



**HEXAGON**

**What's New in CAESAR II  
v13**

# CAESAR II v13

## Co Nowego

Dodano wsparcie dla ASME B31J – 2017 dla współczynników SIF i sprężystości

Zaktualizowano:

B31.1(power piping) – wydanie 2020.

B31.3 oraz B31.3 Chapter IX (process piping) - wydanie 2020.

B31.5 (refrigeration piping & heat transfer) - wydanie 2019.

B31.8 oraz B31.8 Chapter VIII (gas transmission & distribution) - wydanie 2020.

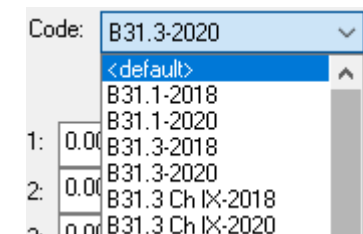
B31.9 (building services) – wydania 2017 oraz 2020.

EN-13480-3:2017/A4:2021.

Dodano wsparcie dla wydań wielu norm rurociągowych – dla wszystkich wymienionych powyżej, poprzednie wydania z wersji v12 są wciąż dostępne

Dodano kreator podpory sprężynowej z tarciem tzw *Spring Can with Friction*, co upraszcza modelowanie tej podpory

Dodano współczynniki gęstości cieczy do edytora przypadków obciążeń tzw FDM (Fluid Density Multiplier). Ten współczynnik pozwala dopasować gęstość cieczy dla każdego przypadku obciążenia



# CAESAR II v13



ASME B31.3 2020 Edition included 1 significant change

Appendix D has now been removed from B31.3 and B31.1

**APPENDIX D  
FLEXIBILITY AND STRESS INTENSIFICATION FACTORS**

**Table D300<sup>1</sup> Flexibility Factor, *k*, and Stress Intensification Factor, *i***

Description	Flexibility Factor, <i>k</i>	Stress Intensification Factor (Notes (2), (3))		Flexibility Characteristic, $\frac{1}{R}$	Sketch
		Out-of-Plane, $l_o$	In-Plane, $l_i$		
Welding tee in accordance with ASME B31.3 (Notes (2), (4), (6), (8), (9))	1	$\frac{0.9}{R^{0.25}}$	$\frac{3}{4}l_o + \frac{1}{4}l_i$	$3.1 \frac{T}{r_2}$	
Reinforced fabricated tee with pad or saddle (Notes (2), (4), (9), (10), (11))	1	$\frac{0.9}{R^{0.25}}$	$\frac{3}{4}l_o + \frac{1}{4}l_i$	$\frac{(\bar{T} + \frac{1}{2}T_x)^{1.5}}{T^{1.5}r_2}$	
Unreinforced fabricated tee (Notes (2), (6), (9), (11))	1	$\frac{0.9}{R^{0.25}}$	$\frac{3}{4}l_o + \frac{1}{4}l_i$	$\frac{T}{r_2}$	
Extruded welding tee with $r_x \geq 0.07 \frac{D_o}{2}$ , $r_y \geq 1.7 \frac{D_o}{2}$ (Notes (2), (4), (9))	1	$\frac{0.9}{R^{0.25}}$	$\frac{3}{4}l_o + \frac{1}{4}l_i$	$\left(1 + \frac{D_o}{r_2}\right) \frac{T}{r_2}$	
Welded in contour insert (Notes (2), (4), (8), (9))	1	$\frac{0.9}{R^{0.25}}$	$\frac{3}{4}l_o + \frac{1}{4}l_i$	$3.1 \frac{T}{r_2}$	
Branch welded on fitting (integrally reinforced) (Notes (2), (4), (11), (12))	1	$\frac{0.9}{R^{0.25}}$	$\frac{0.9}{R^{0.25}}$	$3.1 \frac{T}{r_2}$	

Appendix D was the guidance on SIF and flexibility factors

For SIF and flexibility factors B31.3 2020 now refers to ASME B31J

There is **now no Appendix D** – SIFs and k factors must be calculated according to B31J

Although the “...more applicable data” phrase remains

# ASME B31J

## ASME B31.3 Appendix D Welding Tee

Term	Equation
Flexibility Characteristic, h	$(1 + r_x/r_2)T/r_2$
Out-of-Plane SIF, $i_o$	$0.9/h^{2/3}$
In-Plane SIF, $i_i$	$0.75i_o + 0.25$
Flexibility Factor, k	1

