# **Tutorial on Refrigeration Piping using CAEPIPE**

# Steps to perform Analysis of Refrigeration Piping with ASME B31.5 Code using CAEPIPE:

The snap shot below shows the sample layout of a refrigeration piping system. The system experiences two (2) different temperatures during its operation (from -50 deg. F to 200 deg. F) with installation temperature as 70 deg. F. Being refrigeration piping, the analysis code is selected as ASME B31.5 for this system.

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_	20	Reducer				A53		L1												-	
_	30	Bend	-0'10''			A53		L1					· 30								
_	40			-5'2''		A53		L1					20					- 1			
	50			-1'6''		A53		L1					$1 \geq$								
_	60	Bend		-2'2''		A53		L1													
	70	Bend	-1'8''	01011		A53		L1													
	80 90			2'2'' 1'6''		A53 A53		L1 L1													
_	90 100			0'8''		A53		L1													
12		Reducer		0'6''		A53		L1			Γ	4(10									
12		neuucei		4'2''		A53		L1			L.	100					- 65	b 1			
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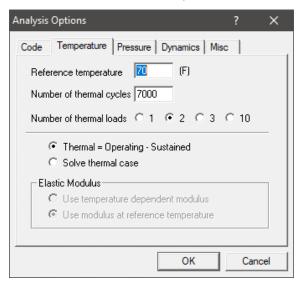
# Step 1:

Select the Analysis code as ASME B31.5 through Layout Window > Options > Analysis as shown below.

Analysis O	otions		?	×
Code T	emperature   Pressure   Dy	namics Mise	c	
Pipir	ng code			
B31	.5 (2016) 🗾 💌			
□	Jse B31J for SIFs and Flexib	ility Factors		
	nclude axial force in stress c	alculations		
<b>آ</b> ا	Jse liberal allowable stresses			
		ОК	Ca	ncel

## Step 2:

As the piping layout involves two (2) operating temperatures, "Number of Thermal Loads" needs to be set as "2". This can be done through Layout Window > Analysis > Temperature as shown below. In addition, the installation temperature (same as "Reference temperature") can be input as shown below.



#### Note:

As per para. 519.4.5(a) of ASME B31.5 (2016), bending and torsional stresses shall be computed using the as-installed modulus of elasticity, i.e.,  $E_c$  at installation temperature (same as "Reference temperature"). Hence, "Use modulus at reference temperature" is set as "default" and is disabled for user to modify.

#### Step 3:

Enter the Operating temperatures of the piping layout through "Layout Window > Misc > Loads" as shown below.

-0	Caepi	pe : l	oads	; (1)	- [Re	efrigerat	ionPiping	.res (C:\T	utorials\04	4_Refrig	erationF	piping)]			×
Eil	e <u>E</u> dit	Vi	ew	<u>O</u> ptio	ons	<u>M</u> isc	<u>W</u> indow	<u>H</u> elp							
-				đ	ô	Q	Н								
#	Name	T1 (F)		T2 (F)	P2 (psi)		Desg.Pr. (psi)		Add.Wgt. (Ib∕ft)	Wind Load 1	Wind Load 2	Wind Load 3	Wind Load 4		
1	L1	-50	100	200	100	240	125	0.01							

#### Note:

Design Temperature entered will be used to determine the allowable stress for material, which is in turn used to compute the Allowable Pressure as per the piping code selected (B31.5 in this case).

The Allowable Pressure so computed as per the piping code selected is then compared against the Design Pressure entered above and reported in the Code Compliance results.

In addition, starting CAEPIPE Version 10.20, a new load case called "Design (W+PD+TD)" is added. When this load case is selected for Analysis, CAEPIPE will compute and show results for Displacements,

Element Forces & Moments, Support Loads and Support Load Summary. This load cases is NOT included in Stress Calculations, Rotating Equipment Qualifications and Flange Equivalent Pressure Calculations.

#### Step 4:

Select the material properties corresponding to "A53 Grade A" through "Layout Window > Misc > Materials > File > Library...".

Mat	terial Library - [B315-2016.mat (	×									
Pipi	ng code : B31.5										
#	Material Description	^									
1	A53 Grade A										
2	A53 Grade B										
3	A106 Grade A										
4	A106 Grade B										
5	A106 Grade C										
6	API 5L Grade A										
7	API 5L Grade B										
8	A312 TP304 (18Cr-8Ni)										
9	A312 TP304L (18Cr-8Ni)										
10	Monel B165 Annealed-(Ni-Cu)										
11	Copper B42 Annealed										
12	Copper B42 Drawn, Size(1/8-2'')	~									
	OK Cancel Library										

From the dialog box shown, select the Material library as B315-2016 from the folder "Material\_Library" available inside the CAEPIPE installation folder. Once selected, highlight the material as shown above and press the button "OK".

