

Version February 2016

Programs

RF-PIPING

Add-on Modules for PIPELINES

Program Description

All rights, including those of translations, are reserved. No portion of this book may be reproduced – mechanically, electronically, or by any other means, including photocopying – without written permission of DLUBAL SOFTWARE GMBH.



© Dlubal Software GmbH 2016 Am Zellweg 2 D-93464 Tiefenbach Germany

Tel.: +49 9673 9203-0 Fax: +49 9673 9203-51 E-mail: info@dlubal.com Web: www.dlubal.com ⊿ Dlub

Contents

Contents

Page

1.	Introduction 3
11	RE-PIPING and RE-PIPING Design Add-On Modules 3
12	Using the Manual
2.	RF-PIPING 4
21	Opening RE-PIPING 4
2.1	Pining Analysis - Settings 5
21.2	Extension for Toolbars Navigator and Tables 7
2.1.2	Dialog Boxes of RE-PIPING
2.2	Pineline 8
2.2.1	Defining Pinelines 9
2.2.1.1	New Pining Cross-Section 11
2.2.1.2	Matorial Library 12
2.2.1.5	Material Library
2.2.2	Neucei 13
2.2.5	Valve
2.2.4	3-Way Valve
2.2.5	4-way valve
2.2.0	Bend
2.2.7	Flange
2.2.8	Blind Flange
2.2.9	lee
2.2.10	Branch Connection
2.3	Load Cases and Combinations
2.3.1	Load Cases
2.3.2	Piping Load Combinations (PC)
2.3.3	Result Combinations (RC)
2.4	Piping Loads
2.5	Selection and Modification of Pipelines
2.6	Graphical Display
2.7	Calculation Settings
2.8	Results
3.	RF-PIPING Design
3.1	Start RF-PIPING Design
3.2	Input Data
3.2.1	General Data
3.2.2	Materials
3.2.3	Cross-Sections
3.3	Calculation
3.3.1	Detail Settings
3.3.2	Starting Calculation
3.4	Results
3.4.1	Design by Load Combination
3.4.2	Design by Cross-Section
3.4.3	Design by Pipeline
3.4.4	Design by Member
3.4.5	Design by x-Location
3.4.6	Governing Internal Forces by Member

4 Dlubal



3.4.7	Governing Internal Forces by Pipeline	
3.4.8	Parts List by Pipeline	
3.5	Evaluation of Results	
3.5.1	Results on RFEM Model	
3.5.2	Result Diagrams	
3.6	Filter for Results	
3.7	General Functions	
3.7.1	Design Cases	
3.7.2	Units and Decimal Places	
3.7.3	Data Transfer	
3.7.3.1	Exporting Materials to RFEM	
3.7.3.2	Exporting Results	61
4.	Printout	62
4.1	Printout Report	
4.2	Graphic Printout	63
A.	Literature	65
В.	Index	

1 Introduction

1.1 **RF-PIPING and RF-PIPING Design Add-On Modules**

Pipelines are used to transport fluids. They are used in all areas of construction. For the design and calculation of pipelines, the two US standards ASME B31.1 [1] and ASME B31.3 [2] are ground-breaking. DIN EN 13480-3 [3] contains the appropriate guidelines for metallic industrial piping.

With the **RF-PIPING** add-on module, DLUBAL offers a powerful tool for modeling piping systems. There is no need to adjust to a new interface because the add-on module is displayed as an extension in the RFEM user interface when modeling pipelines.

You can model the pipelines like members in the RFEM user interface. It is possible to graphically enter connections such as tees and piping components using corresponding dialogs. Helpful libraries for pipelines, flanges and other components are included in the program.

You can enter loads and combine load cases using the usual procedures. You can decide if the load cases should be automatically or manually superimposed.

The calculation of internal forces, deformations and support forces corresponds to the general principle of RFEM. You can use the graphical RFEM user interface with all functions to evaluate the results.

With the second module, **RF-PIPING Design**, you can carry out piping analysis according to the previously defined standard ([1], [2] or [3] - in preparation). In the current state of development of the module, stress designs are carried out due to permanent, occasional or accidental loads.

You can clearly document all data, from modeling to design, in the global printout report of RFEM.

We hope you will enjoy working with RF-PIPING and RF-PIPING Design.

Your DLUBALTeam

1.2 Using the Manual

Since the topics installation, graphical user interface, results evaluation and printout are described in detail in the RFEM manual, no further description is given here. The present manual focuses on typical features of RF-PIPING and RF-PIPING Design.

The descriptions in this manual follow the sequence and structure of the module's input and result tables. In the text, the described **buttons** are given in square brackets, for example [Preset all members]. They are also displayed on the left. The **expressions** that appear in dialog boxes, tables, and menus are set in *italics* to clarify the explanations.

At the end of the manual, you find the index. In addition, feel free to use the search function on our blog website www.dlubal.com/blog/en where you can find tips and tricks in our articles about the add-on modules RF-PIPING.

2 RF-PIPING

In this chapter, you will find information about the different dialog boxes and functions of the add-on module RF-PIPING.

2.1 Opening RF-PIPING

RF-PIPING is an extension of RFEM. The functions of the piping module are available when **Piping analysis** in the *General Data* dialog box, *Options* tab is activated.

New Model - General Data	X
General Options History	
Activate	Standard Gravity
RF-FORM-FINDING Find initial equilibrium shapes of membrane and cable structures	g: 9.81 ▼ ★ [m/s²]
RF-CUTTING-PATTERN	
Piping analysis	
Use CQC Rule	
Rayleigh damping	
oz [rad/s]	
β:	
Cehr's damping	
D:	
Cehr's damping different for each load case	
Enable CAD/BIM model	
	OK Cancel

Figure 2.1: Dialog box New Model - General Data, Options tab

×



After closing the dialog box, additional navigator items and tables as well as a new toolbar are available. They are described in Chapter 2.1.2.

Data Navigator

Piping

ず 🖻 🖄 🗞 🏵 꾼 🕆 🏞

Figure 2.2: Toolbar Piping

2.1.1 Piping Analysis - Settings

To get to the detail settings for RF-PIPING, use the [Edit] button (see Figure 2.1). A dialog box appears with important settings for the piping analysis.

Piping Analysis - Settings	
Stress Intensification Factors (SIFs) and Flexibility Factor Piping Standard: Image: ASME B31.1-2012 Use in-plane/out-of-plane SIFs Default branch connection type: Unreinforced fabricated tee B31.1/B31.3 Welding/Contour Tees meet ASME B16.4 Generated Combinations Load combinations: Image: Create combinations automatically Loads incorporated into automatically Loads incorporated into automatically Generate expansion combinations as: Image: Hydrotest Generate expansion combinations as: Image: Solve independently (piping load combinations)	 Internal Pressure ✓ Displacements due to pressure (Bourdon effect) ● Elongation ● Elongation and straightening Treat Bourdon effect as: ● Expansion load (included in expansion and operating piping combinations) ● Sustained load (included in sustained, operating, occasional and hydrotest piping combinations)
	Material Properties Use temperature dependent material properties OK Cancel

Figure 2.3: Dialog box Piping Analysis - Settings

Stress Intensification Factors (SIFs) and Flexibility Factors

The following standards are available in the list **Piping Standard**:

• ASME B31.1-2012 [1]

-

ASME B31.1-2012 ASME B31.1-2012 ASME B31.3-2012

EN 13480-3:2013

- ASME B31.3-2012 [2]
- EN 13480-3:2013 [3] (in preparation)

The option Use in-plane/out-of-plane SIFs is intended to be used for an analysis according to [3].

For a correct analysis in the module RF-PIPING Design, detailed data on the design of the tee is necessary. The list **Default branch connection type** contains the following options:

- Welding forged tee
- Reinforced fabricated tee with pad or saddle
- Unreinforced fabricated tee
- Extruded welding tee
- Welded-in contour insert
- Branch welded-on fitting (integrally reinforced)
- User-defined

5

The check box **B31.1/B31.3 Welding/Contour Tees meet ASME B16.9** determines if the parameters r_x and T_c are available for the branch connection types *Welding forged tee* and *Welded-in contour insert* (see Chapter 2.2.10, page 27). This option thus refers to the note (7) in [1] Table D-1 and Note (8) in [2] Table D300.

Generated Combinations

This dialog section manages how the load cases are combined.

Create Combinations Automatically

The superposition of load cases is carried out in *piping combinations*. If the check box is selected, these combinations are generated automatically. You can define other combinations individually here.

If the check box *Hydrotest* is selected, additional piping combinations for the hydrostatic test pressure are generated.

Expansion Combinations

The temperature combinations can be generated according to the following two methods:

- Difference between operating and sustained combination (result combinations)
- Solve independently (piping load combinations)

In the first case, result combinations are generated. The second case generates load combinations. The difference between the two possible combinations is described in the RFEM manual, Chapter 5.5 and 5.6.



It is generally recommended to use result combinations: Here, the thermal load cases are entered separately which interact with the other loads.

Internal Pressure

An internal pressure results in elongation and straightening of pipes. The check box *Displacements due to pressure (Bourdon effect)* and the two radio buttons below specify if and how this effect is considered.

Furthermore, if the Bourdon effect is considered, you have to specify if the internal pressure acts as *expansion load* or as *sustained load*.

Material Properties

This check box specifies if the temperature dependent material properties are used which are stored in the library (see Chapter 2.2.1.3, page 13). If the standard setting is deactivated, those values will be used which correspond to the reference temperature T_{ref} indicated in Table 7.1 - *Materials*.

2.1.2 Extension for Toolbars, Navigator and Tables

RF-PIPING is displayed in the RFEM user interface as an extension in the toolbars, navigator and tables.

Toolbar

By activating the module RF-PIPING, the corresponding toolbar is displayed (see Figure 2.2, page 4). The functions contained therein enable the modeling of the pipeline.

Button	Description
T	New Pipeline
Ð	New Reducer
1	New Valve
1	New 3-way Valve
图	New 4-way Valve
7	New Bend
1	New Flange
~1	New Blind Flange
2	New Tee
御	New Branch Connection - Factors

Table 2.1: Buttons of RF-PIPING

The buttons and the corresponding dialog boxes are described in Chapter 2.2.

Navigator

In the navigator, the category *Load Cases and Combinations* is extended by the entry **Piping Load Combinations**.

Moreover, the new category **Piping (RF-PIPING)** is added. All data concerning materials, cross-sections and pipelines are saved here.



Figure 2.4: Data Navigator for RF-PIPING





T

All information about the pipelines are saved in the tables 7.1 to 7.10. To open these tables, use the button shown on the left.

7.4 Comp	onents																×
	3 🖂 🚳 🔚		36	S 🔮	3	🛛 🖹	= = <u>-</u>	2	😤 🐼 🛛		ab=	f_x	fx				
	А	B	C	D	E	F	G	H		J		K		L	М	N	
	Component	Pipeline	Member	Noc	de No.	Pr	ojected Leng	th	Length	Cros	s-Se	ction N	ο.	Weight			
No.	Туре	No.	No.	Start	End	Δχ [mm]	Δγ [mm]	∆z [mm]	L [mm]	Star	t	En	d	W [kg]		Comment	
1	3-way Valve	1	12	23	48		600.0		600.0		1	0	1	176.5	Y		
2	Bend	• 1	27,13	48	24		2400.0		2400.0		1		1	208.5	Y		E
3	Pipe	1	14	24	67	-1286.0			1286.0		1	0	1	82.9	Х		
4	Bend	1	46,15	67	25	-1714.0			1714.0		1	0	1	153.4	Х		
5	Pipe	1	16	25	61		784.0		784.0		1	0	1	42.6	Y		
6	Tee	1	36	61	50		216.0		216.0		1	0	1	17.3	Y		
7	Tee	1	34	50	62		216.0		216.0		1		1	17.3	Y		
8	Bend	1	37,17	62	29		784.0		784.0		1	0	1	78.7	Y		
9	Pipe	1	18	29	1	1466.5			1466.5		1	0	1	97.4	Х		
10	Bend	1	48,19	1	33	1533.5			1533.5		1	0	1	138.9	Х		
11	Bend	1	20,21	33	37		2000.0		2000.0		1	0	1	156.0	Y		
12	Pipe	1	22	37	63	1154.0			1154.0		1	0	1	72.3	Х		
13	Reducer	1	42	63	64	800.0			800.0		1	0	2	215.0	Х		
14	Pipe	1	39	64	75	2046.0			2046.0	0	2	0	2	935.5	Х		
15	Pipe	1	49	75	41	1000.0			1000.0	0	2	0	2	457.2	Х		-
Materials	Cross-Sections	Pipelines C	omponents	Bends	Reducers	Tees Bran	ich Connectio	ons - Factors	Expansion	Joints							
Descriptio	on of piping com	ponent (F7	to select)														

Figure 2.5: Tables 7.xx for RF-PIPING

The functioning of these tables is described in the RFEM manual, Chapter 11.5.

2.2 Dialog Boxes of RF-PIPING

2.2.1 Pipeline

A pipeline is a continuous string of members of the type *piping*. By clicking the button [New Pipeline], you can model new member strings. A dialog box appears where you can provide detailed information about the pipeline.



Figure 2.6: Dialog box New Pipeline

No.

You can assign any number. It is not possible to modify it afterwards.

Pipeline Description

You can enter any description for the pipeline.

Member No.

This number defines the first member of the new pipeline. You can freely define it. Other members of the same pipeline will have sequential numbers.

Cross-Section

You have to define the cross-section of the pipeline in the text box. By using the button , you can select a cross-section from the pipeline library (see Chapter 2.2.1.2, page 11).

For general information about the cross-sections, have a look at the RFEM manual, Chapter 4.13.

Bend

In this dialog section, you can define if the bends are generated automatically during the following modeling and which bend radius is considered.

Bend Factors

The values of the *Flexibility factor* as well as of the *Stress intensification factors* indicated in this dialog section are automatically calculated. However, it is also possible to define them manually.

The flexibility factor k has an influence on the bending stiffness of the pipe bend. The stress intensification factors i only take effect at the piping design with RF-PIPING Design.

2.2.1.1 Defining Pipelines

If you have entered all data, you can close the dialog box by clicking [OK]. You can now define the pipeline as polyline in the work window. The following dialog box appears:

New Pipeline				×
Member No. Reference Current CS Grid origin Last node	Line No. N	lode No.	Coordin X: Y: Z: Length	ates 6.000 ★ [m] 0.000 ★ [m] 0.000 ★ [m] ★ [m]
Bend Bend type: None Bend U-Bend	Bend radius: Short Long User-defin 48	ed: .0 📩 [mm]	Step ∆L:)
	2			Apply

Figure 2.7: Dialog box New Pipeline

In the *New Pipeline* dialog box, the numbers of the new members, lines and nodes are preset, but it is possible to modify them.

For entering the coordinates, you have the following three options:

- *Current CS*: The coordinates always refer to the origin of the coordinate system. The grid is fixed.
- Grid origin: The coordinates refer to the origin of the grid.
- *Last node*: The coordinates always refer to the last defined node. The position of the grid origin is also in the last node.

The *Bend* dialog section controls if bends are generated when gradually defining the polyline and which form they have. The parameters are explained on the previous page.

If you select the check box *Step*, the length of the pipeline L is displayed at the cursor which may help to model the pipeline easier.

Buttons

Two buttons in this dialog box are useful for modeling.

Details

0

New Pipeline - Details	X
Set Coordinates in Table	
In global coordinate system	
Related to node No.:	1 👻
Related to the current grid of	rigin
Auto Connect	
Rotation	
Rotate lines inside	
by axis: y	
ОК	Cancel

Figure 2.8: Dialog box New Pipeline - Details

Set Coordinates in Table: The input data is saved in the RFEM Table 1.1 Nodes. It is possible to save the nodes in the global coordinate system or with reference to another node.

Auto Connect: This check box controls if a connection is generated between two pipelines, when, for example, the end point is placed on an existing pipeline. If this check box is selected, the existing pipeline in this node is separated; both pipelines are connected. If this option is deactivated, the existing pipeline will not be separated. Depending on whether the option *Use division for members with nodes lying on them* is activated in the *FE Mesh Settings* dialog box, the two pipelines are either connected or not.

Rotation: This option may be helpful for bends which look drilled in the rendering. The drilling is caused by a change of the local z-axis direction.



Undo

Modeling a pipeline is equal to modeling a continuous line. From the very start to the very end, all parts are continuously placed. If you have made any mistakes, you can undo your entries step-by-step by using this button without deleting the pipe.



2 RF-PIPING

2.2.1.2 New Piping Cross-Section



In the dialog box *New Piping*, you have to define a cross-section (see Figure 2.6, page 8). You can use the button

The cross-section library is displayed where you can select the piping cross-section. This dialog box is described in the RFEM manual, Chapter 4.13.

