

**Readme Supplement**  
**for**  
**CAEPIPE Version 5.14**

**Disclaimer**

Please read the following carefully:

This software and this document have been developed and checked for correctness and accuracy by SST Systems, Inc. However, no warranty, expressed or implied, is made by SST Systems, Inc., as to the accuracy and correctness of this document or the functioning of the software and the accuracy, correctness and utilization of its calculations.

Users must carry out all necessary tests to assure the proper functioning of the software and the applicability of its results. All information presented by the software is for review, interpretation, approval and application by a Registered Professional Engineer.

CAEPIPE is a trademark of SST Systems, Inc.

CAEPIPE Version 5.14, ©2006, SST Systems, Inc. All Rights Reserved.

---

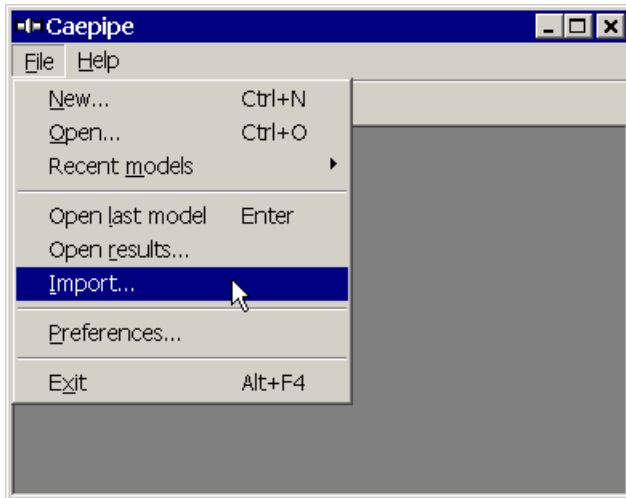
SST Systems, Inc.  
1641 N. First Street, Suite 275  
San Jose, California 95112  
USA.

Tel: (408) 452-8111  
Fax: (408) 452-8388  
Email: [info@sstusa.com](mailto:info@sstusa.com)  
[www.sstusa.com](http://www.sstusa.com)

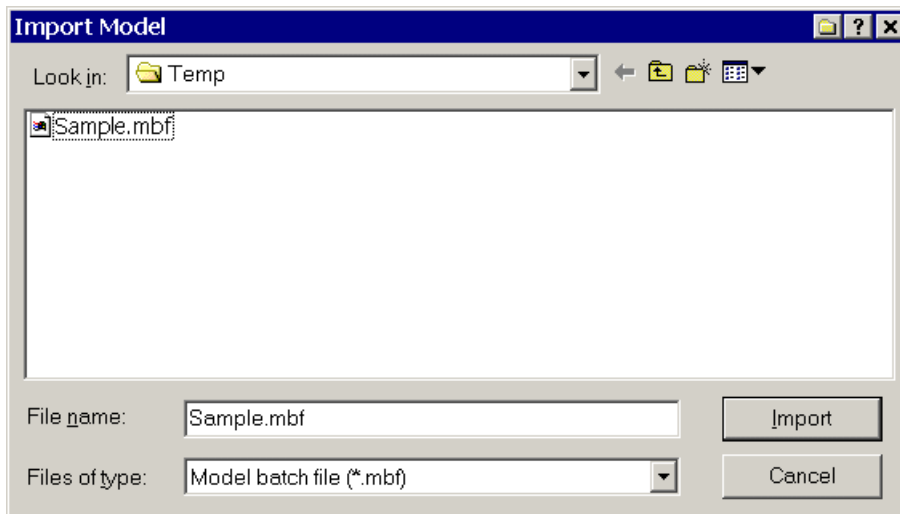
## Import

CAEPIPE can import a model created using a text file (batch file). The text file may be created using a text editor and should have the extension: .mbf (model batch file). The text file may also be created for an existing model using the Export command from the Layout window.

To import a model, select the menu command File > Import from the Main window.



The Import Model dialog is shown.



Select the model batch file (.mbf) and then click on the Import button. The batch file will be read and the corresponding model file (.mod) will be created and then shown in the Layout window, which can be further modified or analyzed.

The input data is given in the following order. Except for the heading, the start of each section is indicated by a keyword. The data for that section follow. Only the first three characters of the keyword are significant.

<u>Keyword</u>	<u>Data</u>
	Heading
OPTIONS	Program options
MATERIAL	Material properties
SOILS	Soil properties
PIPE	Pipe Section properties
LOADS	Loads data
BMATERIALS	Beam Materials
BSECTIONS	Beam section properties
BLOADS	Beam loads
LAYOUT	Layout data
PUMPS	Pump data
COMPRESSORS	Compressor data
TURBINES	Turbine data
SEISMIC	Seismic load
WIND	Wind load

### **Heading**

Any number of heading lines may be given. Only the first will be used as Title in the CAEPIPE model.

### **OPTIONS**

#### **Hanger design**

HGRA	Grinnell ( <b>Default</b> )
HGRB	Bergen-Paterson
HGRC	Fee and Mason
HGRD	Basic Engineers
HGRE	Power Piping
HGRF	Nordon
HGRG	Carpenter and Paterson
HGRH	NPS
HGRI	PTP
HGRJ	Corner and Lada
HGRK	Elcen

#### **Piping code**

B311	ANSI B31.1
B311-67	USAS B31.1 (1967)
B313	ANSI B31.3
B314	ANSI B31.4
B315	ANSI B31.5
B318	ANSI B31.8
ASME	ASME Section III, Class 2 (1980)
ASME-86	ASME Section III, Class 2 (1986)
ASME-92	ASME Section III, Class 2 (1992)

BS806	British code
NORWEGIAN-83	Norwegian code (1983)
NORWEGIAN-90	Norwegian code (1990)
RCC-M	French code (1985)
SNCT	CODETI (1995)
SWEDISH	Swedish code (1978)
STOOMWEZEN	Dutch code (1989)
Z183	Z183 (1990)
Z184	Z184 (1992)
EUROPEAN	EN 13480 (2002)

### Units

SI SI units (default is English units)  
 RAD Radians for angles (default is degrees)

### Vertical Axis

Z Vertical axis is Z (Default is Y)

### OPTIONS Example

```
OPTIONS
HGRA,B311,RAD
```

### MATERIAL

Name is Material Name (up to 3 characters). The values in square brackets ([...]) are optional.

