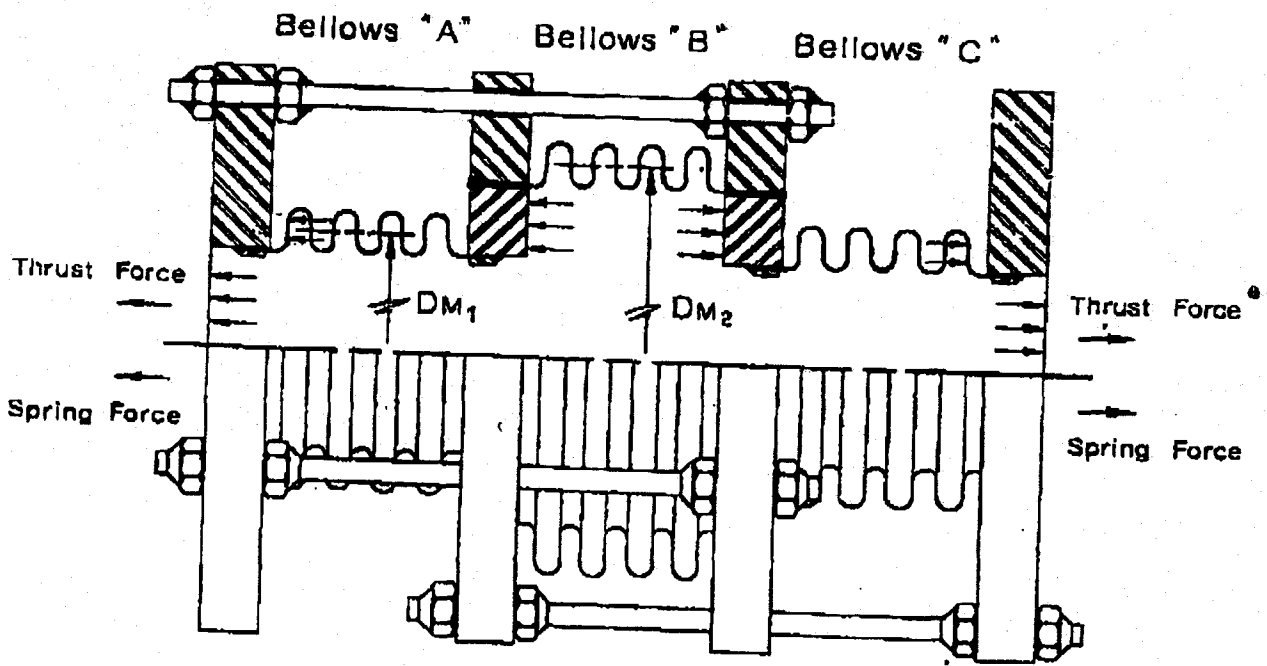
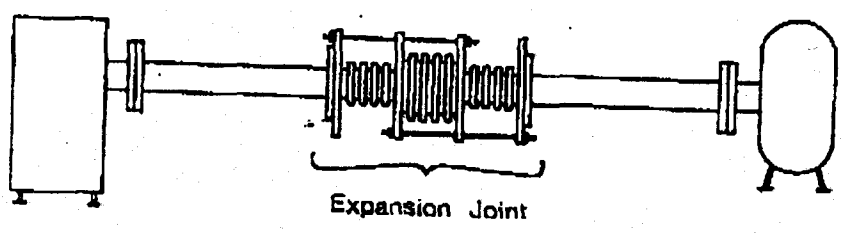


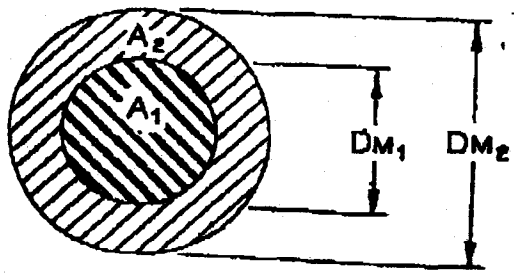
TO L. JONES
 FROM TODD @ NDR-CAL

BALANCING OF PRESSURE THRUST

A. IN-LINE PRESSURE BALANCED JOINTS



AREA 1 = AREA 2
 EQUALIZE
 PRESSURE BALANCE



Conservative Spring Rate
 Total = $SR \cdot A_1 + A_2$
 = $50 + 139 + 50$
 = 239 lb/in
 Tol = $30\% = 167.3 \text{ lb/in}$
 Av S.R = 203 lb/in

BELLOWS DESIGN CALCULATION

Author: M. Lanza

rev. 55, 5/3/01

Design Basis: The Expansion Joint Manufacturer's Association Standard, 7th Edition
 Allowable Stress Basis: ASME Sect. II, 1989 Edition, 2000 Addenda