-=I* Caepipe : Materials (1) - [RefrigerationPiping.mod (C:\Tut — 🛛 🗙															
File	e Edit (	Options He	lp												
#	pe (lb/in3) factor (F) (psi) (in/in/F) (psi)														
1	A53	A53 Grade A	CS	0.283	0.3	1.00	1	-20	29.9E+6	5.89E-6	13700				
2							2	70	29.5E+6	6.08E-6	13700				
							3	100	29.3E+6	6.14E-6	13700				
							4	150	29.1E+6	6.24E-6	13700				
							5	200	28.8E+6	6.35E-6	13700				
							6	250	28.6E+6	6.62E-6	13700				
							7	300	28.3E+6	6.88E-6	13700				
							8	350	28.0E+6	6.85E-6	13700				
							9	400	27.7E+6	6.82E-6	13700				
							10								

## Step 5:

Define the section properties through "Layout Window > Misc > Sections".

1-0-	Caepi	ipe:P	ipe S	ections	(2) -	[Refrig	eration	nPiping.m	od (C:	_		×	(
File	e Edit	Ор	tions	Help	)								
				<b>f</b> ô	ð 🖞	<b>ک</b>	Н						
#	Name	Nom Dia	Sch	OD (inch)	Thk (inch)			Ins.Dens (Ib/ft3)	Ins.Thk (inch)	Lin.Dens (Ib/ft3)	Lin.Thk (inch)	Soil	^
1	β	6"	10S	6.625	0.134								
2	4	4''	10S	4.5	0.12								~

## Step 6:

Generate the piping layout as shown below.

-0-	Саер	ipe : Layo	out (14) -	[Refrigera	tionPipi	—			×
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	] 📔	<b>j</b> 🗖	4				Ô	0	
#	Node	Туре	DX (ft'in'')	DY (ft'in'')	DZ (ft'in'')	Matl	Sect	Load	Data
1	Title =	Tutorial or	n Refrigerati	ion Piping					
2	10	From							Anchor
3	20	Reducer	-0'11''			A53	6	L1	
4	30	Bend	-0'10''			A53	6	L1	
5	40			-5'2''		A53	6	L1	
6	50			-1'6''		A53	6	L1	
7	60	Bend		-2'2''		A53	6	L1	
8	70	Bend	-1'8''			A53	6	L1	
9	80			2'2''		A53	6	L1	
10	90			1'6''		A53	6	L1	
11	100			0'8''		A53	6	L1	
12	110	Reducer		0'6''		A53	4	L1	
13	120			4'2''		A53	4	L1	
14	130	Reducer		0'6''		A53	6	L1	Anchor
15									

# Step 7:

After creating the stress model, turn ON load cases through "Layout Window > Loads > Load cases as shown below.

Expansion (T1) {which is the same as the range (T1 - Tref)}, Expansion (T2) {which is the same as the range (T2 - Tref)}, and Expansion (T1 - T2) [= (T1 - Tref) - (T2 - Tref)].

Load cases (6)	×
🔲 Empty Weight (W)	🔽 Operating (W+P1+T1)
🔽 Sustained (W+P)	✓ Operating (W+P2+T2)
🔽 Expansion (T1)	🔲 Design (W+PD+TD)
💌 Expansion (T2)	🔲 Modal analysis
🔽 Expansion (T1 - T2)	
OK Cancel	All None

After analysis, Expansion Stress (SE) value given at any node in Results Window > Sorted stresses and Results Window > Code compliance is the highest thermal stress range at that node among the three thermal ranges (T1 - Tref), (T2 - Tref) and (T1 - T2).

# Step 8:

Save the model and perform analysis through Layout window > File > Analyze.

In order to understand the loads and load combinations used for analysis, review the CAEPIPE results file for Sorted Stress, Code Compliance, Displacements, Support Loads (loads acting on the supports by the piping for each load case), Element Forces & Moments (local/global forces and moments on each element for each load case) and Support Load Summary (listing support loads at a particular support for all <u>relevant</u> load cases and load combinations).

