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The analysis of stress is shown for analysis no.

- | | |
|---|----------------|
| - Sustained loads (SL, Weight) | analysis no.01 |
| - Sustained and expansion loads (Weight, temp.-range) | analysis no.02 |
| - Sustained + occasional loads (SOL, wind-X) | analysis no.03 |
| - Sustained + occasional loads (SOL, wind-Y) | analysis no.04 |

The results show, that the existing piping system is enough elastic laid and enough supported. There are no exceeding of stress.

The allowable nozzle loads get fullfilled.

The maximum of stress amount to:

- | | |
|--|--|
| - Sustained loads (SL, Weight) | SL = 78,0 N/mm ² ; A = 80,8 % |
| - Sustained and exp. loads (Weight, temp.-range) | SE = 203,9 N/mm ² ; A = 91,1 % |
| - Sustained + occasional loads (wind -X) | SOL = 81,0 N/mm ² ; A = 63,0 % |
| - Sustained + occasional loads (wind -Y) | SOL = 129,3 N/mm ² ; A = 92,1 % |

Other analysis are not task of this calculation

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Analysis of stress

The stress analysis takes the following load cases into account:

Lc-File	Lc-Array	Lc-Name	calculated at:	
Gewl.erg	G1	Weight	09.05.05	12:27:18
Betr1H.erg	T1	Operation1H	09.05.05	12:27:22
Betr2H.erg	T2	Operation2H	09.05.05	12:27:28
Betr6.erg	T3	Operation6	09.05.05	12:27:34
Betr1K.erg	T4	Operation1K	09.05.05	12:27:41
Betr2K.erg	T5	Operation2K	09.05.05	12:27:47
Windl.erg	W1	Windl-X	09.05.05	12:27:52
Windl.erg	W2	Windl-Y	09.05.05	12:27:52

Cross section data printed are net values.

Tolerance inputs are taken into account for:

Pressure stress components S(P)
Moment stress components in SL, SOL

Required equations:

ANSI B31.3 Analysis 01 $SL = SLP + QXL/A + \sqrt{ii \cdot MiL^2 + io \cdot MoL^2} / Z < Sh$
P from ET-record (design pressure)
Ma from load case Weight
Sh calculated using MATDAT or the ET-record factor= 1.00

ANSI B31.3 Analysis 02 $SE = \sqrt{ii \cdot MiE^2 + io \cdot MoE^2 + MT^2} / Z < SA + f \cdot (Sh - SL)$
P from ET-record (design pressure)
Ma from load case Weight
Mc from load case Range
Sh calculated using MATDAT or the ET-record factor= 1.00
Sa calculated using MATDAT or the ET-record factor=0.890
Fatigue factor f =0.890
P, Ma for determination of SL in equation SE
 $Mc = Mc \cdot Y-MODcold / Y-MODhot$

ANSI B31.3 Analysis 03 $SOL = SL + QXO/A + \sqrt{ii \cdot MiO^2 + io \cdot MoO^2} / Z < k \cdot Sh$
P from ET-record (design pressure)
Ma from load case Weight
Mb from load case Windl-X
Sh calculated using MATDAT or the ET-record factor= 1.33

ANSI B31.3 Analysis 04 $SOL = SL + QXO/A + \sqrt{ii \cdot MiO^2 + io \cdot MoO^2} / Z < k \cdot Sh$
P from ET-record (design pressure)
Ma from load case Weight
Mb from load case Windl-Y
Sh calculated using MATDAT or the ET-record factor= 1.33

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EXTRACT OF STRESS ANALYSIS ACC. TO ASME B31.3:

Analysis 01 Stresses due to sustained loads (SL)