#### English units

First line: Name, Density (lb/in<sup>3</sup>), Poisson's ratio, [Long. joint factor], [circ. joint factor]

Following lines: Name, Temp (F), E (psi), alfa (in/in/F), [allowable stress (psi)],  
 [yield stress (psi)], [rupture stress (psi)]

.  
 .  
 .

#### SI units

First line: Name, Density (kg/m<sup>3</sup>), Poisson's ratio, [Long. joint factor], [circ.joint factor]

Following lines: Name, Temp (C), E (N/mm<sup>2</sup>), alfa (mm/mm/C),  
 [allowable stress (N/mm<sup>2</sup>)], [yield stress (N/mm<sup>2</sup>)], [rupture stress (N/mm<sup>2</sup>)]

.  
 .  
 .

## **MATERIAL Example (English units)**

### **MATERIAL**

A53, 0.283, 0.300, 1.00  
A53, 70, 29.5E+6, 6.07E-6, 20000  
A53, 200, 28.8E+6, 6.38E-6, 20000  
A53, 300, 28.3E+6, 6.60E-6, 20000  
A53, 400, 27.7E+6, 6.82E-6, 20000  
A53, 500, 27.3E+6, 7.02E-6, 18900  
ALU, 0.098, 0.330, 1.00  
ALU, 70, 10.0E+6, 12.25E-6, 10000  
ALU, 150, 9.80E+6, 12.67E-6, 10000  
ALU, 200, 9.60E+6, 12.95E-6, 9800  
ALU, 250, 9.40E+6, 13.12E-6, 9000  
ALU, 300, 9.20E+6, 13.28E-6, 6600

## **SOILS (Soil properties)**

Soil properties are input as follows:

### **Note:**

Name is Soil Name (up to 3 characters).  
Type must be 0 or 1 (1 = Cohesive; 0 = Cohesive less).  
If Type = 0, then Delta and Ks is required  
If Type = 1, then Strength is required

### **English units**

Name, Type (0 or 1), Density (lb/ft<sup>3</sup>), Ground level (ft'in"), [Strength (psi) /Delta (deg or rad)], [Ks]

### **SI units**

Name, Type (0 or 1), Density (kg/m<sup>3</sup>), Ground level (mm), [Strength (N/mm<sup>2</sup>) / Delta (deg or rad)], [Ks]

## **PIPE (Section properties)**

Section properties are input as follows for pipe sections:

### **Note:**

Name is Section Name (up to 3 characters).  
OD must be actual OD and not Nominal pipe size (e.g., input 2.125 and not 2.0 for 2" NPS)  
Thk must be an actual numerical value and not a schedule.  
Soil name is Name of the soil (up to 3 characters). It should be defined in the soil section before use in this section.

### **English units**

Name, OD (inch), Thk (inch), Corrosion allowance (inch), Mill tolerance (%), Insulation density (lb/ft<sup>3</sup>), Insulation Thk (inch), Lining density (lb/ft<sup>3</sup>), Lining Thk (inch), Soil name

### **SI units**

Name, OD (mm), Thk (mm), Corrosion allowance (mm), Mill tolerance (%), Insulation density (kg/m<sup>3</sup>), Insulation Thk (mm), Lining density (kg/m<sup>3</sup>), Lining Thk (mm), Soil name

### **PIPE Example (English units)**

```
PIPE  
8, 8.625, 0.5, 0, 0.0, 11, 2  
6, 6.625, 0.28, 0, 0.0, 11, 2
```

### **LOADS (Load data)**

Load data are input as follows:

#### **Note:**

Name is Load Name (up to 3 characters).

T2, P2, T3 and P3 are Temperature 2, Pressure 2, Temperature 3 and Pressure 3 respectively.

#### **English units**

Name, Temperature 1 (F), Pressure 1 (psi), Specific Gravity, [T2,P2,T3,P3, Additional weight (lb/ft)]

#### **SI units**

Name, Temperature 1 (c), Pressure 1 (bar), Specific Gravity, [T2,P2,T3,P3, Additional weight (kg/m)]

### **BMATERIALS (Beam Materials)**

Name is Material Name (up to 3 characters). The values in square brackets ([...]) are optional.

#### **English units**

Name, Young's Modulus (psi), [Poisson's ratio, Density (lb/in<sup>3</sup>), Alfa (in/in/F)]

#### **SI units**

Name, Young's Modulus (Mpa), [Poisson's ratio, Density (kg/m<sup>3</sup>), Alfa (mm/mm/c)]

### **BSECTIONS (Beam Sections)**

Name is Beam Section name (up to 3 characters). The values in square brackets ([...]) are optional.

#### **English units**

Name, Axial area (in<sup>2</sup>), Major moment of inertia (in<sup>4</sup>), Minor moment of inertia (in<sup>4</sup>), [Torsional inertia (in<sup>4</sup>), Major shear area (in<sup>2</sup>), Minor shear area (in<sup>2</sup>), Depth (inch), Width (inch)]

#### **SI units**

Name, Axial area (mm<sup>2</sup>), Major moment of inertia (mm<sup>4</sup>), Minor moment of inertia (mm<sup>4</sup>), [Torsional inertia (mm<sup>4</sup>), Major shear area (mm<sup>2</sup>), Minor shear area (mm<sup>2</sup>), Depth (mm), Width (mm)]

## **BLOADS (Beam Loads)**

Name is Beam Load name (up to 3 characters). The values in square brackets ([...]) are optional.

### **English units**

Name, T1 (F), [T2 (F), T3 (F), Additional weight (lb/ft)]

### **SI units**

Name, T1 (c), [T2 (c), T3 (c), Additional weight (kg/m)]

## **LAYOUT**

The piping layout is entered as a (keyletter-data) pair, which may be input in any order. The exceptions to this convention are the comments, which must always appear last. The pairs are separated by commas. A data line which contains only continued comments (from the previous line) is acceptable. A list of keyletters follows:

- F From node
- T To node
- H Hydro test Load
- L Location node
- K Code for node
- M Material number
- P Pipe (Section) property number
- J Joint code
- X X offset
- Y Y offset
- Z Z offset
- B Bend radius
- C Comments (separated by commas)
- \* Model comments (Example: \* Node 230 = P-427B Suction)

### **LAYOUT Example (English units)**

```
LAYOUT
F10,KA,M5,P12,CT=650,P=500
T20,KI,X10'8-1/2,B20
T30,Z8
T40,JR,X1'6,CWGT=250
```

- F (From) From node is specified. When a new branch is started, the first node of the branch is specified as a "From" node. The X, Y and the Z fields are taken as coordinates rather than offsets from the previous node.
- T (To) To node is specified. This is a "To" node from the previous "From" node or the previous "To" node (but not from the previous "Location node").
- L (Location) Location node is used to input additional data at a node when the node has more than one data item such as a hanger/force, etc.