As stated above, Sorted Stresses in CAEPIPE lists the maximum of Expansion stresses for all thermal range cases at <u>each node</u>. On the other hand, for Sustained case, it always uses the maximum pressure among the input pressures (P1 and P2 in this case) while computing Sustained Stress at <u>each node</u>.

1-0-	Caep	ipe : B	31.5 (20	)16) C	ode co	mplia	nce (So	rted s	tresse			×
File	e Res	ults	View	Optio	ons \	Vindo	w He	lp				
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		Susta				Expa						
#	Node	SL (psi)	SH (psi)	<u>SL</u> SH	Node	SE (psi)	SA (psi)	<u>SE</u> SA				
1	10	1721	13700	0.13	30A	1116	32700	0.03				
2	30A	1550	13700	0.11	10	1025	32529	0.03				
3	30B	1494	13700	0.11	70B	780	32883	0.02				
4	70B	1367	13700	0.10	30B	758	32756	0.02				
5	20	1342	13700	0.10	70A	587	33006	0.02				
6	60A	1322	13700	0.10	60B	525	33000	0.02				
7	40	1286	13700	0.09	20	323	32908	0.01				
8	130	1283	13700	0.09	110	206	33247	0.01				
9	80	1276	13700	0.09	120	189	33231	0.01				
10	90	1273	13700	0.09	80	179	32974	0.01				
11	50	1273	13700	0.09	60A	166	32928	0.01				
12	100	1271	13700	0.09	90	128	32977	0.00				
13	60B	1250	13700	0.09	100	105	32979	0.00				1
14	70A	1244	13700	0.09	130	98	32967	0.00				
15	120	1019	13700	0.07	40	70	32964	0.00				
16	110	1003	13700	0.07	50	19	32977	0.00				

Operating Stress for Impact Test can be seen by selecting the option "Show Operating Stress for Impact Test" through Mouse Right click.

-0-	Саер	ipe : B	31.5 (20	)16) C	ode co	mplia	nce (So	orted s	tresse	-		×		
File	e Res	ults	View	Optio	ons V	Vindo	w He	lp						
4	3	+				) <b>(</b>	2		] 👉	⇒	S	s⁄A		
		Susta				Expa								
#	Node	SL (psi)	SH (psi)	<u>SL</u> SH	Node	SE (psi)	SA (psi)	<u>SE</u> SA						
1	10	1721	13700	0.13	30A	1116	32700	0.03						
2	30A	1550	13700	0.11	10	1025	32529	0.03						
3														
4	4 70B 1367 13700 0.10 30B 758 32756 0.02													
5														
6	60A	1322	13700	0.10	60		ow Stre		inc			- 1		
7	40	1286	13700	0.09	20				105					
8	130	1283	13700	0.09	11	Ih	reshold	s						
9	80	1276	13700	0.09	12	Sh	ow Ope	erating	g Stress f	or Impa	t Test			
10	90	1273	13700	0.09	80	Hi	de Allov	wable	s					
11	50	1273	13700	0.09	60.	Pa	sults							
12	100	1271	13700	0.09	90							- 1		
13	60B	1250	13700	0.09	10	Ne	xt Resu	lt						
14	70A	1244	13700	0.09	13	Pre	evious F	Result						
15	120	1019	13700	0.07	40	70	32964	0.00						
16	110	1003	13700	0.07	50	19	32977	0.00						