Bellows Element Geometry

Bellows Material:		
Collar Material:		SA240-T321
Bellows inside Diameter (in.)		SA240-T304
Bellows Outside Diameter (in.)	H= 0.580	11.58
Number of Convolutions		12.74
Individual Ply thickness (in.)		10
Number of Plies		0.010
Bellows Element Length (in.)	2r= 0.210	1
Bellows Effective Area (in. ²)		4.00
		115.9

Joint Information

Condition Type (i.e. design, upset)		Design
Design Pressure (Psig)		15
Design Temperature (deg. F)		600
Axial Compression (in.)		0.200
Axial Extension (in.)		0.200
Lateral (+) (in.)		0.000
Lateral (-) (in.)		0.000
Angular (+) (deg.)		0.00
Angular (-) (deg.)		0.00
Bellows Stress Analysis		0.00

	Actual Stress	Allow. Stress
S1 Tangent Circumferential Membrane Stress Due to Pressure, psi	1,546	18,300
S1 Collar Circumferential Membrane Stress Due to Pressure, psi	1,585	16,600
S2 Circumferential Membrane Stress Due to Pressure, psi	2,913	18,300
S2 Reinforcing Ring Membrane Stress Due to Pressure, psi	N/A**	N/A**
S3 Meridional Membrane Stress Due to Pressure, psi	448	N/A
S4 Meridional Bending Stress Due to Pressure, psi	18,898	N/A
S3+S4 Meridional Mem. + Bending Stress Due to Pressure, psi	19,344	54,800
S6 Meridional Membrane Stress Due to Deflection, psi	187	N/A
S8 Meridional Bending Stress Due to Deflection, psi	34,450	N/A
Maximum Design Pressure Based Upon Squirm, psig	36	
Fatigue Characteristics		
Total Stress Range for All Movements (St), psi		48,178
Fatigue Life (cycles to failure)	EJMA	1,000,000
Expansion Joint Spring Rates		
Axial Spring Rate (lbs./in.)		139
Lateral Spring Rate (lbs./in.)		1,738
Angular Spring Rate (in.-lbs./deg.)		45
Torsional Spring Rate (in.-lbs./deg.)		165,086
Pressure Thrust at Design Pressure (lbs.)		1,739

** Un-reinforced bellows, reinforcing rings not utilized

BELLOWS DESIGN CALCULATION

Author: M. Lanz

rev. 55, 5/2/01

Design Basis:		The Expansion Joint Manufacturer's Association Standard, 7th Edition	
Allowable Stress Basis:		ASME Sect. II, 1998 Edition, 2000 Addenda	
Bellows Element Geometry			
Bellows Material:		SA240-T321	
Collar Material:		SA240-T304	
Bellows Inside Diameter (in.)		8.00	
Bellows Outside Diameter (in.)		H= 0.580	9.18
Number of Convolutions		10	
Individual Ply thickness (in.)		0.008	
Number of Plies		1	
Bellows Element Length (in.)		2= 0.210	4.00
Bellows Effective Area (in.²)		57.9	
Design Information			
Condition Type (i.e design, upset)		Design	
Design Pressure (psig)		15	
Design Temperature (deg. F)		600	
Axial Compression (in.)		0.200	
Axial Extension (in.)		0.200	
Lateral (+) (in.)		0.000	
Lateral (-) (in.)		0.000	
Angular (+) (deg.)		0.00	
Angular (-) (deg.)		0.00	
Bellows Stress Analysis		0.00	
		Actual	Allow.
		Stress	Stress
S1	Tangent Circumferential Membrane Stress Due to Pressure, psi	1,107	18,300
S1	Collar Circumferential Membrane Stress Due to Pressure, psi	1,126	16,800
S2	Circumferential Membrane Stress Due to Pressure, psi	2,581	18,300
S2	Reinforcing Ring Membrane Stress Due to Pressure, psi	N/A**	N/A**
S3	Meridional Membrane Stress Due to Pressure, psi	583	N/A
S4	Meridional Bending Stress Due to Pressure, psi	27,535	N/A
S3+S4	Meridional Mem. + Bending Stress Due to Pressure, psi	28,089	54,800
S5	Meridional Membrane Stress Due to Deflection, psi	127	N/A
S6	Meridional Bending Stress Due to Deflection, psi	25,813	N/A
	Maximum Design Pressure Based Upon Squirm, psig	18	
Fatigue Characteristics			
Total Stress Range for All Movements (Sr), psi		45,410	
Fatigue Life (cycles to failure)		EJMA 1,000,000	
Expansion Joint Spring Rates			
Axial Spring Rate (lbs./in.)		50	
Lateral Spring Rate (lbs./in.)		314	
Angular Spring Rate (in.-lbs./deg.)		8	
Torsional Spring Rate (in.-lbs./deg.)		43,835	
Pressure Thrust at Design Pressure (lbs.)		869	

** Un-reinforced bellows, reinforcing rings not utilized