QUALIFICATION TEST REPORT

FOR

A 20" TYPE 9200 BUTTERFLY VALVE
WITH
BETTIS ACTUATOR

FOR

FISHER CONTROLS COMPANY
205 SOUTH CENTER STREET
MARSHALLTOWN, IOWA 50158

NEQ

Nuclear Environmental Qualification

Test Report

REPORT NO. 45390-1

WYLE JOB NO. 45390

CUSTOMER P. O. NO. 220272

PAGE i of 18 PAGE REPORT

DATE November 7, 1980

SPECIFICATION (S) See Paragraph 5.0

1.0 CUSTOMER Fisher Controls Company

ADDRESS P. O. Box 190, 205 South Center Street, Marshalltown, Iowa 50158

2.0 TEST SPECIMEN 20" Type 9200 Butterfly Valve with Bettis Actuator

P/N 1R0101X0022

3.0 MANUFACTURER Fisher Controls Company

4.0 SUMMARY

One 20" Type 9200 Butterfly Valve with a Bettis Actuator, hereinafter referred to as the test item, was subjected to four (4) temperature transients and seat leakage tests, as described in Section I of this report. The test item complied with all specified requirements without exception. The tests were performed in accordance with References 5.1 and 5.2.

Ala. Professional Eng. Reg. No. 7913

STATE OF ALABAMA } ss
COUNTY OF MADISON

Robert A. Hall, being duly sworn, deposes and says: The information contained in this report is the result of complete and carefully conducted tests and is to the best of his knowledge true and correct in all respects. Robert A. Hall

SUBSCRIBED and sworn to before me this 18th day of Nov., 1980

SEAL Joyce Oliver

Notary Public in and for the County of Madison, State of Alabama

My Commission expires June 3, 1984

PREPARED BY Earl R Campbell

APPROVED BY Herschel Jordan

WYLE Q. A. Marvin J Kimbell

WYLE LABORATORIES
SCIENTIFIC SERVICES AND SYSTEMS GROUP
HUNTSVILLE, ALABAMA

5.0 REFERENCES

5.1 Fisher Purchase Order 220272

5.2 Fisher Document, Test PGRM/FGS 14A2

6.0 QUALITY ASSURANCE

All test equipment and instrumentation used in the performance of this test program were calibrated in accordance with Wyle Laboratories' Quality Assurance Policies and Procedures Manual, which conforms to the applicable portions of ANSI N-45.2, 10 CFR 50, Appendix B, and Military Specification MIL-C-45662A. Standards used in performing all calibrations are traceable to the National Bureau of Standards.

SECTION I

THERMAL TRANSIENTS AND SEAT LEAKAGE TESTS

1.0 REQUIREMENTS

The valve assembly shall be placed in a preheated 200°F dry oven for 8 hours and the temperature allowed to stabilize. The valve assembly shall be oriented in the oven with the inlet side up and the disc horizontal. The blind flange on the inlet side of the valve shall be secured in such a fashion as to let the oven environment be in contact with T-ring. The outlet side of the valve shall have a blind flange and spool piece secured to it and vented to the atmosphere.

When the stabilization is completed, the test valve assembly shall be removed from the 200°F oven and placed as rapidly as possible in a second oven preheated to 400°F in the same orientation. After the valve assembly has been placed in the oven, the oven temperature shall be brought back to 400°F as rapidly as possible and held for 15 minutes.

Upon completion of the 400°F temperature spike, the blind flange of the valve assembly inlet shall be made air tight. The oven temperature shall be reduced to 125°F and stabilized for 1 hour. Once temperature has been stabilized, the inlet spool piece and blind flange assembly shall be pressurized with air to 2.5 psig for 15 minutes. The seat leakage shall be measured and recorded.

Following the tests outlined above, the oven temperature shall be reduced to 100°F and stabilized for 1 hour. Once the temperature has been stabilized, the inlet spool piece and blind flange assembly shall be pressurized with air to 2.5 psig for 15 minutes. The seat leakage shall be measured and recorded.