Rolled Cross-Sections - Pipes for F	liping - Straight Pipe				×
Cross-Section Type	To Select - Favorites		To Select		NPS 3/4 (1.050x0.065) ASME B 36.10M
	Table	Manufacturer/Standard	Cross-Section	-	
	O NPS	ASME B 36.10M	¹⁾ NPS 1/8 (0.405x0.049)	=	
	O NPS	MSME B 36.19M	3) NPS 1/8 (0.405x0.057)		
	O DN	ASME B 36.10M	4) NPS 1/8 (0.405x0.068)		<u>></u>
	O DN	MSME B 36.19M	6) NPS 1/8 (0.405x0.095)		
	O DN	EN 10220	¹⁾ NPS 1/4 (0.540x0.065)		
	O DN	🧮 DIN 2448	3) NPS 1/4 (0.540x0.073)		
	O DN	🧮 DIN 2458	4) NPS 1/4 (0.540x0.088)		
	O DN	NBR 5580:2002	6) NPS 1/4 (0.540x0.119)		
2	O DN	NBR 5590:1995	¹⁾ NPS 3/8 (0.675x0.065)		
Filter	O NPS (Table 22)	ADM 2010	8) NPS 3/8 (0.675x0.073)		N N N N N N N N N N N N N N N N N N N
			4) NPS 3/8 (0.675x0.091)		
Manufacturer/Standard group:			⁶⁾ NPS 3/8 (0.675x0.126)		
All			⁽¹⁾ NPS 1/2 (0.840x0.065)		
Manufacturer/Standard			¹⁾ NPS 1/2 (0.840x0.083)		
			3) NPS 1/2 (0.840x0.095)		
			4) NPS 1/2 (0.840x0.109)		*
Cross-section shape:			6) NPS 1/2 (0.840x0.147)		
O DN steel pipe sections			⁽⁰⁾ NPS 1/2 (0.840x0.188)		
			⁽⁴⁾ NPS 1/2 (0.840x0.294)		
Cross-section note:			¹⁰ NPS 3/4 (1.050x0.065)		[mm]
All 👻			¹⁾ NPS 3/4 (1.050x0.083)		
			³⁾ NPS 3/4 (1.050x0.095)		
DN/NPS:			4) NPS 3/4 (1.050x0.113)		Material
All 👻			*/ NPS 3/4 (1.050x0.154)		1. Carbon Steel (Coomless Dise and Tube) & 52. Crade A
_			⁽⁰⁾ NPS 3/4 (1.050x0.219)		■ 1 - Carbon Steel (Seamless Fipe and Tube) A 55, Grade A
Include invalid			NPS 3/4 (1.050x0.308)		
Favorites group:			NPS 1 (1.315x0.065)		
ASD 🔻 🎦 🔯			NPS 1 (1.315x0.109)	-	NPS 3/4 (1.050x0.065) ASME B 36.10M
		1	P NPS 1 (1.315X0.114)		
					OK Cancel

Figure 2.9: Dialog box Rolled Cross-Sections - Pipes for Piping - Straight Pipe

After clicking [OK], the *New Piping Cross-Section* dialog box is displayed (see Figure 2.10). In this dialog box, you can provide specific information about the cross-section, the bend, the structure of the pipeline and the stress analysis.

In this dialog box, you can enter specifications separately for straight sections and bends of a pipeline.

Straight Pipe

w Piping Cross-Section	×
Straight Pipe Bend Layers Stress Analysis Parameter	'S
Cross-Section	NPS 3/4 (1.050x0.065) ASME B 36.10M
Standard section	
NPS 3/4 (1.050x0.065) ASME B 36.10M	
Parametric section	
Outside diameter D₀: 1.05 ↓ [in]	· · · · · · · · · · · · · · · · · · ·
○ Inside diameter d: 0.92 ↓ [in]	
Wall thickness t _n : 0.07 + [in]	
Material	Z
1 Carbon Steel (Seamless Pipe and Tube) A 🔻	
	0
	Line Mass
	User-defined
	Line mass: 0.68 () [lb/ft]
Total Line Mass	
Straight pipe: 0.67	Bend: 0.67 (b/ft]
Design Data	
Design pressure PC: 0.0 () [psi]	Design temperature TC: 32.0 👘 [°F]
	OK Cancel

Figure 2.10: Dialog box New Piping Cross-Section

In the first tab, you can provide information about the cross-section of straight sections. You can select between a *Standard section* from the library or a *Parametric section* defined by outside and inside diameter with corresponding wall thickness.



You can select the *Material* of the cross-section from the list of already defined materials. With the buttons below the list, you can open the material library as well as create or edit a material. For more information about the material library, have a look at Chapter 2.2.1.3, page 13 and at the RFEM manual, Chapter 4.3.

The *Line Mass* is automatically calculated by default from the cross-section and the material. However, you can define it manually.

In the dialog section below, the *Total Line Mass* of the straight pipe sections and bends is displayed. It contains additional masses from the *Layers* tab.

In the last dialog section, you can define the Design pressure PC and the Design temperature TC.

If you use piping components such as flanges, the list of possibilities will be reduced automatically according to the design pressure to appropriate elements.

Bend

The setting options of this tab apply solely to bends of pipelines. The concept corresponds to the one for pipes (see above).

Layers

Straight Pipe	Bend	Layers	Stress A	nalysis Parameters	s	
Insulation Image: Apply Specific weight Thickness Plating Image: Apply Specific weight Thickness thickness thickness	ht: ;: ht:	 		[lbf/ft³] [ln] [lbf/ft³] [ln]		D tr tr tr tr tr
Specific weight	ht: :			[lbf/ft ³] [in]	Line Mass User-defined Line mass - pipe: Line mass - bend:	7.89 ↓ [b/ft] 7.89 ↓ [b/ft]

Figure 2.11: Tab Layers

In this tab, you can provide further information on the structure of the pipe. You can define the thickness of the layer as well as the specific weight each for *Insulation*, *Plating* and *Lining*.

If you enter the Line Mass manually, the values of the last calculated line masses are available so that individual values for pipe and bend can be entered.

2.2.1.3 Material Library

RFEM manages the materials for RF-PIPING separately in the category Piping (RF-PIPING). You can access the material library as usual by using the navigator shortcut menu or the button 🔤 in Table 7.1 Materials, Column A.



Figure 2.12: Shortcut menu Materials

In the library, the materials for the pipelines are preset by the *Filter* function.

2

Material Library					x
Filter	Material to Select				
Material category group:	Material Description	Standard			<u> </u>
Metal 👻	Carbon Steel (Seamless Pipe and Tube) A 53, Grade A	A ASME B	31.1-2010		Ξ
	Carbon Steel (Seamless Pipe and Tube) A 53, Grade E	ASME B	31.1-2010		
Material category:	Carbon Steel (Seamless Pipe and Tube) A 106, Grade	ASME B	31.1-2010		
Steel 👻	Carbon Steel (Seamless Pipe and Tube) A 106, Grade	I ASME B	31.1-2010		
Standard group:	Carbon Steel (Seamless Pipe and Tube) A 106, Grade	ASME B	31.1-2010		
	Carbon Steel (Seamless Pipe and Tube) A 179	ASME B	31.1-2010		
ASTM	Carbon Steel (Seamless Pipe and Tube) A 192	ASME B	31.1-2010		
Standard:	Carbon Steel (Seamless Pipe and Tube) A 210, Grade	ASME B	31.1-2010		
ASME B31 1-2010	Carbon Steel (Seamless Pipe and Tube) A 210, Grade	ASME B	31.1-2010		
	Carbon Steel (Seamless Pipe and Tube) A 333, Grade	ASME B	31.1-2010		
Special application:	Carbon Steel (Seamless Pipe and Tube) A 333, Grade	ASME B	31.1-2010		
All	Carbon Steel (Seamless Pipe and Tube) A 369, Grade	I ASME B	31.1-2010		
	Carbon Steel (Seamless Pipe and Tube) A 369, Grade	ASME B	31.1-2010		
	Carbon Steel (Seamless Pipe and Tube) API-5L, Grade	ASME B	31.1-2010		
	Carbon Steel (Seamless Pipe and Tube) API-5L, Grade	ASME B	31, 1-2010		
	Carbon Steel (Eurnace Butt Welded Pine) A 53	ASME B	31, 1-2010		
🔲 Include invalid 🔯	Carbon Steel (Furnace Butt Welded Pipe) API-5L. Gra	ASME B	31, 1-2010		
Favorites group:	Carbon Steel (El. Resistance Welded Pine and Tube)		31, 1-2010		÷
	Search:]	7	×
Material Properties	Carbon Steel (Seamless Pipe a	ind Tube) A 53	, Grade A ASI	NE B31.1-20	010
Main Properties					-
Modulus of Elasticity		E	29444.100	ksi	
- Shear Modulus		G	11324.700	ksi	
- Poisson s Ratio		V ''	0.300	lbf /ft 3	Ξ
Coefficient of Thermal Expansion		1 α.	6 4444F-06	1/°F	
Additional Properties			0.11112.00		
 Yield Strength 		fy	30.000	ksi	
 Ultimate Strength 		fu	48.000	ksi	
Temperature Dependent Properties		T (971	-		
E Modulus of Elasticity		102.0	Et 20100.400	leoi	
		-103.0	29444 100	ksi	
		122.0	29154.000	ksi	
		212.0	28718.900	ksi	
		302.0	28283.800	ksi	
		392.0	27703.600	ksi	
		482.0	27413.500	ksi	
		572.0	26833.300	ksi	
		562.0	25963.000	KSI kei	-
		/02.0	24347.700	1001	
			OK	Cancel	

Figure 2.13: Dialog box Material Library

The characteristic features of pipeline materials are the temperature dependent strengths which are specified in the *Material Properties* dialog section.

Chapter 4.3 of the RFEM manual describes how to select, modify or add materials in the library.

2.2.2 Reducer



Reducers are used to modify the piping cross-section. When clicking the [New Reducer] button, you can select the member in the work window where you want to apply the reducer.

R

Reducers refer to nodes. If a cross-section is modified within a member, you have to divide this member in advance at the appropriate position.

Nember	Reducer Select a pipe member or node to insert Reducer No. 27
	Cancel

Figure 2.14: Select member in the work window

When clicking on the member, the New Reducer dialog box appears.

New Reducer	x
General	
Reducer Type	Member No. Nodes No.
Type: User-defined	58 🐷 1,38
Cross-Section	
Reducer start:	
O 1 NPS 10 (10.750x0.500)	DN
Reducer end:	
■ ○ 2 NPS 18 (18.000x1.250)	
P	19
Geometry	Eccentricity
Start: 0.00 🚔 [in] 🖏 🕺	Eccentricity
Length: 20.00 🔄 [in]	Axial offset:
Cone semi- angle: 16.81 — [°] User-defined	In direction: O Local +y O Local +z
	💿 Local -y 🛛 🔘 Local -z
Dimension Change	Reducer Factors ASME B31.1-2012
To node: 63 🗸	User-defined
	Flexibility factor k : 1.00 + [-]
	Stress intensification factor i: 1.28 + [-]
	OK Cancel

Figure 2.15: Dialog box New Reducer

Reducer Type

If the reducer is specified as *User-defined*, the geometry of the reducer can be defined manually in the other dialog sections.

With the button [11], you can access a library with standardized reducers (see Figure 2.16).

If you have already defined a cross-section for the *Reducer end* (dialog section below), solutions combatible with DN are preset in the library.

Reducer Library						×
Filter Choice	To Select					
Code group:	Major DN	Minor DN	Cod	e	Туре	-
All	20	15	EN 10253	-2	A, concentric	
Cada	20	15	EN 10253-	2	A, eccentric	
Code:	20	15	EN 10253-	2	B, concentric	
All	20	15	EN 10253	2	B, eccentric	
_	20	15	DIN 2616-	1	eccentric	
Type:	20	10	DIN 2616-	1	eccentric	
All	20	15	DIN 2616-	2	eccentric	
	20	10	DIN 2616-	2	eccentric	
	20	15	DIN 2616-	2	concentric	
	20	10	DIN 2616-	2	concentric	
	25	20	EN 10253-	2	A, concentric	
	25	15	EN 10253-	2	A, concentric	
Only satisfactory DN	25	20	EN 10253-	2	A, eccentric	
	20	10	EN 10253	2	A, eccentric	•
Reducer Details					EN 10253-2 - Type A, concentric - DN 20	- DN 15
Length	L		1.50	in		
Maximum semi angle of cone	α		8.00	٠		
Eccentric			No			
						ancel
						ancer

Figure 2.16: Reducer library

Cross-Section

A reducer is – similar to a taper – defined by a start and end cross-section. Depending on which node of the member was selected in the *Dimension Change* dialog section, either the *Reducer start* or the *Reducer end* can be changed.

Geometry

If you have manually defined the reducer, you have to specify the start point (x-location along the member axis) as well as the length of the reducer in addition to the cross-sections. You can also define it graphically with and and .

The Cone semi-angle can be specified as user-defined if necessary.

Dimension Change

The *node* specified here defines which end of the pipe is concerned by the modification of the cross-section.

Eccentricity

Pipes always refer to the cross-section's centroid (wireframe model). For reducers, this leads to the fact that the pipe is continued centrally with a smaller cross-section perimeter. If, for example, the bottom side of the pipe has to be continuous, you can define an *Axial offset* of the local member axes after having selected the check box *Eccentricity*.

Reducer Factors

You can manually define the Flexibility factor and the Stress intensification factor where necessary.

2.2.3 Valve

N

The definition of a valve is used within the program to correctly enter the weight and the stiffness. When clicking on the [New Valve] button, you can select the member where you want to apply the valve.



Valves refer to members. Therefore, they can be arranged within a member.



Figure 2.17: Select member in the work window

When clicking on the member, the New Valve dialog box appears.

New Valve		×
Valve Flanges Additional Mass		
Valve Type Standard:	Member No.	Nodes No.
Cross-Section		
Geometry Start: 25.00 ⊕ [n] (a) (b) (b) (b) (b) (c) (c)		
Parameters Mass: 10.36 * Multiplier of insulation mass: 1.75 *	Start Leng	in the second se
Element type: Multiplier of thickness: 3.00 + [-] Rigid		
	1	OK Cancel

Figure 2.18: Dialog box New Valve

Valve Type

Currently, there are no preset valves available.

Cross-Section

The cross-section of the member is displayed for information purposes.

Geometry

To place the valve at the member, you have to define the *Start* (x-location along the member axis) and *Length* of the valve (end point). By using 3 and 3, you can graphically define both positions.

Parameters

In this dialog section, you can find options to adjust the *Mass* of valve and insulation as well as setting options concerning the stiffness. The mass is uniformly "distributed" over the length of the valve.

Flanges

Valve Flanges Addi	tional Mass	
Flange No.1		
☑ Use at node:	87	
Type:		
EN 1092-1/01/PN 2.5	- 🔊 😑	
Cross-section:		
0 1 DN 250	- A	
Mass:	19.66 (b)	
Nominal pressure:	36.3 🔶 [psi]	
Flange No.2		
✓ Use at node:	88	
Type:		
EN 1092-1/01/PN 2.5	- <u>(11</u>) =	
Cross-section:		
O 1 DN 250	- ()	
Mass:	19.62 A	
Mania I and a second		
ivominal pressure:	36.3 🚽 [psi]	

Figure 2.19: Dialog box New Valve, tab Flanges

Use the second tab of the dialog box to assign flanges on both sides of the valve. By using this function, you can correctly determine the load situation. The [Library] helps to find the correct flange type and thus the correct load (see Figure 2.20).

As an alternative, you can manually define the flanges with Mass and the Nominal Pressure.

If you want to use the same flange type at both ends, you can transfer the flange with the button to the other part.

Filter Choice To Select Code group: DN PN Code Type 250 2.5 EN 1092-1 02 + 32 Loose plate flange + weld-on plate collar					
Code group: 250 2.5 EN 1092-1 02 + 32 Loose plate flange + weld-on plate collar 250 0.0 EN 1092-1 02 + 32 Loose plate flange + weld-on plate collar					
Code group: 250 2.5 EN 1092-1 02 + 32 Loose plate flange + weld-on plate collar Image: EN 1092-1 0.2					
200 6.0 EN 1092-1 02 + 32 Loose plate flange + weld-on plate collar					
250 10.0 M EN 1092-1 02 + 32 Loose plate flange + weld-on plate collar					
Code: 250 16.0 M EN 1092-1 02 + 32 Loose plate flange + weld-on plate collar					
■ EN 1092-1					
250 40.0 EN 1092-1 02 + 32 Loose plate flange + weld-on plate collar					
Type:					
02 + 32					
All					
01 Plate flange for welding					
02 + 32 Loose plate flange + weld-on plate collar					
02 + 35 Loose plate flange + welding neck					
02 + 36 Loose plate flange + pressed collar with long neck					
02 + 37 Loose plate flange + pressed collar					
04 + 34 Loose plate mange + weld-neck collar					
11 Well-Heck linking DN 250 J EN 1002 1/02 +	22/DN 2.5				
Mase M 23.46 lb	32/FN 2.3				
Prosecura n 26-50 b					
length 1155 in					
ОК	Cancel				

Figure 2.20: Flange library

Additional Mass

Valve Flanges	Additional Mass
Additional Mass	
Mass	M: 27.50 () [b]
Offset from the co	mponent center
	Δ _x : 0.00 (n)
	Δy: -5.50 (in]
	Δz: 0.00 🔅 [n]
	Az Ax

Figure 2.21: Dialog box New Valve, tab Additional Mass

To consider the eccentric mass of the handwheel, you can define the *Mass* and the *Offset* in this tab from the center of the pipe.

2.2.4 3-Way Valve

8

You can arrange 3-way valves on nodes where three pipes are connected. When clicking on the button [New 3-way Valve], you can select the corresponding node.