K (Code) The following codes may be used:

Code	Description
A	Anchor
B	Branch connection
H	Hinge (To node only)
M	Miter bend (To node only)
I	Tangent intersection (To node only)
T	Welding Tee
S	Sweepolet
W	Weldolet
F	Fabricated Tee
E	Extruded Tee
R	Radiused branch
P	Branch on thickened pipe

M (Material) A material is retained until altered. Another material should be entered only when there is a change.

P (Pipe) A pipe (section property) is retained until altered. Another section property should be entered only when there is a change.

J (Joint Code) **Code Description**

B	Ball joint
C	Cut pipe
D	Reducer
E	Expansion
I	Jacket bend
L	Elastic element
M	Beam
P	Jacket pipe
R	Rigid
S	Slip joint
T	Tierod
V	Valve

The weight of a rigid joint should be entered using a WGT comment. The stiffnesses of the expansion joint should be entered using an ES comment and the pressure thrust area should be entered using the TA comment.

X, Y and Z            The offsets may be entered in combination of feet, inches and fractions of an inch for English units and mm for SI units.

Example: (English units)

Entry	Value
-10	-10 ft
10'8 or 10-8	10 ft 8 in
0'8 or 0-8	8 in
10.5	10 ft 6 in
1'6-3/8 or 1-6-3/8	1 ft 6.375 in

B (Bend Radius)    The bend radius (inch or mm) is entered only if a tangent intersection (i.e, Bend, Jbend and Miter Bend) has been specified. The default is the long radius for the bend and jacketed bend.

C (Comment)        The comment section allows entry of data related to a particular node or element. For example, a pipe end specified as a hinge would have the rotational spring constant and the direction vector entered in the comment section. A line temperature can be entered as comment and is retained until changed.

Multiple comments may be entered separated by commas. If a comma follows the last comment, the comment is continued on the next line.

\* (Model comment)    The model comment section allows entry of notes relevant to analysis model. The model comment can be up to 70 characters.  
Example: \*Load cases considered for analysis are T1 and P1.

**The comments are as follows:**

AMB                    Ambient or reference temperature (F or C)  
Default is 70 F.  
Example: AMB=80

AWGT                  Additional weight for valve (lb. or kg)  
Use only for valve.  
Example: AWGT=100

BTHK                  Bend thickness (inch or mm)  
Use for Bend and Jbend (core).  
Example: BTHK=6.01

BMAT                  Name of Bend Material (Up to 3 characters)  
Should be defined in Material section before use.  
Example: BMAT=BM1

BK                      Bending stiffness (in-lb/deg or Nm/deg)  
Use only for Bellows  
Example: BK=1000

BSIF                    Bend SIF  
Inplane  
Outplane  
Example: BSIF(1.5,2.0)

	For Piping code with one SIF, use inplane=outplane=SIF Example: BSIF(2.0,2.0)
BETA	Beta angle for Beam (deg or rad) Use only for Beam Example: BETA=90
CONE	Cone angle for reducer (deg. or rad.)
CNOD	Connected to Node Use for Guide, Hanger, Limit Stop, Rod Hanger, Skewed Restraint, User Hanger and Constant Support Example: CNOD=150
CLD	Cold load Use only for User Hanger. Example: CLD=1
CRTCH	Crotch radius for an extruded tee (inch or mm) Example: CRTCH=1.25
CS	Constant support spring Example: CS=2: Two constant support springs
CWGT	Concentrated weight (lb or kg) Use only for concentrated weight. Example: CWGT=200
D or DIS	Specified displacements (Inch or mm) Note: Entry of zero is ignored and not treated as a specified displacement. Example: D(0.1,-0.25,0) or DIS(0.1,-0.25,0) DX=0.1,DY=-0.25 or DISX=0.1,DISY=-0.25
DV	Direction vector. DV(xcomp,ycomp,zcomp) Use for Hinge, Snubber and Nozzle Example: DV(1,-2,0)
DIS2	Specified Displacement for Temperature 2 (inch or mm) Use only for Anchor Note: Entry of zero is ignored and not treated as a specified displacement. Example: DIS2(1,-2,0)
DIS3	Specified Displacement for Temperature 3 (inch or mm) Use only for Anchor Note: Entry of zero is ignored and not treated as a specified displacement. Example: DIS3(1,-2,0)
E	Young's modulus (psi or Mpa) Use only for Nozzle Example: E=28E6
ES	Expansion joint stiffness Axial (lb/in or N/mm) Lateral (lb/in or N/mm) Torsional (in-lb/deg or NM/deg) Example: ES(1000,5000,200)

F or FIXD	Translational restraint Example: FIXD(1,0,1) : Restrain X and Z translations FIXDX=1 or FX or FIXDX																
FF	Bend Flexibility factor Use for Bends and Miter bends Example: FF=1.5																
FIXR	Rotational restraint Example: FIXR(0,1,0) : Restrain Y rotation. FIXRY=1 or FIXRY																
FLANGE	<table> <thead> <tr> <th>Type</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>WN</td> <td>Weld neck flange</td> </tr> <tr> <td>SO</td> <td>Single welded slip on</td> </tr> <tr> <td>DW</td> <td>Double welded slip on</td> </tr> <tr> <td>SW</td> <td>Socket welded</td> </tr> <tr> <td>FW</td> <td>Fillet welded</td> </tr> <tr> <td>LJ</td> <td>Lap joint</td> </tr> <tr> <td>TH</td> <td>Threaded</td> </tr> </tbody> </table> <p>Example: FLANGE=TH (threaded flange)</p>	Type	Description	WN	Weld neck flange	SO	Single welded slip on	DW	Double welded slip on	SW	Socket welded	FW	Fillet welded	LJ	Lap joint	TH	Threaded
Type	Description																
WN	Weld neck flange																
SO	Single welded slip on																
DW	Double welded slip on																
SW	Socket welded																
FW	Fillet welded																
LJ	Lap joint																
TH	Threaded																
FOR	Force (lb or N) Use for Force and Harmonic load. Example: FOR(100,0,-200) or FORX=100, FORZ=200																
FFOR	Friction force (lb or N) Use for Slip joint Example: FFOR=100																
FTOR	Friction torque (ft-lb or Nm) Use for Slip joint Example: FTOR=100																
FRCT	Bending and Torsional friction Torque (ft-lb or Nm). FCRT(Bending, Torsional) Use only for Ball joint Example: FCRT(100,150)																
FREE	Free anchor during hanger design Example: FREE: Free all directions FREEY: Free Y direction																
FRE	Frequency (Hz) Use only for Harmonic Load. Example: FRE=30																
G	Guide																
GAP	Tension and Compression gap (inch or mm) GAP(Tension, Compression) Use only for Tie rod. Example: GAP(10,15)																
GGAP	Guide Gap (inch or mm) Use only for guide Example: GGAP=5																
HSG	Hydrotest Specific Gravity																