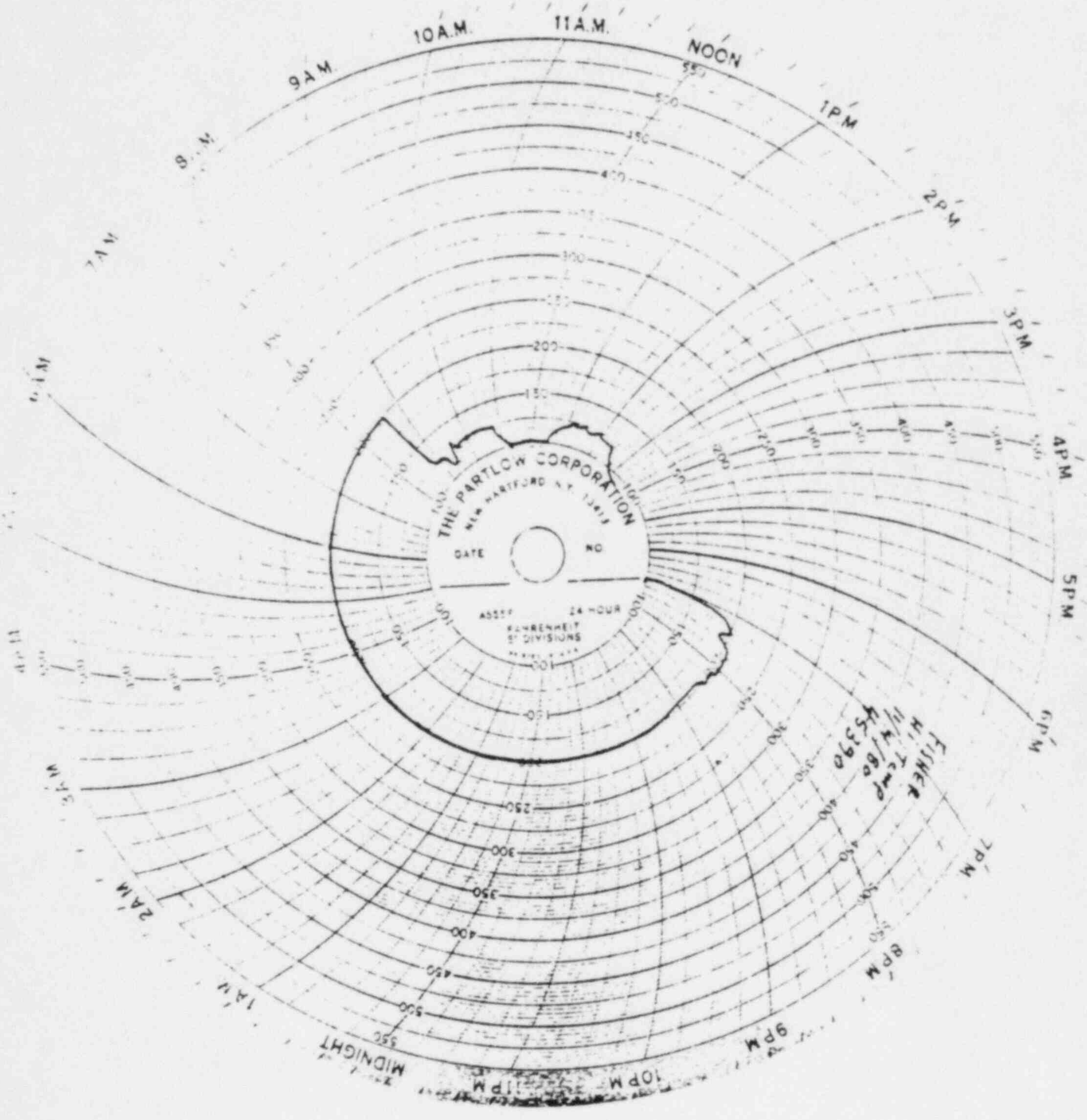
2.0 PROCEDURES

The test item was placed in a temperature controlled oven and the oven temperature stabilized at 200°F ± 3°F for 11 hours. The valve temperature stabilized at 199.4°F.