Figure 2.22: Select node in the work window

When clicking on the node, the New 3-way valve dialog box appears.

v 3-way Valv alve Flange	e Additional	Mass				
Valve Type			-	Node No. 19		
Valve Segmen	ts Member No.	: Cross	-section:		Length:	
Segment 1:	28		0 (10.750x0.500)		8.00 🗭 [in]	Exe F
Segment 2: Segment 3:	59		0 (10.750x0.500) 0 (10.750x0.500)		8.00 💽 [in]	2 2
Parameters						
Mass: Multiplier of nsulation mas	s:	1.75 (b) [-]	User-defined			gth 1 Length 2
Element type: Multiplier o	of thickness:	3.00 💌	E-1	(
Rigid						Length .
					0	K Cancel

Figure 2.23: Dialog box New 3-way Valve

Valve Type

Currently, there are no preset 3-way valves available.

Valve Segments

In this dialog section, you have to define the *Length* of the individual segments. By using 🔊 and



The *Parameters* dialog section and the other tabs *Flanges* and *Additional Mass* are described in Chapter 2.2.3.

闵

2.2.5 4-Way Valve

You can arrange 4-way valves on nodes where four pipes are connected. When clicking on the button [New 4-way Valve], you can select the corresponding node.



Figure 2.24: Dialog box New 4-way Valve

Currently, there are no preset 4-way valves available.

The sections of this dialog box are described in Chapter 2.2.3 and Chapter 2.2.4.

2.2.6 Bend

2

If the check box for generating bends is selected in the *New Pipeline* dialog box (see Figure 2.6, page 8), bends are generated automatically between straight pipeline sections when defining a pipeline. By using the [New Bend] button, you can subsequently define a bend to connect two straight pipeline sections.

When clicking on the corresponding node, the New Bend dialog box appears.

New Bend		×
General Flanges		
Cross-Section	Member No.	Nodes No.
O 1 NPS 10	▼ 62	81,77
	NPS 10 (10.750×0.50	00) ASME B 16.9
Bend ASM	E B 16.9	
Bend radius:		
○ Short		
O Long		•
O User-defined:		
R: 10.00 🔶 [in]		
		Ţ.
		5
Bend Angle	Bend Factors	ASME B31.1-2012
Angle γ: 92.72 🔶 [°]	User-defined	
	Flexibility factor	k: 5.78 ÷ [-]
	Stress intensification	factors
		i: 2.08 + [-]
		OK Cancel

Figure 2.25: Dialog box New bend

In the first tab, you define the cross-section as well as the member number of the bend.

The *Bend* and *Bending Factors* dialog sections are explained in Chapter 2.2.1, the *Flanges* tab in Chapter 2.2.3.

The Bend Angle is displayed for information purposes.

2.2.7 Flange

1

For detailed views of the loading, you can define flanges. When clicking on the [New Flange] button, you can select the node or member in the work window where you want to apply the flange.

Nember	Flange Select a pipe member or node to insert Flange No. 58
	Cancel

Figure 2.26: Select member in the work window

When clicking on the node or member, the New Flange dialog box appears.

New Flange	×
General	
Flange Type Node No. Type: EN 1092-1/02 + 36/PN 2.5 ▼ 10,12	
Cross-Section DN 250 (273x12.5) DIN 2448 0 1 DN 250 (273x12.5) • Geometry • Start: 55.00 (*) [n] Length: 2.68 (*) [n]	
Flange Parameters Mass: 24.18 (1) [b] Nominal pressure: 36.3 (1) [psi]	
	ancel

Figure 2.27: Dialog box New Flange

Flange Type

If the flange is specified as *User-defined*, the parameters of the reducer can be defined manually in the other sections.

With the button (1), you can access a library with standardized flanges (see Figure 2.19, page 18). Here are solutions preset which are suitable for the cross-section. In the library, you can filter according to DN and PN compatible entries.

Cross-Section

The current piping cross-section is displayed here for information purposes.

Geometry

If you have manually defined the flange, you have to specify the *Start* (x-location along the member axis) as well as the *Length* of the flange. You can also define it graphically with $\boxed{\mathbb{N}}$.

When you use flanges from the library, you just have to indicate the position of the flange.

1

2.2.8 Blind Flange

Blind flanges are used to lock nozzles and piping ends. When clicking on the button [New Blind Flange], you can select the corresponding node in the work window.

When clicking on the node, the New Blind Flange dialog box appears.

New Blind Flange	×
General	
Flange Type	Node No.
Type: EN 1092-1/05/PN 25.0 -	19
Cross-Section	DN 250 (273x12.5) DIN 2448
O 1 DN 250 (273x12.5)	
Flange Parameters	
Mass: 73.85 (Ib]	
Nominal pressure: 362.6 [psi]	
	2
	OK Cancel

Figure 2.28: Dialog box New Blind Flange

Flange Type

If the flange is specified as *User-defined*, the parameters can be defined manually in the dialog section below.

With the button (1), you can access a library with standardized blind flanges (see Figure 2.29). Here are preset solutions which are suitable for the cross-section. In the library, you can filter according to DN and PN compatible entries.

Blind Flange Library							×
Filter Choice	To Select						
	DN	PN	Code	Туре			
Code group:	250	2.5	EN 1092-1	05	Blind flange		
EN T	250	6.0	EN 1092-1	05	Blind flange		
	250	10.0	EN 1092-1	05	Blind flange		
Code: 250		16.0	EN 1092-1	05	Blind flange		
■ EN 1092-1 - 250		25.0	🔯 EN 1092-1		Blind flange		
250		40.0	EN 1092-1	05	Blind flange		
Туре:	250	63.0	EN 1092-1	05	Blind flange		
05 ·	250	100.0	EN 1092-1	05	Blind flange		
PN designation / Pressure Class: All satisfactory v Only satisfactory PN Only satisfactory DN							
Flange Details						DN 250 EN 1	092-1/05/PN 25.0
Mass	M		73.85	b			
Pressure	p	p 362.6		ò psi			
Length	L		1.26	in			
					C	ОК	Cancel

Figure 2.29: Blind flange library



The current piping cross-section is displayed here for information purposes.

Flange Parameters

If you have selected the blind flange from the library, *Mass* and *Nominal Pressure* are preset. The pressure classes refer to the design pressure which you can define in the piping cross-section.

If the blind flange is specified as *User-defined*, both parameters can be defined manually. Only the mass is considered as an additional load for the calculation.

2.2.9 Tee



If a pipe is connected to an existing pipeline, prefabricated tees can be used for connection. When clicking on the [New Tee] button, you can select the corresponding node in the work window.



Only nodes are allowed where two pipes go straight through. The third pipe can be connected in any way.

Node N	Tee Select node to insert Tee lo. 87	
	Cancel	

Figure 2.30: Select node in the work window

When clicking on the node, the New Tee dialog box appears.

New Tee	×
Tee Flanges	
Тее Туре	Node No.
Type: User-defined 🔹 🔊	89
Cross-Section	
Run:	E LE E L
2 NPS 18 (18.000x1.250)	r 1
📔 🗃 🗃	
Branch:	
□ 0 1 NPS 10 (10.750x0.500)	
	0 F _w I
Geometry	ть и
Length:	ŭ_+ k
Run F: 12.50 🔶 [in] 🖏 🕺	
Branch G: 8.00 🕀 [in]	Other Parameters
	Mass: 228.11 (b) User-defined
	OK Cancel

Figure 2.31: Dialog box New Tee

Tee Type

If the tee is specified as *User-defined*, the parameters can be defined manually in the dialog sections below.

With the button (1), you can access a library with standardized tees (see Figure 2.32). Here are preset solutions which are suitable for the connection. In the library, you can filter according to DN compatible entries.

Tee Library								
Filter Choice	To Selec	t						
		DN				Wall thickn	ess	
Code group:	run	branch	Code	Туре	series	run (mm)	branch [mm]	
All	250	250	EN 10253-2	A	1	5.0	5.0	
	250	250	EN 10253-2	A	2	6.3	6.3	
Code:	250	250	EN 10253-2	A	3	8.8	8.8	
All 🔻 250		250	EN 10253-2	A	4	10.0	10.0	
	250	250	EN 10253-2	Α	5	12.5	12.5	-
Tee Type: 25		250	EN 10253-2	A	6	16.0	16.0	-
All		250	EN 10253-2	A	7	22.2	22.2	
	250	250	EN 10253-2	A	8	30.0	30.0	
Wall thickness series: 250		250	EN 10253-2	B	1	5.0	5.0	
All - 25		250	EN 10253-2	B	2	6.3	6.3	
	250	250	EN 10253-2	B	3	8.8	8.8	
	250	250	EN 10253-2	B	4	10.0	10.0	
Colu estisfactory DN	250	250	🔯 EN 10253-2	B	5	12.5	12.5	
Only saustactory DN	250	250	EN 10253-2	B	6	16.0	16.0	Ŧ
T - D / 1					511.40		4 070 40 07	
Tee Details					EN 10	253-2 - Type A	- 4 - 2/3X10 - 2/3	SX10
Langth (contents and)		F	0 50	in				
Wall thickness at welding and		т Т	0.00	in .				
Wall thickness at welding end		T 0.35 m		in .	in line			
		15	0.55					
Length (center to end)		G	8.50	in				
Wall thickness at welding end		T1	0.39	in				
Wall thickness inside branch		Ть	0.39	in				
			0.00					
D OK Cancel								

Figure 2.32: Tee Library according to EN 10253-2 [4]

Cross-Section

If the tee is specified as user-defined, you can define the cross-sections for the Run and the Branch.

Geometry

If you select the tee from the library, the geometry parameters of the connection will be entered automatically. If you manually enter the data, you have to define the *Length* and inner *Wall thickness* for the run and the branch. You can define the lengths also graphically by using the buttons \Im and \Im .

Other Parameters

The *Mass* of the tee is uniformly distributed as a distributed load over the parts of the tee. Only the corresponding pipe weight is considered for the value 0.

Flanges

In the second tab of the dialog box, you have the possibility to arrange flanges on the connection. The functions of this tab are described in Chapter 2.2.3 on page 18.

2.2.10 Branch Connection

The stress intensification factors (SIF) relevant for the design differ according to the type of tee. The type preset in the basic settings is used by default (see Chapter 2.2.9). You can manually define the factors for each connection by using the [New Branch Connection] button.

When clicking on the corresponding node, the New Branch Connection - Factors dialog box appears.

New Branch Connection - Factors	×
Branch Connection	
Tee Type ASME B31.1-2012	Node No.
Type: Unreinforced fabricated tee	87
Cross-Section Dimensions	
Header outside diameter: 10.75 * [n] Header wall thickness: 0.49 * [n] Branch outside diameter: 10.75 * [n] Branch wall thickness: 0.49 * [n]	
Parameters	Factors
Crotch radius r _X :	Flexibility factor k: 1.00 + [-]
Reinforcing pad Tr:	i: 4.29 () [-]
	Stress intensification factor - Branch i: 4.29 (1)
	OK Cancel

Figure 2.33: Dialog box New Branch Connection - Factors

Тее Туре

This list contains different types of tees according to [1] (see also Chapter 2.1.1, page 5). Depending on the selection, more information about, for example, diameters or wall thicknesses is necessary.



Figure 2.34: Tee Types



With the option *User-defined*, you can manually define the flexibility and stress intensification factors.

2.3 Load Cases and Combinations

The loads acting in the piping structure are organized in different load cases. It is possible to superimpose these load cases – manually or automatically – in **Piping Load Combinations** (*PC*) and in **Result Combinations** (*RC*).

The functionality of these two combination possibilities is similar to the load and result combinations in RFEM. They are described in the RFEM manual, Chapter 5. Only the specific characteristics of piping construction will be mentioned in the following.

2.3.1 Load Cases

Load cases enable sorting of loads according to their action category. By activating RF-PIPING in the *General Data* dialog box, the list of possible action categories is extendend.

Action Category	EN 1990 CEN / ASME B31.1-2012
WO ^O Pipe self-weight	•
QIA Imposed - Category A: domestic, residential areas	3.A 🔺
QIB Imposed - Category B: office areas	3.B
QiC Imposed - Category C: congregation areas	3.C
Qi D Imposed - Category D: shopping areas	3.D
QIE Imposed - Category E: storage areas	3.E
QiF Imposed - Category F: traffic area - vehicle weight ≤	30 kN 3.F
QiG Imposed - Category G: traffic area - vehicle weight ≤	160 kN 3.G
Qi H Imposed - Category H: roofs	3.H
Qs Snow (Finland, Iceland, Norway, Sweden)	4.A
Qs Snow (H > 1000 m a.s.l.)	4.B
Qs Snow (H ≤ 1000 m a.s.l.)	4.C
Qw Wind	5
Qt Temperature (non fire)	6
A Accidental	7 =
AE Earthquake	8
Imp Imperfection	
WO ^O Pipe self-weight	1
W1º Fluid	2
W2 ^o Fluid - Pressure Test	3
T ^o Temperature	4
P ⁰ Pressure	5
HP ⁰ Test pressure	6
D ^o Displacement	7
H ^o Hanger	8
CS ^o Cold spring	9 👻

Figure 2.35: Action categories for piping load cases (in green)

The action categories for the classification of piping loads are:

- Pipe self-weight
- Fluid
- Fluid Pressure Test
- Temperature
- Pressure
- Test pressure
- Displacement
- Hanger
- Cold spring

A load case which is adequate for piping design has to be classified in one of the piping-specific action categories. These categories are described, for example, in [3] Section 4.2.5 as design conditions.

If the load combinations are generated automatically according to the default settings in the *Settings* dialog box (see Figure 2.3, page 5), only those load cases which have been classified as piping load cases are considered for creating piping combinations and result combinations. Load cases of other action categories are ignored.



The superposition of load cases is normally carried out in *Piping load combinations*. They are based on the principle of the load combinations: The loading of the single load cases is combined to a "big load case" according to the combination criterion.

Edit Load Cases	and Combinations								×
Load Cases L	oad Combinations Piping Load Combina	tions Result Con	binations						
Existing Piping	Load Combinations	PC No.	Stress Type / Piping Load Com	bination D	escription			To Solve	
SUS PC1	Traditional Sustained 1	1	SUS - Traditional Sustain	ned 1			•	V	
SUS PC2	Traditional Sustained 2								
SUS PC3	Traditional Sustained 3	General Calo	ulation Parameters						
SUS PC5	Piping Weight + Fluid Weight	Existing Piping	Load Cases	4	Load Cas	es in Piping Loa	d Combination	PC	
OPE PC6	Operating 1	WO ^o LC1	Self-weight Fluid		1.00	W0° LC1	Self-weight Fluid		
OPE PC7	Operating 2	T ^O LC3	Temperature 1		1.00	P º LC6	Pressure 1		
OPE PC8	Operating 3	T º LC4	Temperature 2						
		P 9 LC5	Pressure 1						
		P º LC7	Pressure 2						
		P º LC8	Pressure 3						
		HP° LC9	Hydro Pressure Test						
		Loro		~~					
				44					
		7	All (10) 🔻 🛃		Ľ	1			
1		Comment							
							- 6		
	G _B All (8) 🔻 🗙						•		
9 🖻 🔓	đ							OK	Cancel

Figure 2.36: Dialog box Edit Load Cases and Combinations, tab Piping Load Combinations

Depending on the load situation, you may have to generate different combinations of the load cases. They are classified in *Stress Types*. If you manually define a combination, you have the following options:

OPE Operating SUS Sustained OCC Occasional	
SUS Sustained	
OCC Occasional	
HGR Hanger	
HP Hydro Pressure Test	

Later on during the design in the module RF-PIPING Design, the stress type of a piping combination determines which analysis is carried out with the resulting internal forces. If you manually define combinations, you have to take care that they are correctly allocated.

If combinations are created automatically (see *Settings* dialog box, Figure 2.3, page 5), the piping load combinations are automatically allocated to the corresponding stress types.

If there are more relevant temperature/pressure load cases, the pairs have to be defined appropriately before the combination. An appropriate message will be displayed before the combination. However, it is also possible to assign it later by using the button at the botton in the *Edit Load Cases and Combinations* dialog box. The *Grouping of Thermal and Internal Pressure Load Cases for Operating Combinations* dialog box will be displayed (see Figure 2.38).

M-	Thermal Land Case	Internal Descriptional Const
INO.	Inemai Load Case	Internal Pressure Load Case
1	LC3 - Temperature 1	P C6 - Pressure 1
2	T ^o LC4 - Temperature 2	P º LC7 - Pressure 2
3	T ^o LC5 - Temperature 3	P º LC8 - Pressure 3
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		

Figure 2.38: Dialog box Grouping of Thermal and Internal Pressure Load Cases for Operating Combinations

2.3.3 Result Combinations (RC)

The function of result combinations is described in the RFEM manual, Chapter 5.6.

Result combinations are used in piping construction to generate temperature combinations. If you have selected the automatic generation of combinations in the *Settings* dialog box (see Figure 2.3, page 5), the combinations of the stress type *Expansion* will be created as a result combination. The internal forces result from the difference between the operating stress piping combinations (OPE) and the sustained piping combinations (SUS).

