Argon Spill Duct Bellows Leak Test Procedures and Results

G.R. Trotter
John Wu

March 11, 1991

DØ Engineering Note 3740.512-EN-297

Approved: _____

Bellows Leak Test

March 11, 1991
G.R. Trotter, John Wu

Overview:

This engineering note describes the testing of the argon spill duct bellows. It includes a detailed explanation of the procedures, along with a summary of the results of the testing done on 2/18/91 and 2/19/91 by Gary Trotter. The original bellows were purchased from Expansion Joint Systems (see Appendix 2). The general conclusion from the testing was that the leaks that were found were small enough so that they would not show up at the design pressure of 0.1 psig. Therefore, the leaks were acceptable, and the conclusion was that the bellows were fit for use.

March 11, 1991
G.R. Trotter, John Wu

Leak Test Procedure:

1. Permanently mark each of four bellows with a serial number - 1, 2, 3, and 4 in this case.

2. Fabricate and put in place rubber covered discs (see Appendix 1) to seal the bellow's ends.

3. The nominal bellows length of 64.5" is compressed in a fixture to 35-7/8" to provide a seal pressure of 3 pounds per lineal inch at the bellows spring constant of 6 pounds per inch.

4. Pressurize the bellows from a 1.5 psig relief limited pressure source to 1 psig and snoop carefully. All leaks must be marked, repaired as required, and retested. DO NOT OVER-PRESSURE, SEVERE DAMAGE MAY OCCUR.

5. The EC drive cylinder (relief installed and tested, see DØ Note 3740.510-EN-298) is attached to the test fixture and plumbed to a pump, in this case an Enerpac pump PEM 5045 with a pump mounted VM-4-AG3 valve, and a 12000 V8 overload gauge (see Appendix 1).

6. Install the bellows to be tested in the test fixture and tack weld in place (see Appendix 1).

7. Cycle the bellows through 5 complete cycles, using 35-7/8" to 72" strokes, at a rate of no more than 10" per minute in either direction. Throttle the power supply flow to assure the cylinder can't move faster than that. In this case, the power was throttled with two V8 OVO valves.

8. The bellows mounting tack welds are cut to remove the bellows and the cuff ground smooth, being careful to keep the debris away from the bellows.

9. Rubber covered discs (see Appendix 1) to seal the end are fabricated and put in place.

10. Repeat steps 3 and 4.

11. Record the serial number, length and number of test cycles, leaks found, repair details, and retest information in a logbook for the purpose.

12. Apply the procedures 2 through 11 to each of the four bellows.

13. Record the procedures used, a summary of the test results, and, in particular, details and locations of any and all repairs that were required in a DØ Engineering Note.

Leak Test Results:

The test pressure used was 1.5 to 2 psig.

The first bellows unit was stamped with the serial number 1. It was leak checked and no leaks were found, then it was cycled five times. It was cycled from 35-7/8" to 72". The unit would not go any shorter than 35-7/8". After cycling, the unit was leak checked again, and no leaks were found.

The second bellows unit was stamped with the serial number 2. It was leak checked first. The manufacturer had used epoxy to fix one leak, and this section did not leak. There was one leak found in the seam of the bellows. This leak was the result of the manufacturer's welding method, and could not be repaired because of the fragile bellows. However, the leak was not significant because it would not show up at the design pressure of 0.1 psig. The unit was cycled five times from 35-7/8" to 72". Afterwards, the unit was leak checked again, and no additional leaks were found.

The third unit was stamped with the serial number 3. The first leak check found seam weld leaks in two sections, which, like the second bellows, were not repaired because they would not show up at the design pressure. The unit was then cycled five times from 35-7/8" to 72", and leak checked again. No additional leaks were found.

The fourth unit was stamped with the serial number 4. The first leak check found one leak in the seam, which was not significant, and was not repaired. The unit was cycled five times from 35-7/8" to 72", and the second leak check found no additional leaks.