The test item was removed from the oven and placed in another oven, which was pre-conditioned to 400°F ±3°F. The oven temperature was re-established at 400°F ± 3°F and maintained for 15 minutes. The test item was positioned such that the inlet side was up, the disc horizontal and the T-ring seal exposed to the oven environment. The test item temperature at the end of the 15-minute test was 218°F.

APPENDIX I

CIRCULAR CHARTS



LEAK CHECKS AT 125°F AND 100°F

APPENDIX II

PHOTOGRAPHS

PHOTOGRAPH I-2

INSTRUMENTATION AND LEAK CHECK EQUIPMENT

APPENDIX III

DATA SHEET

APPENDIX IV

INSTRUMENTATION EQUIPMENT SHEET

APPENDIX V

FISHER DOCUMENT
TEST PGRM/FGS 14A2

Attachment A-5

to

Vogtle Qualification Report, FQP-11A

Isomedix Radiation Exposure
Certification Letter, Feb. 3, 1981

ISOMEDIX

February 3, 1981

Mr. Steve Hanzlik
Fisher Controls Company
P.O. Box 190
Marshalltown, Iowa 50158

Dear Mr. Hanzlik:

This will summarize parameters pertinent to the irradiation of one (1) 20" butterfly valve and actuator and two (2) each of 20" spools and blind flanges, as per your Purchase Order #220409. This is Wyle Job #45088.

The unit was exposed for a total of 189 hours at a dose rate of 0.49 megarads and received a dose of 90 megarads. It was then removed from the irradiator, tested by Fisher Controls personnel, and placed back into the radiation field for 206 hours at a dose rate of 0.49 megarads receiving an additional 100 megarads. This was the same unit previously exposed to 11 megarads (see July 22, 1980 certification to E. Campbell, Wyle Labs). Hence the total dose from all exposures was 201 megarads.

Dosimetry was performed using Harwell Red 4034 Perspex dosimeters, utilizing a Bausch and Lomb Model 710 spectrophotometer as the readout instrument. This system is calibrated directly with NBS, with the last calibration being November 11, 1980. A copy of the dosimetry correlation report is available upon request.

Irradiation was conducted in air at ambient temperature and pressure. Radiant heat from the source heated the samples somewhat, but the temperature did not exceed 100 degrees F, as indicated by previous measurements on an oil solution in the same relative position.

Isomedix Inc. • 25 Eastmans Road, Parsippany, New Jersey 07054 • (201) 887-2666

9510-AX5AC03-5068-4 503

Irradiation was initiated on December 12, 1980 and was completed on December 23, 1980.

Very truly yours,

ISOMEDIX, INC.

David P. Constantine

David P. Constantine
Production Manager

DC:ns
cc: Mr. G. Dietz

Attachment A-6

to

Vogtle Qualification Report, FQP-11A

NA-30

Continental Mechanical Aging
Test Report No. 92-395

FISHER Controls MARSHALLTOWN, IOWA	6" Type 9200 Butterfly Valve Cycle Test Report No. 92-395	NO. NA-30	A
		BY CTS	8-14-91
		APVD	9-3-91
		PAGE 0.1	OF
		REV	

THE TABLE BELOW SHOWS THE REVISION LEVEL OF EACH PAGE OF THIS DOCUMENT. A REVISION OF THIS PAGE WILL BE MADE WHEN ANY PAGE OF THIS DOCUMENT IS REVISED.

WHEN REFERRING TO THIS DOCUMENT, SPECIFY THE REVISION LEVEL OF THIS PAGE.

PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL
0.1	A				
1	A				
2	A				
3	A				
4	A				
5	A				
6	A				

TEST REPORT NO. 92-395

SUBJECT: CYCLE TEST ON 6" TYPE 9200 VALVE

PURPOSE: To determine cycle life of seat, bushings, shaft, packing, etc. on Type 9200 adjustable tee ring valve.

EQUIPMENT: 6" 150# Type 9200 adjustable tee ring valve with EPT seat, graphite bronze bushings, and preformed ribbon grafoil packing
480-30 POP actuator
164A Switching valve
Cycle box
Torque transducer
BLH Recorder

PROCEDURE: See Figure I for mounting and piping used.

The valve was cycled every 20 seconds, opening against 150 psig pressure differential on each cycle. Zero pressure differential was maintained in the open position.

The packing was tightened only enough to obtain a seal at 150 psig for the first 10,000 cycles after which the packing nuts were tightened to approximately 110 inch-pounds.

The seat was adjusted to maintain bubble tight shut-off at 150 psig pressure differential.

RESULTS: Seat - The first T-ring installed lasted 16,000 cycles, requiring adjustment every one to three thousand cycles. The second T-ring installed lasted 25,000 cycles, requiring adjustment every one to six thousand cycles.

Packing - The packing required adjustment every one to two thousand cycles for the first 10,000 cycles and every two to five thousand cycles for the remainder of the test. Total compression of the packing was approximately 35%. The packing was in good condition after 50,000 cycles.

Bushing - The bushing showed no appreciable wear after 50,000 cycles. The projected bearing stress was 5,450 psi.

Shaft - The shaft showed no appreciable wear after 50,000 cycles. The shaft stress exceeded code allowable stress by 25%.

Torque - Calculated torque was 820 inch-pounds. As the first T-ring wore the torque increased from 630 inch-pounds initial torque to 1,170 inch-pounds. The second T-ring had an initial torque of 495 inch-pounds and a maximum torque of 810 inch-pounds.

ABSTRACT

A 6" Type 9200 adjustable tee ring valve with EPT seat, graphite bronze bushings and preformed ribbon grafoil packing was cycle tested for 50,000 cycles to determine the cycle life of the various components. Based on the test results, the minimum life of the various components should be as follows:

Metallic parts - greater than 50,000 cycles

Grafoil packing - greater than 50,000 cycles

E.P.T. T-ring - greater than 12,000 cycles

The packing and seat should be checked for leakage and adjusted every one thousand cycles.

WRITTEN BY: Carl D. Wilson
CARL D. WILSON:kac

APPROVED BY: [signature]

Job No. CD76-5

Dist. EDL-5

CONTINENTAL DIVISION

CONCLUSIONS:

Based on the resluts of this test, the minimum life of the various components should be as follows:

Metallic parts - greater than 50,000 cycles

Grafoil packing - greater than 50,000 cycles

E.P.T. T-ring - greater than 12,000 cycles

The packing and seat should be checked for leakage and adjusted as necessary every one thousand cycles.