Ec	lit Load Cases a	and Combinations									×
[Load Cases Lo	ad Combinations Piping Load Combinati	ons Result Com	pinations							
	Existing Result	Combinations	RC No.	Result Combination Descrip	otion				Us	se	
	EXP RC1	Expansion 1.	1	EXP - Expansion 1					-	7	
	EXP RC2	Expansion 2								1	
	EXP RC3	Expansion 3	General Calcu	lation Parameters							
	EXP RC4	Expansion 4	Existing Loadin	0			Loading in	Result Combinat	tion PC		
	EXP RC5	Expansion 5	woll LC1	Self-weight			Factor	No.	Description	Criterion	Group
	EXP RC6	Expansion 6	W1º LC2	Fluid			1.00	OPE PC9	Operating	Permanent	•
	EXP RC7	Expansion 7	T ^o LC3	Temperature 1			-1.00	SUS PC10	Traditional Sust	ain Permanent	-
d.	EXP RC8	Expansion 8	T º LC4	Temperature 2							
	EXP RC9	Expansion 9	LC5	Temperature 3							
	EXP RC10	Expansion 10	P 9 1 C7	Pressure 2							
	EXP RC11	Expansion 11	P º LC8	Pressure 3							
	EXP RC12	Expansion 12	HP [®] LC9	Hydro Pressure Test		\triangleright_{α}					
			W2 ^o LC10	Fluid - Pressure Test		S					
			OPE PC9	Operating							
			SUS PC10	Traditional Sustained 1	E						
			SUS PC11	Traditional Sustained 2		\triangleleft					
			SUS PC12	No Content Weight		44					
			SUS PC14	Piping Weight + Fluid Weight							
			OPE PC15	Operating 1							
			OPE PC16	Operating 2							
			OPE PC17	Operating 3							
			EXP RC2	Expansion 2							
			EXP RC3	Expansion 3							
			EXP RC4	Expansion 4							
			EXP RCS	Expansion 5							
			EXP RC7	Expansion 7							
			EXP RC8	Expansion 8							
			EXP RC9	Expansion 9	Ŧ						
				· ■(22)	20						-
	•	m +	Comment								
	1	→B All (12) ▼ 🕅							-		
	0 🔊 🕼]								ОК	Cancel
Ľ											

Figure 2.39: Dialog box Edit Load Cases and Combinations, tab Result Combinations

If the option *Solve independently (piping load combinations)* in the *Settings* dialog box (see Figure 2.3, page 5) is selected, no result combinations will be generated. The situations *Expansion* are represented in this case by piping combinations.

2.4 Piping Loads

The loading of the pipeline can be carried out with nodal and member loads.

Pipe content - full
Displacement
Rotation
Pipe content - full
Pipe content - partial
Pipe internal pressure
Rotary motion

For member loads, you can also select piping-specific load types such as *Pipe content - full/partial* and *Pipe internal pressure* in addition to temperature loads.

New Member Load					
No. Reference to Members List of men Sets of men	On Members mbers	s No.	\$ \$ 2	Load Type 'Pipe content - ful Load Distribution 'Uniform'	т
Load Type	Load Distribution	Load Direction			
Force Moment Temperature	Concentrated:	Local related to true member length:	○x ○y ○u ○z ○v	i •	i
Axial strain Axial displacement Precamber Initial prestress	Uniform Trapezoidal Tapered Parabolic Varying	Global related to true member length: Global related to projected member length:	 XL YL ZL XP YP 	Load Direction 'Global ZI'	
End prestress Extra: Pipe content - full Displacement Rotation Rotation			C ZP	Y X	
Pipe content - partial Pipe internal pressure Rotary motion d: Y? (bf/h3) d: Comment	A: B: Relative distan Load over tota member	(t) ↓ (t) hace in % al length of		z j	i i
			- C		OK Cancel

Figure 2.40: Dialog box *New Member Load* with options for piping loads

The piping-specific load types are briefly described in the following table:

Load Type	Description
Temperature	Temperature load evenly distributed over the member cross-section. You have to define the heating T_c with reference to the member center line.
Pipe content - full	Distributed load due to complete filling of a pipe. You have to define the specific weight γ of the pipe content.
Pipe content - partial	Distributed load due to partial filling of a pipe. In addition to the specific weight γ of the pipe content, you have to define the filling level d .
Pipe internal pressure	Constant internal pressure of a pipe. You have to define the value of the internal pressure.

Table 2.2: Specific load types for pipelines

The definition of node and member loads is described in the RFEM manual, Chapter 6.1 and 6.2.

2.5 Selection and Modification of Pipelines

Before you can edit pipes or pipelines, you have to select the relevant objects. You have different options:

- Selection in the work window by clicking the object
- Selection in the Data Navigator by clicking the entry
- Selection in the table by clicking the line

The selection of pipelines in the work window is similar to the selection of members: Left-click to select the object, double-click to open the editing dialog box of the pipe or a component (pipe, bend, reducer, etc.).

When you right-click the object, a shortcut menu is displayed where you have different editing options.



Figure 2.41: Piping shortcut menu with editing options (highlighted)

Edit Pipe

This option is the same as double-clicking the object. The dialog box is displayed and you can edit the pipe (or the valves, flanges, etc.).

Edit Pipeline Part

With this function, the whole pipeline can be edited. In the *Edit Pipeline Part* ... dialog box (see Figure 2.42), you can define, for example, a new bend radius for all bends or a new cross-section for the pipeline.

Figure 2.42: Dialog box Edit Pipeline Part 1/2

Edit Pipeline

With this function, you can edit the *description* of the pipeline and change the *members* which display the pipeline. Thus, you can add members at a later time.

Edit Pipeline	×
No. Description Cold 1- Nytrogen Type Pipeline Members No. 12-22,27,34,36,37,39,42,46,48,49 Comment Comment	
	OK Cancel

Figure 2.43: Dialog box Edit Pipeline

Delete Piping

The selected pipeline or the selected object will be deleted.

2

Compose Pipeline

If connected piping elements (members of the member type *Piping*) are present, which have not been assigned to any pipeline, you can define a new pipeline with this function.

Compose Pipeline		×
No. Description 9 Branch B Type (a) Pipeline Members No.	•	
72-75	۵.	
Comment	- 🖻	,,,,,
D		OK Cancel

Figure 2.44: Dialog box Compose Pipeline

Join Pipelines

With this function, you can connect multiple pipelines. However, they have to match the criteria of a continuous member, i.e. the members of each pipeline must not branch.

Join Pipelines	×
No. Description 9 Section F	
Type Pipeline Pipelines No.	
8.4 🔊 🗩	
	OK Cancel

Figure 2.45: Dialog box Join Pipelines

Explode Pipeline

The selected pipeline is divided in its single elements. Afterwards, you can rearrange these elements.



Pipes which do not belong to a pipeline cannot be designed at a later stage with the module RF-PIPING Design.

2.6 Graphical Display

For visual control and a clearly arranged display, it is possible to display each pipeline in a different color. You can set this function in the *Display* navigator: **Colors in Graphics According to** \rightarrow **Pipelines**.



Figure 2.46: Pipelines in rendering

The functions of the graphical user interface are described in the RFEM manual, Chapter 11.

2.7 Calculation Settings

You can modify piping-specific settings for the analysis in the *Piping Analysis* - *Settings* dialog box (see Chapter 2.1.1, page 5). In this dialog box, the global settings for stress intensification factors, load combinations, internal pressure and material parameters can be adjusted.

The settings for the internal pressure are checked with the *Calculation Parameters* RFEM dialog box, *Global Calculation Parameters* tab: If you select, for example, the Bourdon effect for the add-on module RF-PIPING, the check box for the RFEM analysis will be also activated.

Pipe Internal Pressure	
Displacements due to member loads of type 'Pipe internal pressure' (Bourdon effect)	

Figure 2.47: Dialog section Pipe Internal Pressure in the dialog box Calculation Parameters



The Bourdon effect is only fully considered for members of the type *Piping*: Regular members are only subject to elongation, the curvatures are considered additionally for pipelines (option *Elongation and straightening*).

2.8 Results

You have the same possibilities for the results display and evaluation in RF-PIPING as for normal load cases and combinations. They are described in the RFEM manual, Chapter 8 and 9.



Figure 2.48: Axial forces of RF-PIPING load case with display mode Cross-Sections

You can include the results in the printout report (see Chapter 4, page 62).

3 RF-PIPING Design

The add-on module RF-PIPING Design is a tool for piping analysis according to the standards ASME B31.1 [1], ASME B31.3 [2] and DIN EN 13480-3 [3] (in preparation). The stress designs due to permanent and occasional loads and from thermal expansion are carried out.

RF-PIPING Design is integrated in RFEM. Thus, the design-relevant input data is already preset when you start the module. After the design, you can use the graphical RFEM user interface to evaluate the results. You can include the designs in the printout report.

3.1 Start RF-PIPING Design

In RFEM, you have the following possibilities to start the add-on module RF-PIPING Design.

Menu

You can open the add-on module with the RFEM menu

Add-on Modules \rightarrow Piping \rightarrow RF-PIPING Design.



Figure 3.1: Menu Add-on Modules → Piping → RF-PIPING Design

Navigator

Alternatively, you can open the add-on module in the Data Navigator by clicking

 $\textbf{Add-on Modules} \rightarrow \textbf{RF-PIPING Design}.$



Figure 3.2: Data Navigator Add-on Modules \rightarrow RF-PIPING Design

3.2 Input Data

When you start the add-on module, a new window is displayed. A navigator is displayed on the left, managing the currently available tables. The drop-down list above the navigator contains the design cases (see Chapter 3.7.1, page 59).

The design-relevant data is stored in three tables. When you open RF-PIPING for the first time, the following parameters are imported automatically:

- Pipelines
- Piping Combinations (PC) and Piping Result Combinations (RC)
- Materials
- Cross-Sections



To select a table, click the corresponding entry in the navigator. To set the previous or next table, use the buttons shown on the left. Alternatively, you can use the function keys to go to the next [F2] or previous [F3] table.

OK Cancel

To save the results, click [OK]. You exit RF-PIPING Design and return to RFEM. To exit the add-on module without saving the data, click [Cancel].

3.2.1 General Data

In Table 1.1 *General Data*, you select the pipelines and combinations that you want to design. The standard is already preset due to the default setting for RF-PIPING (see Chapter 2.1.1, page 5).

RF-PIPING Design - [Pipeline-05	5]	×
File Edit Settings Help		
CA1 - Design of piping 🔹	 1.1 General Data 	
Input Data General Data Materials Cross-Sections	Design of Standard / National Annex (NA Ppelines No.:	
	Combination Selection	
	Existing Combinations Combinations Selected for Piping Design	PT AZ
	IBKE RC1 Expansion 1 IBKE RC1 Expansion 1 IBKE RC1 Expansion 1 IBKE RC1 Expansion 1 IBKE RC2 Expansion 2 IBKE RC5 Expansion 5 IBKE RC6 SUS IBKE RC7 Expansion 6 IBKE RC7 Expansion 7 IBKE RC6 SUS IBKE RC7 Expansion 7 IBKE RC8 Expansion 7 IBKE RC8 Expansion 7 IBKE RC8 Expansion 7 IBKE RC8 Expansion 9 IBKE RC8 Expansion 9	DNId
		RF-PI Design
		Design of Piping according to - ASME B31.1 - ASME B31.3
	Al (7) • 💆 🔠	
	Comnent	
	Calculation Details Graphics	OK Cancel

Figure 3.3: Table 1.1 General Data

Design

It is only possible to design *Pipelines*. Single piping components which are not assigned to a pipeline are not available.



If you want to analyze only selected pipelines, clear the check box *All*: Then you can access the text box to enter the numbers of the relevant pipelines. Use the [Delete] button to clear the list of preset numbers in the box. By using the [Select] button, you can also select the pipelines graphically in the RFEM work window.

Standard/ National Annex (NA)

In this dialog section, the design is displayed which is preset in the *General Data* RFEM dialog box for the calculation with RF-PIPING (see Figure 2.3, page 5). You have the following opportunities:

- ASME B31.1-2012 [1]
- ASME B31.3-2012 [2]
- EN 13480-3:2013 [3] (in preparation)

Select Load Case

The column Existing Load Combinations lists all piping combinations PC and result combinations RC that have been created in RFEM.

Use the button > to transfer selected entries to the list *Selected for Piping Design* on the right. Alternatively, you can double-click the entries. To transfer the complete list to the right, use the button ≫ .

To transfer multiple entries of combinations, click the entries while pressing the [Ctrl] key as common for Windows applications. Thus, you can transfer several combinations at the same time.

If the number of a combination is displayed in red, such as RC 6 in Figure 3.3, you cannot design it: This happens when a combination is defined without any load data. When you transfer such a load case, a corresponding warning appears.

At the end of the list, several filter options are available. They will help you assign the entries sorted according to certain criteria.

	All (7)
	All (7)
PC	Piping Load Combinations (0)
PC	Piping Load Combinations - Generated (0)
RC	Result Combinations (7)
RC	Result Combinations - Generated (7)
	Piping Load and Result Combinations - Generated (7)
SUS	Sustained (0)
EXP	Expansion (7)
Fie	nure 3.4. Filter options for combination

e 3.4: Filter options for combinations

The buttons have the following functions:

₿√ All combinations in the list are selected. 82 The selection of the combinations is inverted.

Table 3.1: Button in the tab Load Combination Selection

The column Selected for Piping Design lists all piping combinations and result combinations that have been selected for design. Click or double-click to remove selected entries from the list. The button < empties the whole list.

Comment

In this text box, you can type user-defined notes describing, for example, the current design case.

3.2.2 Materials

This table is split into two parts. The upper part lists all materials created in RFEM. In the *Material Properties* section, the properties of the current material, e.g. the table row currently selected in the upper section, are displayed.

1.2 Materi	als							
	Α				B			
Material	Material							
No.	Description				Comment			
1	Carbon Steel (Seamless Pipe and Tube) A 53. Grade A I	ASME B31.1-2010		-				
2	Stainless Steel (Pipes and Tubes) A 269, Grade TP304L	, 18Cr-8Ni (Tube) /	ASME B31.3-2	2010				
3	Stainless Steel (Pipes and Tubes) A 376, Grade TP321,	18Cr-10Ni-Ti (Pipe	> 3/8 in) ASN	IE B31				
					R R (>		
Material F	Properties							
🖂 Main F	roperties					-		
- Moo	Julus of Elasticity	E	29444.100	ksi				
She	ar Modulus	G	11324.700	ksi				
Pois	son's Ratio	v	0.300					
- Spe	cific Weight	Y	499.75	lbf/ft 3		=		
Coe	fficient of Thermal Expansion	α	6.4444E-06	1/°F		-		
Part	ial Safety Factor	γM	1.00				Material No. 1 used in	
Addition	nal Properties						indicitaritio. 1 docu in	
- Yiel	d Strength	fy	30.000	ksi		4	Cross-sections No.:	
Ultin	nate Strength	fu	48.000	ksi			1,2	
Tempe	erature Dependent Properties		_	1				
	fulus of Elasticity	1[1]	Et				Members No.:	
		-103.0	30169.300	ksi				
		68.0	29444.100	ksi			2-4,0,0-37,41-44,40,40,50-52,57	
		122.0	29154.000	ksi				
		212.0	28/18.900	KSI			Pipelines:	
		302.0	28283.800	KSI			1-3	
		392.0	27/03.600	KSI				
		482.0	2/413.500	KSI			Σ Lengths: Σ Masses:	
		5/2.0	26833.300	KSI Isoi			122.20 [#] 0.77 [Rinl
		752.0	23303.000	kei			102.05 [1] 0.77 [IMP3
		/32.0	24347.700	kei				
		922.0	23437.300	kei				
		1022.0	19726 100	kei		-		
		1022.0	13726.100	Nor				

Figure 3.5: Table 1.2 *Materials*

Materials that won't be used in the design appear in gray lettering. Materials that are not allowed are highlighted red, modified materials are displayed in blue.

The material properties required for the determination of internal forces (*Main Properties*) are described in Chapter 4.3 of the RFEM manual. The material properties required for design are stored in the global material library. These values are preset (*Additional Properties*).

To adjust the units and decimal places of material properties and stresses, select **Settings** \rightarrow **Units** and **Decimal Places** (see Chapter 3.7.2, page 60).

Material Description

The materials defined in RFEM are already preset, but it is always possible to modify them: To activate the field, click the material in column A. Then click the button I or press function key [F7] to open the material list.

I	Carbon Stool (Seemland Ping and Tube) A 52 Crade A ASME P21 1 2010		
	Calibon Steel (Seamless Fipe and Tube) A 55, Grade A (ASME BS1: 1-2010		
	Carbon Steel (Seamless Pipe and Tube) A 53, Grade A	ASME B31.1-2010	
	Carbon Steel (Seamless Pipe and Tube) A 53, Grade B	ASME B31.1-2010	
	Carbon Steel (Seamless Pipe and Tube) A 106, Grade A	ASME B31.1-2010	
	Carbon Steel (Seamless Pipe and Tube) A 106, Grade B	ASME B31.1-2010	
	Carbon Steel (Seamless Pipe and Tube) A 106, Grade C	ASME B31.1-2010	
	Carbon Steel (Seamless Pipe and Tube) A 179	ASME B31.1-2010	
ļ	Carbon Steel (Seamless Pipe and Tube) A 192	ASME B31.1-2010	
	Carbon Steel (Seamless Pipe and Tube) A 210, Grade A1	ASME B31.1-2010	
	Carbon Steel (Seamless Pipe and Tube) A 210, Grade C	ASME B31.1-2010	
	Carbon Steel (Seamless Pipe and Tube) A 333, Grade 1	ASME B31.1-2010	Ŧ

Figure 3.6: List of materials

In compliance with the design concept, you can select only piping materials.

Material Library

Numerous materials are already available in the library. To open the library, select

Edit ightarrow Material Library

or use the button shown on the left.

The material library is described in Chapter 2.2.1.3 on page 13.

3.2.3 Cross-Sections

This table lists the cross-sections that are used for the design.

