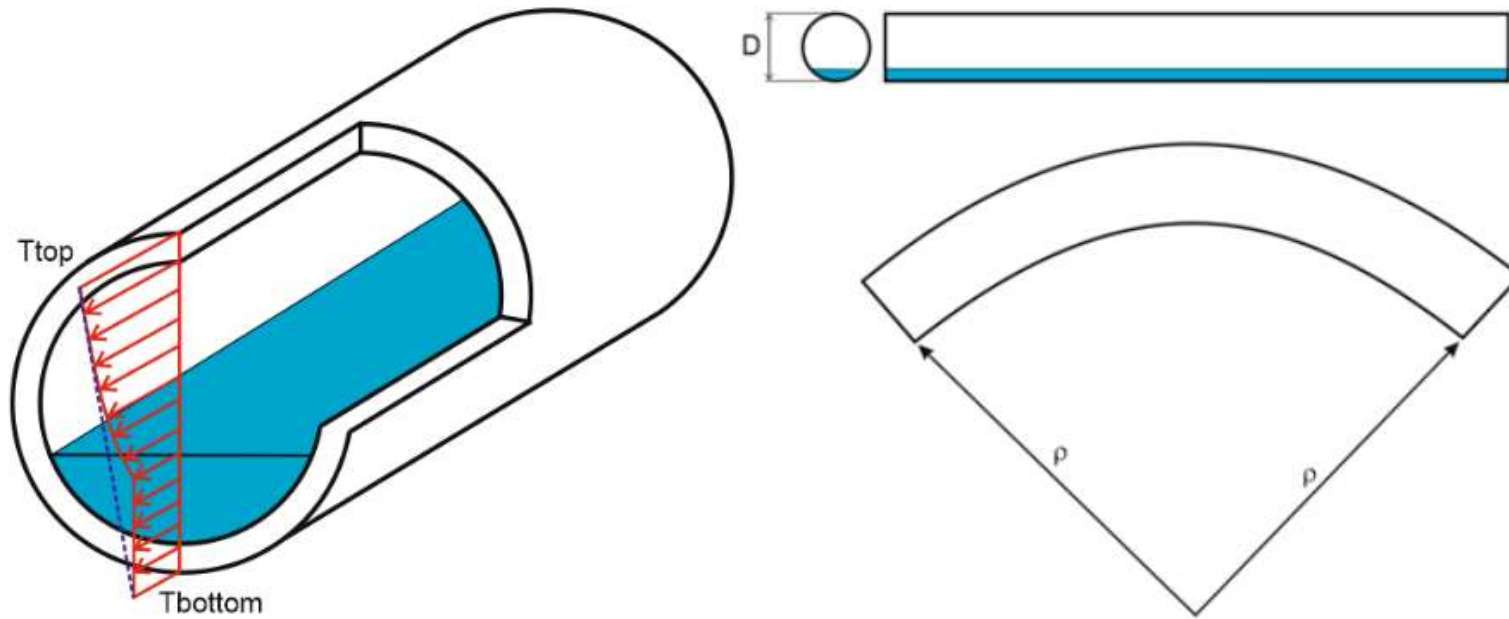


PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE



PASS/Start-Prof | Analysis Capabilities

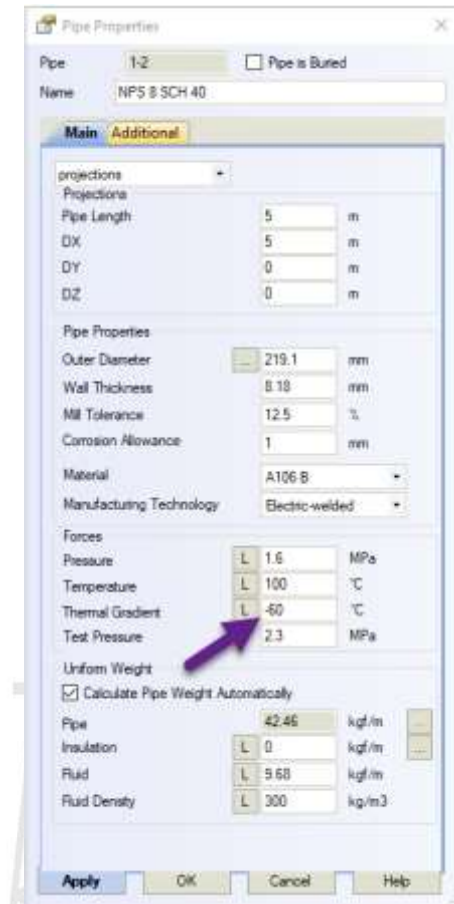
Thermal Bowing Analysis – phenomenon occurs when a horizontal pipe is filled partially by hot or cold fluid (LNG). Many thermal bowing occurrences cause unexpected damage to the piping or supporting structure



$$\frac{1}{\rho} = \frac{\alpha(T_{top} - T_{bottom})}{D}$$



PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

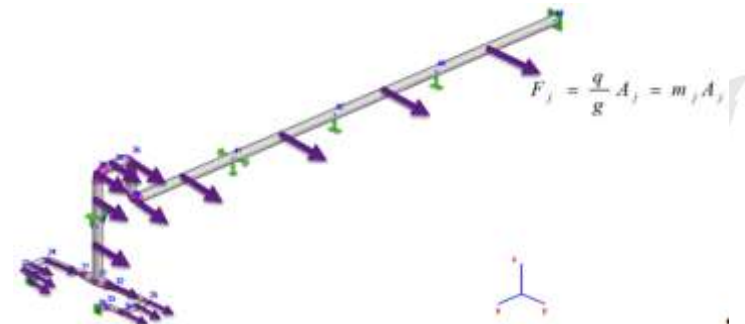
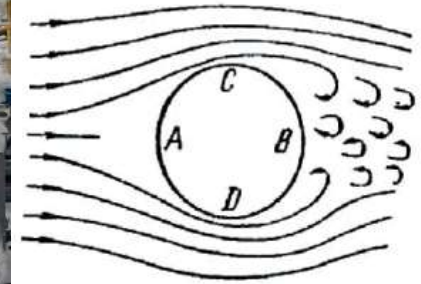


PASS/Start-Prof | Analysis Capabilities

Automatic generation of a wind, snow, ice, seismic loads according to 18 national codes

The image shows two overlapping software windows from the PASS/Start-Prof suite. The 'Pipe Properties' window on the left has a red box highlighting the 'Wind, Snow, Ice' tab, with values for Snow Shape Factor (0.4), Snow (and Rain) Load (0.084 kgf/m), and Ice Load (7.45763830 kgf/m). The 'Project Settings...' window on the right has a red box highlighting the 'Wind, Snow, Ice' tab, showing dropdown menus for Snow Loads (ASCE 7-16 USA), Ice Loads (ASCE 7-16 USA), and Wind Loads (CFE 2008 Mexico), along with various input fields and a table of parameters.

Parameter	Value
Basic Wind Speed, V0, m/s	0
Outdoor Temperature, s, °C	0
Altitude, hm, m	0
Surface Roughness, hr, mm	0
Total Structure Height, Zt, m	0
Terrain Category	1