	Use only for Hydrotest Load Example: HSG=0.7
HPRES	Hydrostatic Pressure (psi or bar) Use only for Hydrotest Load Example: HPRES=3
HTYP	Defines the Hanger Type. Refer Appendix-1 of this doc for details. Use only for Hanger Example: HTYP=16 (Grinnell)
IN1	Intermediate Node 1 for Bends Node Number (>1 and < 9999) Angle (deg or rad) Use for Bend and Jbend Example: IN1(300,30)
IN2	Intermediate Node 2 for Bends Node Number (>1 and < 9999) Angle (deg or rad) Use for Bend and Jbend Example: IN2(400,30)
INSF	Insulation factor Use only for Valve Example: INSF=3.0
JCAP	Jacked End Cap Defines the data type Jacked End Cap Example: JCAP
JMAT	Jacket Material (up to 3 characters) Use for Jpipe and Jbend Example: JMAT=A53
JSEC	Jacket Section (up to 3 characters) Use for Jpipe and Jbend Example: JSEC=N10
JLOAD	Jacket Load (up to 3 characters) Use for Jpipe and Jbend Example: JLOAD=L3
JTHK	Jacket Thickness (inch or mm) Use only for Jbend
JR	Jacket Radius (inch or mm) Use only for Jbend. Example: JR=6.75
K	Translational stiffness (lb/inch or N/mm) Use for Skewed restraint Example: K=500,DV(1.5,-0.75,0.25)
KR	Rotational stiffness (in.-lb./deg. or N-m/deg) Use for Skewed restraint Example: KR=1200,DV(1.2,2.5,0)

KTIE	Tension and Compression stiffness. KTIE(Tension, Compression) (lb/in or N/mm). Use only for Tie rod Example: KTIE(1000,1500)
LS	Limit stop LS(M1,M2) M1=allowable movement in negative direction (in. or mm) M2=allowable movement in positive direction (inch or mm) Example : LS(-1.0,1.5), DV(0,1,0), MU=0.3
LOAD	Beam load reference (up to 3 characters) Note: Beam load should be defined in BLOADS section before use. Example: LOAD=B1
LEN	Length (inch or mm) Use only for Branch SIF with type Branch on Thickened Pipe Example: LEN=5
L1	Length 1 (ft-in or mm) Use to define "L" for API 650 Nozzle and "L1" for WRC 297 Nozzle Example: L1=3'0" or L1=900
L2	Length 2 (ft-in or mm) Use only for WRC 297 Nozzle to define "L2" Example: L2=4'0" or L2=1200
LONG	Cut long (inch or mm) Use only for Cut pipe. Example: LONG=100
LXAX	Local X axis. LXAX(xcomp, ycomp, zcomp) Use only for Elastic Element Example: LXAX(1,0,0)
LYAX	Local Y axis. LYAX(xcomp,ycomp,zcomp) Use only for Elastic Element Example: LYAX(0,1,0)
MAT	Beam material reference (up to 3 characters) Note: Beam material should be defined in Beam material (BMATERIALS) section before use. Example: MAT=M1
MM	Mismatch (inch or mm) Use only for weld Example: MM=5
MLV	Maximum load variation (%) in hanger design Default is 25%. Example: MLV=30
MOM	Moment (ft-lb or NM) Example: MOM(200,-100,0) or MOMX=200, MOMY=-100
MU	Friction co-efficient Example: MU=0.3
NOD	Nozzle outside diameter (inch or mm)

	Example: NOD=104
NTHK	Nozzle thickness (inch or mm) Example: NTHK=6.01
NOZZLE	Defines the Nozzle data type. (650 or 297) Example: NOZZLE=650 (API 650) or NOZZLE=297 (WRC 297)
OD1	Outer diameter at from end for the reducer (inch or mm)
OD2	Outer diameter at to end for reducer (inch or mm)
OFFSET	Offset of concentrated weight from node or additional weight of valve from the center of valve (inch or mm). OFFSET(X offset, Y offset, Z offset). Example: OFFSET(0,18,0)
PAD	Thickness of reinforcement for fabricated tee (inch or mm) Example: PAD=0.25
PH	Phase (deg or rad) Use only for Harmonic Load Example: PH=10
P or PRES	Pressure (psig or bar) Example: P=500
ROT	Specified rotation (deg or rad) Note: Entry of zero ignored and not treated as a specified rotation. Example: ROT(1.5,0,-0.25) ROTX=1.5,ROTZ=-0.25
RLIM	Rotation limit (deg or rad) Use only for Hinge Example: RLIM=10
ROTL	Rotational limit in Bending and Torsion ROTL(Bending, Torsion) (deg or rad) Use only for Ball joint Example: ROTL(10,20)
ROTK	Rotational stiffness. ROTK(kxx,kyy,kzz) (deg or rad) Use for Anchor and Elastic element Example: ROTK(5,6,3)
ROT2	Rotational Displacement for Temperature 2. (deg or rad) ROT2(kxx,kyy,kzz) Use only for Anchor Example: ROT2(10,15,10)
ROT3	Rotational Displacement for Temperature 3. (deg or rad) ROT3(kxx,kyy,kzz) Use only for Anchor Example: ROT3(10,15,10)
R	Fillet radius (inch or mm) Use only for Branch SIF (Radiused Branch and Branch Connection) Example: R=10