Components with maximum stress percentages

Pt		ii	io	Sum of stresses (N/mm2)	Allowable stresses (N/mm2)	(%)
283	(BGL)	4.28	3.57	78.0	96.6	80.8
93	(TTU)	9.36	12.14	78.0	105.5	73.9
35	(TTU)	9.36	12.14	77.6	105.5	73.6
547	(BGL)	5.14	4.29	70.9	105.5	67.2
437	(TWA)	5.48	5.48	67.0	105.5	63.5
545	(BGL)	5.14	4.29	53.9	105.5	51.1
51	(TWA)	5.36	5.36	48.1	96.6	49.8
542	(PGR)	1.00	1.00	48.4	105.5	45.8
1	(PGR)	1.00	1.00	57.5	128.1	44.9
2	(PGR)	1.00	1.00	56.7	128.1	44.3
3	(PGR)	1.00	1.00	53.8	128.1	42.0
5	(PGR)	1.00	1.00	50.3	128.1	39.3
127	(TTV)	4.88	6.18	37.4	96.6	38.7
527	(TTU)	8.12	10.49	40.8	105.5	38.6
284	(PGR)	1.00	1.00	36.2	96.6	37.4
532	(PGR)	1.00	1.00	39.3	105.5	37.3
7	(PGR)	1.00	1.00	46.6	128.1	36.3
523	(TTU)	8.12	10.49	38.2	105.5	36.2
61	(TWA)	5.48	5.48	34.1	96.6	35.4
441	(BGL)	4.33	3.61	35.4	105.5	33.6
365	(BGL)	4.70	3.92	35.4	105.5	33.5
541	(BGL)	5.14	4.29	34.4	105.5	32.6
336	(PGR)	1.00	1.00	31.4	96.6	32.5
423	(PGR)	1.00	1.00	41.1	128.1	32.1
425	(PGR)	1.00	1.00	40.9	128.1	31.9
125	(TWA)	5.48	5.48	30.5	96.6	31.6
427	(PGR)	1.00	1.00	39.7	128.1	31.0
421	(PGR)	1.00	1.00	39.4	128.1	30.8
69	(PGR)	1.00	1.00	35.9	117.9	30.5
135	(PGR)	1.00	1.00	35.9	117.9	30.5

0 Sections with stress(es) exceeded

(*)

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EXTRACT OF STRESS ANALYSIS ACC. TO ASME B31.3:

Analysis 02 Stresses due to sust. and expansion loads

Components with maximum stress percentages

Pt		ii	io	Sum of stresses (N/mm2)	Allowable stresses (N/mm2)	(%)
235	(TWA)	5.48	5.48	203.9	223.9	91.1
215	(TWA)	5.48	5.48	191.7	221.6	86.5
61	(TWA)	5.48	5.48	138.8	206.8	67.1
127	(TTV)	4.88	6.18	122.7	203.9	60.2
177	(TFS)	2.21	2.62	110.7	227.8	48.6
125	(TWA)	5.48	5.48	102.6	223.5	45.9
179	(BGL)	2.79	2.32	104.5	228.8	45.7
195	(BGL)	2.84	2.36	93.5	224.1	41.7
335	(BGL)	2.79	2.32	80.5	219.6	36.6
337	(BGL)	2.79	2.32	71.7	221.3	32.4
51	(TWA)	5.36	5.36	62.2	194.4	32.0
59	(TWA)	5.48	5.48	70.5	226.6	31.1
283	(BGL)	4.28	3.57	52.0	167.8	31.0
53	(BGL)	5.63	4.69	63.2	217.4	29.1
183	(BGL)	2.79	2.32	63.9	226.1	28.3
35	(TTU)	9.36	12.14	60.2	215.1	28.0
437	(TWA)	5.48	5.48	51.5	187.5	27.5
185	(BGL)	2.79	2.32	56.8	225.9	25.1
329	(BGL)	2.79	2.32	52.8	230.3	22.9
190	(PGR)	1.00	1.00	45.0	216.1	20.8
237	(TFS)	3.17	3.90	47.0	226.7	20.7
178	(PGR)	1.00	1.00	47.7	231.4	20.6
217	(TFS)	3.17	3.90	46.5	226.9	20.5
191	(BGL)	2.79	2.32	45.1	229.4	19.7
31	(TFS)	3.17	3.90	43.2	223.1	19.4
275	(BGL)	4.28	3.57	42.2	220.3	19.2
259	(BGL)	4.28	3.57	41.6	220.1	18.9
343	(BGL)	2.79	2.32	42.9	229.1	18.7
117	(BGL)	5.63	4.69	40.7	217.6	18.7
168	(PGR)	1.00	1.00	39.2	220.8	17.8

0 Sections with stress(es) exceeded

(*)

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EXTRACT OF STRESS ANALYSIS ACC. TO ASME B31.3:

Analysis 03 Stresses due to sustained + occasional loads (SOL)