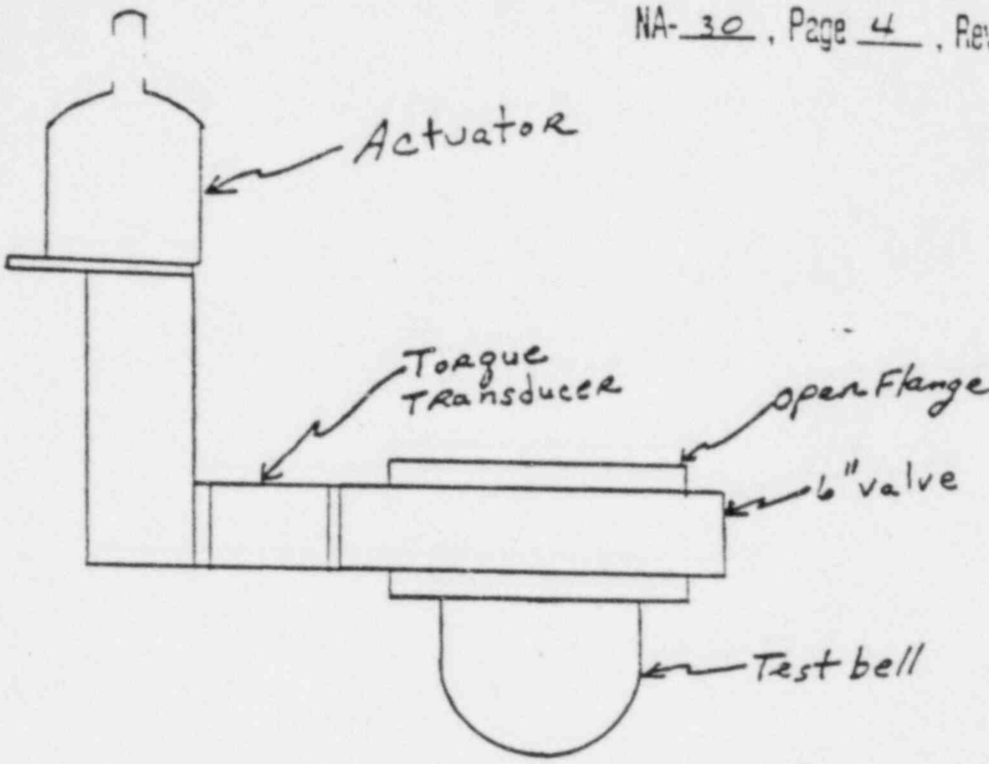
WRITTEN BY: Carl D. Wilson
CARL D. WILSON:kac

APPROVED BY: [signature]