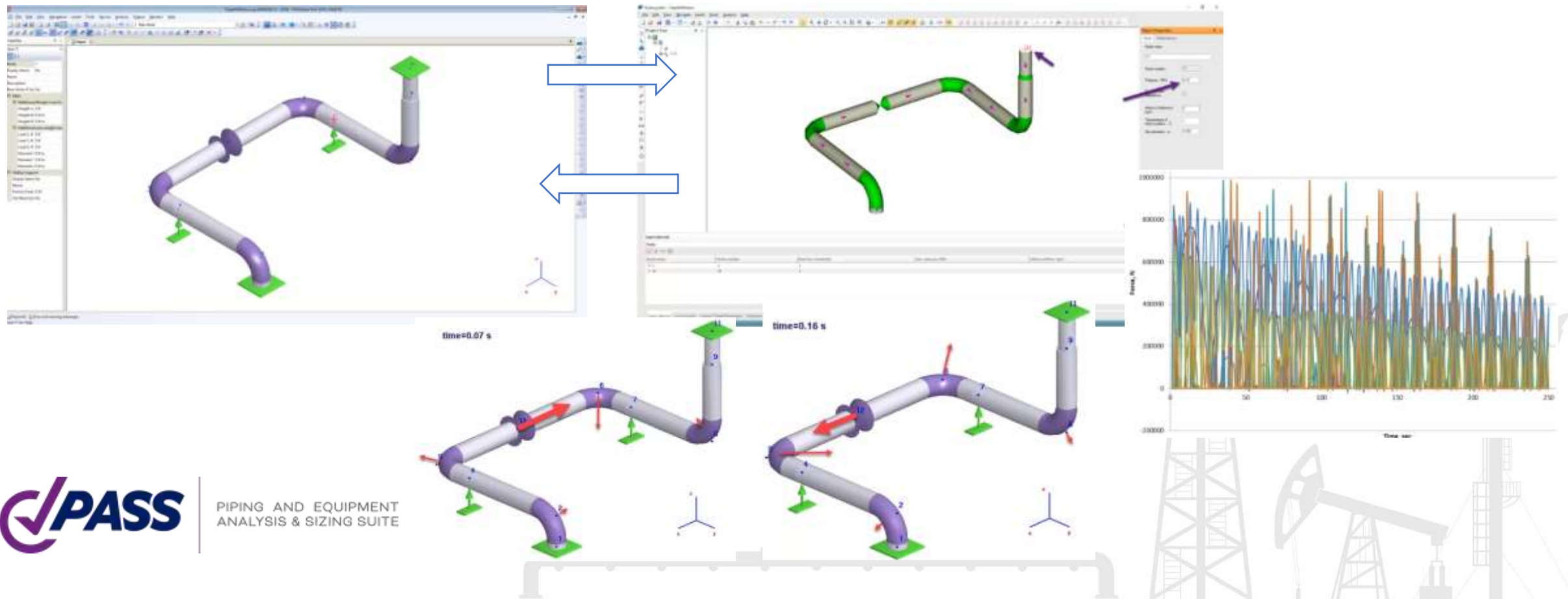
PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE



PASS/Start-Prof | Analysis Capabilities

PASS/START-PROF + PASS/HYDROSYSTEM Allows to Water Hammer Surge Analysis

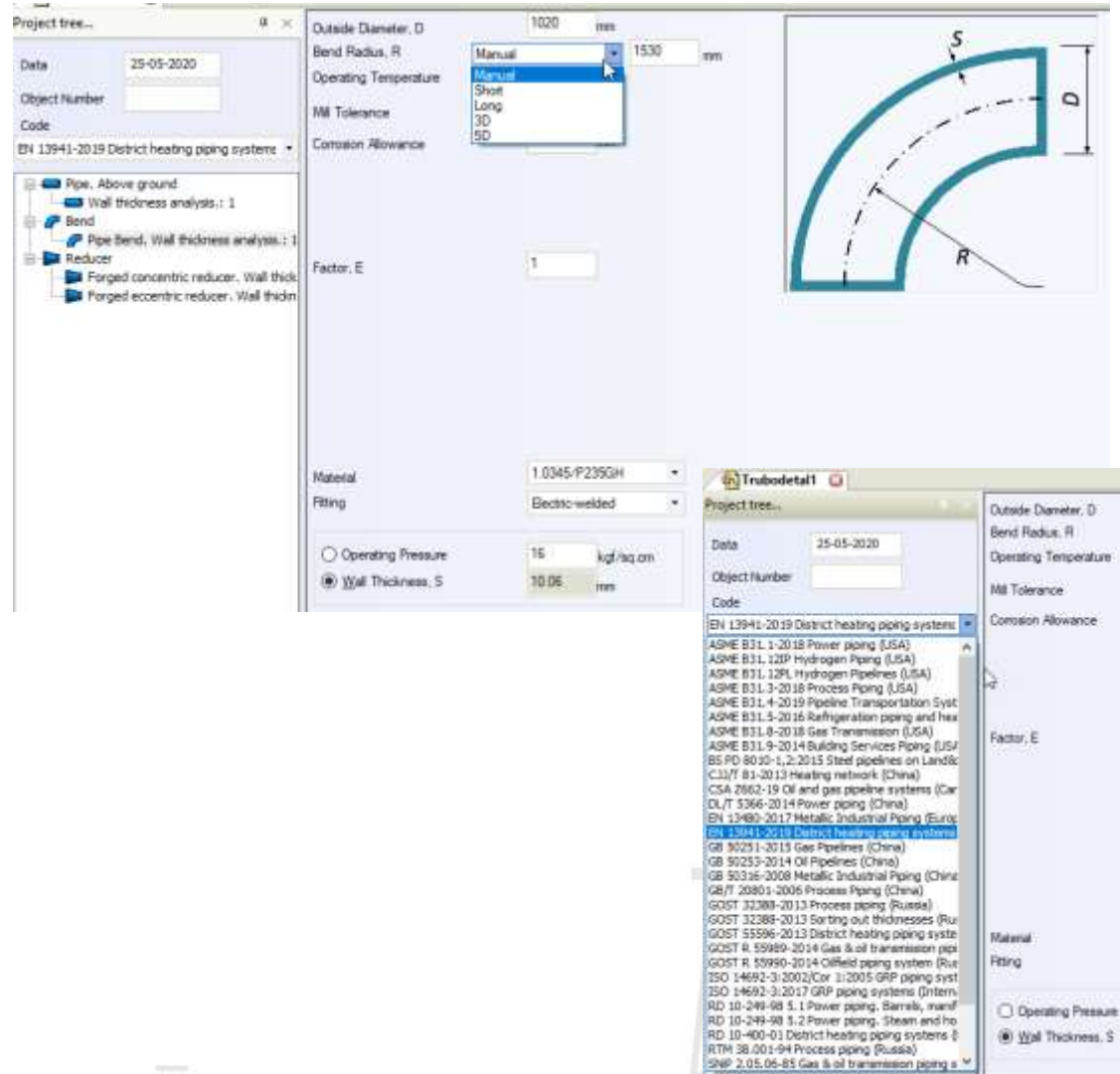
- 3D piping Models converted automatically from START-PROF to HYDROSYSTEM and back
- 3D loading is converted simultaneously for all nodes in the system at the same moment of time



PASS/Start-Prof | START-Elements

Pipe wall thickness calculator and bend wall thickness calculator for all piping codes.

All pipe and fitting wall thicknesses are automatically checked before every run of the pipe stress analysis according to the selected code.



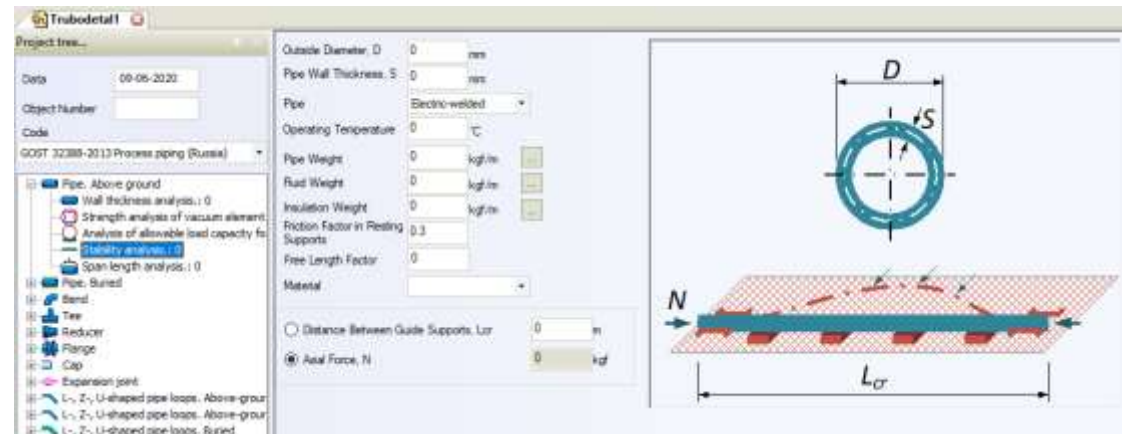
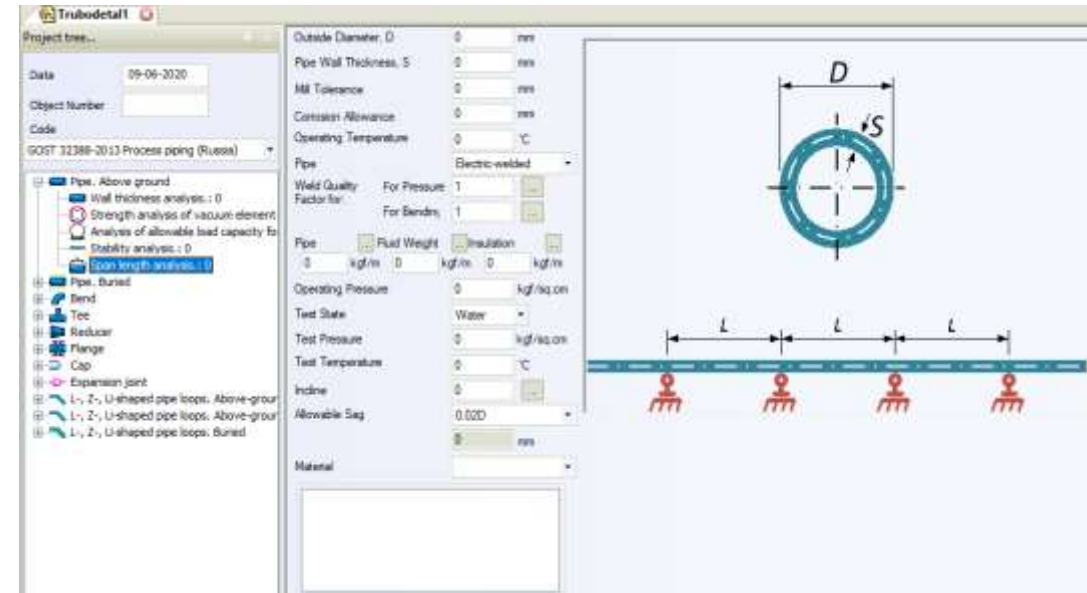
PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE



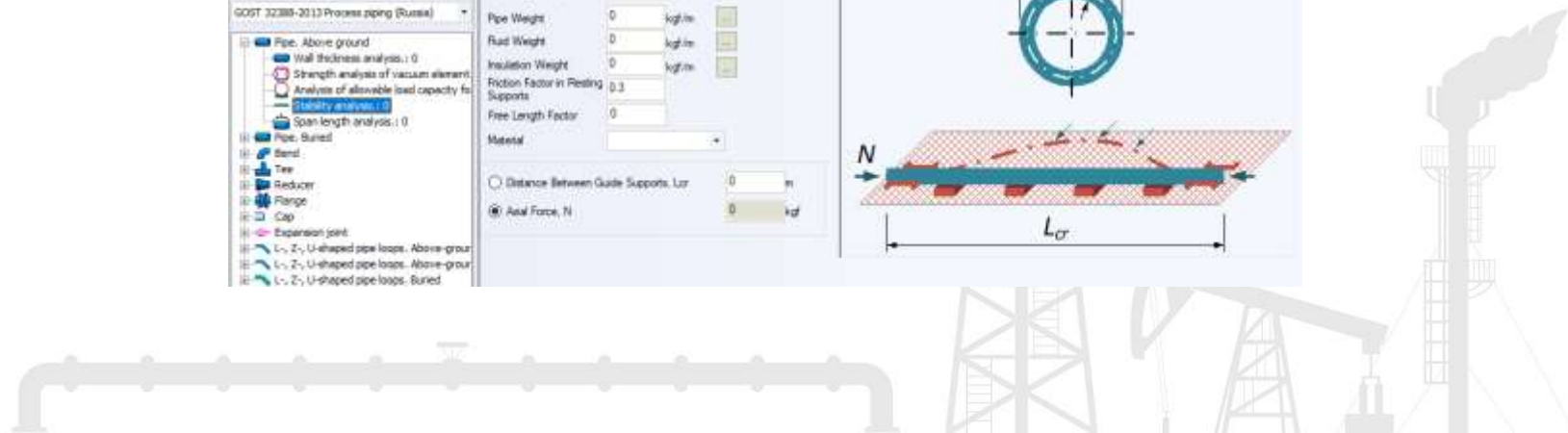
PASS/Start-Prof | START-Elements

Pipe Span Length Analysis

Longitudinal Stability Analysis



PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE



PASS/Start-Prof | START-Elements

Calculate Wall Thickness
Under Vacuum and External
Loading

Simple Expansion Loop
Analysis

The image displays two screenshots of the Trubodetail1 software interface. The top screenshot shows the 'Pipe. Above ground' analysis settings. The 'Project tree...' window on the left lists analysis items: 'Wall thickness analysis.: 0', 'Strength analysis of vacuum element', 'Analysis of allowable load capacity fo', 'Stability analysis.: 0', and 'Span length analysis.: 0'. The main settings panel includes: 'Outside Diameter, D' (0 mm), 'Operating Temperature' (0 °C), 'Pipe' (Electric-welded), 'Weld Quality Factor for Pressure' (1), 'Mill Tolerance' (0 mm), 'Corrosion Allowance' (0 mm), and an unchecked 'Availability of stiffening ribs' checkbox. A circular diagram on the right shows a pipe cross-section with diameter D and wall thickness S .

The bottom screenshot shows the 'L-, Z-, U-shaped pipe loops. Above-ground' analysis settings. The 'Project tree...' window lists various loop types, with 'U-shaped' selected. The main settings panel includes: 'Pipe Diameter, D' (0 mm), 'Pipe Wall Thickness, S' (0 mm), 'Stretch factor (without stretch - 0)' (0), 'Operating Pressure' (0 kgf/sq cm), 'Material' (blank), 'Expansion joint back, B' (0 m), 'Expansion joint leg, H' (0 m), 'Allowable load on end support' (0 kgf), 'Friction Factor in Resting Supports' (0.3), 'Pipe' (Electric-welded), 'Weld Quality Factor for: pressure' (1), 'bending' (0.5), 'Flexibility of bends' (ignore), 'Bend curve radius' (0 mm), and 'Compensated lengths' (L1: 0 m, L2: 0 m). A diagram on the right shows a U-shaped expansion loop with horizontal segments of length L_1 and L_2 , a vertical segment of height H , and a bend radius R . A circular inset shows the pipe cross-section with diameter D and wall thickness S .



PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

PASS/Start-Prof | Piping Model Creation

- No need to create the load cases manually
- Save a lot of time and protect from mistakes
- Operation Mode Editor will do this job for you
- Easy to understand and change
- No limit on pressure, temperature number

67 complex load cases are automatically generated based on simple five START-PROF operating modes

#	Name	High temperature	Cold State	Seismic	Wind	Snow/Ice	Use Load Factors	Friction Multiplier	Weight Multiplier	Mode Type	Stress Range Between
1	Operating	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	1.00	1.00	SUS	1-1A, 1-2, 1-3, 1-4
1.1	Safety Valve Thrust 1	-	-	-	-	-	-	-	-	OCC	-
2	Operating 2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	1.00	1.00	SUS	2-1, 2-1A, 2-3, 2-4
2.1	Safety Valve Thrust 2	-	-	-	-	-	-	-	-	OCC	-
3	Filling	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	1.00	1.00	SUS	3-1A
4	Emergency	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	1.00	1.00	SUS	4-1A
5	Test	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-	-	Test	-

Simplified Load Case Templates. Real load case templates please see in help

Operation Mode #1: Operating
L1: W1+P1 SUS Stress, Disp, Force, etc.
L2: W1+P1+T1 OPE Disp, Force, etc.
L3: L2+L1(≠1) EXP(1-1A) Stress
L4: L2+L2(≠2) EXP(1-2) Stress
L5: L2+L2(≠3) EXP(1-3) Stress
L6: L2+L2(≠4) EXP(1-4) Stress
L7: W1+P1+T1+5 Disp, Force, etc. (S - Snow)
L8: L7+L2 Algebraic
L9: L1+L8 Scalar SUS Stress
L10: W1+P1+T1+I Disp, Force, etc. (I - Ice)
L11: L10+L2 Algebraic
L12: L1+L11 Scalar SUS Stress
L13: W1+P1+T1 +5Siesmic(+X) Disp, Force, etc.
L14: L13+L2 Algebraic
L15: L1+L14 Scalar OCC Stress
L16: W1+P1+T1 +5Siesmic(-X) Disp, Force, etc.
L17: L16+L2 Algebraic
L18: L1+L17 Scalar OCC Stress
L19: W1+P1+T1 +5Siesmic(+Y) Disp, Force, etc.
L20: L19+L2 Algebraic
L21: L1+L20 Scalar OCC Stress
L22: W1+P1+T1 +5Siesmic(-Y) Disp, Force, etc.
L23: L22+L2 Algebraic
L24: L1+L23 Scalar OCC Stress
L25: W1+P1+T1 +5Siesmic(+Z) Disp, Force, etc.
L26: L25+L2 Algebraic
L27: L1+L26 Scalar OCC Stress
L28: W1+P1+T1 +5Siesmic(-Z) Disp, Force, etc.
L29: L28+L2 Algebraic
L30: L1+L29 Scalar OCC Stress
L31: L1+MAX(L14,L17,...)^0.5 Scalar OCC Stress
L32: L1+MAX(L14,L17,...)^0.5 Scalar OCC Stress
L33: L2+MAX(L14,L17,...)^0.5 Disp, Force, etc.