1-0-	Саер	ipe : B	31.5 (20	)16) C	ode co	mplia	nce (So	rted s	tresse				×
File	e Res	ults	View	Opti	ons \	Vindo	w He	lp					
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l	Sustained Expansion Oper. Stress for Impact Test   # SL SH SL SE SA SE   Note SC SH SL SF SC SOPr Sall Sopr												
#	Node (psi) (psi) SH Node (psi) (psi) SA Node (psi) (psi) Sall   1 10 1721 13700 0.13 30A 1116 32700 0.03 30B 1828 4795 0.38   2 30A 1550 13700 0.11 10 1025 32529 0.03 70B 1724 4795 0.36												
1	10	1721	13700	0.13	30A	1116	32700	0.03	30B	1828	4795	0.38	
3	3 30B 1494 13700 0.11 70B 780 32883 0.02 70A 1513 4795 0.32												
4	4 70B 1367 13700 0.10 30B 758 32756 0.02 60B 1464 4795 0.31												
5	5 20 1342 13700 0.10 70A 587 33006 0.02 30A 1434 4795 0.30												
6	60A	1322	13700	0.10	60B	525	33000	0.02	80	1358	4795	0.28	
7	40	1286	13700	0.09	20	323	32908	0.01	90	1331	4795	0.28	
8	130	1283	13700	0.09	110	206	33247	0.01	130	1329	4795	0.28	
9	80	1276	13700	0.09	120	189	33231	0.01	100	1319	4795	0.28	
10	90	1273	13700	0.09	80	179	32974	0.01	40	1306	4795	0.27	
11	50	1273	13700	0.09	60A	166	32928	0.01	20	1279	4795	0.27	
12	100	1271	13700	0.09	90	128	32977	0.00	50	1269	4795	0.26	
13	60B	1250	13700	0.09	100	105	32979	0.00	10	1260	4795	0.26	
14	70A	1244	13700	0.09	130	98	32967	0.00	60A	1245	4795	0.26	
15	120	1019	13700	0.07	40	70	32964	0.00	120	1106	4795	0.23	
16	110	1003	13700	0.07	50	19	32977	0.00	110	1097	4795	0.23	

Similarly, Code Compliance report lists the Stresses <u>element-wise</u> following the same procedure as done for Sorted Stresses.

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1	10 20	125	1721 1342	13700 13700	0.13 0.10	1025 323	32529 32908	0.03 0.01						
2	20 30A	125 563	1342 1324	13700 13700		323 314	32908 32926							
3	30A 30B	125 563	1550 1494	13700 13700		1116 758	32700 32756							
4	30B 40	125 563	1326 1286	13700 13700		221 70	32924 32964	0.01 0.00						
5	40 50	125 563	1286 1273	13700 13700		70 19	32964 32977	0.00 0.00						
6	50 60A	125 563	1273 1260	13700 13700		19 56	32977 32990	0.00 0.00						
7	60A 60B	125 563	1322 1250	13700 13700		166 525	32928 33000							
8	60B 70A	125 563	1240 1239	13700 13700	0.09 0.09	149 167	33010 33011	0.00 0.01						
9	70A 70B	125 563	1244 1367	13700 13700		587 780	33006 32883							
10	70B 80	125 563	1279 1276	13700 13700		227 179	32971 32974	0.01 0.01	~					

From the Displacement results for Expansion (T1) and Expansion (T1-T2), it is observed that the Displacements are +ve in Global Y direction confirming that the piping is shrinking due to temperature decrease for both expansion cases.

-0-	Саер	ipe : Disp	lacement	s: Expans	ion (T1) -	[Refriger	ati	- 🗆 X	HUH Ca	aepipe	: Deflect	ed	_		$\times$
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#										Y	^				
		X (inch)	Y (inch)	Z (inch)		YY (deg)					ԱԱԽ	n		- <u>†</u>	
1	10	0.000	0.000	0.000	0.0000	0.0000	0.0000					0		z 🖍	× 1
2	20	0.008	0.000	0.000	0.0000	0.0000	-0.0019					~~~			
3	30A	0.008	0.000	0.000	0.0000	0.0000	-0.0020					لائد.	20	_	
4	30B	0.013	0.008	0.000	0.0000	0.0000	-0.0151					Ĩ		)	
5	40	-0.002	0.044	0.000	0.0000	0.0000	-0.0170						~		
6	50	-0.007	0.057	0.000	0.0000	0.0000	-0.0171								
7	60A	-0.013	0.069	0.000	0.0000	0.0000	-0.0171								
8	60B	-0.009	0.077	0.000	0.0000	0.0000	-0.0125				식이	0			
9	70A	-0.007	0.078	0.000	0.0000	0.0000	-0.0124				• 90				
10	70B	0.000	0.073	0.000	0.0000	0.0000	-0.0019					40			
11	80	0.000	0.061	0.000	0.0000	0.0000	-0.0011				• 80				
12	90	0.001	0.049	0.000	0.0000	0.0000	-0.0004					50			
13	100	0.001	0.043	0.000	0.0000	0.0000	-0.0001								
14	110	0.001	0.039	0.000	0.0000	0.0000	0.0001				• 70	Ų.			
15	120	0.000	0.004	0.000	0.0000	0.0000	0.0002					- 60			
16	130	0.000	0.000	0.000	0.0000	0.0000	0.0000								~
									<						>

