Argon Spill Trough Bellows - Leak Test

Engineering Note #3740.215-EN-251

Issued: April 30, 1990

Originator: Al Jaques

Checked: _____

D-Zero Engineering Note
3740.215-EN-251
Issued 4/30/90

Argon Spill Trough Bellows - Leak Test

Al Jaques

The four argon spill trough bellows were leak tested with helium during the week of March 12, 1990. Three passed without incident, but the fourth was found to have a leak in the weld at one of the ring/clamps. The hole was approximately 1/32" in diameter (a likely result of a welding burn through) and located on an inflexible portion of the bellows, the ring/clamp.

Frank Juravic, who conducted the tests, suggested using grey structural epoxy to plug the leak. The epoxy is metallic with some inherent flexibility. The epoxy was applied and the bellows retested in the same manner as before. The repair was a success as the bellows proved to be leaktight. The bellows were then put in their original shipping crates and placed in storage at Lab C.

Included in this report is the manufacturer's spec sheets on the bellows, a copy of the Quality Control Report form and a sketch of the test setup with an explanation of the procedure. On the bellows data sheet entitled "Analysis of Stress in Bellows", the analysis output is obtained through a theoretical bellows program that uses quadratic equations to approximate characteristic curves for such data as axial, lateral and angular movement and spring rates. The program is best suited for bellows with a wall thickness of at least 0.015" and an operating pressure significantly above atmospheric. Thus EJS Inc. warned that the output data would not be very accurate in some instances.

The data given on the EJS Inc. sketch sheet should be taken as accurate, though, for it was taken from the actual bellows delivered. The 72" length includes the 64.64" of bellows section, the (3) 1/2" ring/clamps and the (2) 1-1/2" end bands. The remainder of the discrepancy is accounted for by a 2.75" factory elongation of the bellows from the original free length. The 40" compression capability includes the 2.75" of factory elongation, the program

determined 31.9" of compression from free length and 5.35" of elastic compression of the bellows convolutions due to such a thin bellows wall. EJS Inc. ran a single (16-3/16") bellows section through a 10" compression stroke for 1000 cycles with no sign of rupture or plastic deformation.

M89-253.

EXPANSION JOINT SYSTEMS

ANALYSIS OF STRESS IN BELLOWS.
(SINGLE BELLOWS)
PER E.J.M.A. 5TH EDITION
UNREINFORCED CONVOLUTED BELLOWS.

INPUT,,,,,

OPERATING PRESSURE	.1 PSIG
BELLOWS I.D.	10.75 IN
BELLOWS O.D.	12.5 IN
MEMBRANE THICKNESS	5E-03 IN
NO. OF PLYS	1
NO. OF CONS	64
MOD. OF ELASTICITY	28000000 PSI
U.T.S. AT AMB.TEMP	1 PSI
U.T.S. AT OP.TEMP	1 PSI
ROLL SIZE	.5 IN
CYCLE LIFE	100000

ANALYSIS,,,

MAXIMOVE PER CON	.499 IN
AXIAL MOVEMENT	31.9 IN
LATERAL MOVEMENT	213. IN
ANGULAR MOVEMENT	87.1 DEG
AXIAL SPRING RATE	6 LBS/IN
LATERAL SPRING RATE	0 LBS/IN
ANGULAR SPRING RATE	1 LBS-IN/DEG
SAFE OPERATING PRESSURE	0 PSIG
BELLOWS WEIGHT	7 LBS
BELLOWS LENGTH	64.64 IN
EFFECTIVE AREA	106 SQ.IN
PRESSURE THRUST	10.6 LBS

ANALYSIS OF STRESS,,,

BELLOWS CIRC. MEMBRANE STRESS @ PRESSURE	[S2]	50 PSI
BELLOWS MERID. MEMBRANE STRESS @ PRESSURE	[S3]	9 PSI
BELLOWS MERID. BENDING STRESS @ PRESSURE	[S4]	323 PSI
BELLOWS MERID.MEMBRANE STRESS @ DEFLEC.N	[S5]	1038 PSI
BELLOWS MERID. BENDING STRESS @ DEFLEC.N	[S6]	31253 PSI
BELLOWS TOTAL STRESS RANGE	[ST]	32524 PSI

EXPANSION JOINT SYSTEMS INC.