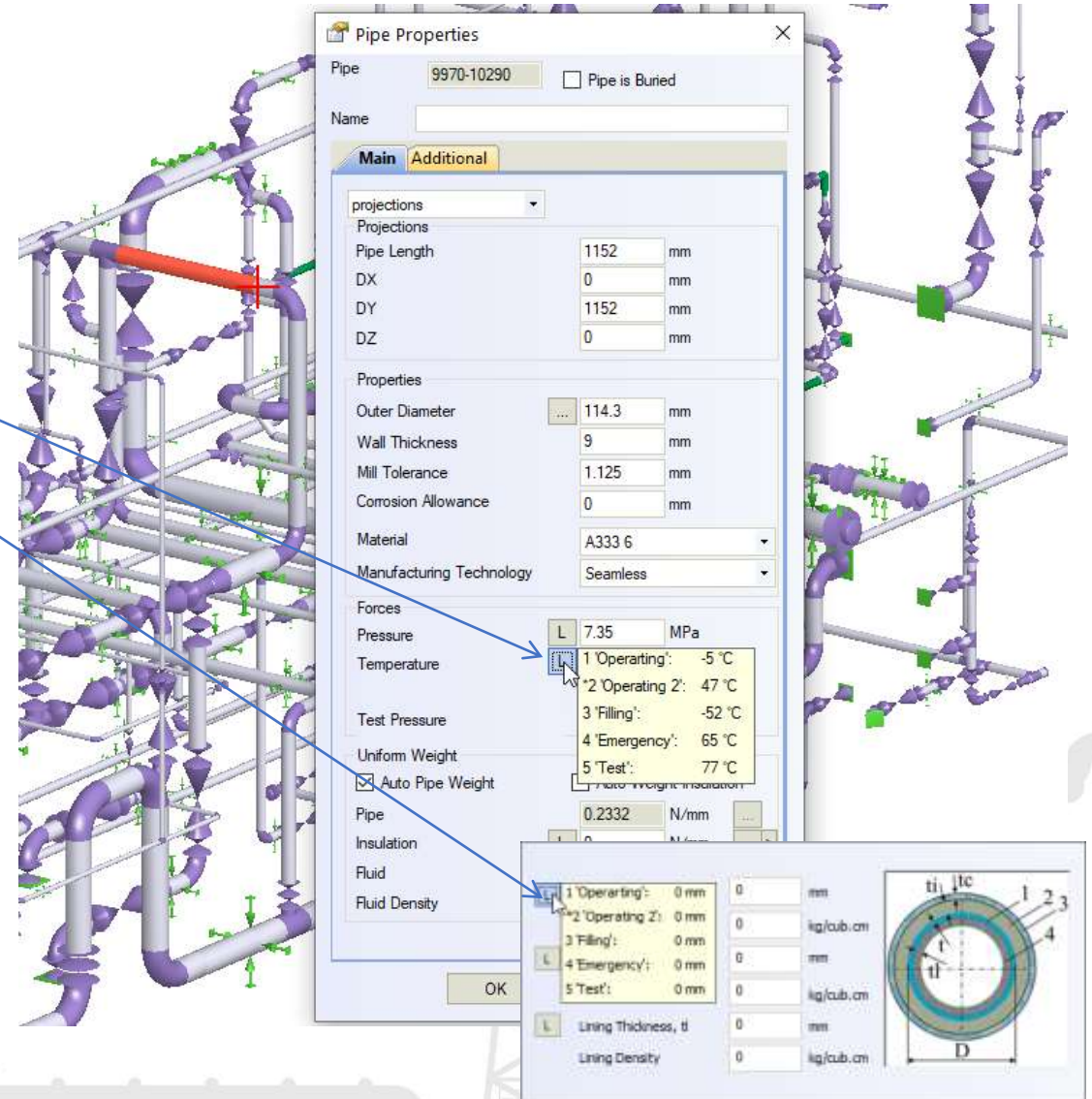


PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

PASS/Start-Prof | Piping Model Creation

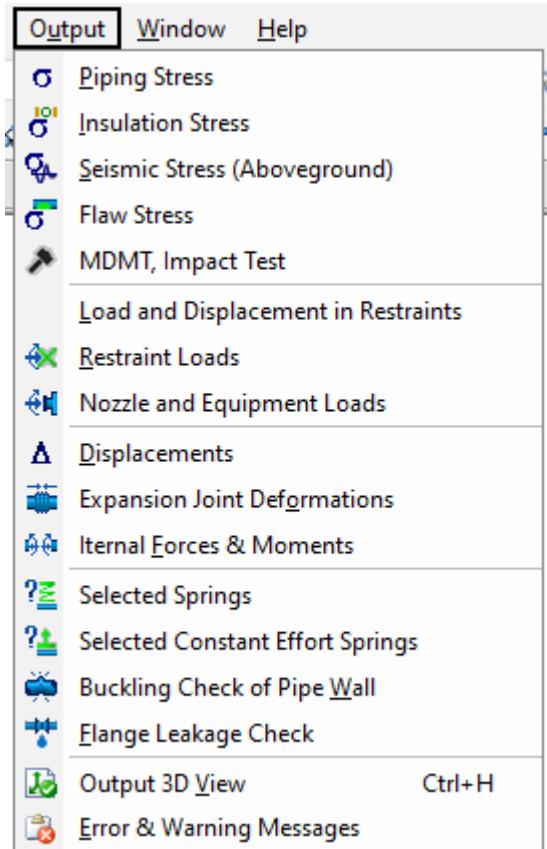
Different operating modes can have different:

- Temperatures 1-∞
- Pressures 1-∞
- Fluid weight 1-∞
- Restraint displacements 1-∞
- Forces and moments, uniform loads 1-∞
- Insulation layers and density, weight 1-∞
- No limit on pressure, temperature, etc. number
- No limit on operation mode number
- Load cases created automatically
- Interactive reports are compiled automatically for all operating modes



PASS/Start-Prof | Reports

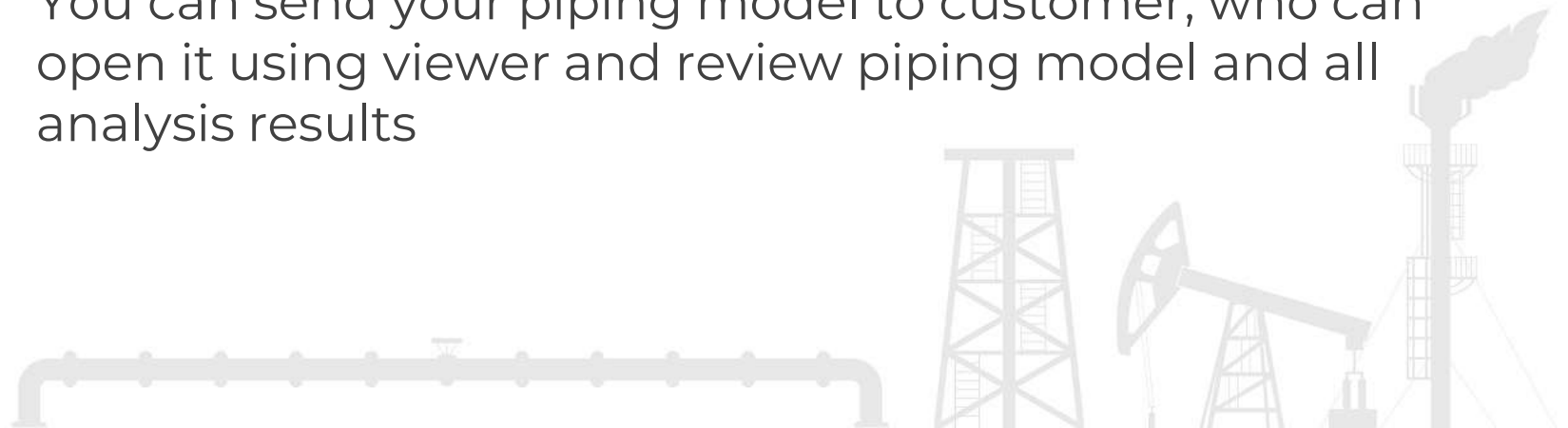
Full scope of the needed interactive reports after analysis