## B31J 2017 Welding Tee

Term	Equation
Run In-plane Flexibility Factor, $k_{ir}$	$0.18 (R/T)^{0.91} (d/D)^5$
Run Out-of-plane Flexibility Factor, $k_{or}$	1
Run Torsional Flexibility Factor, $k_{tr}$	$0.08 (R/T)^{0.91} (d/D)^{5.7}$
Branch In-plane Flexibility Factor, $k_{ib}$	$(1.91(d/D) - 4.32(d/D)^2 + 2.7(d/D)^3) (R/T)^{0.77} (d/D)^{0.47}(t/T)$
Branch Out-of-plane Flexibility Factor, $k_{ob}$	$(0.34(d/D) - 0.49(d/D)^2 + 0.18(d/D)^3) (R/T)^{1.46}(t/T)$
Branch Torsional Flexibility Factor, $k_{tb}$	$(1.08(d/D) - 2.44(d/D)^2 + 1.52(d/D)^3) (R/T)^{0.77} (d/D)^{1.61}(t/T)$
Run SIF In-plane, $i_{ir}$	$0.98 (R/T)^{0.35} (d/D)^{0.72}(t/T)^{-0.52}$
Run SIF Out-of-plane, $i_{or}$	$0.61 (R/T)^{0.29} (d/D)^{1.95}(t/T)^{-0.53}$
Run SIF Torsional, $i_{tr}$	$0.34 (R/T)^{2/3} (d/D)(t/T)^{-0.5}$
Branch SIF In-plane, $i_{ib}$	$0.33 (R/T)^{2/3} (d/D)^{0.18}(t/T)^{-0.7}$
Branch SIF Out-of-plane, $i_{ob}$	$0.42 (R/T)^{2/3} (d/D)^{0.37}(t/T)^{0.37}$
Branch SIF Torsional, $i_{tb}$	$0.42 (R/T)^{2/3} (d/D)^{1.1}(t/T)^{1.1}$

# CAESAR II v13

Code: B31.3-2018

SC: 137.892

SH1:	137.878	F1:	
SH2:	137.892	F2:	
SH3:	137.892	F3:	
SH4:	137.892	F4:	

If a piping code is chosen that includes SIF/k calculations, CAESAR II will use the code guidance

Bend  Reducer

Rigid  SIFs & Tees

Expansion Joint

Restrains  Displacements

Node: 40

Type: 3 - Welding

SIF:	Index:	SIF:	Index:

B31.3 2018 Appendix D would be used to calculate SIFs here

Node: 40

Type: 3 - Welding

Crotch Thk:		Header SIF(i):	4.414
Ftg Ro:		Header SIF(o):	5.552
Crotch R:		Branch SIF(i):	4.414
Weld ID:		Branch SIF(o):	5.552
Weld(d):			
Fillet:			
Header OD:	609.600	Flexibility Characteristic:	0.065
Header Thk:	6.350	Branch Section Modulus:	1796216.625
Branch OD:	609.600		
Branch Thk:	6.350		

# CAESAR II v13

**Allowable Stresses**

Code:

SC:

SH1:	<input type="text" value="137.892"/>	F1:	<input type="text"/>
SH2:	<input type="text" value="137.892"/>	F2:	<input type="text"/>
SH3:	<input type="text" value="137.892"/>	F3:	<input type="text"/>

**Classic Piping Input**

From:  To:   Name

DX:   Restraints

DY:

DZ:

B31J Bend

Rigid

Expansion Joir

Hangers

Nozzle Flex.

B31J - Review Intersection SIF, Index, & Flexibility

Type:   Welding and Contour Tee  SIF Without Flexibility Elastic Modulus:

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**RUN**

Node:  Crotch Tc:  mm.

No. Flanges:  Crotch rx:  mm.

Outside Dia, OD:  mm. Fitting rp:  mm.

Nom. Thk, T:  mm. Avg Mismatch:  mm.

Pad Thk, tp:  mm. Max Mismatch:  mm.

**BRANCH**

Surface Node:  Socket Cx:  mm.

Outside Dia, od:  mm. Weld ID:

Nom. Thk, t:  mm.  Lateral Tee/olet

---

Branch Reinforcement Type:  Thickness tn:  mm. Angle Theta\_n:  deg.

Effective Branch Thickness, t':  mm. Length, L1:  mm. Taper, y:  mm.

Radius, r2:  mm.