RPAD	Reinforcing Pad (0 or 1) Use only for Nozzle (API 650) Example RPAD=1
RK	Rotational Stiffness in Bending and Torsion. RK(Bending, Torsion) (ft-lb or Nm) Use only for Ball joint Example: RK(100,150)
SG	Specific Gravity Example: SG=0.8
SIF	Stress intensification factor at node. SIF=value or SIF(inplane, outplane) Example: SIF=1.3 or SIF(1.5,2.0)
SHORT	Cut short (inch or mm). Use only for Cut pipe. Example: SHORT=100
SEC	Beam section reference (up to 3 characters) Note: Beam section should be defined in Beam section (BSECTIONS) before use. Example: SEC=BS1
STIFF	Stiffness (lb/in or N/mm) Use for Guide, Limit stop and Snubbers Example: STIFF=1000
SR	Turn on the option Short range. Use only for Hanger. Example: SR
SPIDER	Defines the data type SPIDER Example: SPIDER
T or TEMP	Temperature (F or C) Example: T=650
TA	Pressure thrust area for bellows and Slip joints (in <sup>2</sup> or mm <sup>2</sup> ). Example: TA=12.3
THK	Thickness (inch or mm) Use only for Branch SIF (Radiused Branch & Branch on Thickened Pipe) Example: THK=10
THK1	Thickness at from end for reducer (inch or mm).
THK2	Thickness at to end for reducer (inch or mm).
THKF	Thickness factor Use only for Valve. Example: THKF=3.0
TRAK	Translational Stiffness (lb/in or N/mm). TRAK(kx,ky,kz) Use for Anchor and Elastic element. Example: TRAK(1000,1500,2000)
TJOINT	Defines the Threaded Joint Example: TJOINT
U or UNIF	Uniform load (lb/ft or Kg/m)

	Example: U=200
US	User defined spring hanger US(No.of hangers, spring rate(lb./inch or N/mm), hot load(lb. or N)) Examples: US(2,600,1540) US(1,0,2300) : Constant support
VS	Variable spring hanger Example: VS, VS=2: two variable spring hangers
VOD	Vessel outside diameter (inch or mm) Use only for Nozzle. Example: VOD=250
VTHK	Vessel thickness (inch or mm) Use only for Nozzle Example: VTHK=10
VWGT	Valve weight (lb or kg) Example: VWGT=100
WGT	Weight of an item (ball joint, flange, Slip joint, etc.) (lb or kg) Example: WGT=50
WS	Widely Spaced Use only for Miter bend Example: WS
WTYPE	Weld type Example: WTYPE=1 (1 = Butt weld, 2 = Fillet weld, 3 = Concave fillet weld, 4 = Tapped Transition)

## PUMPS

Description (up to 16 characters)

Suction/Discharge location (0 = Top, 1 = Side, 2 = End)

Shaft axis (xcomp, ycomp, zcomp)

Center of pump (x,y,z)

### English units

Desc, Horizontal / Vertical inline (0 or 1), Shaft axis, Center of pump (ft-in), Suction node, Suction location, Discharge Node, Discharge Location

### SI units

Desc, Horizontal / Vertical inline (0 or 1), Shaft axis, Center of pump (mm), Suction node, Suction location, Discharge Node, Discharge Location

### Horizontal Pumps

Desc, 0, Shaft axis, Center of pump, Suction node, Suction location, Discharge Node, Discharge Location

### Vertical Inline Pumps

Desc, 1, Suction node, Discharge Node

## Example

```
PUMPS
427BSOUTH, 1, 350
427ANORTH, 0, 0.0000, 1.0000, 0.0000, -3.8299, -13'8", 44.33, 390, 2, 410, 2
427WEST, 1, 300
```

## COMPRESSORS

Description (up to 16 characters)  
Shaft axis (xcomp, ycomp, zcomp)

Description, Shaft axis direction, Inlet Node, Exhaust Node, Extraction Node 1, Extraction Node 2.

## Example

```
COMPRESSORS
Compressor1, 1.0000, 0.0000, 0.0000, 210, 300
```

## TURBINES

Description (up to 16 characters)  
Shaft axis (xcomp, ycomp, zcomp)

Description, Shaft axis direction, Inlet Node, Exhaust Node, Extraction Node 1, Extraction Node 2.

## Example

```
TURBINES
TURBINE1, 1.0000, 0.0000, 0.0000, 250, 360
```

## SEISMIC

X,Y,Z Static equivalent seismic loads in g's.

**SEISMIC Example:** Static seismic loads of 0.25 and 0.3 g's in X and Z directions.

```
SEISMIC
0.25, 0.00, 0.30
```

## WIND

Wind velocity (MPH or m/s), Shape factor (defaults to 0.6), X, Y, Z components of wind direction.

**WIND Example:** A wind load of 100 mph in the X direction.

```
WIND
100, 0.600, 1.000, 0.000, 0.000
```

### Example:

An example of a model batch file (.mbf file) is shown below:

Desalter Pumps

OPTIONS

HGRA,B313

MATERIAL

A53,0.283,0.300,1.00  
A53,-325,31.4E+6,5.00E-6,20000  
A53,-200,30.8E+6,5.35E-6,20000  
A53,-100,30.2E+6,5.65E-6,20000  
A53,70,29.5E+6,6.07E-6,20000  
A53,200,28.8E+6,6.38E-6,20000  
A53,300,28.3E+6,6.60E-6,20000  
A53,400,27.7E+6,6.82E-6,20000  
A53,500,27.3E+6,7.02E-6,18900  
A53,600,26.7E+6,7.23E-6,17300  
A53,650,26.1E+6,7.33E-6,17000  
A53,700,25.5E+6,7.44E-6,16500  
A53,750,24.9E+6,7.54E-6,13000  
A53,800,24.2E+6,7.65E-6,10800  
A53,850,23.3E+6,7.75E-6,8700  
A53,900,22.4E+6,7.84E-6,6500  
A53,950,21.4E+6,7.91E-6,4500  
A53,1000,20.4E+6,7.97E-6,2500  
A53,1050,19.2E+6,8.05E-6,1600  
A53,1100,18.0E+6,8.12E-6,1000

PIPE

4,4.5,0.237,0,12.5,11,2  
6,6.625,0.28,0,12.5,11,2  
8,8.625,0.322,0,12.5,11,2  
10,10.75,0.365,0,12.5,11,2  
12,12.75,0.406,0,12.5,11,2

LOADS

1,400,280,0.85,400,280,350,190  
1N,400,280,0.85,100,280,350,190  
1S,100,280,0.85,400,280,350,190  
1C,100,280,0.85,100,280,100,190  
4,400,600,0.85,400,600,285,450  
4N,400,600,0.85,100,600,285,450  
4S,100,600,0.85,400,600,285,450  
SO1,350,190,0.85,70,0,70,0  
SOA,230,145,0.85,70,0,70,0  
SD1,400,280,0.85,70,0,70,0  
DO1,285,450,0.85,70,0,70,0  
DOA,225,485,0.85,70,0,70,0  
DD1,400,600,0.85,70,0,70,0