- Reports are interactive. For example, you can add or remove stresses from axial force on-the-fly, change global/local coordinates, add or remove creep stress etc.
- Reports can be copied to MS Excel
- Reports can be exported into MS Word
- Free Viewer is Available
You can send your piping model to customer, who can open it using viewer and review piping model and all analysis results



PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE



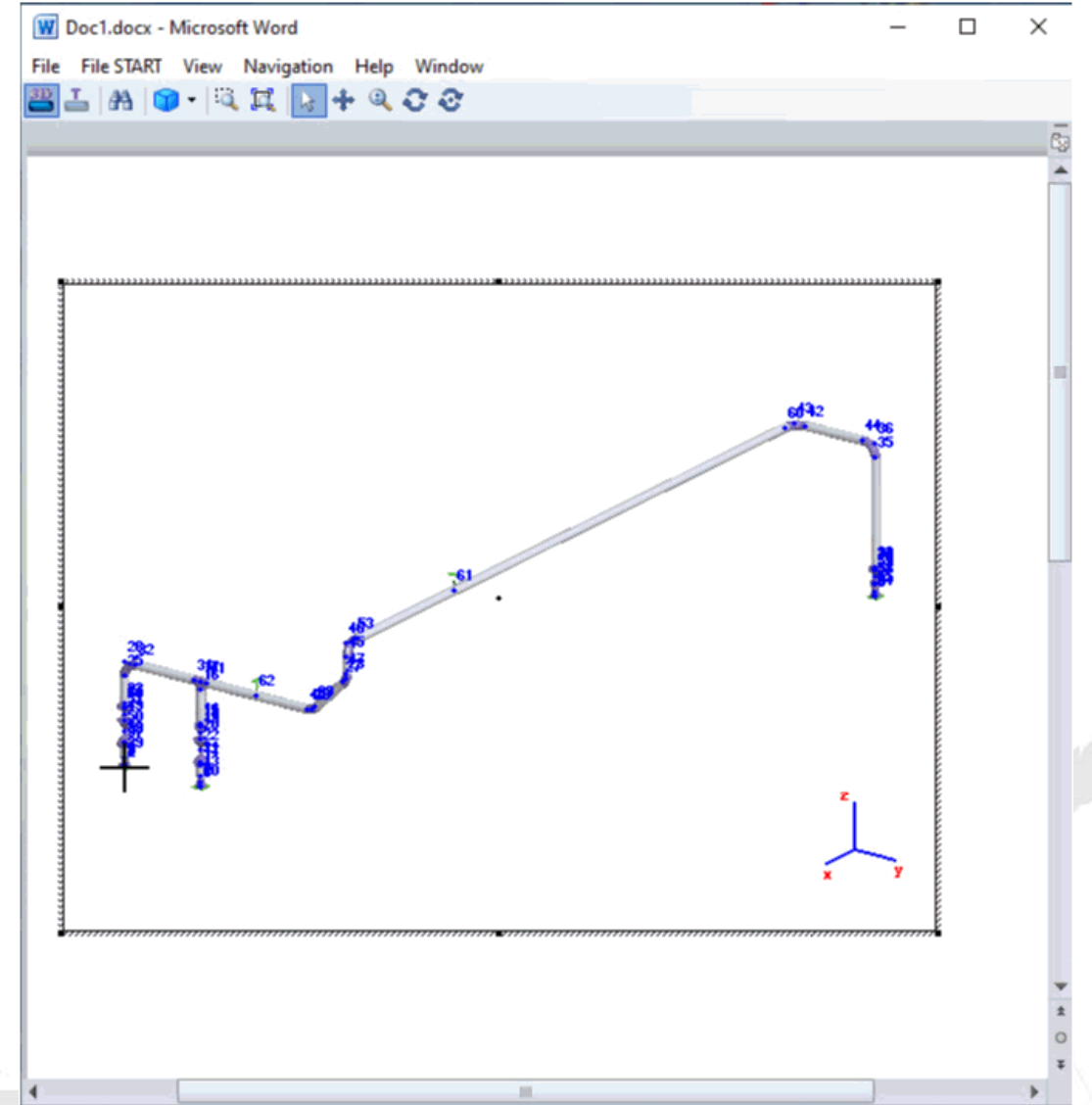
PASS/Start-Prof | Features

Function 'Copy Whole Model'.

Allows to copy whole piping model as an object into clipboard. After that you can insert this interactive model into any other software like MS WORD, EXCEL etc.

You can rotate, pan zoom the model right inside MS Word

You can add interactive into report in MS Word and send to your customer for review



PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

PASS/Start-Prof | Reports

Start-Prof Econom 2017 v.04.82 R2 - [Transfer 55-80 ASME B11.3.ctp - Load on Restraints and Equipment]

File Edit View Service Analysis Output Window Help

Input Loads

Operating Mode: 1 Main (0) | Submode: Operation | Axis: Global axis | Support Type: Anchor fixed; Sliding

Node Number	Type	Forces along coordinate axis, (kgf)			Moments around coord			
		X	Y	Z	X	Y	Z	
2	Console	Anchor (fixed)	0.10	0	-1151.20	0	-575458.38	0.01
3	Restrained	Anchor (fixed)	567378.30	0	-325.80	0	-54294.99	0
4	Restrained	Anchor (fixed)	-567378.30	0	-325.80	0	54295.04	0
5	Bend	Anchor (fixed)	3760.80	556.90	-554.50	-10066.75	-106026.59	-235113.50
7	Bend	Anchor (fixed)	13603.30	-5447.70	-1294.60	-302600.69	9588.95	-1653202.63
9	Anchor (fixed)		-3902.60	2185.80	-720	75899.34	237117.89	209446.26
11	Anchor (fixed)		-287.60	-131	-403	-83200.50	114312.74	54883.24
13	Sliding Support		-71.90	-102	-814.10	0	0	0
15	Anchor (fixed)		96.20	151.30	-486.60	25559.60	-32059.35	42000.25
17	Anchor (fixed)		126.90	247.60	-422.20	63066.41	-52465.34	34842.89
19	Anchor (fixed)		11.10	383.20	-343.40	116306.95	-26298.11	26296.48
21	Anchor (fixed)		-13362.30	2155.90	-543.80	-55819.34	112108.12	407537.56

Restraint Loads

Error and warning messages

Type	Node/pipe	Description
Notes	Node:5	(N265) Failed the stress check from pressure and weight loads (1, 'Main')
Notes	Node:5	(N265) Failed the stress check from pressure and weight loads (1, 'Main')
Notes	Node:5	(N284) Failed the fatigue strength check (1, 'Main')
Notes	Node:5	(N284) Failed the fatigue strength check (1, 'Main')
Notes	Node:5	(N268) Failed the stress check in operation condition (1, 'Main')
Notes	Node:5	(N268) Failed the stress check in operation condition (1, 'Main')

Pipes list | Error and warning messages

Для справки нажмите F1

START-PROF 04.82 R1 - [START1.ctp - Displacement]

File Edit View Service Analysis Output Window Help

Input Displ

Operating Mode: 1 Main mode | Submode: Operation | Choose Axis: Global axis | Type Filter: Linear | Object Filter: All nodes

Node Number	Type	Displacement along coordinate axis, (mm)		
		X	Y	Z
1	Anchor (fixed)	0	0	0
2	Welding Tee	3	-1.1	-0.4
3	Single-direction Guide	6.1	0	0
4	Forged Elbow	2.8	1.6	1.3
6	Forged Elbow	2.3	-2.2	-0.6
8	Forged Elbow	0.7	-4.9	0.3
9	Sliding Support	0.1	-4	0
10	Anchor (fixed)	0	0	0
12	Spring Hanger	3	1.3	1.4

Displacements

Error and warning messages

Type	Node/pipe	Description	Help
Warning	Node:3	(W522) Gap is not considered in the analysis, since it is too small	?
Warning	Node:2	Tee length must be greater than 0	?
Warning	Node:2	(W660) Dummy free end at pipe border may cause analysis inaccuracies if in fact the pipeline continues beyond this point	?
Information	-	(W562) Number of degrees of freedom 13	?