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**RESULTS**

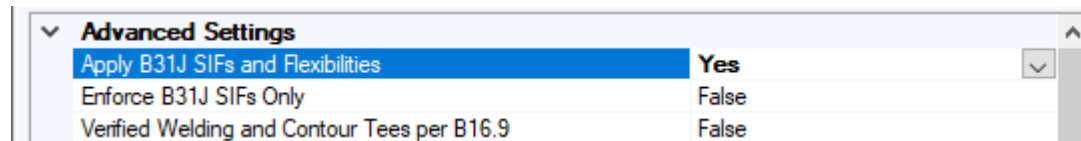
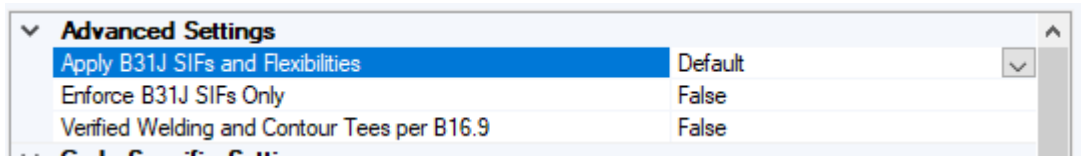
	In Plane	Out Plane	Torsional		In Plane	Out Plane	Torsional
SIF, i	3.785	1.869	4.459	BRANCH	4.328	5.509	5.509
Sustained Index, I	1.946	1.367	2.112	Sustained Index, I	2.080	2.347	2.347
Flexibility Factor, k	3.950	1.000	2.685	Flexibility Factor, k	5.668	8.416	3.127
Elem. Stiffness, K	8.1278E+05	1.1298E+11	1.196E+06	Elem. Stiffness, K	5.6643E+05	3.8151E+05	1.0267E+06
			N.m./deg				N.m./deg

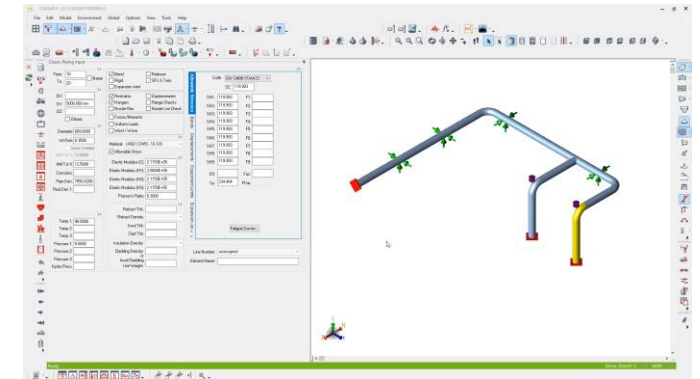
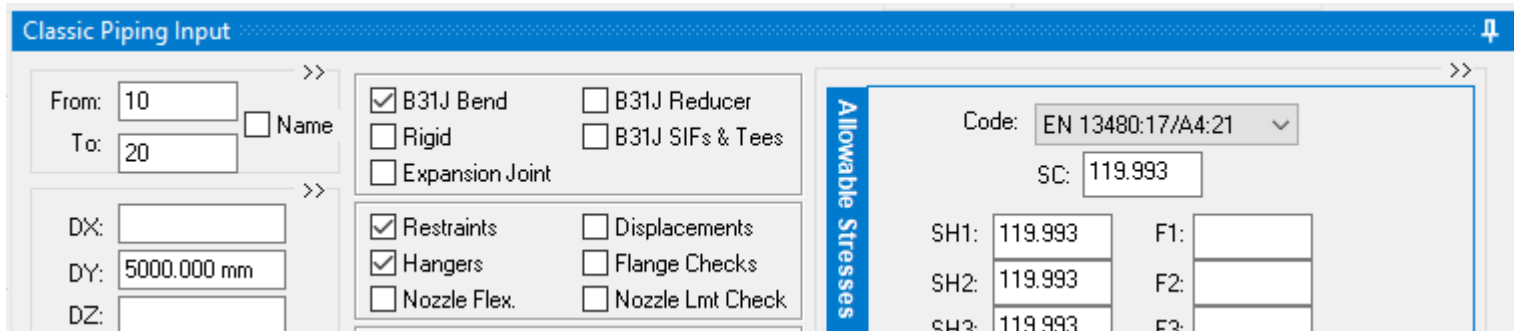
Mean Dia. D	<input type="text" value="603.250"/> mm.	Mean Dia. d	<input type="text" value="603.250"/> mm.
Section Modulus, Z	<input type="text" value="1796216.625"/> cu. mm.	Section Modulus, Zb	<input type="text" value="1796216.625"/> cu. mm.
		Effective d'	<input type="text" value="603.250"/> mm.