LAYOUT

F10,CNOZZLE=297,L2=10'0",NOD=17.5,NTHK=1.3125,VOD=144,VTHK=1.375,  
L1=10'0",E=29.0E+6,DV(0.0000,0.0000,1.0000)  
L10,CFLANGE=WN,WGT=220

T20, JV, MA53, P10, Y1'6-1/4", CL=1, VWGT=625, THKF=3.0000, INSF=1.7500,  
FLANGE=WN, WGT=220  
T30, Y0'4-5/8"  
T40, JD, P8, Y0'7", COD1=10.75, THK1=0.365, OD2=8.625, THK2=0.322  
T50, KI, B12, Y6'0-1/8"  
T60, KI, B12, X-1.0017, Z1.0017  
T70, KI, B12, X-5'8-15/16  
T80, KI, B12, Y-11'3"  
T90, Z6'6", CLS(0.000, None), DV(0.0000, 1.0000, 0.0000), STIFF=Rigid  
T100, Z20'0", CLS(0.000, None), DV(0.0000, 1.0000, 0.0000), STIFF=Rigid  
T110, JI, B6.75, P4, Z17'6", CJMAT=A53, JSEC=12, JLOAD=1, JR=19.125  
T120, P8, X10'11", CLS(0.000, None), DV(0.0000, 1.0000, 0.0000),  
STIFF=Rigid  
T130, KI, B12, X2'0"  
\*  
T240, KT, JE, Z6'4-9/16", CES(100, 400, 300), TA=500, BK=11459  
\*  
T160, X-2'0", CLS(0.000, None), DV(0.0000, 1.0000, 0.0000), STIFF=Rigid  
T170, KI, B12, X-8'0"  
T180, Y-8'2-13/16, CFLANGE=WN, WGT=152  
T190, JV, Y-1'4-3/4", CVWGT=590, THKF=3.0000, INSF=1.7500, FLANGE=WN,  
WGT=152  
T200, KI, B12, Y-1'4-3/8", CL=1N  
T210, JS, Z-1'0", CFFOR=1000  
T220, JD, P6, Y0'0-15/16", Z-0'6", COD1=8.625, THK1=0.322, OD2=6.625,  
THK2=0.28, FRE=30.000  
L200A, CUS(1, 900, 2250)  
\*  
F240  
T250, KT, P8, Z1'2", CL=1  
\*  
T260, KT, Z1'2"  
T270, Z0'11"  
\*  
F260  
T280, X-2'0", CLS(0.000, None), DV(0.0000, 1.0000, 0.0000), STIFF=Rigid  
T290, KI, B12, X-8'0"  
T300, Y-8'2-13/16, CFLANGE=WN, WGT=96  
T310, JV, Y-1'4-3/4", CVWGT=590, THKF=3.0000, INSF=1.7500,  
FLANGE=WN, WGT=152  
T320, KI, B8, Y-1'4-3/8", CL=1S  
T330, Z1'0"  
T340, JD, Y0'0-  
15/16", Z0'6", COD1=8.625, THK1=0.322, OD2=6.625, THK2=0.28  
\*Node 230 = P-427B Suction  
T350, KA, P6, Z1'5-3/16", CDIS(0, 0.027, 0), DIS2(0, 0.027, 0),  
DIS3(0, 0.027, 0)  
L350, CFLANGE=WN, WGT=96  
\*Node 550 = P-427A Suction  
F220  
T390, KA, Z-2'7", CL=1N, DIS(0, 0.027, 0), DIS3(0, 0.027, 0)  
L390, CFLANGE=WN, WGT=96

T400,Z-1'6-3/8"  
T410,JL,Z-1'5-3/8",CTRAK(1,1,1),ROTK(1,1,1),  
LXAX(1.0000,0.0000,0.0000),LYAX(0.0000,1.0000,0.0000)  
\*From node 200 2'11.5" in the Z direction  
F370,KA,X-3.8300,Y-13'8",Z59.6267,CDIS(0,0.027,0),  
DIS2(0,0.027,0),DIS3(0,0.027,0)  
L370,CFLANGE=WN,WGT=58  
T420,P4,Z0'3-3/8",CL=4S  
T430,JD,P6,Z0'5-1/2",COD1=4.5,THK1=0.237,OD2=6.625,THK2=0.28  
T440,KI,B9,Z2'0-5/8"  
T450,Y1'0-7/8",CFLANGE=WN,WGT=96  
T460,JV,Y1'5-5/8",CVWGT=204,THKF=3.0000,INSF=1.7500,  
FLANGE=WN,WGT=96  
T470,JV,Y1'4-1/8",CVWGT=334,THKF=3.0000,  
INSF=1.7500,FLANGE=WN,WGT=96  
T480,KI,B9,Y7'0-3/8"  
T490,X8'0",CLS(0.000,None),DV(0.0000,1.0000,0.0000),STIFF=Rigid  
T500,KT,X3'6"  
\*  
\*From node 340 -2'11.5" in the -Z direction  
F410,KA,CDIS(0,0.027,0),DIS3(0,0.027,0)  
L410,CFLANGE=WN,WGT=58  
T510,P4,Z-0'3-3/8",CL=4N  
T520,JD,P6,Z-0'5-1/2",COD1=4.5,THK1=0.237,OD2=6.625,THK2=0.28  
T530,KI,B9,Z-4'0-5/8"  
T540,Y1'0-7/8",CFLANGE=WN,WGT=96  
T550,JV,Y1'5-5/8",CVWGT=204,THKF=3.0000,  
INSF=1.7500,FLANGE=WN,WGT=96  
T560,JV,Y1'4-1/8",CVWGT=334,THKF=3.0000,  
INSF=1.7500,FLANGE=WN,WGT=96  
T570,KI,B9,Y7'0-3/8"  
T580,X8'0",CLS(0.000,None),DV(0.0000,1.0000,0.0000),STIFF=Rigid  
T590,KI,B9,X3'6"  
T500  
L530B,CUS(1,520,1392)  
F500  
T600,KI,B9,Z1'7",CL=4  
T610,X-3'6",CLS(0.000,None),DV(0.0000,1.0000,0.0000),STIFF=Rigid  
T620,KI,B9,X-10'11"  
T630,KI,B9,Y-4'6-11/16  
T640,KI,B9,Z7'4"  
T650,Y1'1",CFLANGE=WN,WGT=96  
T660,Y0'11"  
T670,JD,P8,Y0'6",COD1=6.625,THK1=0.28,OD2=8.625,THK2=0.322  
T680,KT,Y0'7"  
\*  
F250  
T685,P4,X-2'0",CL=1C,LS(0.000,None),DV(0.0000,1.0000,0.0000),  
STIFF=Rigid  
T690,KI,B6,X-10'11"  
T700,KI,B6,Y-1'5-11/16  
T710,Z1'10",CFLANGE=WN,WGT=58