3 Cross-	Sections						
	А	В	С	D	E	F	1 - NPS 10 (10 750×0 500) LASME B 36
Section	Material	Cross-Section	Cross-Section Type	Max. Design			
No.	No.	Description	for Classification	Ratio	Remark	Comment	
1	1	O NPS 10	Pipe	1.09			8
2	2	O NPS 18	Pipe	0.67			
						i	
Cross-Se	ection Prop	perties - NPS 10					Cross-section No. 1 used in
E Straig	nt Pipe - N	PS 10 (10.750×0.500) ASME B 36.10M					
Out	side Diame	ter	Do	10.75	in		Members No.:
Insi	de Diamet	er	d	9.75	in		2-4,6,8-37,41-44,46,48,50-52,55,57
Nor	ninal Wall	Thickness	tn	0.50	in		
Are	a of Cross	Section	A	16.1	in ²		Pipelines:
Elas	tic Sectio	n Modulus	Z	39.4	in ³		1.3
Con	rosion Allo	wance	C0	0.01	in		1.3
- Mill	Tolerance	1	C1	0.00	in		
Mar	nufacturing	Allowances	C2	0.00	in		Σ Lengths: Σ Masses:
We	ld Joint Eff	iciency Factor	E	1.000			134.69 [ft] 0.81 [kip]
Con	roded Area	a of Cross-Section	_	15.8	in ²		
Con	roded Elas	tic Section Modulus		38.8	in ³		Material:
E Bend			1				1 Carbon Steel (Seamloss Dina and Tub
Out	side Diame	eter	Do	10.75	in		1 - Carbon Steer (Seamless Pipe and Tub
Insi	de Diamet	er	d	9.63	in		
Nominal Wall Thickness			tn	0.56	in		
Are	a of Cross-	Section	A	17.9	in ²		-
-			1				

Figure 3.7: Table 1.3 Cross-Sections

Cross-Section Description

The cross-sections defined in RFEM are preset together with the assigned material numbers.

If you want to modify a cross-section, click the entry in column B to activate this field. Click [Cross-Section Library] or in the field or press function key [F7] to open the dialog box *Edit Piping Cross-Section* (see Figure 2.10, page 12).

Modifying the cross-section also affects the model in RFEM!

Max. Design Ratio

1

[-2

This column will be shown after the calculation. It serves as a decision support for the optimization: By means of the design ratios and colored relation scales, you can see which piping cross-sections are little utilized and thus oversized, or overloaded and thus undersized.



This column shows remarks in the form of footers that are described in detail below the cross-section list.

Info About Cross-Section



In the *Info About Cross-Section* dialog box, you can view the cross-section properties, stress points, and c/t-parts.

Info About Cross-Section NPS 10 (10)	.750×0.500)	ASME B 36.1	0M			x
Cross-Section Property	Symbol	Value	Unit		NPS 10 (10.750×0.500) ASME B 36.10M	
Outer diameter	D	10.75	in			
Wall thickness	t	0.50	in			
Cross-sectional area	Α	16.1	in ²			
Shear area	Ay	8.0	in ²		91	
Core area	Ac	82.5	in ²		0.5	
Plastic shear area	A pl,y	10.3	in ²			
Moment of inertia	Iy	212.0	in ⁴			
Governing radius of gyration	ry	3.63	in			
Polar radius of gyration	ro	5.13	in			
Volume	V	193.2	in ³ /ft		20	
Weight	wt	54.79	lb/ft		107	•
Surface	Asurf	2.81	ft²/ft	Ξ		-
Section factor	Am/V	82.581	1/m			
Torsional constant	J	422.9	in ⁴			
Elastic section modulus	Sγ	39.4	in ³			
Statical moment of area	Q _{y,max}	13.1	in ³			
Plastic section modulus	Zy	52.6	in ³			
Plastic shape factor	Zy/Sy	1.333			z	
Buckling curve (DIN 18800-2:2008-11)	BC _V ,DIN	a				
Buckling curve for steel with f_y >=460 N/r	BCy, DIN, S4	ao				
Buckling curve acc. to EN	BC _V ,EN	a				
Buckling curve acc. to EN for steel S 460	BC _V ,EN,S4€	ao				fiel
Full-plastic axial force acc. to DIN 18800-1	N pl,d	509.567	kip			[FU]
Full-plastic shear force acc. to DIN 18800-	V pl,d	187.293	kip		The stress points the stress p	<u>Å</u>
Full-plastic bending moment acc. to DIN 18	M pl,d	138.546	kipft	_	c/t-Parts	
Eull abatic targing all moment acc. to DTN 1	мтт	105 647	1 	4		
					Clo	se

Figure 3.8: Dialog box Info About Cross-Section

The buttons below the cross-section graphic have the following functions:

Button	Function
Ŧ	Displays or hides the stress points
	Displays or hides the c/t-parts
123	Displays or hides the numbers of stress points or c/t-parts
	Displays the details of the stress points or c/t-parts
X	Displays or hides the dimensions of the cross-section
;⇒	Displays or hides the main axes of the cross-section
X	Resets the full view of the cross-section graphic
\mathbf{b}	Prints the cross-sections properties and graphic

Table 3.2: Buttons of the cross-section graphic



3.3.1 Detail Settings

```
Details...
```

Before starting the calculation, you should check the design details. To open the corresponding dialog box, use the [Details] button available in every window of the add-on module. The content of this dialog box varies depending on the design standard. The following description refers to the detail settings for ASME B31.1 [1].

The Details dialog box contains the following tabs:

- Details
- Used Literature

Details - ASME B31.1-2012	
Detail Settings Used Literature	
Stresses	Display Results Tables
Number of thermal cycles N acc. to 102.3.2: 7000 🛓	2.1 Design by Load Combination
Occasional load factor k acc. to 104.8.2: 1.00 -	Image: Section Image: Section Image: Section Image: Section Image: Section
Corrosion Allowances	2.4 Design by Member
Consider corrosion, mill and mechanical allowances in stress calculations:	2.5 Design by x-Location
According to Standard	 3.1 Governing Internal Forces by Member 3.2 Governing Internal Forces by Pipeline
 In all stress calculations (conservative approach) 	
	Only for pipelines to be designed
	Of all pipelines
	OK Cancel

Figure 3.9: Dialog box Details, tab Details

Stresses

The limit stresses based on the designs may vary. They are, amongst other things, dependent on two parameters which you can define manually in this dialog section:

- Number of thermal cycles N according to [1] sec. 102.3.2
- Occasional load factor k according to [1] sec. 104.8.2

Display Result Tables

In this dialog section, you can select the result tables including parts list that you want to display. These tables are described in Chapter 3.4 from page 46.

3.3.2 Starting Calculation

Calculation

To start the calculation, click the [Calculation] button that is available in all input tables of the RF-PIPING Design add-on module.

RF-PIPING Design searches for the results of the piping combinations and result combinations selected for design. If no results can be found, the program starts the RFEM calculation to determine the design-relevant internal forces.

You can also start the calculation in the RFEM user interface: The *To calculate* dialog box (menu **Calculation** \rightarrow **To Calculate**) includes, amongst other things, design cases of the add-on modules.

To Calculate							×
Load Cases /	Combinations / Module Cases Result Tables		_				
Not Calculate			-	Selected for (alculation		_
No	Description	-		No	Descript	ion	
110.	Call unitable			CA1	DE DIDING Design Design of sig		
	Seir-weight			CAT	RE-FIFING Design - Design of pip	ng	
T 0 1 C 3	Temperature 1						
T ^O IC4	Temperature 2						
T º LC5	Temperature 3						
P º LC6	Pressure 1						
P º LC7	Pressure 2						
P º LC8	Pressure 3		>				
HP LC9	Hydro Pressure Test		>				
W2 º LC10	Fluid - Pressure Test						
OPE PC7	Operational 2		_				-
OPE PC8	Operational 3	-	4				=
EXP RC4	Expansion 4						
EXP RC5	Expansion 5		_				
EXP RC6	Expansion 6						
EXP RC7	Expansion 7						
EXP RC8	Expansion 8						
EXP RC9	Expansion 9						
		-					-
Al	•						
2 B						OK Ca	incel

Figure 3.10: Dialog box *To Calculate*



If the RF-PIPING Design cases are missing in the *Not Calculated* list, select *All* or *Add-on Modules* in the drop-down list at the end of the dialog section.

To transfer the selected RF-PIPING Design cases to the section on the right, click \ge . Click [OK] to start the calculation.

Subsequently, you can observe the design process in a separate dialog box.

3.4 Results

Immediately after the calculation, the Table 2.1 Design by Load Combination is displayed.