The bend, reducer and SIFs & Tees check boxes are now labelled as B31J

# CAESAR II v13

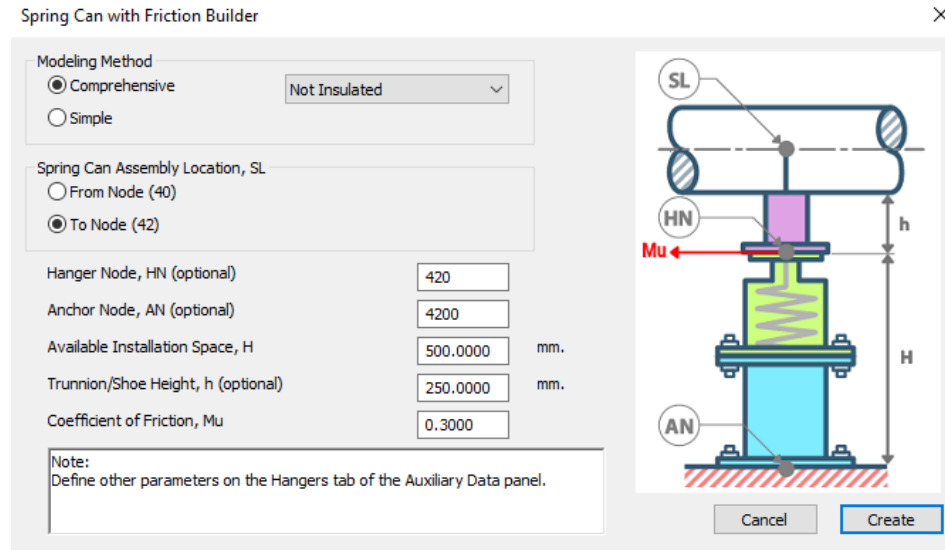


A simple change to a config switch tells CAESAR II to use B31J for any code (metallic piping codes only)



e.g. with EN-13480 as the code, B31J is still active

# Spring Can with Friction



A long-requested feature from the user base has been the ability to add friction onto spring cans.

This has been possible for some time using a set of restraints and hangers connected with Cnodes

Zero weight rigids could also be added for a comprehensive design – but this added further complexity to the modelling

The new Spring Can Modeller can build these arrangements automatically with just a few values from the user

Hanger Node, HN (optional)	<input type="text"/>	
Anchor Node, AN (optional)	<input type="text"/>	
Available Installation Space, H	<input type="text"/>	mm.
Trunnion/Shoe Height, h	<input type="text"/>	mm.
Coefficient of Friction, Mu	<input type="text"/>	



# Spring Can with Friction

Spring Can with Friction Builder

Modeling Method  
 Comprehensive  Simple  
 Not Insulated

Spring Can Assembly Location, SL  
 From Node (40)  
 To Node (42)

Hanger Node, HN (optional)

Anchor Node, AN (optional)

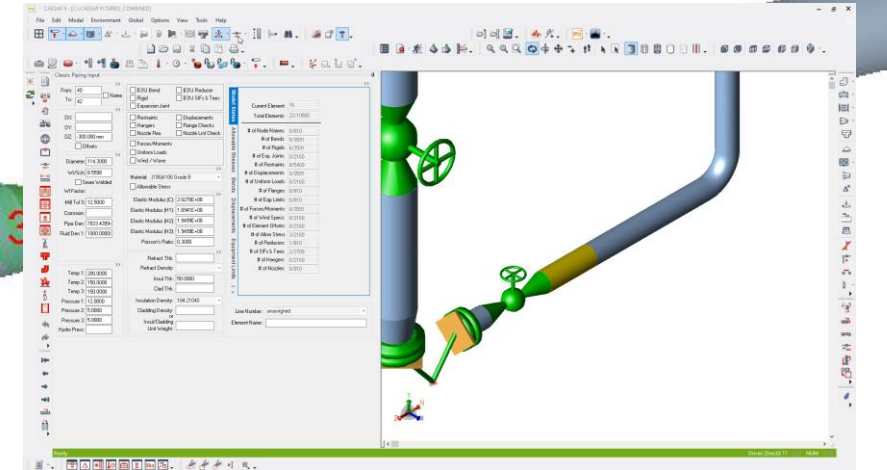
Available Installation Space, H  mm.

Trunnion/Shoe Height, h (optional)  mm.