Job No. CD76-5
Dist. EDL-4

FISHER CONTROLS COMPANY
CONTINENTAL DIVISION

March 31, 1976
Test Report #92-395



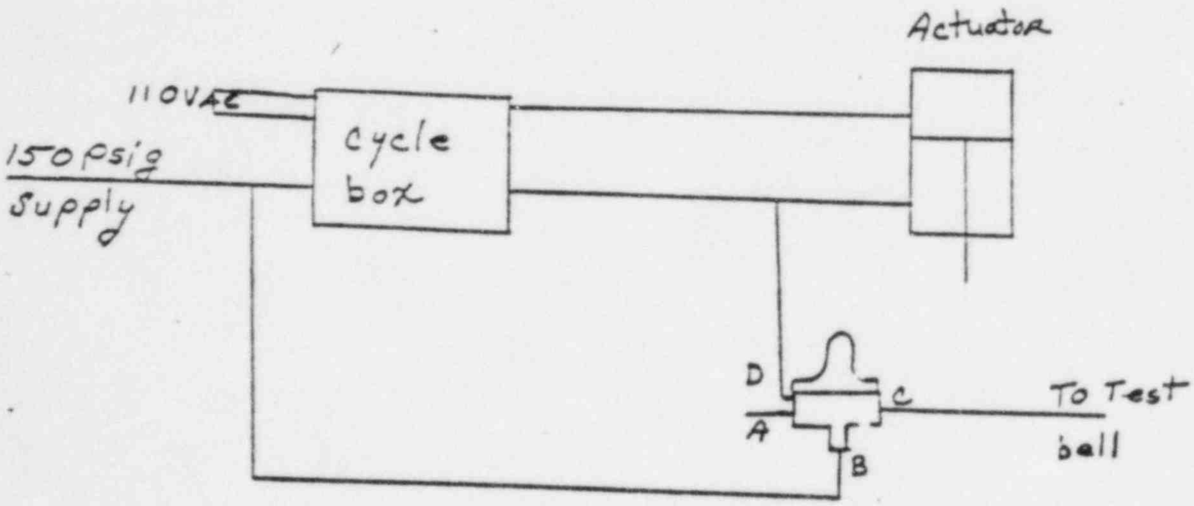


FIGURE I

[illegible]	adjustment	adjustment	[illegible] inch-lbs	[illegible]
0	—	—	630	Packing tightened only enough to seal at 150 p[illegible]
250	both ends.	—	720	
500	Power end.	—	765	
750	—	—	765	
1000	—	yes	810	
1250	—	—	810	
1500	—	—	810	
1750	—	—	810	
2000	power end	—	810	
3000	opp. end	yes	765	
4000	—	—	765	
5000	opp. end	yes	765	
6000	opp. end	—	765	
7000	power end	—	855	
8000	—	yes	765	
9000	opp. end	—	720	
[illegible]	both ends.	yes	835	Packing tightened to
[illegible]	—	yes	900	approx. 110 inch-pounds
12,000	—	yes	945	
13,000	—	—	945	
14,000	—	yes	900	
15,000	opp. end.	yes	990	
16,000	—	yes	1170	
17,000	—	yes	1080	seat bad. Leakage NOT
18,000	—	—	1035	stopped.
19,000	—	—	495	New seat installed
20,000	power end	—	495	
21,000	—	—	630	
22,000	both ends.	yes.	770	packing tightened to
23,000	—	—	765	approx 110 inch-pounds.
24,000	—	—.	765	
25,000	—	—	810	
[illegible],000	—	—	810	
[illegible]	power end	—.	765	
[illegible]	—	yes	765	
[illegible]	—	—	765	
30,000	—	—	720	

[illegible]	adjustment	adjustment	inch-lbs	Remarks
[illegible]1,000	opp. end	—	720	
32,000	—	—	720	
33,000	both ends	yes	720	Packing tightened to
34,000	—	yes	720	approx 120 inch-pounds
35,000	—	—	720	
36,000	both ends	yes	675	
37,000	—	yes	810	
38,000	—	yes	810	
39,000	—	—	765	
40,000	—	yes	765	
41,000	opp. end	—	765	
42,000	—	yes	720	
43,000	—	yes	720	
44,000	—	yes	720	
45,000	power end	yes	720	Seat bad. Leakage not
46,000	—	—	720	stopped
[illegible],000	opp. end	—	720	
48,000	—	—	720	
49,000	—	—	720	
50,000	—	—	720	

Rev. A

Attachment A-7

to

Vogtle Qualification Report FQP-11A

Fisher Lab Problem 1685-3, Report 11
"Determination of Activation Energies
for Nuclear Service Elastomeric Materials"

Dated August 31, 1981

9510-AX5AC03-5068-4 513

DISTRIBUTION RESTRICTED

W. H. Haslett

CONFIDENTIAL DOCUMENT
Single Copy Release
To Lee Waits
By Neal F. Rinehart
Date 8/31/81
DO NOT REPRODUCE

FISHER CONTROLS COMPANY
MARSHALLTOWN, IOWA

PROB. 1685-3
REPORT 11
PAGE 1
DATE 8-31-81

LABORATORY REPORT

LABORATORY REPORT

DETERMINATION OF ACTIVATION ENERGIES FOR NUCLEAR SERVICE ELASTOMERIC MATERIALS

ABSTRACT

Activation energy, a parameter defining the time/temperature interrelationship via the Arrhenius rate equation, was determined for nine elastomeric materials presently used in Fisher nuclear service valves and accessories. Major material types tested were ethylene propylene rubber, nitrile rubber, neoprene and Viton.

M40A1

FISHER CONTROLS COMPANY
MARSHALLTOWN, IOWA

PROB. 1685-3
REPORT 11
PAGE 2
DATE 8-31-81

LABORATORY REPORT

INTRODUCTION

Of the many predictive models for long-term thermal aging of organic material, the most generally accepted [1], [2], [3], [4]* is the Arrhenius reaction rate equation,

$$\frac{dR}{dt} = Ae^{-\frac{\phi}{KT}}$$

The terms of this equation are defined as:

$\frac{dR}{dt}$ = the rate of reduction in some property with time

A = a constant

k = the Boltzmann constant = 8.6168×10^{-5} eV/°K

T = absolute temperature, in °K

ϕ = the Activation Energy of the aging reaction, in eV

In order to establish confidence in our accelerated aging techniques for qualification of nuclear service valves actuators, and other appurtenances, a study was made to determine the actual activation energies for nine materials using as specimens actual parts wherever possible. Up to this time, we have used factors for general organic materials which have been considered conservative.