File Edit Settings Help CA1-Design of poing X X Design hy Load Combination Point Data A B C Design hy Load Combination Point Data A B C Design hy Load Combination Point Data A B C Design hy Load Combination Point Data A B C Design hy Load Combination Point Data C Description N NB Design hy Combination Point Data C Description N NB Design hy Combination NB Statistical Statistic	RF-PIPING Design - [Pipeline]													
CA1-Design of poing 21 Design by Load Combination IPput Data General Data Materials Costs Sections Results Design by Coss Sections Design by Coss Section Design Baco Design Reso Design Reso D	File Edit Settings Help													
Input Data —decard Data —decard Data —decard Data —decard Data —decard Data Controls A B C D E F —decard Data —decard Data Controls Decard Data Decard Data Controls Decard Data Controls Deca	CA1 - Design of piping 👻	2.1 Design	n by Load Combination											
Matchie Description Member Location Description Matchie Comb X and Contrustion 0.89 \$11 103 Stees due to deplacement load ranges acto. 10 148.3 Real/s Real/s Real/s Real/s Real/s Real/s Real/s Description 1 22 1.31 0.89 \$11 103 Stees due to deplacement load ranges acto. 10 148.3 Description 2/ Scatton 22 1.31 0.89 \$11 103 Stees due to adtained loads acto. 10 148.3 Description 2/ Scatton 22 1.31 102 \$11 107 \$11 107 \$11 107 \$11 107 \$11 107 \$11 107 \$11 107 \$11 107 \$11 107 \$11 107 \$11 107 \$11 107 \$11 107 \$11 107 \$110 108 \$110 108 \$110 108 \$110 108 \$110 108 \$110 108 \$110 108 \$100 \$110 108 \$110 108 \$110 108 \$110 \$110 \$110 \$110 </td <td>Input Data</td> <td></td> <td>A</td> <td>В</td> <td>С</td> <td></td> <td></td> <td>E</td> <td></td> <td></td> <td>F</td> <td></td> <td></td> <td></td>	Input Data		A	В	С			E			F			
Mathematical Control Description No. X RI Ratio Description Description <thdescription< th=""> Description Descri</thdescription<>	··· General Data	LC		Member	Location	C	lesign							
Consider 0.83 st 100 Stress due to deplacement load ranges acc. to 104.8.3 Peakls CC2 Expension 2 22 1.31 0.83 st 100 Stress due to deplacement load ranges acc. to 104.8.3 Design by Consideration 22 1.31 0.28 st 100 Stress due to deplacement load ranges acc. to 104.8.1 Design by Consideration 22 1.31 0.29 st 100 Stress due to suttained loads acc. to 104.8.1 Design by Kender 22 1.31 0.29 st 100 Stress due to suttained loads acc. to 104.8.1 Design by Kender 22 1.31 0.29 st 100 Stress due to suttained loads acc. to 104.8.1 COS wering Internal Forces by Peakle CC2 Expension 2 2.31 1.07 > 1 00 Stress due to suttained loads acc. to 104.8.1 COS wering Internal Forces by Peakle Maxc 1.07 > 1 00 Stress due to suttained loads acc. to 104.8.1 COS wering Internal Forces by Peakle Maxc 1.07 > 1 00 Stress due to suttained loads acc. to 104.8.1 COS wering Internal Forces by Peakles Maxc 1.07 > 1 00 Stress due to suttained loads acc. to 104.8.1 COS wering Internal Forces by Peakles Maxc 1.07 > 1 00 Stress due to suttained loads acc. to 104.8.1 COS wering Internal Forces by Peakles Stress Actor Roads Al ASME B11.2010 Image: Stress Actor Roads Al ASME B11.2010	···· Materials	Combin.	Description	No.	x [ft]	Ra	tio			0	esign According to	o Formula		
Mexistion 131 0.89 \$1 100 Stees due to deplacement tod ranges acc. to 104.8.3 - Decign by Kross-Getton CCS Sustained 1 32 1.31 1.02 \$100 Nees due to sustained loads acc. to 104.8.1 - Decign by Kross-Getton Cost Sustained 2 32 1.31 1.07 >1 100 Nees due to sustained loads acc. to 104.8.1 - Decign by Kross-Getton Cost Weight empty 32 1.31 0.69 \$1100 Nees due to sustained loads acc. to 104.8.1 - Decign by Kross-Getton Cost Mexici 1.07 >1 100 Nees due to sustained loads acc. to 104.8.1 - Cost mong Internel Torces by P - Ref Mexici 1.07 >1 100 Nees due to sustained loads acc. to 104.8.1 - Cost mong Internel Torces by P - Nees due to sustained loads acc. to 104.8.1 -	···· Cross-Sections	RC1	Expansion 1	32	1.31		0.89	≤1	103) Stress due to	o displacement loa	d ranges acc. to 1	04.8.3		
Percent of Model Model Society of USA Society of U	Results	RC2	Expansion 2	32	1.31		0.89	≤ 1	103) Stress due to	o displacement loa	d ranges acc. to 1	04.8.3		
Pecky IV Problet PC3 Sustained 2 32 1.31 1.07 > 1 100 Stress due to sustained loads acc. to 104.8.1 Pecky IV Problet PC3 Sustained 2 1.31 1.07 > 1 100 Stress due to sustained loads acc. to 104.8.1 Pecky IV Problet PC3 Very IV Stress due to sustained loads acc. to 104.8.1 PC3 Very IV Stress due to sustained loads acc. to 104.8.1 Pecky IV Problet PC3 Very IV Stress due to sustained loads acc. to 104.8.1 PC3 Very IV Stress due to sustained loads acc. to 104.8.1 PC4 Weight empty 32 1.31 0.59 \$1 10) Stress due to sustained loads acc. to 104.8.1 PC4 Weight empty 32 1.31 0.59 \$1 10) Stress due to sustained loads acc. to 104.8.1 PC4 Weight empty 32 1.31 0.59 \$1 100 \$700.05.94) ASME B16.9 Botes Herman Forces Botes Antenne Sector Notes (Semises Ppe and Tube) A53. Grade A1ASME B31.2010 IV PC4 IV PC4 IV PC4 Botes Antenne Forces Botes Antenne Forces IV PC4 Sector Module IV PC4 Sector Module IV PC4	Design by Crass Section	PC1	Sustained 1	32	1.31		1.02	>1	101) Stress due to	o sustained loads a	icc. to 104.8.1			
Peaking by Pyeaking PCA Veget endy 32 1.31 107 > 1 1010) Stress due to sustained loads acc. to 104.8.1 Peaking by X-Acation PCA Veget endy 32 1.31 0.96 ≤ 1 1010) Stress due to sustained loads acc. to 104.8.1 PCS Weight full 32 1.31 0.96 ≤ 1 1010) Stress due to sustained loads acc. to 104.8.1 PCS Weight full 32 1.31 0.96 ≤ 1 1010) Stress due to sustained loads acc. to 104.8.1 Owering Internal Forces by P Parts List by Ppelne Max: 1.07 1 Image: Stress due to sustained loads acc. to 104.8.1 Detais Meetral Properties - Cathon Steel (Semises Ppe and Tube) A53, Grade ALASME B31.1-2010 Image: Stress Transfloation factor Image: Stress Transfloat	Design by Cross-Section	PC2	Sustained 2	32	1.31		1.07	>1	101) Stress due to	o sustained loads a	icc. to 104.8.1			
Deskip by x 40cation -exering Internal Forces by P -Parts List by Ppelne PC Weight full 32 131 0.95 § 51 100) Steas due to sustained loads acc. to 104.8.1 Overing Internal Forces by P -Parts List by Ppelne Max: 1.07 > 1 Image: Control of the sustained loads acc. to 104.8.1 Detain Max: 1.07 > 1 Image: Control of the sustained loads acc. to 104.8.1 Detain Max: 1.07 > 1 Image: Control of the sustained loads acc. to 104.8.1 Detain Max: 1.07 > 1 Image: Control of the sustained loads acc. to 104.8.1 Detain Max: 1.07 > 1 Image: Control of the sustained loads acc. to 104.8.1 Image: Control of the sustained loads acc. to 104.8.1 Image: Control of the sustained loads acc. to 104.8.1 Image: Control of the sustained loads acc. to 104.8.1 Image: Control of the sustained loads acc. to 104.8.1 Image: Control of the sustained loads acc. to 104.8.1 Image: Control of the sustained loads acc. to 104.8.1 Image: Control of the sustained loads acc. to 104.8.1 Image: Control of the sustained loads acc. to 104.8.1 Image: Control of the sustained loads acc. to 104.8.1 Image: Control of the sustained loads acc. to 104.8.1 Image: Control of the sustained loads acc. to 104.8.1 Image: Control of the sustained loads acc. to 104.8.1 Image: Control of the sustai	Design by Member	PC3	Sustained 3	32	1.31		1.07	>1	101) Stress due to	o sustained loads a	ICC. to 104.8.1			
Governing Internal Forces by Parts List by Pipeline L2 1.31 U.39 S 1 101 Jatess due to suscended rooss acc. to tou.c.1 Basic material Forces by Parts List by Pipeline Max: 1.07 101 S 1 101 Jatess due to suscended rooss acc. to tou.c.1 Details - Member 32 - x: 1.31 fl - RC1 Max: 1.07 101 S 2 1.0 V S 10 (10.750x.0594) [ASME B 16.9 Details - Member 32 - x: 1.31 fl - RC1 B. Material Properties - Cabon Steel (Seamless Pipe and Tube) A 53. Grade A I ASME B 31.1:2010 El Coss-Scott Non-Cabon Steel (Seamless Pipe and Tube) A 53. Grade A I ASME B 31.1:2010 El Coss-Scott Non-Cabon Steel (Seamless Pipe and Tube) A 53. Grade A I ASME B 31.1:2010 Design Ratio Max: Z 4.5 gl n ³ 1 1 -NPS 10 (10.750x.0594) [ASME B 16.9 Design Ratio Max: Z 4.5 gl n ³ 1 1 2.385 1 1 Design Ratio Max: S = 113.700 ks S = 113.700 ks S = 113.700 ks 1	Design by X-Location	PC4	Weight empty	32	1.31		0.96	<u>≤</u> 1	101) Stress due to	o sustained loads a	ICC. to 104.8.1			
Governing Internal Porces by P Parts List by Pipeline Max: 1.07 > 1 • Image: Control Distribution Properties - NPS 10 (10.750x0.594) I ASME B 15.9 Image: Distribution Properties - NPS 10 (10.750x0.594) I ASME B 15.9 Image: Distribution Properties - NPS 10 (10.750x0.594) I ASME B 15.9 Image: Distribution Properties - NPS 10 (10.750x0.594) I ASME B 15.9 Image: Distribution Properties - NPS 10 (10.750x0.594) I ASME B 15.9 Image: Distribution Properties - NPS 10 (10.750x0.594) I ASME B 15.9 Image: Distribution Properties - NPS 10 (10.750x0.594) I ASME B 15.9 Image: Distribution Properties - NPS 10 (10.750x0.594) I ASME B 15.9 Image: Distribution Properties - NPS 10 (10.750x0.594) I ASME B 15.9 Image: Distribution Properties - NPS 10 (10.750x0.594) I ASME B 15.9 Image: Distribution Properties - NPS 10 (10.750x0.594) I ASME B 15.9 Image: Distribution Factor Image: Distribution Factor Image: Distribution Factor Image: Distribution Factor<	Governing Internal Forces by N	PC5	Weight full	32	1.31		0.99	51	TUT) Stress due to	o sustained loads a	ICC. to 104.8.1			
Parts List by Pipeline Max: 1.07 > 1 • Max: 1.07 > 1 • Image: Second Seco	Governing Internal Forces by P													
Max: 1.07 > 1 • Details - Member 32 - x: 131 ft - RC1 IIII Material Properties - Carbon Steel (Seamless Pipe and Tube) A 53, Grade A1 ASME B 31,1-2010 IIIII Design Failo IIIII Design Failo Resultation month due to themal expansion IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	Parts List by Pipeline													
Max: 1.07 > 1 • Details - Member 32 - x: 131 ft - RC1 B Material Properties - Carbon See eard Tube) A 53. Grade AI ASME B31.1-2010 B Cross-Section Properties - NPS 10 (10.750x.0594) ASME B 16.9 B Design Internal Forces B Design Internal Forces B Design Ratio - Section Modula 2 Cotolson Table - Section Modula 2 Section Section Factor - Section Modula - Section Modu														
Details - Member 32 - x: 131 ft - RC1 IB: datarial Properties - Cachon Steel (Seamless Pipe and Tube) A 53, Grade A I ASME B 31.1-2010 ID: Coces - Section Properties - NFS 10 (10 7560, 0594) I ASME B 16.9 ID: Design Ration ID: Beauk art moment due to themal expansion ID: Design Ration ID: Section Modula: ID: Section </td <td></td> <td></td> <td></td> <td></td> <td>Max:</td> <td></td> <td>1.07</td> <td>>1</td> <td>8</td> <td></td> <td>5</td> <td>> 1,0</td> <td>• 🕐 🗳 🛃 🐧</td> <td></td>					Max:		1.07	>1	8		5	> 1,0	• 🕐 🗳 🛃 🐧	
B Heariel Properties - Cabon Steel (Semiess Pope and Tube) A53, Grade AI ASME B311-2010 B Coses Social On Properties - NPS 10 (10,750k0.594) IASME B 16.3 B Design Ratio - Resultant moment due to themal expansion - Resultant moment due to themal expansion - Section Modulus		Details -	Member 32 - x: 1.31 ft - RC1									1 - NPS 10	(10.750×0.594) ASME	B 16.9
B Coss-Section Properties - NPS 10 (10.75kd.534) i ASME B 16.9 B Design Flatio Besign Flatio B Design Flatio Z 4.5 6 (n ³) G Section Modulus Z 4.5 6 (n ³) G Section Modulus Z 4.5 6 (n ³) G Section Modulus Z 4.5 6 (n ³) G Section Modulus Z 4.5 6 (n ³) G Section Modulus Z 4.5 6 (n ³) G Section Modulus Z 4.5 6 (n ³) G Section Modulus Z 4.5 6 (n ³) G Section Modulus Z 4.5 6 (n ³) G Section Modulus S 1.1 2.035 Basic material allowable stress at miximum temperature S 1.1 3.700 (ks) Section Modulus atress at miximum temperature S 1.1 3.700 (ks) Section Modulus atress at miximum temperature S 1.1 3.700 (ks) Movable stress range S.A 20.550 (ks) 1 Movable stress range S.A 20.550 (ks) 1 Movable stress range N N N N Movable stress range N N N N Movable stress range		🕀 Materi	ial Properties - Carbon Steel (Se	amless Pip	e and Tube)	A 53, Gra	de A A	SME	B31.1-2010					
B) Design Internal Forces Design Atternal Forces B) Raio B) Section Modula C) Section Modula D) Section Modula Basic material allowable stress at monimum temperature So 13.700 kai Basic material allowable stress at monimum temperature So 13.700 kai Design Ratio m Novable stress arge SA Allowable stress arge SA Allowable stress arge SA Allowable stress arge SA Novable stress arge SA		Cross-	Section Properties - NPS 10 (10	.750x0.59	4) ASME B	16.9								
Image: Constraint of the co		🕀 Desig	n Internal Forces											
Image: Section Module Section Secti		🖂 Desig	n Ratio											
Section Modulus Z 4.56 m ³ Stress interenfaction factor i 2.2385 Occilo stress range factor f 1000 Basic material allowable stress at maximum temperature Sn 13.700 kai Stress due to displacement load ranges SE 18.2725 kai Allowable stress range SA 20250 kai Design Ratio η 0.89 ≤ 1 Design Ratio η 0.89 ≤ 1 One material allowable stress angle SA 20250 kai (n) Design Ratio η 0.89 ≤ 1 (n) Out at the stress range SA 20250 kai (n) Out at the stress range SA 20250 kai (n) Out at the stress range SA 20250 kai (n) Out at the stress range SA 20250 kai (n) Out at the stress range SA SA (n) <td></td> <td>Res</td> <td>sultant moment due to thermal e</td> <td>cpansion</td> <td></td> <td></td> <td>Mc</td> <td></td> <td>29.001</td> <td>kipft</td> <td></td> <td></td> <td>55</td> <td></td>		Res	sultant moment due to thermal e	cpansion			Mc		29.001	kipft			55	
Image: Stress interafication factor i 2.395 Opendic stress range factor f 1.000 Basic material allowable stress at moinum temperature Sn 13.700 ksi Basic material allowable stress at moinum temperature Sn 13.700 ksi Basic material allowable stress at moinum temperature Sn 13.700 ksi Basic material allowable stress at moinum temperature Sn 13.700 ksi Basic material allowable stress at moinum temperature Sn 13.700 ksi Basic material allowable stress at moinum temperature Sn 13.700 ksi Basic material allowable stress at moinum temperature Sn 13.700 ksi Basic material allowable stress at moinum temperature Sn 18.222 ksi Basic material allowable stress at moinum temperature Sn 10.001 Basic material allowable stress at moinum temperature Sn 11.001 Basic material allowable stress at moinum temperature Sn 12.001 Basic material allowable stress at moinum temperature Sn 11.001 Basic material allowable stress at moinum temperature Sn 11.001 Basic material allowable stress at moinum temperature Sn 11.001		Sec	ction Modulus				Z		45.6 i	in ³		1 t-		
- Gyclic stress range tactor r 1.3700 ks - - Basic material allowable stress at minimum temperature So 13.700 ks - - Basic material allowable stress at minimum temperature So 13.700 ks - - Stress duct of diplecement load ranges Sa 20.550 ks - - Allowable stress range - - - -		Stre	ess intensification factor				1		2.395					
Basic material allovable stress at mixmum temperature Sn 13.000 Ka Basic material allovable stress at mixmum temperature Sn 13.000 Ka Stress due to displacement load ranges Sz 18.272 Ka Allovable stress at mixmum temperature SA 20.550 Ka Design Ratio η 0.88 S1 More allovable stress range SA 20.550 Ka Design Ratio η 0.88 S1 More allovable stress range SA 20.550 Ka Design Ratio η 0.88 S1 More allovable stress range SA 20.550 Ka More allovable stress range SA 20.550 Ka Design Ratio η 0.88 S1 η More allovable stress range SA No No No More allovable stress range Sa Sa No No No More allovable stress range Sa Sa Sa No No No More allovable stress range Sa Sa Sa Sa		Cyc	clic stress range factor				F		1.000				/ N	
Image: Sec 13:00 Ka Image: Sec 13:00 Ka Sec 13:00 Ka Image: Sec 13:00 Ka Sec 13:00 Ka Image: Sec 13:00 Ka Alowabie stress armge Se 13:00 Ka Design Ratio Image: Sec 13:00 Ka Design Ratio Image: Sec 13:00 Ka Design Ratio Image: Sec 13:00 Ka Image: Sec 13:00 Ka Image: Sec 13:00 Ka Design Ratio Image: Sec 13:00 Ka Image: Sec 13:00 Ka Image: Sec 13:00 Ka Image: Sec 13:00		Bas	sic material allowable stress at m	aximum ter	nperature		Sh		13.700	ksi		2		
→ aftes due to sanges Se 16.2/2 (si		Bas	sic material allowable stress at m	inimum ten	perature		50		10.272	KSI		9		y I
Image: construction of the set of t		Stre	ess due to displacement load rar	iges			SE C.		18.272	KSI				
Image: Calculation Image: Ca		Der	sign Patio				SA m		20.330	Kai (1				
Image: state stat		Des	sgri nado				4		0.05	21		↓	Contra .	
Image: constraint of the second se													+	
Image: marked series of the													z	
Image: Calculation Detais Graphics OK														
Image: Calculation Details Graphics OK														
Image: Calculation Detais Graphics OK														
Image: Calculation Details Graphics OK														fiel
Calculation Details Graphics OK Cancel												_		find
Image: Calculation Detais Graphics OK Cancel												0	⇒ 1 ⁺	<u>A</u>
D D Calculation Detais OK Cancel														
		Calculat	ion Details				Gra	aphics	;			(OK Ca	ncel



The designs are sorted in the result tables 2.1 to 2.5 by different criteria. The Tables 3.1 and 3.2 display the governing internal forces, the Table 4.2 displays the parts list.

4

OK

Each table can be selected by clicking the corresponding entry in the navigator. To go to the previous or next table, use the buttons shown on the left. Alternatively, you can use the function keys to select the next [F2] or previous [F3] table.

Click [OK] to save the results. You exit RF-PIPING Design and return to RFEM.

The buttons below the table have the following functions:

Button	Description	Function							
	Color bar	Displays or hides the colored reference scales in the result tables							
> 1,0 • > 1,0 Max Define	Filter parameters	Represents the criterion for filtering the results in tables: Design ratios greater than 1, maximum value, or user-defined limit							
7	Apply filter	Shows only rows where the filter parameters are valid (ratio : 1, maximum, user-defined value)							
2	Result diagrams	Opens the dialog box Result Diagram on Member \rightarrow Chapter 3.5.2, page 57							
A	Member selection	Allows for the graphical selection of a member to display its results in the table							
۲	View mode	Goes to the RFEM work window for changing the view							

Table 3.3: Buttons in the result tables 2.1 to 2.5

3.4.1 Design by Load Combination

The upper part of the table shows a summary of the governing checks sorted by piping combinations and result combinations.

The lower part provides detailed information about the cross-section properties, design internal forces, and check parameters for the combination selected above.

	,								
	A	B	C	D	E			F	
LC		Member	Location	Design					
Combin.	Description	No.	x [ft]	Ratio				Design Accord	ling to Formula
RC1	Expansion 1	32	1.31	0.89	≤1	103) Stress due	to displac	ement load ranges acc.	. to 104.8.3
RC2	Expansion 2	32	1.31	0.89	≤1	103) Stress due	to displac	ement load ranges acc.	. to 104.8.3
PC1	Sustained 1	32	1.31	1.02	>1	101) Stress due	to sustain	ed loads acc. to 104.8.	1
PC2	Sustained 2	32	1.31	1.07	>1	101) Stress due	to sustain	ed loads acc. to 104.8.	1
PC3	Sustained 3	32	1.31	1.07	>1	101) Stress due	to sustain	ed loads acc. to 104.8.	1
PC4	Weight empty	32	1.31	0.96	≤1	101) Stress due	to sustain	ed loads acc. to 104.8.	1
PC5	Weight full	32	1.31	0.99	≤1	101) Stress due	to sustain	ed loads acc. to 104.8.	1
			Max	1.07		a		[]	
					1	-		Ľ	
Details - N	Member 32 - x: 1.31 ft - PC1								1 - NPS 10 (10.750x0.594) ASME B 16.9
🕀 Materia	al Properties - Carbon Steel (Sea	amless Pipe	e and Tube) A 53, 0	irade A A	SME	B31.1-2010			
E Cross-	Section Properties - NPS 10 (10	.750x0.59	4) ASME B 16.9						
🖃 Design	Internal Forces								
— Axia	I Force			N		-4.679	kip		
- She	ar Force			Vy		-0.170	kip		<u>ě</u> ;
- Shei	ar Force			Vz		0.190	kip		
- Tors	sional Moment			Mx		0.720	kipft		
Ben	ding Moment			My		-27.711	kipft		
Ben	ding Moment			Mz		-7.691	kipft		
🖃 Design	n Ratio								
Inter	mal design pressure			P		87.0	psi		
Res	ultant bending moment due to p	ressure, w	eight and other sust	ain M _A		28.767	kipft		
Sect	tion Modulus			Z		45.6	in ³		
- Outs	side Diameter			Do		10.75	in		
- Nom	ninal Wall Thickness			tn		0.59	in		*.
Stree	ss intensification factor			i		2.395			
- Sum	of the longitudinal stresses due	to pressu	re, weight and other	su SL		13.987	ksi		
Basi	ic material allowable stress at ma	aximum ten	nperature	Sh		13.700	ksi		
Desi	ign Ratio			η		1.02		>1	
									(in)

Figure 3.12: Table 2.1 Design by Load Combination

Description

This column shows the descriptions of the piping and result combinations used for the designs.

Member No.

This column shows the number of the member with the maximum design ratio of the analyzed action.

Location

This column shows the respective x-location where the member's maximum stress ratio occurs. For the table output, the program uses the following member locations x:

- Start and end node
- Division points according to possibly defined member division (see RFEM Table 1.16)
- Member division according to specification for member results (*Calculation Parameters* RFEM dialog box, *Global Calculation Parameters* tab)
- Extreme values of internal forces



Design Ratio



Columns D and E display the design conditions with the ratios which result from the design according to the set standard.

The length of the color scale displays graphically the respective ratio.

Design According to Formula

This column displays more information about the performed design.

3.4.2 Design by Cross-Section

.2 Desigr	n by Cross	s-Section									
	A	B	С	D	E					F	
Section	Member	Location	Load-	Design							
No.	No.	x [ft]	ing	Ratio					Design	According	g to Formula
1	NPS 10										
	2	0.00	RC1	0.00	≤1	100) Negligible int	ternal force	s			
	32	1.31	PC2	1.07	>1	101) Stress due to	o sustained	loads acc. to	104.8.1		
	32	1.31	RC1	0.89	≤1	103) Stress due to	o displacem	ent load range	s acc.	to 104.8.3	•
2	NPS 18										
	49	1.09	PC5	0.00	≤1	100) Negligible int	ternal force	s			
	43	0.00	PC2	0.62	≤1	101) Stress due to	o sustained	loads acc. to	104.8.1		
	43	0.00	RC1	0.36	≤1	103) Stress due to	o displacem	ent load range	s acc.	to 104.8.3	
			Max:	1.07	>1	8					> 1,0 ▼ ?
Material Properties - Carbon Steel (Seamless Pipe and Tube) A 53, Grade A ASME B31.1-2010 Cross-Section Properties - NPS 10 (10.750x0.594) ASME B 16.9 Outside Diameter Da											
- Insi	de Diamete	er					d	9.56	in		
- Nor	ninal Wall '	Thickness					tn	0.59	in		
- Are	a of Cross-	Section					A	19.0	in ²		
- Elas	stic Sectior	n Modulus					Z	45.6	in ³		
- We	ld Joint Eff	iciency Facto	r				E	1.000			
Design	n Internal F	orces									g
Design	n Ratio										¢
Inte	mal design	n pressure					P	232.1	psi		
Hes	sultant ben	ding moment	due to pressur	e, weight and othe	er sus	tained loads	MA	28./6/	kipft		
Sec	tion Modu	lus					2	45.6	in 3		
Out	Outside Diameter						Do	10.75	in .		
Nor	Stress interestination factor						Ln .	0.59	In		z
Stre	 Sum of the longitudinal stresses due to pressure, weight and other sustained to 						1 C.	2.390	les:		
- Sun	in of the lof	gluanal stres	sses que to pre	ssure, weight and	otrie	n sustained ioâds	5L C.	14.043	KSI		
Das	io material	allowable stre	ss at maximum	temperature			3h	1.07	KSI	<1	
Des	agit natio						4	1.07		21	II
<u> </u>											(in
											🔁 🔛 🕰

Figure 3.13: Table 2.2 Design by Cross-Section

This table shows the maximum design ratios of all pipelines selected for design, sorted by cross-section.