Components with maximum stress percentages

Pt		ii	io	Sum of stresses (N/mm2)	Allowable stresses (N/mm2)	(%)
283	(BGL)	4.28	3.57	81.0	128.4	63.0
35	(TTU)	9.36	12.14	79.2	140.3	56.5
93	(TTU)	9.36	12.14	79.1	140.3	56.4
547	(BGL)	5.14	4.29	75.9	140.3	54.1
437	(TWA)	5.48	5.48	71.2	140.3	50.7
215	(TWA)	5.48	5.48	62.6	128.4	48.7
51	(TWA)	5.36	5.36	61.7	128.4	48.0
235	(TWA)	5.48	5.48	59.4	128.4	46.2
1	(PGR)	1.00	1.00	75.7	170.3	44.4
2	(PGR)	1.00	1.00	72.8	170.3	42.7
545	(BGL)	5.14	4.29	57.9	140.3	41.3
335	(BGL)	2.79	2.32	52.4	128.4	40.8
337	(BGL)	2.79	2.32	52.0	128.4	40.5
542	(PGR)	1.00	1.00	53.4	140.3	38.1
3	(PGR)	1.00	1.00	62.8	170.3	36.9
343	(BGL)	2.79	2.32	45.8	128.4	35.7
527	(TTU)	8.12	10.49	49.0	140.3	34.9
329	(BGL)	2.79	2.32	44.7	128.4	34.8
127	(TTV)	4.88	6.18	40.9	128.4	31.9
5	(PGR)	1.00	1.00	53.5	170.3	31.4
523	(TTU)	8.12	10.49	43.6	140.3	31.1
61	(TWA)	5.48	5.48	38.3	128.4	29.8
284	(PGR)	1.00	1.00	37.0	128.4	28.8
532	(PGR)	1.00	1.00	39.3	140.3	28.0
7	(PGR)	1.00	1.00	46.7	170.3	27.4
365	(BGL)	4.70	3.92	38.3	140.3	27.3
373	(BGL)	5.21	4.34	37.8	140.3	27.0
190	(PGR)	1.00	1.00	34.5	128.4	26.8
125	(TWA)	5.48	5.48	34.4	128.4	26.8
541	(BGL)	5.14	4.29	36.7	140.3	26.2

0 Sections with stress(es) exceeded

(*)

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EXTRACT OF STRESS ANALYSIS ACC. TO ASME B31.3:

Analysis 04 Stresses due to sustained + occasional loads (SOL)

Components with maximum stress percentages

Pt		ii	io	Sum of stresses (N/mm2)	Allowable stresses (N/mm2)	(%)
437	(TWA)	5.48	5.48	129.3	140.3	92.1
283	(BGL)	4.28	3.57	97.4	128.4	75.8
93	(TTU)	9.36	12.14	83.6	140.3	59.6
35	(TTU)	9.36	12.14	81.6	140.3	58.2
547	(BGL)	5.14	4.29	76.5	140.3	54.5
51	(TWA)	5.36	5.36	61.2	128.4	47.7
1	(PGR)	1.00	1.00	74.7	170.3	43.9
2	(PGR)	1.00	1.00	71.9	170.3	42.2
527	(TTU)	8.12	10.49	57.8	140.3	41.2
545	(BGL)	5.14	4.29	56.1	140.3	40.0
3	(PGR)	1.00	1.00	62.2	170.3	36.5
542	(PGR)	1.00	1.00	51.0	140.3	36.4
523	(TTU)	8.12	10.49	47.9	140.3	34.1
284	(PGR)	1.00	1.00	42.2	128.4	32.9
127	(TTV)	4.88	6.18	41.7	128.4	32.4
365	(BGL)	4.70	3.92	45.4	140.3	32.4
441	(BGL)	4.33	3.61	44.4	140.3	31.6
259	(BGL)	4.28	3.57	40.3	128.4	31.4
5	(PGR)	1.00	1.00	53.1	170.3	31.2
275	(BGL)	4.28	3.57	39.8	128.4	31.0
61	(TWA)	5.48	5.48	37.0	128.4	28.8
532	(PGR)	1.00	1.00	39.3	140.3	28.0
7	(PGR)	1.00	1.00	46.6	170.3	27.3
182	(PGR)	1.00	1.00	33.6	128.4	26.2
541	(BGL)	5.14	4.29	36.2	140.3	25.8
125	(TWA)	5.48	5.48	33.1	128.4	25.8
571	(PGR)	1.00	1.00	35.6	140.3	25.4
336	(PGR)	1.00	1.00	32.0	128.4	24.9
425	(PGR)	1.00	1.00	41.8	170.3	24.6
59	(TWA)	5.48	5.48	31.4	128.4	24.5

0 Sections with stress(es) exceeded

(*)