-0-	Саер	ipe : Disp	lacement	s: Expans	ion (T1-T2	2) - [Refri	ger	- 🗆 X	🍽 Caepipe : Deflected 🗕 🗆 🗙
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#					ents (globa			-	Y ^
		X (inch)	Y (inch)	Z (inch)	XX (deg)				
1	10	0.000	0.000	0.000	0.0000	0.0000	0.0000		
2	20	0.017	0.000	0.000	0.0000	0.0000	-0.0042		
3	30A	0.018	0.001	0.000	0.0000	0.0000	-0.0044		•.30
4	30B	0.028	0.017	0.000	0.0000	0.0000	-0.0331		
5	40	-0.004	0.098	0.000	0.0000	0.0000	-0.0372		
6	50	-0.016	0.126	0.000	0.0000	0.0000	-0.0375		
7	60A	-0.027	0.152	0.000	0.0000	0.0000	-0.0373		
8	60B	-0.019	0.171	0.000	0.0000	0.0000	-0.0274		400
9	70A	-0.016	0.172	0.000	0.0000	0.0000	-0.0272		90
10	70B	0.000	0.161	0.000	0.0000	0.0000	-0.0043		• 40
11	80	0.001	0.135	0.000	0.0000	0.0000	-0.0024		• 80
12	90	0.001	0.107	0.000	0.0000	0.0000	-0.0009		50
13	100	0.001	0.095	0.000	0.0000	0.0000	-0.0004		
14	110	0.001	0.086	0.000	0.0000	0.0000	0.0001		
15	120	0.000	0.009	0.000	0.0000	0.0000	0.0005		60
16	130	0.000	0.000	0.000	0.0000	0.0000	0.0000		
									< >

Similarly, from the Displacement results for Expansion (T2), it is observed that the Displacements are -ve in Global Y direction confirming that the piping is expanding downward due to temperature increase.

-0-	Саер	ipe : Disp	lacement	s: Expans	ion (T2) -	[Refriger	ati	- 🗆	×	HDH Caepipe : Deflected 🗆 🗙
File	e Res	ults Vie	ew Opti	ons Wi	ndow H	elp				File View Options Window Help
4	3	+			1 Q		<b>-</b>	⇒≡	-	🎒 🖬 📄 📸 🍳 🍳 Q
#				<u> </u>	ents (globa	<u> </u>		-		Y A
	Node	· · /	Y (inch)	Z (inch)		YY (deg)				
1	10	0.000	0.000	0.000	0.0000	0.0000	0.0000			$\nabla I_{20}^{30}$
2	20	-0.009	-0.000	0.000	0.0000	0.0000	0.0023			26 30
3	30A	-0.010	-0.000	0.000	0.0000	0.0000	0.0024			•.30
4	30B	-0.015	-0.009	0.000	0.0000	0.0000	0.0179			
5	40	0.002	-0.054	0.000	0.0000	0.0000	0.0202			
6	50	0.009	-0.069	0.000	0.0000	0.0000	0.0203			
7	60A	0.015	-0.083	0.000	0.0000	0.0000	0.0202			r+ 110
8	60B	0.010	-0.093	0.000	0.0000	0.0000	0.0149			4400
9	70A	0.009	-0.094	0.000	0.0000	0.0000	0.0148			90
10	70B	0.000	-0.088	0.000	0.0000	0.0000	0.0023			• 40
11	80	-0.000	-0.074	0.000	0.0000	0.0000	0.0013			80
12	90	-0.001	-0.059	0.000	0.0000	0.0000	0.0005			• 50
13		-0.001	-0.052	0.000	0.0000	0.0000	0.0003			
14	110	-0.001	-0.047	0.000	0.0000	0.0000	-0.0000			kzo .
15	120	0.000	-0.005	0.000	0.0000	0.0000	-0.0003			60
16	130	0.000	0.000	0.000	0.0000	0.0000	0.0000			
										< >

Element Forces & Moments (local forces and moments on each element for Expansion (T2) load case) are shown below.