TEL:[619]562-6083
FAX:[619]562-0636
TLX:821117 EJS UD

QUOTE NUMBER: M89-253 REV.A

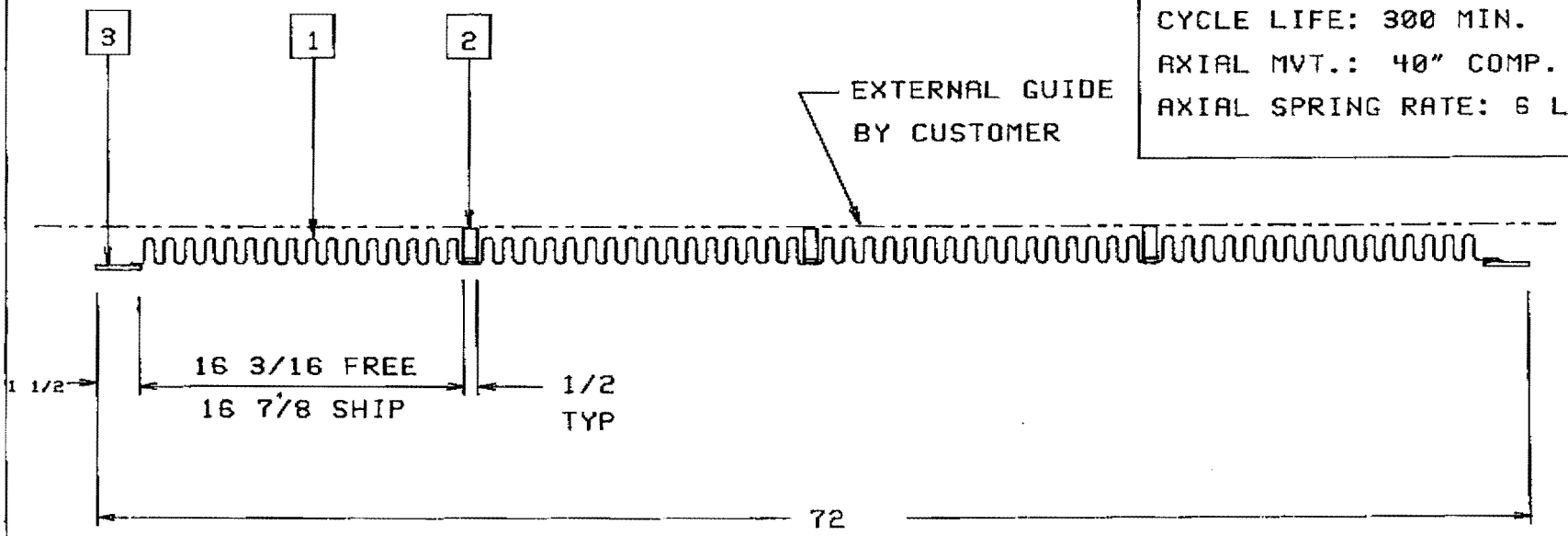
QTY.	SIZE
4	10 3/4 OD.

DATE : 6-8-89

SKETCH # 1 OF 1

CUSTOMER: FIRMI LAB

DESIGN DATA
DES. PRESS: .1 PSIG
CYCLE LIFE: 300 MIN.
AXIAL MVT.: 40" COMP.
AXIAL SPRING RATE: 6 LBS/IN



1	BELLOWS .005 x 10 3/4 ID. x 12 1/2 OD. x (4) 16 CON	A240-304
2	RING/CLAMP 3/8 THK. x 13 OD.	A240-304
3	BAND 1/8 THK. x 10 3/4 OD.	A240-304
4		

REF:

Fermi National Accelerator Laboratory
P.O. Box 500 • Batavia, Illinois • 60510

Approved By _____
Written By _____
DATE 3-14-90

QUALITY CONTROL REPORT NO. I INT 10526

TYPE OF DISCREPANCY (check one)

- ☐ Purchase Item – to document discrepant purchased material
- ☐ Internal Fabrication – to document discrepant material, assembly or procedure
- ☐ Customer Report – to document discrepant final product

E. RAMIREZ X2670
AL JACQUES X3009
DØ DETECTOR

SECTION 1

Part No. _____ Part Name _____

Purchase Order No. _____ Batch Receiving Date _____

Batch Quantity Received _____ Qty. Inspected _____

Item No.	Discrepancy Details (For measurements, list print requirement and tolerance followed by "Reads" followed by actual measurement.) Fill out "Red" hold tags.
1	PURGE OF HELIUM AT LOW PRESSURE (.01PSIG) ON BELLOWS ASSEMBLY, PERFORM HELIUM LEAK CHECK WITH SNIFFER ON ALL WELDS. BAGGED BELLOWS ASSEMBLY FOR FINAL LEAK CHECK. FOUND ONE LEAK REPAIRED LEAK WITH GREY STRUCTRAL EPOXY

Final Disposition (completed by signatories below)