The test plan was carried out in much the same manner as suggested in the document[1], attached to the letter requesting this study.

* Superscript numbers refer to items listed in Reference Section.

FISHER CONTROLS COMPANY
MARSHALLTOWN, IOWA

PROB. 1685-3
REPORT 11
PAGE 3
DATE 8-31-81

LABORATORY REPORT

TEST PROCEDURE

Materials Tested

A summary of the materials tested is given in Table 1. In general, the materials can be divided into 4 material groups:

A. Ethylene propylene rubber (EPDM) products

B. Nitrile rubber (NBR) products

C. Neoprene (CR) gasket material

D. Viton or fluorelastomer products.

These materials are representative of the major elastomeric components used in Fisher's nuclear service butterfly valves, actuators and regulators.

Specimen Preparation

Items 1 & 2

Extruded T-ring stock was obtained from the supplier in 50 foot lengths (for both cross-sections) and cut into 8" lengths.

Items 3, 4 & 5

O-ring specimens were ordered from existing stock and were aged and tested as whole O-rings.

Item 6

Size 60 molded diaphragms were ordered from stock and test specimens cut from the flat sections of these diaphragms.

Item 7, 8 & 9

Sheet stock was obtained from our local supplier. This is the same stock that is used to cut the various diaphragms and gaskets cited in Table I. Specimens for Mullen Burst Test were cut out of the diaphragm sheet stock and tensile bar specimens were die cut from the gasket stock.

FISHER CONTROLS COMPANY
MARSHALLTOWN, IOWA

PROB. 1685-3
REPORT 11
PAGE 4
DATE 8-31-81

LABORATORY REPORT

Oven Aging

Specimens were aged in circulating air ovens in accordance with ASTM D573-67, "Standard Test Method for Rubber Deterioration in an Air Oven". No attempt was made to control or to add humidity to the oven air. For the record, a calculation was made to approximate the relative humidity at the aging temperature. If room temperature air at 100% relative humidity were heated to 200°F (the lowest aging temperature), the relative humidity would be 0.7%. It is, therefore, safe to state that at all aging conditions, the relative humidity was less than 1%.

The aging temperatures were selected, based on past experience, literature sources, etc., to produce the desired amount of property degradation in a minimum of one day to a maximum of 30 days. In general, this amounted to 3 temperatures for each sample spaced 25°F apart. Using the recommended ASTM D1349 temperatures with spacing of 25°C would have spread the test times out considerably. An attempt was made to obtain 4 different exposure times at each temperature. For most materials this meant a total of 13 data sets (1 control + 3 temperatures x 4 times) with four replicates in each set.

Physical Testing

All Items

Hardness data was obtained on all specimens. Tests were run according to ASTM D2240 using Durometer Type "A" where possible. In some instances where "A" readings were extremely high, Type "B" readings were obtained and converted to "A" reading using a standard conversion chart.

Items 1 & 2

Tensile tests were run using wedge action grips and the following test conditions.

	Item 1	Item 2
Test Machine	Instron	Tinius-Olsen
Test Speed	20"/minute	3"/minute
Initial grip separations	1"	2"
Maximum extension	17"	6"

FISHER CONTROLS COMPANY
MARSHALLTOWN, IOWA

PROB. 1685-3
REPORT 11
PAGE 5
DATE 8-31-81

LABORATORY REPORT

Items 3, 4 & 5

Tensile tests for the O-ring specimens were performed in accordance with ASTM D1414-78 "Testing Rubber O-Rings" using Scott Tester and standard O-ring test fixture.