The *Member No*. column shows the number of the member with the maximum design ratio for the individual design criteria.

3.4.3 Design by Pipeline

2.3 Desigr	n by Pipel	ine											
	A	B	С	D	E					F			
Pipeline	Member	Location	Load-	Design	_								
No.	No.	x [ft]	ing	Ratio				[Design Accor	ding to Formula			
1	Cold 1- N	ytrogen (Men	nber No. 12,27	13,14,46,15,16,3	6,34,3	7,17,18,48,19-22	2,42,39,49)		-				
	49	1.09	PC5	0.00	≤1	100) Negligible ir	nternal forces						-
	15	1.31	PC2	0.82	≤1	101) Stress due t	to sustained loa	ds acc. to	104.8.1				-
	15	1.31	RC1	0.66	≤1	103) Stress due t	to displacement	load rang	es acc. to 10)4.8.3			
2	Cold 2 - C)xygen (Mem	ber No. 29,35,	30,31,44,32,33,43	,40)								
	29	0.00	RC1	0.00	≤1	100) Negligible ir	nternal forces						
	32	1.31	PC2	1.07	>1	101) Stress due t	to sustained loa	ds acc. to	104.8.1				
	32	1.31	RC1	0.89	≤1	103) Stress due t	to displacement	load rang	es acc. to 10)4.8.3			
			Max:	1.07	>1	8					> 1,0	- 7 😂 🖳 1	\$
Dataila	Hombor 1	E	000								4 100	40 (40 750-0 504) 401	(5 D 40 0
El Materi	al Propertie	o - X. T.OT IL·	- PCZ	Pipe and Tube) (52 G		211.2010				1 - NPS	10 (10.750x0.594) [ASM	AE E 16.9
	Section Pr	nnerties - NP	S 10 (10 750x)	1 594) LASME B 1	6 9		51.1-2010						
E Desig	n Internal F	Forces	0 10 (10.700.0		0.0								
Axia	al Force	0.000				N	-0 156	kin					
She	ar Force					Vv	-0.173	kip				6	
She	ar Force					Vz	0.224	kip				0	
Ton	sional Mon	nent				Mx	-21.429	kipft					
Ben	nding Mom	ent				My	2.780	kipft					
Ben	nding Mom	ent				Mz	0.435	kipft			ω		
E Desigr	n Ratio										10.7	(<u></u>)	·-•
- Inte	mal desigr	n pressure				P	232.1	psi					
Res	sultant ben	ding moment	due to pressur	e, weight and othe	er sust	ain MA	21.613	kipft					
- Sec	tion Modu	lus				Z	45.6	in ³					
- Out	side Diame	eter				Do	10.75	in			-		
- Nor	minal Wall	Thickness				tn	0.59	in				*	
Stre	ess intensif	ication factor				i.	2.395					-	
Sun	n of the lor	ngitudinal stre	sses due to pre	essure, weight and	other	su SL	11.263	ksi					
Bas	ic material	allowable str	ess at maximun	n temperature		Sh	13.700	ksi					
- Des	sign Ratio					η	0.82		≤1				
													[in]
L												X	
												4	

Figure 3.14: Table 2.3 Design by Pipeline

This result table lists the maximum design ratios sorted by pipelines.

3.4.4 Design by Member



Figure 3.15: Table 2.4 Design by Member

The maximum design ratios are displayed sorted by member number.

3

3.4.5 Design by x-Location

2.5 Design by x-Location

	A	В	С	D					E				
Member	Location	Load-	Design										
No.	× [ft]	ing	Ratio					Design A	According to	to Formula			
43	Cross-section	n No. 1 - N	PS 10 2 - NPS	18									
	0.00	RC1	0.00	≤1	100) Negligible in	temal forces							
	0.00	PC2	0.62	≤1	101) Stress due t	o sustained load	ds acc. to 104	.8.1					
	0.00	RC1	0.36	≤1	103) Stress due t	o displacement	load ranges a	cc. to 104	.8.3				
	0.00	RC1	0.00	≤1	100) Negligible in	ternal forces							
	0.00	PC2	0.62	≤1	101) Stress due t	o sustained load	ds acc. to 104	.8.1					
	0.00	RC1	0.36	≤1	103) Stress due t	o displacement	load ranges a	cc. to 104	.8.3				
	0.63	RC1	0.00	≤1	100) Negligible in	temal forces							
	0.63	PC2	0.28	≤1	101) Stress due to	o sustained load	ds acc. to 104	.8.1					
	0.63	RC1	0.14	≤1	103) Stress due t	o displacement	load ranges a	cc. to 104	.8.3		Ŧ		
		Max:	1.07	>1	8					🗾 > 1,0 🔹 🖓 🚳			
Details -	Member 43 - : ial Properties -	x: 0.00 ft - Carbon St	PC2 eel (Seamless Pip	e and	d Tube) A 53, Grade A ASME B31.1-2010 ASME B 36, 10M								
E Cross-	-Section Prope	enties - INPS	5 10 (10.750x0.59	4) I A	SME B 36.10M								
	n internal Ford	ces				N	4.040	l den					
- Axia	al Force					N	-4.840	KIP					
She	ear Force					Vy V	-0.200	KIP		0.55			
Ter	sar roice	•				V Z M	-0.1/1	kipt					
Por	sional Moment					M	7 117	kipt					
Bor	iding Moment					My		kipt					
Design	n Ratio					1412	-27.150	Kipit					
Inte	mal design pr	19661 IFA				P	222.1	nei			e - 1		
Res	antar design pr	a moment i	due to pressure w	eicht	and other sustain	MA	28.057	kinft					
Sec	tion Modulus	gmoment	ade to pressare, n	roigin	and other sustain	7	45.6	in 3					
- Out	side Diameter					Do	10.75	in	+ +				
Nor	minal Wall Thi	ckness				to	0.59	in		÷			
Stre	ess intensificat	tion factor				i	1.000			z			
- Sur	n of the lonait	udinal stres	ses due to pressu	ire, w	eight and other su	SL	8.431	ksi					
Bas	sic material allo	wable stre	ss at maximum ter	mpera	ture	Sh	13.700	ksi					
Des	sign Ratio					η	0.62		≤1				
	-					-					-1		
											14		
											X		

Figure 3.16: Table 2.5 Design by x-Location

This result table lists the maxima for each member at any locations **x** resulting from the division points in RFEM:

- Start and end node
- Division points according to possibly defined member division (see RFEM Table 1.16)
- Member division according to specification for member results (RFEM dialog box *Calculation Parameters*, tab *Global Calculation Parameters*)
- Extreme values of internal forces



3.1 Governing Internal Forces by Member

									1				
	A	B	С	D	E	F	G	H					
/lember	Location	Load-		Forces [kip]		I.	loments [kipft]						
INO.	x [ft]	ing	N	Vy	Vz	MT	My	Mz	Design According to Formula				
12	Cross-section	No. 1 - NF	S 10										
	0.00	RC1	0.000	0.000	0.000	0.000	0.000	0.000	100) Negligible internal forces				
	0.00	PC2	0.157	+0.152	1.858	-15.359	-10.052	0.275	101) Stress due to sustained loads acc. to 104.8.1				
	0.00	RC1	0.327	+0.222	1.839	-15.440	+9.905	0.871	103) Stress due to displacement load ranges acc. to 104.8.3				
27	Cross-section	No. 1 - NF	S 10										
	0.00	RC1	0.000	0.000	0.000	0.000	0.000	0.000	100) Negligible internal forces				
	0.00	PC2	0.156	-0.157	1.455	-15.360	+6.791	0.575	101) Stress due to sustained loads acc. to 104.8.1				
	0.00	RC1	0.326	+0.227	1.436	-15.442	6.681	1.308	103) Stress due to displacement load ranges acc. to 104.8.3				
13	Cross-section	No. 1 - NF	S 10										
	0.00	RC1	0.000	0.000	0.000	0.000	0.000	0.000	100) Negligible internal forces				
	1.31	PC2	0.169	0.157	0.879	2.523	16.275	1.706	101) Stress due to sustained loads acc. to 104.8.1				
	1.31	RC1	0.239	0.328	0.860	2.484	16.344	2.845	103) Stress due to displacement load ranges acc. to 104.8.3				
14	Cross-section	No. 1 - NF	S 10										
	0.00	RC1	0.000	0.000	0.000	0.000	0.000	0.000	100) Negligible internal forces				
	3.39	PC2	0.169	0.155	0.645	2.522	18.705	1.187	101) Stress due to sustained loads acc. to 104.8.1				
	3.39	RC1	0.238	0.325	0.626	2.481	18.708	1.751	103) Stress due to displacement load ranges acc. to 104.8.3				
46	Cross-section	No. 1 - NF	'S 10										
	0.00	RC1	0.000	0.000	0.000	0.000	0.000	0.000	100) Negligible internal forces				
	4.79	PC2	0.171	0.155	0.315	2.520	21.004	0.443	101) Stress due to sustained loads acc. to 104.8.1				
	4.79	RC1	0.171	+0.155	-0.315	-2.520	-21.004	-0.443	103) Stress due to displacement load ranges acc. to 104.8.3				
	-												
15	Cross-section	No. 1 - NF	'S 10	1									
	0.00	RC1	0.000	0.000	0.000	0.000	0.000	0.000	100) Negligible internal forces				
	1.31	PC2	0.156	+0.173	0.224	-21.429	2.780	0.435	101) Stress due to sustained loads acc. to 104.8.1				
	1.31	RC1	0.156	0.173	-0.224	21.429	-2.780	-0.435	103) Stress due to displacement load ranges acc. to 104.8.3				
16	Cross-section	No. 1 - NF	S 10										
	0.00	RC1	0.000	0.000	0.000	0.000	0.000	0.000	100) Negligible internal forces				
	1.74	PC2	0.154	+0.172	0.104	-21.240	3.020	0.736	101) Stress due to sustained loads acc. to 104.8.1				
	1.74	RC1	0.154	0.172	-0.104	21.240	3.020	+0.736	103) Stress due to displacement load ranges acc. to 104.8.3				

Figure 3.17: Table 3.1 Governing Internal Forces by Member

This table shows for each member the governing internal forces - those internal forces which result in maximum design ratios at the individual designs.

Location **x**

This column shows the respective x-location where the member's maximum stress ratio occurs.

Loading

This column displays the number of the piping or result combination whose internal forces produce the maximum design ratio.

Forces / Moments

For each member, this column displays the axial and shear forces as well as the torsional and bending moments producing the maximum design ratio in the respective designs.

Design According to Formula

The final column provides information on the type of design and the formulas used in the designs according to the specified standard.



3.2 Governing	Internal	Forces	by Pipeline	

		-							
	A	В	С	D	E	F	G	Н	
Pipeline	Location	Load-		Forces [kip]		Ν	Noments [kipft]		
No.	x [ft]	ing	N	Vy	Vz	ΜT	My	Mz	Design According to Formula
1	Cold 1- Nytrog	gen (Memb	er No. 12,27,1	3,14,46,15,16	36,34,37,17,1	8,48,19-22,42	2,39,49)		
	1.09	PC5	-0.005	0.000	0.810	0.000	-1.205	0.000	100) Negligible internal forces
	1.31	PC2	-0.156	-0.173	0.224	-21.429	2.780	0.435	101) Stress due to sustained loads acc. to 104.8.1
	1.31	RC1	0.156	0.173	-0.224	21.429	-2.780	-0.435	103) Stress due to displacement load ranges acc. to 104.8.3
2	Cold 2 - Oxyg	en (Membe	r No. 29,35,30),31,44,32,33,4	43,40)				
	0.00	RC1	0.000	0.000	0.000	0.000	0.000	0.000	100) Negligible internal forces
	1.31	PC2	-4.679	-0.170	0.190	0.720	-27.711	-7.691	101) Stress due to sustained loads acc. to 104.8.1
	1.31	RC1	-4.701	-0.239	0.286	0.910	-27.862	-7.995	103) Stress due to displacement load ranges acc. to 104.8.3
3	Hot (Member	No. 54,53,	56,55,52-50,2-	4,41,6,57,8,9	24,25,10,11,2	6,23,28)			
	0.00	RC1	0.000	0.000	0.000	0.000	0.000	0.000	100) Negligible internal forces
	0.00	PC2	0.182	-0.165	2.512	-24.797	-0.104	0.761	101) Stress due to sustained loads acc. to 104.8.1
	0.00	RC1	0.252	-0.337	2.507	-24.899	-0.216	0.303	103) Stress due to displacement load ranges acc. to 104.8.3
									🖺 🗳 🐴 🔇 🔍

Figure 3.18: Table 3.2 Governing Internal Forces by Pipeline

This table shows the internal forces of each pipeline which result in the maximum design ratios for the individual designs.

3.4.8 Parts List by Pipeline

Finally, RF-PIPING Design provides a summary of all cross-sections that are included in the design case.

4.2 Parts	List by Pipeline								
	A	B	С	D	F	F	G	Н	
Part	Pipeline	Number of	Length	Total Length	Surface Area	Volume	Unit Weight	Weight	Total Weight
No.	Description	Pipelines	[ft]	[ft]	[ft 2]	[ft 3]	[lb/ft]	[b]	[kip]
1	Cold 1- Nytrogen	1	57.27	57.27	182.63	11.21	95.96	5495.11	0.56
2	Cold 2 - Oxygen	1	28.81	28.81	91.40	5.56	94.54	2723.80	0.28
3	Hot	1	81.29	81.29	264.92	16.89	101.81	8276.31	0.84
Sum		3		167.37	538.94	33.66			1.68
									\ \

Figure 3.19: Table 4.1 Parts List by Pipeline

By default, this list contains only the designed pipelines. If you need a parts list for all pipelines of the model, select the corresponding option in the *Details* dialog box (see Figure 3.9, page 44).

Part No.

Details...

The program automatically assigns part numbers to similar pipelines.

Pipeline Description

This column shows the pipeline descriptions.

Number of Pipelines

This column shows for each part how many similar pipelines exist.

Length

This column displays the length of a single pipeline.

Total Length

The values in this column are the product from the previous two columns.

Surface Area

0

For each part, the program indicates the surface areas relative to the total length. They are determined from the *surface area* of the cross-sections that can be viewed in the Tables 1.3 and 2.1 to 2.5 in the cross-section properties (see Figure 3.8, page 43).

Volume

The volume of a part is determined from the cross-sectional area and the total length.

Unit Weight

The unit weight is the weight of the section relative to the length of one meter.

Weight

The values of this column are determined from the respective product of the entries in column C and G.

Total Weight

The final column indicates the total weight of each part.

Sum

At the bottom of the list, you find a summary of the values in columns B, D, E, F, and I. The last row of the *Total Weight* column informs you about the total amount of required steel.

3.5 Evaluation of Results

You can evaluate the design results in different ways. The buttons in the Tables 2.1 to 2.5 may help you to evaluate the results. You can find them below the upper table.

2.2 Desigi	r by cross	-section				
	A	B	С	D	E	F
Section	Member	Location	Load-	Design		
No.	No.	x [ft]	ing	Ratio		Design According to Formula
1	NPS 10					
	2	0.00	RC1	0.00	≤1	100) Negligible internal forces
	32	1.31	PC2	1.07	>1	101) Stress due to sustained loads acc. to 104.8.1
	32	1.31	RC1	0.89	≤1	103) Stress due to displacement load ranges acc. to 104.8.3
2	NPS 18					
	49	1.09	PC5	0.00	≤1	100) Negligible internal forces
	43	0.00	PC2	0.62	≤1	101) Stress due to sustained loads acc. to 104.8.1
	43	0.00	RC1	0.36	≤1	103) Stress due to displacement load ranges acc. to 104.8.3
			Max:	1.07	> 1	⊗

Figure 3.20: Buttons for evaluation of results

The functions of the buttons are described in Table 3.3 on page 46.

3.5.1 Results on RFEM Model

You can also evaluate the design results in the RFEM work window.

RFEM Background Graphic and View Mode

The RFEM graphic in the background may be useful when you want to check the position of a particular pipeline in the model: The member selected in the RF-PIPING Design result table is highlighted in color in the background graphic. Furthermore, an arrow indicates the member's x-location displayed in the currently selected table row.