Hand carry completed form to Requisitioner

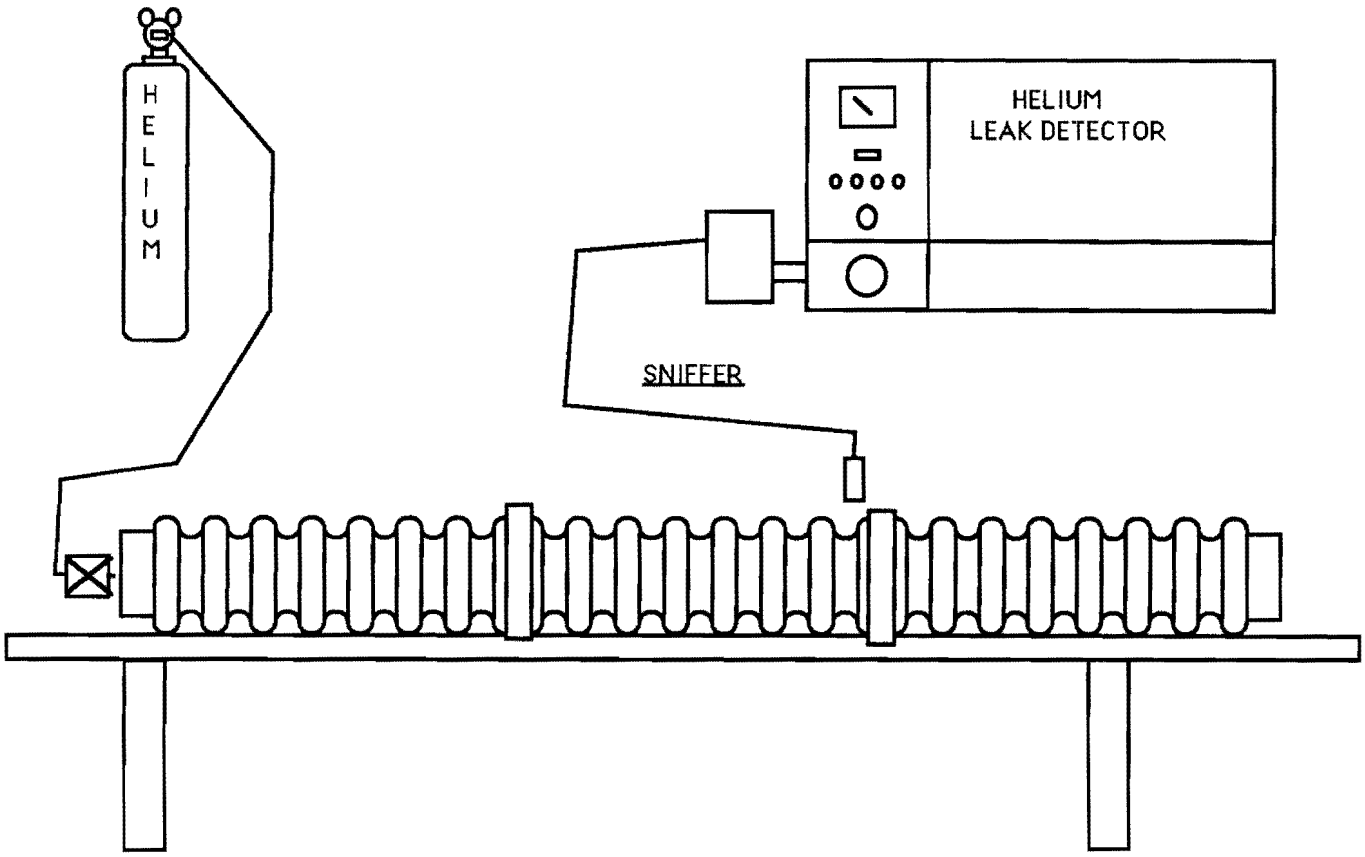
Do copies go with Parts Yes____ No____	Signature Accepted	Rejected
Production Manager		
Engineering Manager	ABJ.	
Material Control Manager		

(After signature, route copies as follows:)

Material Control Office—Original
Requisitioner—(1)
Production Manager—(1)
Engineering Manager—(1)
Quality Control—(2)
Contracts Administrator—(1)
Material Control Manager—(1)

4/25/90
F. Juravic

Helium Leak Test



This arrangement was used to detect leaks in the expansion bellows. The bellows was pressurized to .01 psig with a flow rate of +0.01 SCFH for minimum of three hours. The bellows was covered with plastic and the sniffer probe was positioned under the plastic for 30 minutes. This is the requirement for passing the test. One bellows showed a leak and was fixed with grey structural epoxy.