Pipes list | Error and warning messages

Для справки нажмите F1

PASS/Start-Prof | Reports

- Stress report show all used equations
- You can add/remove stress from axial force
- Activate individual features for each pipe stress code
- Cells where the check fails has a red color
- Messages about stress check fail duplicated in the errors and warning window

The screenshot displays the 'Start-Prof Econom 2017 v.04.82 R2 - [Transfer 56-80 ASME B31.3.ctp - Code Stress]' application. The main window shows a 'Stress' report table with columns for 'Stress range (kgf/sq.cm)', 'Sustained with creep (Operating State) (kgf/sq.cm)', and 'Sustained with creep (Cold State) (kgf/sq.cm)'. The table lists various components like 'Above ground pipe', 'Forged Elbow', 'Joint', 'Eccentric Reducer', 'Concentric Reducer', and 'Welding Tee'. Several cells in the table are highlighted in red, indicating failed checks. A yellow tooltip window is open over one of the red cells, displaying detailed stress analysis equations and values. At the bottom, an 'Error and warning messages' window is open, showing a list of messages with columns for 'Type', 'Node/pipe', and 'Description'. The messages are listed as 'Notes' for 'Node:1' and 'Node:2', with descriptions indicating failed stress checks.

Component	Code	Stress range (kgf/sq.cm)	Sustained with creep (Operating State) (kgf/sq.cm)	Sustained with creep (Cold State) (kgf/sq.cm)	Notes
Above ground pipe	1, Console	187.82	187.82	187.82	
Above ground pipe	2, Console	3998.54	3998.54	3998.54	1,2,7,8,9,10
Above ground pipe	4, Restrained	494.99	472.22	359.55	7,8
Forged Elbow	4, Restrained	494.99	472.22	359.55	7,8
Above ground pipe	6,0 Flange	706.01	706.01	706.01	1,2,3,7,8
Joint	24	648.07	648.07	648.07	7,8
Above ground pipe	24	353.30	353.30	353.30	
Eccentric Reducer	22	407.28	407.28	407.28	
Above ground pipe	22	407.28	407.28	407.28	
Concentric Reducer	23	629.84	629.84	629.84	1,2,7,8
Above ground pipe	23	629.84	629.84	629.84	1,2,7,8
Forged Elbow	5, Bend	1345.04	1345.04	1345.04	1,2,7,8
Above ground pipe	6,0 Flange	1049.41	1049.41	1049.41	1,2,3,7,8
Above ground pipe	8	552.69	552.69	552.69	7,8
Welding Tee	8	614.07	614.07	614.07	7,8
Above ground pipe	8	1208.19	1208.19	1208.19	1,2,3,7,8
Non-standard bend	25	484.39	484.39	484.39	
Above ground pipe	25	484.39	484.39	484.39	

Type	Node/pipe	Description
Notes	Node:1	(N265) Failed the st
Notes	Node:1	(N265) Failed the st
Notes	Node:1	(N284) Failed the fa
Notes	Node:1	(N284) Failed the fa
Notes	Node:1	(N268) Failed the st
Notes	Node:1	(N268) Failed the st



PASS/Start-Prof | Reports

PASS/START-PROF has smart warnings in error checker.

It show all engineering warnings like support is lifting off, support loads are greater than allowable, expansion joint deformation exceed the limits, buckling analysis failed, flange leakage failed, spring hanger variable range greater than 25%, spring load in one of load cases is greater than allowable, rod rotation exceed the limit and many others.

The screenshot displays the PASS/Start-Prof software interface. On the left, a 'Properties' panel shows details for 'Node: 234'. The main window shows a 3D model of a piping system with various nodes and supports. A purple arrow points from the 'Error and warning messages' table at the bottom to the 3D model. The table lists several warnings, with the most prominent one being 'Pipe is lifted above the support'.

Type	Node/pipe	Description	Help
Notes	Node:127	(N165) Failed the stress check from pressure and weight loads (1. Main mode)	?
Notes	Node:127	(N165) Failed the stress check from pressure and weight loads (2. Test mode)	?
Notes	Node:129	(W582) Restriction on force along axis has been violated O2 (Operating State) - 2. Test mode	?
Notes	Node:129	(W582) Restriction on force along axis has been violated O2 (Cold State) - 1. Main mode	?
Notes	Node:129	(W582) Restriction on force along axis has been violated O2 (Operating State) - 1. Main mode	?
Notes	Node:234	(W305) Pipe is lifted above the support (Operating State) - 2. Test mode	?
Notes	Node:279	(W305) Pipe is lifted above the support (Operating State) - 1. Main mode	?
Notes	Node:279	(W305) Pipe is lifted above the support (Operating State) - 2. Test mode	?
Notes	Node:447	(W305) Pipe is lifted above the support (Operating State) - 1. Main mode	?
Notes	Node:447	(W305) Pipe is lifted above the support (Operating State) - 2. Test mode	?
Notes	Node:815	(W305) Pipe is lifted above the support (Operating State) - 1. Main mode	?
Notes	Node:815	(W305) Pipe is lifted above the support (Operating State) - 2. Test mode	?
Notes	Node:895	(W305) Pipe is lifted above the support (Operating State) - 1. Main mode	?
Notes	Node:895	(W305) Pipe is lifted above the support (Cold State) - 1. Main mode	?



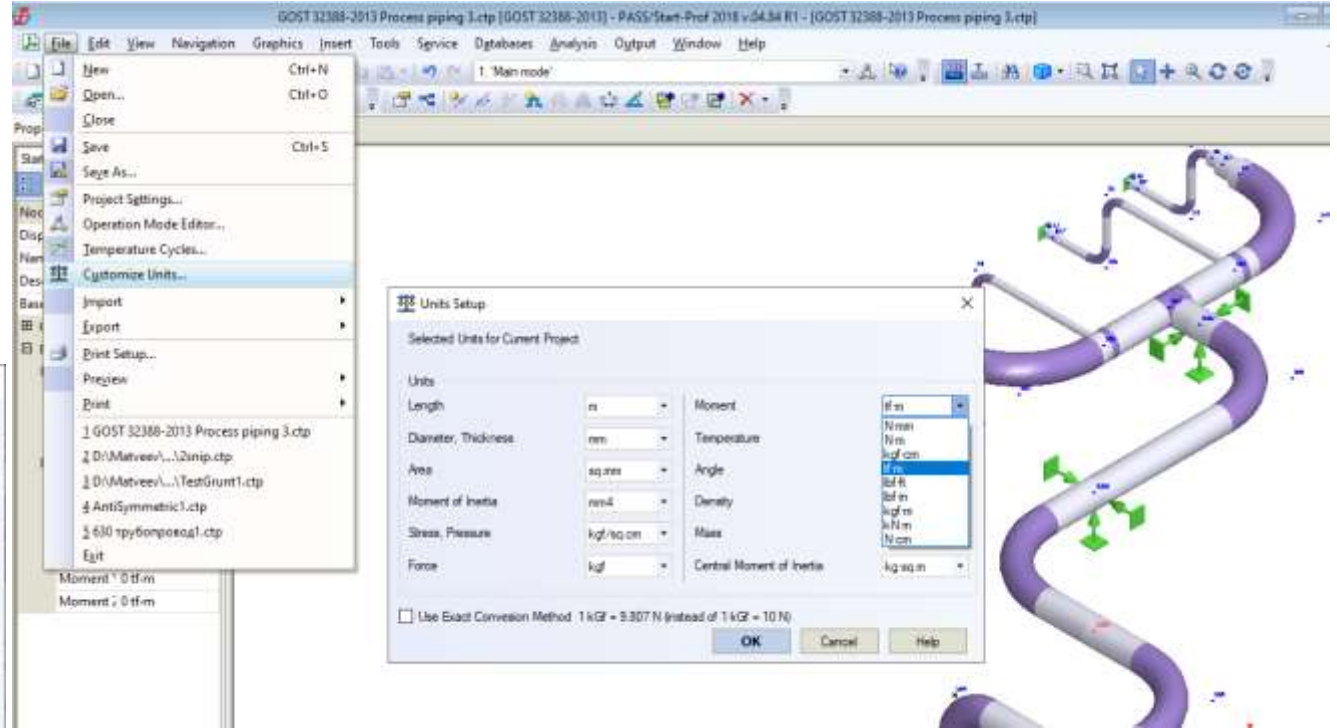
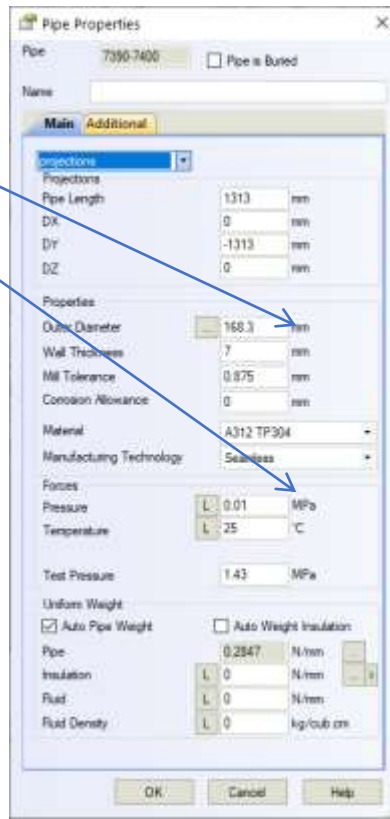
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PASS/Start-Prof | Features

Change of the model units available at any moment of time on-the-fly, even after analysis is done.