\*  
 F680  
 T720, Z-1'6", CL=4, FLANGE=WN, WGT=58  
 T730, JV, Z-1'0-1/4", CVWGT=170, THKF=3.0000,  
 INSF=1.7500, FLANGE=WN, WGT=58  
 T735, Z-6'6-3/4", CL=1C, LS(0.000, None), DV(0.0000, 1.0000, 0.0000),  
 STIFF=Rigid  
 T710, CL=1  
 \*  
 F680  
 T800, KI, B12, P8, Y3'0", CL=4  
 T810, Z6'1-5/8", CFLANGE=WN, WGT=152  
 T820, Z0'4-3/8", CLS(0.000, None), DV(0.0000, 1.0000, 0.0000),  
 STIFF=Rigid  
 T830, KI, B12, Z1'0"  
 T840, KI, B12, X7'0"  
 T850, KI, B12, X1'6", Y-1'6"  
 T860, X6'0", CFLANGE=WN, WGT=152  
 T870, JV, X1'4-3/4", CVWGT=410, THKF=3.0000, INSF=1.7500,  
 FLANGE=WN, WGT=152  
 T880, KT, X1'4"  
 \*  
 T890, KI, B12, Y1'7"  
 T900, KI, B12, Z2'0"  
 T910, Y-1'1-1/4", CFLANGE=WN, WGT=152  
 T920, JV, Y-1'4-3/4", CVWGT=410, THKF=3.0000, INSF=1.7500, FLANGE=WN,  
 WGT=152  
 T930, KI, B12, Y-1'1-1/4"  
 T940, KT, Z-2'0"  
 \*  
 T950, X1'0", CLS(0.000, None), DV(0.0000, 1.0000, 0.0000), STIFF=Rigid  
 T960, X1'0"  
 \*  
 F940  
 T970, X-1'4"  
 \*  
 F880  
 T980, KI, B12, X10'6"  
 T990, KI, B12, Y4'6"  
 T1000, X1'10", CLS(0.000, None), DV(0.0000, 1.0000, 0.0000), STIFF=Rigid  
 T1010, X26'8", CLS(0.000, None), DV(0.0000, 1.0000, 0.0000), STIFF=Rigid  
 T1020, KI, B12, X6'2"  
 T1030, KI, B12, Z2'0"  
 T1040, Y4'2"  
 T1050, JD, P10, Y0'7", COD1=6.625, THK1=0.28, OD2=8.625, THK2=0.322  
 T1060, KI, B15, Y1'3"  
 T1070, Z7'2", CLS(0.000, None), DV(0.0000, 1.0000, 0.0000), STIFF=Rigid  
 T1080, Z18'8", CLS(0.000, None), DV(0.0000, 1.0000, 0.0000), STIFF=Rigid  
 T1090, KI, B15, Z15'2"  
 T1100, KI, B15, Y-25'6"  
 T1110, KI, B15, X-3.8971, Z-2'3"  
 T1120, Y1'7-7/8", CFLANGE=WN, WGT=220

```

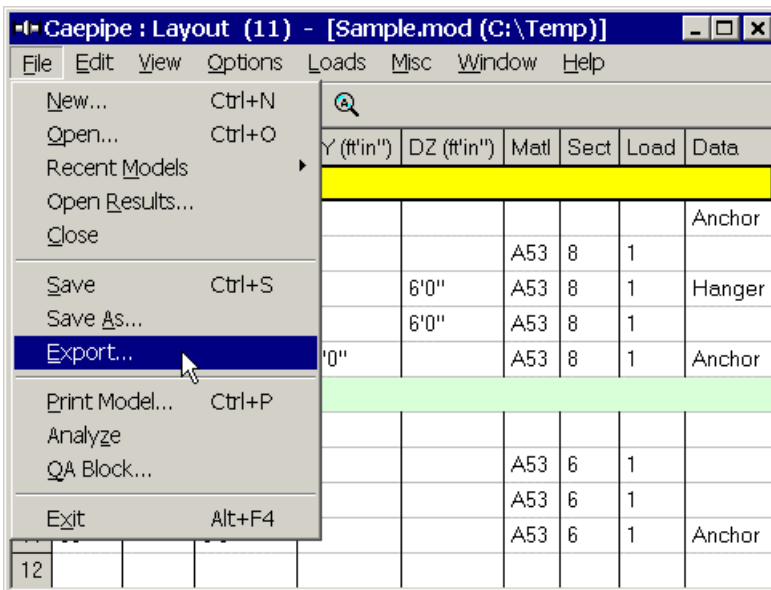
PUMPS
427BSOUTH,1,350
427ANORTH,0,0.0000,1.0000,0.0000,-3.8299,13'8",44.3351,390,2,410,2
COMPRESSORS
Compressor_1,1.0000,0.0000,0.0000,210,300
SEISMIC
0.25,0.00,0.30
WIND
100,0.600,1.000,0.000,0.000

```

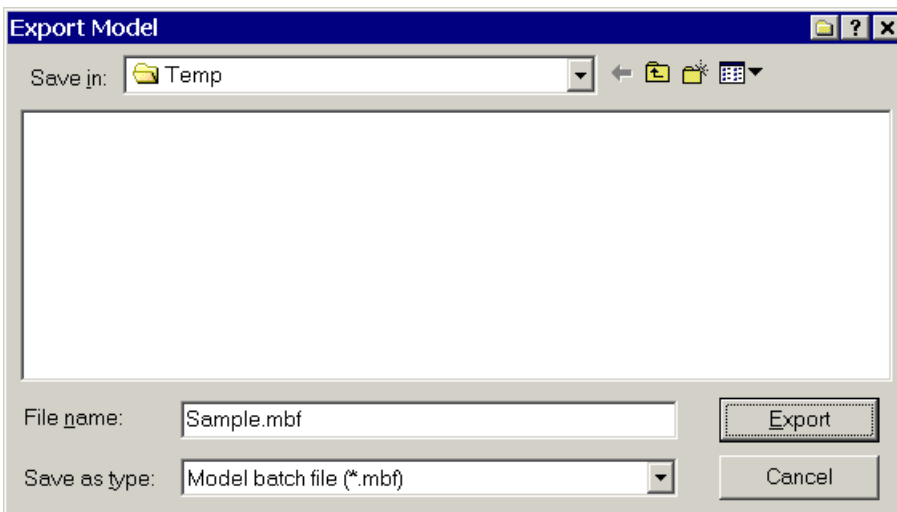
## Export

CAEPIPE can export a model to a text file with the extension .mbf (model batch file). The text file may be edited using a text editor. The edited text file may be read back into CAEPIPE by using the Import feature.