All of the leaks were there before cycling, and all remained very slight at the test pressure of 1.5 to 2 psig. None of the leaks were repaired because the leaks would not show up at the design pressure of 0.1 psig. Therefore, the leaks were considered acceptable, and all of the bellows passed the test.

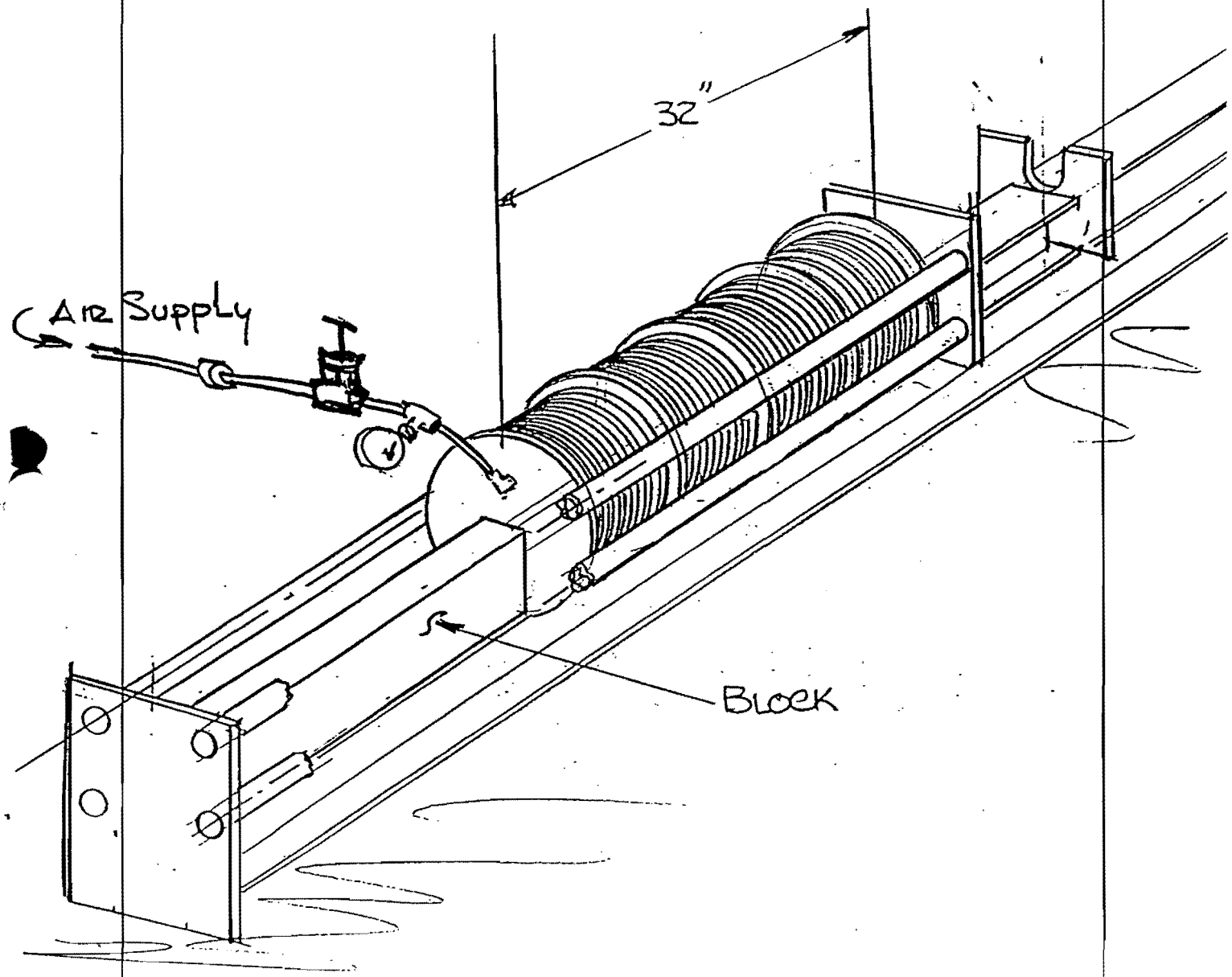
Appendix 1

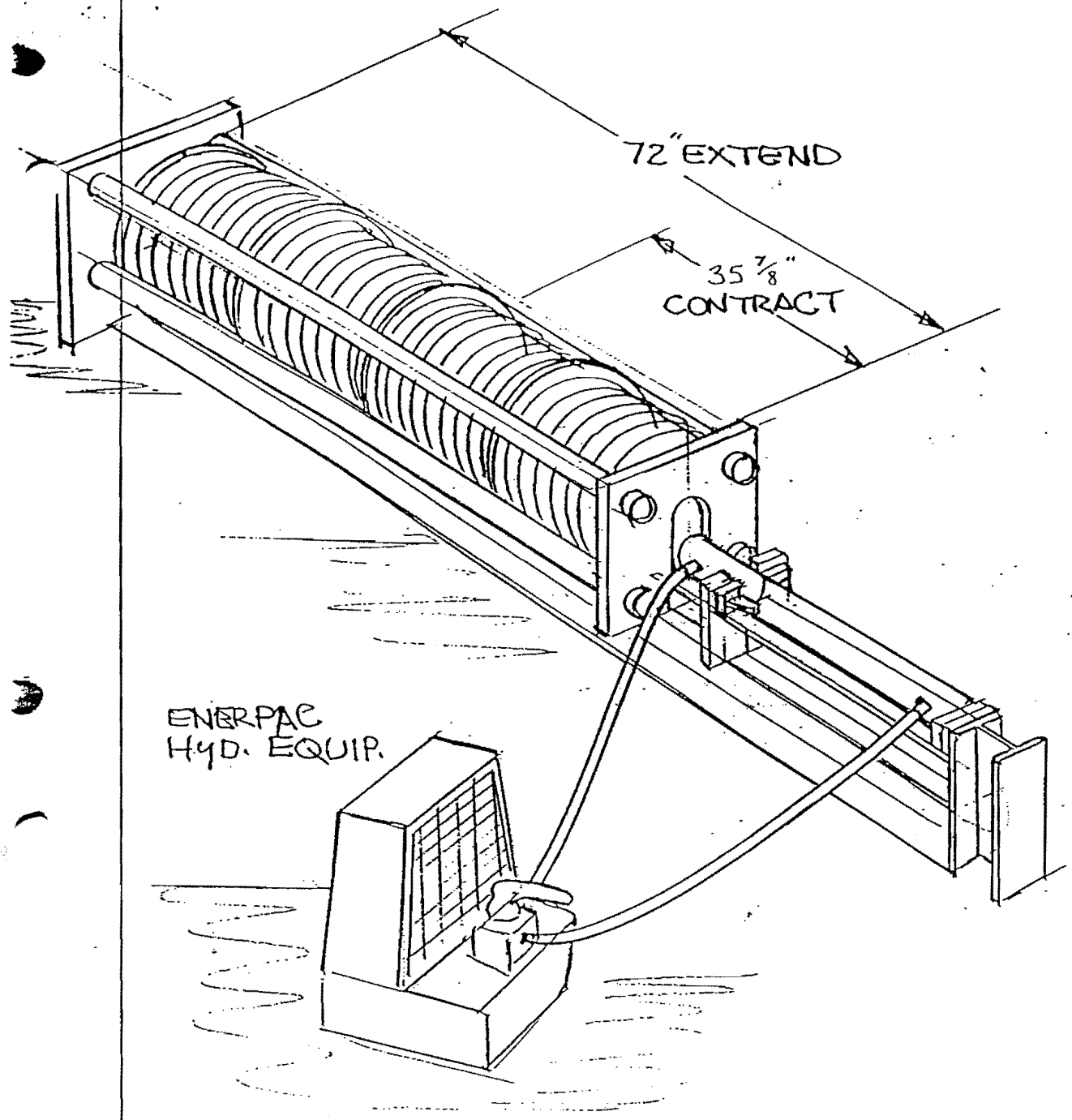
G.R. Trotter