Max Design Ratio [-] RF-PIPING Design CA1 - Design of piping 0 41 RF-PIPING Design - [Pipeline] <u>File Edit Settings H</u>elp CA1 - Design of piping 2.4 Design by Member Input Data В D General Data Location Load-Design Member Materials No x [ft] ing Ratio Design According to Formula Cross-Sections 2 Cross-se ction No. 1 - NPS 10 Results 0.00 ≤ 1 100) Negligible internal forces 0.00 RC1 Design by Load Combination PC2 0.22 ≤ 1 101) Stress due to sustained loads acc. to 104.8.1 Design by Cross-Section 0.14 $\left| \ \leq 1 \ \right|$ 103) Stress due to displacement load ranges acc. to 104.8.3 1.31 RC1 Design by Pipeline Design by Member ss-section No. 1 - NPS 10 Design by x-Location 0.00 ≤ 1 100) Negligible internal forces RC1 0.00 Governing Internal Forces by N 4.90 PC2 101) Stress due to sustained loads acc. to 104.8.1 0.20 <1 Governing Internal Forces by P 0.13 $\left| \ \leq 1 \ \right|$ 103) Stress due to displacement load ranges acc. to 104.8.3 RC1 4.90

Figure 3.21: Indication of the member and the current *Location x* in the RFEM model



If you cannot improve the display by moving the module window, click [Jump to Graphic] to activate the *View Mode*: The program hides the module window so that you can modify the display in the RFEM user interface. In the view mode, you can use the functions of the *View* menu, for example zooming, moving, or rotating the display. The indication arrow remains visible.

Click [Back] to return to the add-on module RF-PIPING Design.

RFEM Work Window

Graphics

The design ratios can also be checked graphically in the RFEM model: Click the [Graphics] button to exit the design module. In the RFEM work window, the design ratios are now displayed, such as the internal forces of a load case.



To display or hide design results, use the [Show Results] button known from the display of internal forces. To display the result values, click the [Show Result Values] button in the toolbar to the right.

To set the design cases (see Chapter 3.7.1, page 59), you can use the list in the RFEM menu bar.

To adjust the results display, use the *Display* navigator below the entry **Results** \rightarrow **Members**. The display of the design ratios is *Two-Colored* by default.



3 **RF-PIPING Design**

Project Navigator - Display	×
🕀 🗹 🔛 Model	~
🗄 🖳 🗹 🔀 Results	
🖶 🗆 🌠 Result Values	
🗹 🌠 Title Info	
🗹 🚾 Max/Min Info	
🗄 🔲 🌠 Deformation	
🖕 🔲 🌠 Members	Ξ
🔿 🛜 With Diagram	
🔿 🛜 Without Diagram	
OM Cross-Sections	
🔽 🔀 Result Diagrams Filled	
🗹 🛜 Hatching	
🔲 🔂 All Values	
🔽 🔀 Extreme Values	
🔲 🛜 Display Hidden Result Diagram	
····· 🔲 🛜 Reverse Results V-y and V-z	
🔽 🛜 Results on Couplings	
🛓 🔳 🛜 Stresses	
🖶 🔲 🔀 Type of Display	-
🛱 Data 🖀 Display 🔏 Views 🗢 Results	

Figure 3.22: Display Navigator: Results \rightarrow Members

When you select a multicolor representation (options *With/Without Diagram* or *Cross-Sections*), the color scale panel becomes available. It provides the common control functions described in the RFEM manual, Chapter 3.4.6.





RF-PIPING Design

To return to the add-on module, click [RF-PIPING Design] in the panel.

3

2

Ł

3.5.2 Result Diagrams

You can also graphically evaluate a member's result distributions in a result diagram.

Select the member in the RF-PIPING Design result table by clicking in the table row of the member. Then, open the *Result Diagram on Member* dialog box by clicking the button shown on the left. You can find the button below the upper result table (see Figure 3.20, page 54).

To display the result diagrams in the RFEM graphic, select in the menu

Results ightarrow Result Diagrams for Selected Members

or use the corresponding button in the RFEM toolbar.

A window opens, graphically presenting the distribution of the maximum design ratios on the member.



Figure 3.24: Dialog box Result Diagram on Member

Use the list in the toolbar to choose the relevant RF-PIPING Design design case (see Chapter 3.7.1, page 59).

The Result Diagram on Member dialog box is described in the RFEM manual, Chapter 9.5.

3.6 Filter for Results



The RF-PIPING Design result tables allow you to sort the results by various criteria. In addition, you can filter options for the tables (see Figure 3.20, page 54) to limit the numerical output by design ratios. This function is described in the following article of the DLUBAL Blog: https://www.dlubal.com/blog/11217

Furthermore, you can use the filter options described in Chapter 9.9 of the RFEM manual in order to evaluate the results graphically.



1

In RF-PIPING Design, you can also use the *Visibility* option to filter the members in order to evaluate them (see RFEM manual, Chapter 9.9.1).

Filtering Designs



The design ratios can easily be used as filter criteria in the RFEM work window which you can access by clicking [Graphics]. To apply this filter function, the panel must be displayed. If the panel is not active, select in the RFEM menu

View ightarrow Control Panel (Colour scale ightarrow Factors ightarrow Filter)

or use the toolbar button shown on the left.

You define the filter settings for the results in the first panel tab (Color spectrum). Because this tab is not available for the two-colored results display, you have to use the *Display* navigator and set the display options *With/Without Diagram* or *Cross-Sections* first (see Figure 3.22, page 56).

The panel is described in the RFEM manual, Chapter 3.4.6. In Chapter 9.9.3, you can find detailed information about filter options for result values.

Filtering Members

In the *Filter* tab of the control panel, you can specify the numbers of particular members to display only those results. This function is described in the RFEM manual, Chapter 9.9.3.



Figure 3.25: Member filter for the design ratios of a pipeline

Unlike the partial view function (Visibilities), the graphic displays the entire pipeline model. The figure above shows the design ratios of a pipeline. The remaining pipelines are displayed in the model, but are shown without design ratios.

3.7 General Functions

3.7.1 Design Cases

Design cases allow you to group pipelines for a design or analyze members with particular design specifications. It is no problem to analyze the same pipeline in different design cases.

To calculate a design case, you can also use the load case list in the RFEM toolbar.

Create New Design Case

To create a new design case, use the RF-PIPING Design menu and click

$\mathbf{File} \rightarrow \mathbf{New} \ \mathbf{Case}.$

New RF-PI	PING Design Case	
No. 2	Description Design of piping	
٢		OK Cancel

Figure 3.26: Dialog box New RF-PIPING Design Case

In this dialog box, enter a *No*. (one that is still available) for the new design case. An appropriate *Description* will make the selection in the load case list easier.

When you click [OK], Table 1.1 General Data opens where you can enter the new design data.

Rename Design Case

To change the description of a design case, use the RF-PIPING Design menu and click

 $\textbf{File} \rightarrow \textbf{Rename Case}.$

Copy Design Case

To copy the input data of the current design case, use the RF-PIPING Design menu and click File \rightarrow Copy Case.

Delete Design Case

To delete design cases, use the RF-PIPING Design menu and click

 $\textbf{File} \rightarrow \textbf{Delete Case}.$

Delete Ca	ases 🛛 🔀
Availabl	e Cases
No.	Description
1	Design of piping
2	Design A 106, Grade B
	-
	OK Cancel

Figure 3.27: Dialog box Delete Cases

You can select the relevant design case in the list of *Available Cases*. To delete the selected case, click [OK].

3.7.2 Units and Decimal Places

Units and decimal places for RFEM and the add-on modules are managed in one dialog box. In RF-PIPING Design, you can use the menu to adjust the units. To open the corresponding dialog box, click

Settings \rightarrow Units and Decimal Places.

The following dialog box appears which you already know from RFEM. RF-PIPING Design is preset in the *Program / Module* list.

Units and Decimal Places						×
Program / Module	RF-PIPING Design					
RF-TIMBER	Output Data			Parts List		
	output butu	11.5		Turto Liot	11.5	D
···· RF-DYNAM Pro		Unit	Dec. places		Unit	Dec. places
	Stresses:	ksi 👻	3 ≑	Lengths:	ft 🔫	2 🌲
···· RF-END-PLATE	Design offers		2	Total Investigation		2 🔺
RF-CONNECT	Design ratios:	- ×	2 💌	Total lengths:	π •	2 💌
···· RF-FRAME-JOINT Pro	Dimensionless:	- v	3 🜩	Surface areas:	ft^2 👻	2 🌩
RF-DSTV						
RF-DOWEL				volumes:	ft 3 ▼	2 -
RF-HSS				Weight per length:	lb/ft ▼	2 🌲
RF-FOUNDATION						
···· RF-FOUNDATION Pro				Weight:	b 🔻	2 🤤
RF-STABILITY				Total weight:	kip 🔻	2 🌩
RF-DEFORM						
RF-MOVE						
RF-IMP						
RF-SOILIN						
RF-GLASS						
···· RF-LAMINATE						
RF-TOWER Structure						
···· RF-TOWER Equipment =						
RF-TOWER Effective I						
RF-TOWER Design						
RF-INFLUENCE						
RF-LIMITS						
IIII RF-PIPING Design						
•						
	2					
					ОК	Cancel

Figure 3.28: Dialog box Units and Decimal Places



You can save the settings as a user profile to reuse them in other models. These functions are described in Chapter 11.1.3 of the RFEM manual.

3.7.3 Data Transfer

3.7.3.1 Exporting Materials to RFEM

If you adjust the materials in RF-PIPING Design for design, you can export the modified materials to RFEM: To do this, go to the Table *1.2 Materials*, and then select the command in the menu

$\textbf{Edit} \rightarrow \textbf{Export All Materials to RFEM}.$

Alternatively, you can export the modified materials to RFEM by using the shortcut menu in Table 1.2.

L.2 Materi	ials				
	A				В
Material	Material				
No.	Description				Comment
1	Carbon Steel (Seamless Pipe and Tube) A 106.	Grad	le B ASME B31.1-2010 🔄		
2	Stainless Steel (Pipes and Tubes) A 269, Grade		Material Library		
3	Stainless Steel (Pipes and Tubes) A 376, Grade		Export Material to RFEM		
			Export <u>A</u> ll Materials to RF	EM N	
			Import Material from RFI	EM	
		_	Import All Materials from	RFEM	🛐 🐺 🐧 💿

Figure 3.29: Shortcut menu of Table 1.2 Materials



3 RF-PIPING Design

Calculation

Before the modified materials are transferred to RFEM, a query appears as to whether you want to delete the results in RFEM. By confirming the query and starting the [Calculation] in the RF-PIPING Design module, the RFEM internal forces as well as the design ratios will be determined in a single calculation run.

If the modified materials have not been exported to RFEM yet, you can reimport the original materials in the design module by using the options shown in Figure 3.29. Please note that this option is only available in Table *1.2 Materials*.

3.7.3.2 Exporting Results

You can use the RF-PIPING Design results also in other programs.

Clipboard

To copy cells selected in the result tables to the Clipboard, use the keys [Ctrl]+[C]. Press [Ctrl]+[V] to insert the cells, for example in a word processing program. The headers of the table columns will not be transferred.

Printout Report

You can print the data of RF-PIPING Design into the printout report (see Chapter 4.1, page 62). To export them, click

 $\textbf{File} \rightarrow \textbf{Export to RTF}.$

The function is described in the RFEM manual, Chapter 10.1.11.

Excel / OpenOffice

RF-PIPING Design provides a function for the direct data export to MS Excel, OpenOffice Calc or the file format CSV. To open the corresponding dialog box, select in the module menu

File \rightarrow Export Tables.

The following export dialog box appears:

Export of Tables	×
Table Parameters	Application
With table header	Microsoft Excel
Only marked rows	OpenOffice.org Calc
	CSV file format
Transfer Parameters	
Export table to active workbook	
Export table to active workshee	t
Rewrite existing worksheet	
Selected Tables	
 Active table 	Export hidden columns
All tables	Export tables with details
✓ Input tables	
Result tables	
٦	OK Cancel

Figure 3.30: Dialog box Export - Export of Tables

When you have selected the relevant options, you can start the export by clicking [OK]. Excel or OpenOffice will be started automatically, you do not need to open the programs first.

4 Printout

4.1 Printout Report

Like in RFEM, the program generates a printout report for the RF-PIPING Design results, to which you can add graphics and descriptions. The selection in the printout report determines which data from the add-on modules will be included in the final printout.

4



The printout report is described in the RFEM manual. Chapter 10.1.3 *Define Contents of Printout Report* explains how to prepare the input and output data for the printout.



Figure 4.1: Printout Report for RF-PIPING and RF-PIPING Design

For large piping structures, it is recommended to split the data into several printout reports, thus allowing for a clearly-arranged printout.

4.2 Graphic Printout

In RFEM, you can add every picture displayed in the work window to the printout report or send it directly to a printer. In this way, you can also prepare the internal forces, deformations or design ratios displayed on the RFEM model for the printout.

To print the currently displayed graphic click

File \rightarrow Print Graphic

or use the toolbar button shown on the left.

Also in the *Result Diagram* dialog box (see Figure 3.24, page 57), you can use the button with transfer the graphic of internal forces, deformations or design ratios to the printout report or print it directly.

The following dialog box appears:

Graphic Printout								
General Options Color Scale Factors Borde	er and Stretch Factors							
Graphic Picture ○ Directly to a printer ⑧ To a printout report: PR1: Ir ▼ ○ To the Clipboard ○ To 3D PDF	Window To Print Graphic Scale © Current only More Mass print Mass print Mass print To scale 1: 5 							
Graphic Picture Size and Rotation Options If Use full page width Show results for selected x-location in result diagram Use full page height Lock graphic picture (without update) Image: Height: 49 - [%] [% of page] Image: Rotation: Image: Imag								
Header of Graphic Picture Design: Ultimate Limit State - Cross-Section Design OK Cancel								

Figure 4.2: Dialog box Graphic Printout

Printing graphics is described in the RFEM manual, Chapter 10.2. In this chapter, the other tabs of the *Graphic Printout* dialog box are explained.



Figure 4.3: Printout report with pipeline graphic

	Remove from Printout Report								
	Start with New Page								
	Selection								
	Properties								
_	15								

To move a graphic within the printout report, use the drag-and-drop function. To adjust a graphic in the printout report at a later time, right-click the corresponding entry in the navigator of the printout report. The *Properties* option in the shortcut menu opens the *Graphic Printout* dialog box, offering various options for adjustment.



- [1] ASME B31.1-2012: Power Piping. The American Society of Mechanical Engineers, 2012.
- [2] ASME B31.3-2012: Process Piping. The American Society of Mechanical Engineers, 2013.
- [3] DIN EN 13480-3: Metallische industrielle Rohrleitungen Teil 3: Konstruktion und Berechnung. Beuth Verlag GmbH, 2014.
- [4] EN 10253-2: Formstücke zum Einschweißen Teil 2: Unlegierte und legierte ferritische Stähle mit besonderen Prüfanforderungen. Beuth Verlag GmbH, 2008.

∠ Dlubal

Index

3-way valve	• •		•	•		• •		•	•	•	•		• •	•	20
4-way valve				•			•		•	•				•	21

A

Action categories																28
Additional mass	• •	•	• •	•	•	• •	•	•	•	•	•	•	• •	•	•	19

В

Bend	9, 10, 12, 22
Bend factors	9
Blind flange	
Bourdon effect	6, 35
Branch	
Branch connection	
Buttons	

С

D

Delete design case	
Design	. 39, 46, 47, 48
Design case	
Design pressure	12
Design ratio	
Design temperature	12
Detail settings	

Е

Eccentricity	б
Evaluation of results	4
Excel	1
Exit RF-PIPING Design	8
Expansion	0
Expansion load	б

B

F

Filter	46, 58
Filtering members	
Flange	18, 23, 25
Flexibility factor	. 5, 9, 16, 27

G

General data	39
Generating expansion combinations	. 6
Geometry	26
Go to window	38
Graphic printout	63
Graphics	55

Н

Handwheel						19
-----------	--	--	--	--	--	----

I

Installation	. 3
Insulation	13
Internal forces	51
Internal pressure	. 6

L

Layer
Length
Line mass
Lining
Load case
Loading
Loads

М

Mass	18, 25, 26
Material	6, 12, 13, 41
Material library	
Material properties	14, 41
Materials	60
Member	9

Ν

National annex	39
Navigator	38
New pipeline	9
Nominal pressure	25
Number of thermal cycles	44

⊿ Dlubal

Occasional load	44
Opening the program	. 4
OpenOffice	61
Operating combination	29

Ρ

Panel
Parameters
Parametric section
Part
Parts list
Pipe
Pipe content
Pipe internal pressure
Pipeline 10, 32, 33, 34, 39, 52
Pipeline part
Piping combination
Piping combinations
Piping cross-section
Piping load
Piping load combination 29
Plating
Polyline
Pressure load case
Print
Printout report

R

Reducer	15
Reducer factors	16
Remark	43
Result combination	30, 40, 47
Result diagram	57
Result diagrams	57
Result tables	46
Results	
Results display	
RFEM graphic	57, 63
RFEM work window	55, 58
Rotation	10
Run	

S

Selection	2
Shortcut menu	2
Standard 39	9
Start	7
Start RF-PIPING Design	7
Starting calculation	5
Starting RF-PIPING	4
Stress intensification factor	7
Stress point	3
Stress type	9
Stresses	4
Sum	4
Surface area	4
Sustained load	5

B

т

Table	8
Tables	38
Тее	5, 25
Tee type	27
Temperature	6, 14, 31
Temperature combinations	30
Temperature load case	

U

Units	41, 60
User profile	60

V

17
20
55
58
54

Х

x-location																						47	7,	5	1	
------------	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	----	----	---	---	--

W

Wall thickness	26
Weight5	54