To export a model, select the menu command File > Export from the Layout window.



The Export Model dialog is shown. Click on the Export button to write to the batch file.



## Appendix – A

### Hanger Type

This section describes the hanger type number to be used for defining variable spring hanger type.

<b>Hanger Description</b>	<b>Type Value</b>
ABB-PBS	1
Basic Engineers	2
Bergen Paterson	3
Bergen Paterson (L)	4
BHEL Hyderabad	5
BHEL Trichy	6
Borrello	7
Carpenter & Paterson	8
Corner & Lada	9
Dynax	10
Elcen	11
Fee and Mason	12
Flexider (30-60-120)	13
Flexider (50-100-200)	14
Fronek	15
Grinell	16
Hydra	17
Lisega	18
Mitsubishi (30-60-120)	19
Mitsubishi (80-160)	20
Myricks	21
NHK (30-60-120)	22
NHK (80-160)	23
Nordon	24
NPS Industries	25
Piping Services	26
Piping Tech & Products	27
Power Piping	28
Sanwa Tekki (30-60-120)	29
Sanwa Tekki (85-170)	30
Sarathi	31
Spring Supports	32
SSG	33
Comet	34

## Appendix – B

### B31.4 (2002)

#### Allowable Pressure

For straight pipes and bends (including closely spaced and widely spaced miter bends), the allowable pressure is calculated from paras 404.1.2. and 404.2.1.

$$P = \frac{2St_a}{D}$$

where

P = allowable pressure

S = allowable stress = 0.72 x E x minimum yield strength as per para. 402.3.1(a)

In setting the design factor 0.72, due consideration has been given to and allowance has been made for the under thickness tolerance and maximum allowable depth of imperfections provided for in the specifications approved by the code.

E = weld joint factor (input as material property) from para. 402.3.1(a).

t<sub>a</sub> = available thickness for pressure design

= t<sub>n</sub> - corrosion allowance

(Any additional thickness required for threading, grooving, erosion, corrosion, etc., should be included in corrosion allowance; mill tolerance is indirectly included in allowable stress S above via the design factor 0.72)

t<sub>n</sub> = nominal pipe thickness

D = outside diameter

#### Sustained Stress (Restrained and Unrestrained lines)

The stress (S<sub>L</sub>) due to sustained loads (pressure, weight and other sustained mechanical loads) is calculated from para. 402.3.2(d).

$$S_L = \frac{PD}{4t_n} + \frac{\sqrt{(i_i M_i)^2 + (i_o M_o)^2}}{Z} \leq 0.75S_A$$

where

P = maximum of CAEPIPE input pressures P<sub>1</sub>, P<sub>2</sub> and P<sub>3</sub>

D = outside diameter

t<sub>n</sub> = nominal wall thickness of pipe

i<sub>i</sub> = in-plane stress intensification factor

i<sub>o</sub> = out-of-plane stress intensification factor

M<sub>i</sub> = in-plane bending moment

M<sub>o</sub> = out-of-plane bending moment

Z = uncorroded section modulus; for reduced outlets, effective section modulus

S<sub>A</sub> = allowable thermal stress range = k x minimum yield strength

where,

k = 0.72 for unrestrained lines from para 402.3.2 (c) and

k = 0.90 for restrained lines from para 402.3.2 (c).

## Occasional Stress (Restrained and Unrestrained lines)

The stress ( $S_{Lo}$ ) due to occasional loads is calculated from para. 402.3.3(a) as the sum of stress due to sustained loads ( $S_L$ ) and stress due to occasional loads ( $S_o$ ) such as earthquake or wind. Wind and earthquake are not considered to occur concurrently.

$$S_{Lo} = \frac{P_{peak} D}{4t_n} + \left[ \frac{\sqrt{(i_i M_i)^2 + (i_o M_o)^2}}{Z} \right]_{sust} + \left[ \frac{\sqrt{(i_i M_i)^2 + (i_o M_o)^2}}{Z} \right]_{occasional} \leq 0.80 S_y$$

where

$P_{peak}$  = peak pressure = (peak pressure factor) x P

where P = maximum pressure, as defined above

Z = uncorroded section modulus; for reduced outlets, effective section modulus

$S_y$  = minimum yield strength

## Expansion Stress (Restrained and Unrestrained lines)

### Unrestrained Lines

The stress ( $S_E$ ) due to thermal expansion is calculated from para. 419.6.4(c) for unrestrained lines (i.e., for those portions of the piping without substantial axial restraint, which normally occurs in buried piping)

$$S_E = \sqrt{S_b^2 + 4S_t^2} \leq 0.72S_y$$

where

$$S_b = \text{resultant bending stress} = \frac{\sqrt{(i_i M_i)^2 + (i_o M_o)^2}}{Z}$$

$$S_t = \text{torsional stress} = \frac{M_t}{2Z}$$

$M_t$  = torsional moment

Z = uncorroded section modulus (based on nominal dimensions); for reduced outlets, effective section modulus ( $Z_e$ ), where

$$Z_e = \pi r_b^2 t_e$$

$t_e$  = effective branch thickness, lessor of  $i_i t_b$  or  $t_h$ ,

where

$t_b$  = branch nominal thickness

$t_h$  = header nominal thickness

$i_i$  = in-plane SIF at branch

### Restrained Lines

The net longitudinal compressive stress due to the combined effects of temperature rise and the fluid pressure is calculated from para. 419.6.4 (b) for restrained lines

$$S_E = E_{ref} \alpha (T_2 - T_1) - \gamma S_h \leq 0.90 S_y$$

where,

$S_E$  = longitudinal compressive stress

$$S_h = \text{hoop stress due to fluid pressure} = \frac{PD}{2t_n}$$

$t_n$  = nominal thickness

$T_1$  = temperature at time of installation

$T_2$  = maximum or minimum operating temperature

$E_{\text{ref}}$  = modulus of elasticity of steel at reference temperature

$\alpha$  = linear coefficient of thermal expansion at the concerned operating temperature

$\gamma$  = Poisson's ratio = 0.30 for steel