Bellows Drawings

Argon Spill Duct
C.C. To E.C. Bellows
Leak Test

G. R. Trotter
2-11-91





ARGON SPILL DUCT
E.C. TO C.C. BELLOWS
TEST FIXTURE

By: G.R. TROTTER

Pump PEM 5045

Pump Mounted VM-4-AG3

Cap Side V8 OVO Valve

Gauge 12000 V8 Overload

Appendix 2

Expansion Joint Systems, Inc.

Bellows Drawings and Data

EXPANSION JOINT SYSTEMS INC.

QUOTE NUMBER: M89-253 REV.A

TEL:(619)562-6083
FAX:(619)562-0636
TLX:821117 EJS UD

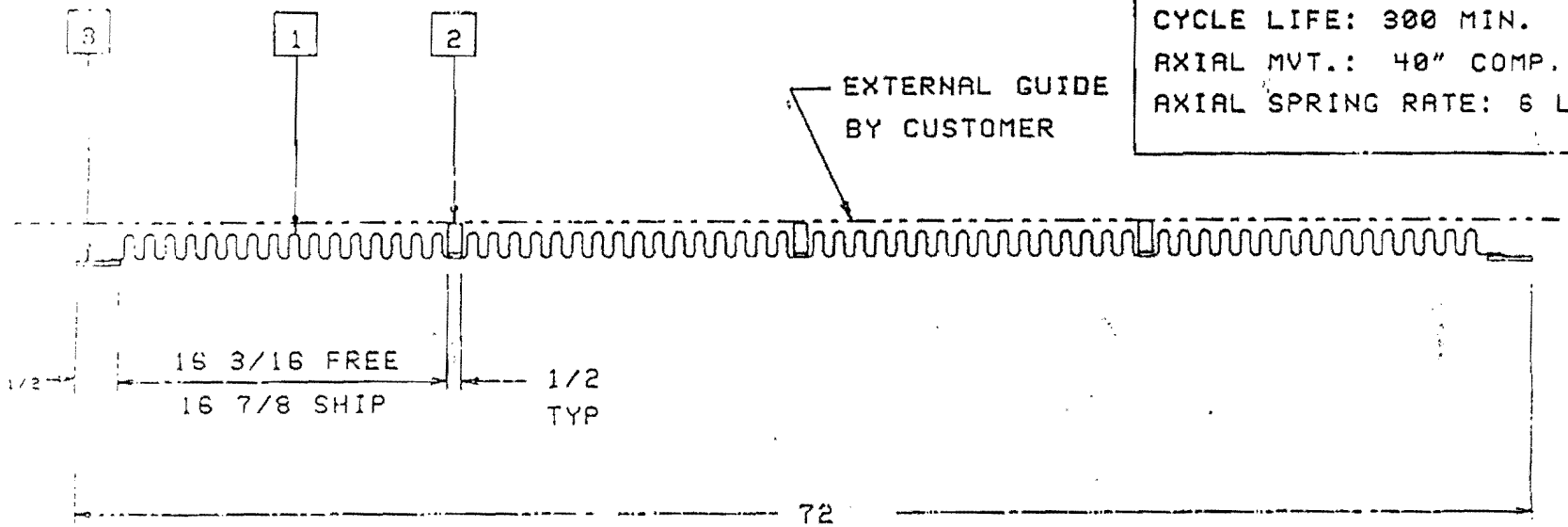
QTY.	SIZE
4	12.15 ~~10 3/4~~ OD.

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



4	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 [illegible] OD.	A240-304
3	BAND 1/8 THK. x 10 3/4 ID.	A240-304

REF:

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,,,

MAX!MOVE 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