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BELLOWS DESIGN CALCULATION SPREADSHEET

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Design Code: EJMA Standards, 10th Edition
Allowable Stress Basis: ASME Section II-D, 2019 Edition

BELLOWS DESIGN INFORMATION

<i>Bellows Material:</i>	SA240-T321	<i>Sa at Design Temp.:</i>	132 (MPa)
<i>Collar Material:</i>	N/A	<i>Sa at 70 deg F:</i>	138 (MPa)
<i>Reinforcing Ring Mat.:</i>	N/A	<i>E at Design Temp.:</i>	186.096 (MPa)
<i>Design Pressure:</i>	25,0 (barg)	<i>E at 70 deg F:</i>	195.129 (MPa)
<i>Design Temperature:</i>	150 (deg C)	<i>Weld efficiency:</i>	1,00
<i>Axial Extension:</i>	0,00 (mm)	<i>Cycle Life:</i>	654 cycles
<i>Axial Compression:</i>	100,00 (mm)	<i>Cycle Life Based on:</i>	EJMA Standards, 10th Edition
<i>Lateral (+):</i>	0,00 (mm)	<i>EJMA fc factor:</i>	1,00
<i>Lateral (-):</i>	0,00 (mm)		
<i>Angular (+):</i>	0,00 (deg.)		
<i>Angular (-):</i>	0,00 (deg.)		

SPRING RATE INFORMATION

	Total Expansion Joint		Spring Forces	
<i>Axial Spring Rate:</i>	459	(N/mm)	<i>Axial:</i>	45871 N
<i>Lateral Spring Rate:</i>	4.970	(N/mm)	<i>Lateral:</i>	N/A N
<i>Angular Spring Rate:</i>	190	(N-m/deg)	<i>Angular:</i>	N/A (N-m/deg)
<i>Torsional Spring Rate:</i>	263.589	(N-m/deg)		

BELLOWS GEOMETRY

<i>Bellows Inside Diameter:</i>	406,00 (mm)	<i>Convolution Height:</i>	27,0 (mm)
<i>Bellows Outside Diameter:</i>	464,80 (mm)	<i>Re-roll (2r):</i>	12,0 (mm)
<i>Number of convolutions:</i>	9	<i>Bellows Convoluted Length:</i>	250,00 (mm)
<i>Individual Ply Thickness:</i>	0,800 (mm)	<i>Center Spool Length:</i>	N/A (mm)
<i>Number of Plies:</i>	3	<i>Theoretical Neutral Length:</i>	259 (mm)

BELLOWS STRESS ANALYSIS

		Design Stress	Allowable Stress
S1	Tangent Circumferential Membrane Stress Due to Pressure	150 (MPa)	132 (MPa)
S'1	Collar Circumferential Membrane Stress Due to Pressure	N/A (MPa)	N/A (MPa)
S2	Circumferential Membrane Stress Due to Pressure	97 (MPa)	132 (MPa)
S'2	Reinforcing Ring Membrane Stress Due to Pressure	N/A (MPa)	N/A (MPa)
S3	Meridional Membrane Stress Due to Pressure	15 (MPa)	N/A (MPa)
S4	Meridional Bending Stress Due to Pressure	309 (MPa)	N/A (MPa)
S3+S4	Meridional Mem. + Bending Stress Due to Pressure	323 (MPa)	395 (MPa)
S5	Meridional Membrane Stress Due to Deflection	21 (MPa)	N/A (MPa)
S6	Meridional Bending Stress Due to Deflection	2.031 (MPa)	N/A (MPa)
St	Total Stress Range for All Movements	2.278 (MPa)	N/A (MPa)
S"1	Collar Circumferential Bending Stress Due to Pressure	N/A (MPa)	N/A (MPa)
S'1 + S"1	Collar Circumferential Bending + Membrane Stress Due to Pressure	N/A (MPa)	N/A (MPa)
Squirm	Maximum Design Pressure Based Upon Squirm	27,9 (barg)	

MISCELLANEOUS INFORMATION

Bellows Annealed/Not-Annealed After Forming	Not-Annealed
Reinforcing Rings Utilized/Not Utilized	Not-Utilized
Reinforcing Ring Area	N/A cm ²
Bellows Weight	17,2 kg
Bellows Effective Area	1.490 cm ²
Pressure Thrust	371.690 N
Convolution Switch Value (for manufacturing)	69 mm
Pitch	27,8 mm