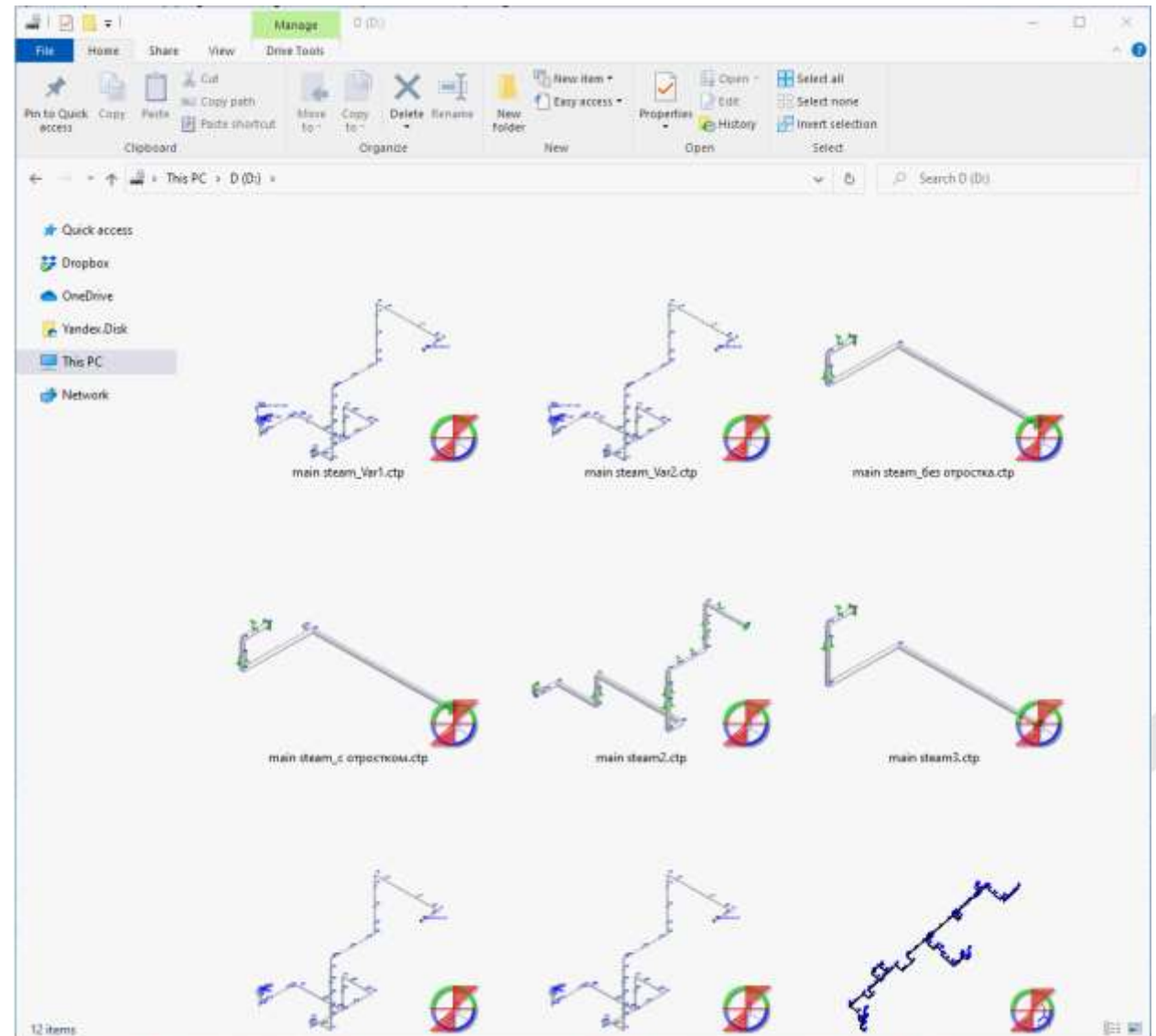
The units are always displayed for each input field.



PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

PASS/Start-Prof | Features

- Each piping system project is stored in just one file
- Thumbnails for windows explorer. You can preview all piping models right in the explorer before opening the file
- Fast opening even big models
- High speed of stress analysis and working with a really big models



PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

PASS/Start-Prof | Reliability

Full Verification and Validation manual. Added a lot of verification examples, compared to manual calculations and other software.

The collage features several key elements:

- 3D Pipe Models:** Multiple 3D renderings of pipe systems, including a long straight section with a bend (START-PROF model 1848, CAESAR II model 1848) and a complex loop system (START-PROF model - 320571, CAESAR II model - 320571).
- Technical Drawing:** A detailed 2D drawing titled "1.6 ASME B31.3 Appendix S (S302) ASME B31.3-2018 Appendix S [S302] Model Figure S302.1 Liftoff Model". It shows a pipe with a lift-off section, with dimensions in meters and feet: 12.2 m (40 ft), 3.05 m (10 ft), 9.15 m (30 ft), 9.15 m (30 ft), 3.05 m (10 ft), 12.2 m (40 ft), and a lift-off height of 6.1 m (20 ft). Nodes are numbered 10 through 145.
- Book Cover:** The cover of the "PASS START-PROF Pipe Stress Analysis Software VERIFICATION AND VALIDATION MANUAL Version 4.84 July 2020".
- Engineering Diagrams:** A diagram of a "Burgess Bend" (START-PROF model NRG1) showing a pipe with a sharp U-turn, and another diagram of a "Serpentine Bend" (START-PROF model NRG4-1) showing a pipe with multiple curves. Both include coordinate axes and dimension lines.



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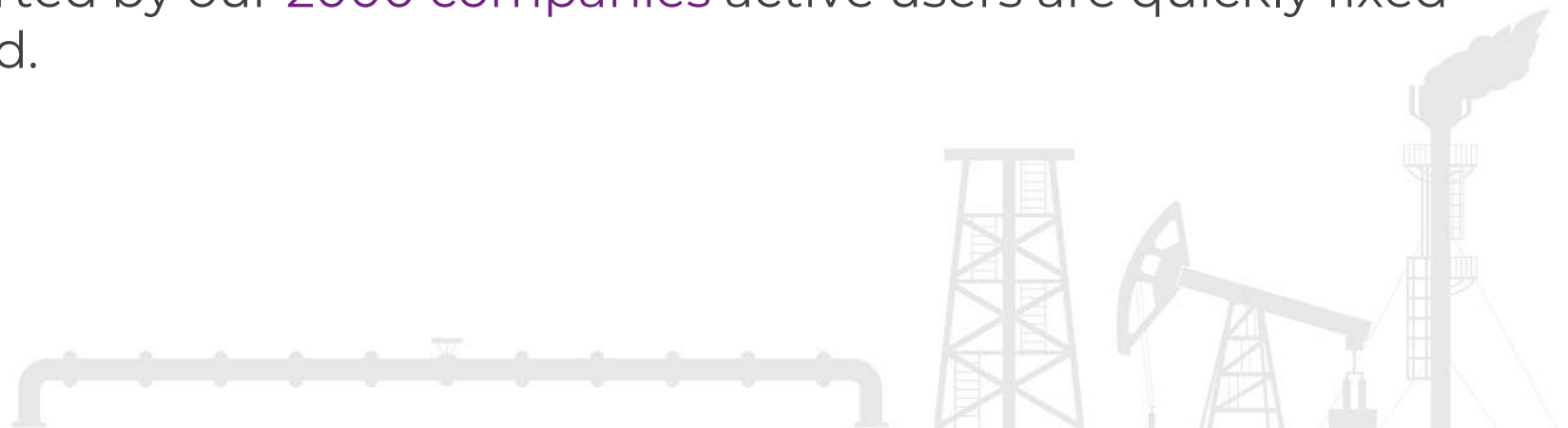
PASS/Start-Prof | Reliability

Each new PASS/START-PROF release is:

- Automatically verified on more than **300 examples** with previous versions (quality assurance system).
- Checked manually with group of pipe stress experts (testers).
- Each release pass through 1-3 pipe stress training with 10-20 students before official release.
- After release, all bugs reported by our **2000 companies** active users are quickly fixed and new release is provided.



PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE



PASS/Start-Prof | Licensing

Configurations/Pricing Options

<p>PASS/Start-Prof Complete Advanced</p> <p>Simulation and sizing for any piping network considering all applicable national codes.</p> <p>PASS/Start-Prof Complete Standard</p> <p>configuration includes only worldwide popular standarts.</p>	<p>PASS/Start-Prof Process Advanced</p> <p>Simulation and sizing for piping networks based on applicable national codes for process plants as well as for gas and oil transportation systems.</p> <p>PASS/Start-Prof Process Standard</p> <p>configuration includes only worldwide popular standarts.</p>	<p>PASS/Start-Prof Power Advanced</p> <p>Simulation and sizing for any piping networks based on applicable national codes for power generation piping as well as for central heating networks.</p> <p>PASS/Start-Prof Power Standard</p> <p>configuration includes only worldwide popular standarts.</p>	<p>PASS/START-PROF HDPE+FRP</p> <p>Piping stress analysis of high density polyethylene and/or fiberglass reinforced plastic piping systems.</p>
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- Permanent License at Affordable Price (+1 year maintenance for free!)
- Maintenance Renew 1 Year: 25%
- Annual License: 40%
- Semi-Annual License: 25%

Configurations Comparison

Code	Complete Advanced	Process Advanced	Power Advanced	Complete Standard (40% discount)	Process Standard (40% discount)	Power Standard (40% discount)	HDPE+FRP (40% discount)
ISO 14692	✓	✓	✓				✓
HDPE Piping	✓	✓	✓				✓
ASME B31.1	✓		✓	✓		✓	
ASME B31.3	✓	✓		✓	✓		
ASME B31.4	✓	✓		✓	✓		
ASME B31.5	✓	✓	✓	✓	✓	✓	
ASME B31.8	✓	✓		✓	✓		
ASME B31.9	✓	✓	✓	✓	✓	✓	
EN 13480	✓	✓	✓	✓	✓	✓	
GB 50316	✓	✓	✓	✓	✓		
GB/T 20801	✓	✓		✓	✓		
GB 50251	✓	✓		✓	✓		
GB 50253	✓	✓		✓	✓		
DL/T 5366	✓		✓	✓		✓	
CJJ/T 81	✓		✓				
RD 10-249-98	✓		✓				
GOST R 55596	✓		✓				
GOST 32388	✓	✓					
SNIP 2.05.06-85	✓	✓					
SP 36.13330	✓	✓					



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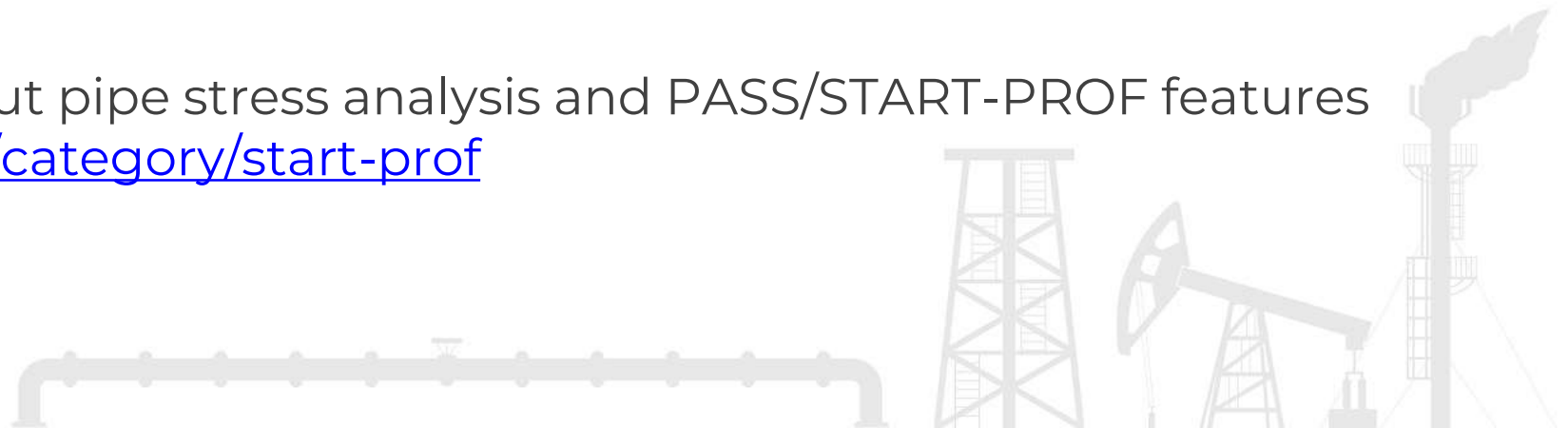
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- Facebook: www.facebook.com/PASSuite
- Twitter: twitter.com/passuitecom
- More than 50 articles about pipe stress analysis and PASS/START-PROF features
<https://whatispiping.com/category/start-prof>



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Subscribe our YouTube channel, you will find a lot of PASS/START-PROF training videos

www.youtube.com/passuite



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The screenshot displays the YouTube channel page for PASS, which has 716 subscribers. The page is organized into a grid of video uploads. The top navigation bar includes links for HOME, VIDEOS, PLAYLISTS, CHANNELS, DISCUSSION, and ABOUT. Below the navigation, there are tabs for 'Uploads' and 'PLAY ALL'. The video grid consists of 24 thumbnails, each with a title, view count, and upload date. The videos cover a wide range of topics, including software overviews, import tutorials, stress analysis, and specific case studies.

Video Title	Views	Upload Date
PASS/EQUIP Overview Webinar: Comprehensive...	124 views	4 days ago
PASS/START-PROF Overview Webinar: Your software for...	334 views	2 months ago
PASS/Equip Nozzle-FEM Overview Webinar: Powerful...	135 views	2 months ago
How to Import piping model from CADWorx to START-...	193 views	2 months ago
How to Import piping model from CADWorx to START-...	119 views	2 months ago
PASS/HYDROSYSTEM Overview Webinar...	229 views	3 months ago
PASS/START-PROF was used for 2022 Winter Olympic...	162 views	4 months ago
Beijing Universal Amusement Park Buried Hot Water Pipin...	261 views	4 months ago
PASS/START-PROF Overview Webinar: Your software for...	196 views	5 months ago
New START-PROF option: Import from Autodesk Revit	370 views	6 months ago
18 How to calculate the 'slurry' flow in Hydrosystem	111 views	9 months ago
17 How to calculate the gas liquid liquid flow in...	134 views	9 months ago
How to import PCF file to START PROF	365 views	1 year ago
How to run PASS/START PROF Trial	1.3K views	1 year ago
Pipe Stress Analysis From Water Hammer Loads	2.2K views	1 year ago
Creating a Simple Piping Model Tutorial in START-...	TK views	1 year ago
CAESAR II Convergence Issue (2019 training) Piping...	5K views	1 year ago
Big Piping Model Analysis Tutorial with PASS/START-...	1.4K views	1 year ago
GRP / GRE / FRP Piping Stress Analysis Tutorial usi...	8:27	
HDPE Piping Stress Analysis Tutorial With PASS/START-...	4:07	
HDPE Piping Stress Analysis With PASS/START-PROF...	13:06	
Two-way integration between PASS/Start-Prof Pipe Stress...	3:25	
16 Interface between Hydrosystem and START-...	2:30	
Buried Piping/Pipelines Stress Analysis with...	26:21	

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Q & A

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Thank YOU!