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BELLOWS DESIGN CALCULATION SPREADSHEET

Author: Klinger Turkey
14th Issue, 23 November 2022

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

BELLOWS DESIGN INFORMATION

Bellows Material:	SA240-T321				
Collar Material:	N/A		*Sa at Design Temp.:*	132	(MPa)
Reinforcing Ring Mat.:	N/A		*Sa at 70 deg F:*	138	(MPa)
Design Pressure:	25,0	(barg)	*E at Design Temp.:*	186.096	(MPa)
Design Temperature:	150	(deg C)	*E at 70 deg F:*	195.129	(MPa)
Axial Extension:	0,00	(mm)	*Weld efficiency:*	1,00	
Axial Compression:	80,00	(mm)			
Lateral (+):	0,00	(mm)	*Cycle Life:*	706	cycles
Lateral (-):	0,00	(mm)	*Cycle Life Based on:*		
Angular (+):	0,00	(deg.)	EJMA Standards, 10th Edition		
Angular (-):	0,00	(deg.)	*EJMA fc factor:*	1,00	

SPRING RATE INFORMATION

	Total Expansion Joint		Spring Forces		
Axial Spring Rate:	361	(N/mm)	*Axial:*	28907	N
Lateral Spring Rate:	1.915	(N/mm)	*Lateral:*	N/A	N
Angular Spring Rate:	46	(N-m/deg)	*Angular:*	N/A	(N-m/deg)
Torsional Spring Rate:	52.168	(N-m/deg)			

BELLOWS GEOMETRY

Bellows Inside Diameter:	219,00	(mm)	*Convolution Height:*	19,2	(mm)
Bellows Outside Diameter:	262,20	(mm)	*Re-roll (2r):*	8,0	(mm)
Number of convolutions:	10		*Bellows Convoluted Length:*	200,00	(mm)
Individual Ply Thickness:	0,600	(mm)	*Center Spool Length:*	N/A	(mm)
Number of Plies:	4		*Theoretical Neutral Length:*	208	(mm)

BELLOWS STRESS ANALYSIS

		Design Stress		*Allowable Stress*	
S1	Tangent Circumferential Membrane Stress Due to Pressure	115	(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	54	(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	10	(MPa)	N/A	(MPa)
S4	Meridional Bending Stress Due to Pressure	206	(MPa)	N/A	(MPa)
S3+S4	Meridional Mem. + Bending Stress Due to Pressure	216	(MPa)	395	(MPa)
S5	Meridional Membrane Stress Due to Deflection	24	(MPa)	N/A	(MPa)
S6	Meridional Bending Stress Due to Deflection	2.060	(MPa)	N/A	(MPa)
St	Total Stress Range for All Movements	2.235	(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	27,7	(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	7,7	kg
	Bellows Effective Area	452	cm^2
	Pressure Thrust	113.500	N
	Convolution Switch Value (for manufacturing)	48	mm
	Pitch	20,0	mm

Digitally signed by Catan Vladimir
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