-8-	- Caepipe : Pipe forces in local coordinates: Expansion (T2) - [RefrigerationPiping.res — 🛛 🗙														(
File	e Res	ults Vi	iew Op	tions \	Window	Help									
4															
#	Node	Axial	y Shear	z Shear	Torsio	<u>` ´</u>	· · · ·	ie(ft-lb)	Outplane(ft-lb)		Flex. Factors			SE	^
		(lb)	(lb)	(lb)	Moment	SIF	Moment		Moment		FFi	FFo	FFt	(psi)	
1	10 20	-7 -7	-20 -20	0 0	0 0		-81 -63	1.00 1.00	0 0	1.00 1.00				556 175	
2	20 30A	-7 -7	-20 -20	0 0	0 0		-63 -61		0 0					175 170	
3	30A 30B	-7 20	20 7	0 0	0 0		61 41	3.59 3.59	0 0	2.99 2.99	13.74 13.74	13.74 13.74		606 411	
4	30B 40	20 20	-7 -7	0 0	0 0		-41 -11		0 0					120 38	
5	40 50	20 20	-7 -7	0 0	0 0		-11 -1		0 0					38 11	
6	50 60A	20 20	-7 -7	0 0	0 0		-1 8		0 0					11 30	
7	60A 60B	20 -7	-7 -20	0 0	0 0		8 28	3.59 3.59	0 0	2.99 2.99	13.74 13.74	13.74 13.74		90 285	
8	60B 70A	-7 -7	-20 -20	0 0	0 0		28 32		0 0					81 90	
9	70A 70B	-7 -20	-20 7	0 0	0 0		32 42	3.59 3.59	0 0	2.99 2.99	13.74 13.74	13.74 13.74		318 423	
10	70B 80	-20 -20	-7 -7	0 0	0 0		-42 -32		0 0					123 97	
11	80 90	-20 -20	-7 -7	0 0	0 0		-32 -22		0 0					97 69	~

Element Forces & Moments (global forces and moments on each element for Expansion (T2) load case) are shown below.

10	Caep	ipe : F	pipe fo	rces i	n glob	al coo	rdinat	es:	:: Expansion (T2) - [RefrigerationPiping.r — 🗆 🗘	×
Fil	e Res	ults	View	Opt	ions	Wind	low	He	lelp	
4	3	╢				Ô	Q			
#	Node	FX (Ib)	FY (lb)	FZ (lb)	MX (ft-Ib)	MY (ft-Ib)	MZ (ft-lb)	^		
1	10 20	-7 7	20 -20	0 0	0 0	0 0	-81 63			
2	20 30A	-7 7	20 -20	0 0	0 0	0 0	-63 61			
3	30A 30B	-7 7	20 -20	0 0	0 0	0 0	-61 41			
4	30B 40	-7 7	20 -20	0 0	0 0	0 0	-41 11			
5	40 50	-7 7	20 -20	0 0	0 0	0 0	-11 1			
6	50 60A	-7 7	20 -20	0 0	0 0	0 0	-1 -8			
7	60A 60B	-7 7	20 -20	0 0	0 0	0 0	8 -28			
8	60B 70A	-7 7	20 -20	0 0	0 0	0 0	28 -32			
9	70A 70B	-7 7	20 -20	0 0	0 0	0 0	32 -42			
10	70B 80	-7 7	20 -20	0 0	0 0	0 0	42 -32			
11	80 90	.7 7	20 -20	0 0	0 0	0 0	32 -22	¥		

-0-	Саер	ipe : I	Loads on	Anchors:	Operating	(W+P1+	T1) - [Ref	rigeration	Pipi	-		×
File	e Res	ults	View (	Options	Window	Help						
4	5	+			ô tô		] 🔶		$\equiv$	+	→	
#	Node	Tag	FX (lb)	FY (lb)	FZ (lb)	MX (ft-lb)	MY (ft-lb)	MZ (ft-lb)				
1	10		-8	-70	0	0	0	47				
2	130		8	-106	0	0	0	19				

Support Loads on all supports by the piping for Operating Load case 1 are shown below.

Support Load Summary (listing loads on a particular support by the piping) for all <u>relevant</u> load cases and load combinations) is shown below.

Caepipe : Support load summary for anchor at node 10 - [RefrigerationPiping.re													
<u>F</u> ile <u>R</u> esults <u>\</u>	<u>/</u> iew <u>O</u> p	tions <u>W</u>	(indow	<u>H</u> elp									
Load combination	FX (lb)	FY (lb)	FZ (lb)	MX (ft-lb)	MY (ft-lb)	MZ (ft-lb)							
Sustained	-2	-87	0	0	0	115							
Operating1	-8	-70	0	0	0	47							
Operating2	5	-107	0	0	0	196							
Maximum	5	-70	0	0	0	196							
Minimum	-8	-107	0	0	0	47							
Allowables	0	0	0	0	0	0							