Coefficient of Friction, Mu

Note:  
 Define other parameters on the Hangers tab of the Auxiliary Data panel.

Cancel Create



CAESAR II adds the Spring Can and connects via CNode to the restraints, with friction added appropriately

If a comprehensive build is selected, the trunnion is also built and anchored at the base

Restraint 1  
 Node:  CNode:   
 Type:  Gap:   
 Stif:  Mu:   
 Tag:

Restraint 2  
 Node:  CNode:   
 Type:  Gap:   
 Stif:  Mu:   
 Tag:

Restraint 3  
 Node:  CNode:   
 Type:  Gap:   
 Stif:  Mu:   
 Tag:

s/Moments Hangers Node

Node:  CNode:

Design Data  
 Hanger Table:

Tag:

Extended Range  Cold Load  Hot Load Centered

Available Space (neg. for can):

Allowable Load Variation (%):

# Fluid Density Multiplier

Drag a column header and drop it here to group by that column

	Exclude ▾	Definition ▾	Name ▾	Stress Type ▾	Alternate SUS/OCC ▾	Fluid Density Multiplier ▾	Lo Cy
L1	<input type="checkbox"/>	W+T1+P1	OPERATING CASE CONDITI	OPE		1.00	
L2	<input type="checkbox"/>	W+T2+P2	OPERATING CASE CONDITI	OPE		0.50	
L3	<input type="checkbox"/>	W+T3+P3	OPERATING CASE CONDITI	OPE		1.50	
L4	<input type="checkbox"/>	W+P1	SUSTAINED CASE CONDITK	SUS	<input type="checkbox"/>	1.00	
L5	<input type="checkbox"/>	W+P2	SUSTAINED CASE CONDITK	SUS		0.50	
L6	<input type="checkbox"/>	W+P3	SUSTAINED CASE CONDITK	SUS		1.50	
L7	<input type="checkbox"/>	L1-L4	EXPANSION CASE CONDITI	EXP			

Fluid Den 1:

Another long-requested feature is the ability to utilize multiple fluids.

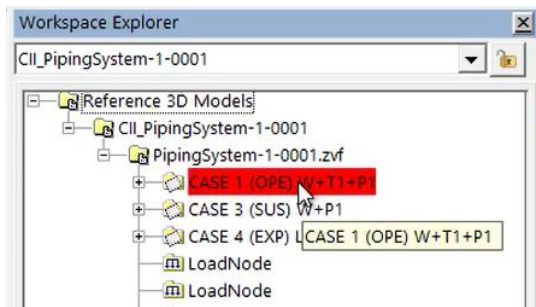
CAESAR II v13 includes a “Fluid Density Multiplier” in the load case editor to achieve this

The multiplier factors the Fluid Density specified in the input for the selected load case for the weight computation

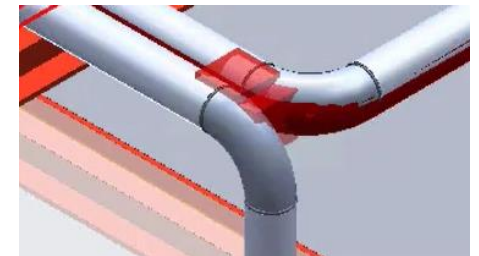
# CAESAR II® 13: Enhancements

## Smart 3D Integration - Displacements for Load Cases – Deflected Pipe Interference Detection

- An integration enhancement was made by Smart Interop Publisher (SPIOP) to retrieve the CAESAR II displacement values per load case made available by the Data Export Wizard creating an Access MDB.
- Using SPIOP with data imported from the CAESAR II MDB data export, translate the data into a Deflected Piping Intelligent 3D model.
- Attach the Deflected Piping Intelligent 3D model as a Reference 3D file in Smart 3D. This includes the displacement values per load case.
- Review and analyse the deflected piping clashes in Smart 3D using the Interference Detection functionality.



Name	Part A	Part B	Type
	90 Degree Direction Change-0105	Deflected Pipe from Nodes 120 to 130	Severe
	Pipe	Deflected Pipe from Nodes 120 to 130	Severe
	Pipe	Deflected Pipe from Nodes 130 to 140	Severe
	90 Degree Direction Change-0105	Bend at Node 120	Severe



This integration feature allows detecting, and correcting, early during the design phase. These clashes would only occur during normal operation or transient conditions. Resolving these piping clash issues early can result in significant cost savings as well as improving operational safety and reducing overall risk.

**Thank you!**