Items 6, 7 & 8

The diaphragm materials were tested for burst strength as described in ASTM D751-73 "Testing Coated Fabrics" (Section 15.3) using Mullen Tester.

Item 9

The neoprene gasket material was tested for tensile properties using ASTM D412-75 "Standard Test Methods for Rubber Properties in Tension". Scott Tester was used with standard cam action grips.

Treatment of Data

Data for each set was averaged and generally each property was plotted versus log time, resulting in a curve for each temperature. Then, at a certain degree of physical degradation (usually a value close to the mid-range of the data was picked) the times to reach the stated degradation was obtained. The activation energy was calculated using regression analysis to obtain the best fit to the expression:

$$\ln t = A + \frac{\phi}{K}\left(\frac{1}{T}\right)$$

The resulting slope was ϕ/K,

and the activation energy ϕ was obtained by multipying the slope by the Boltzmann constant, $K = 8.6168 \times 10^{-5}$ eV/°K.

The same results could also be obtained graphically by plotting the data on log time vs reciprocal of absolute temperature and finding the resulting slope.

LABORATORY REPORT

DISCUSSION OF RESULTS

The test results are summarized in Table II. Here the calculated Activation Energies are given for all the materials tested. Also listed are the temperature range of the oven aging and the properties tested to determine the activation energies. Only valid results are included in this table. In some cases, such as Item 7, a nitrile/nylon diaphragm material, there was not a significant change in burst strength to use for a valid determination.

Due to the nature of the tests and the inherent variability of elastomeric material there was considerable data scatter. However, when several data points are plotted for each aging temperature, the effect of the scatter is considerably reduced.

In most cases, at least two properties were used to determine the activation energy, and in these cases the agreement was reasonably good.

In the Appendix, the average value and the standard deviation is listed for all the aging temperature/time conditions for all nine materials tested. Also given are plots of each property versus log time, and Arrhenius plots of log time vs reciprocal absolute temperature for each material. These latter plots are presented to establish a visual degree of the conformance of the data to the Arrhenius relationship. The actual activation energies were calculated using linear regression curve fitting to the same Arrhenius equation which is more accurate than the graphical technique.

The object of this study was to establish a minimum (most conservative) activation energy for Fisher valves and components for use in qualification testing. Due to impracticality of aging elastomeric parts to their end of life condition at normal use temperatures, an accelerated aging step is included in almost every qualification test. The aging conditions are established using the Arrhenius rate equation and require knowledge of the actual activation energy or if more than one elastomer is involved, the lowest activation energy value.

In Table III, the average and minimum activation energy values are listed for the four major types of materials tested. For valves and components containing either EPDM or nitrile rubbers it is apparent that an activation energy of $\phi = 0.79$eV would be conservative. There is a high probability that the actual activation energy is higher.

To further establish the validity of the test results, activation energy values from the literature are listed in Table IV along with results from this study. With the possible exception of the Viton O-ring material which was quite high in this study, all tested materials agree quite well with literature values. Even if the literature values are used for Viton, the .79eV minimum is still very conservative.

FISHER CONTROLS COMPANY
MARSHALLTOWN, IOWA

PROB. 1685-3
REPORT 11
PAGE 7
DATE 8-31-81

LABORATORY REPORT

CONCLUSIONS

1. The Arrhenius rate equation is a valid method for predicting time/temperature effects in elastomeric materials.

2. For materials used in Fisher valves and accessories, the use of an activation energy of 0.79 eV to establish qualification aging parameters would be conservative. (The lower the activation energy, the longer the simulated aging time at any given aging temperature.)

3. Exposing specimens in a circulating air oven appears to be a valid technique for accelerating the elastomeric aging process.

RECOMMENDATIONS

1. As the materials chosen for this study were the major elastomeric components used in Fisher nuclear service valves and accessories, the minimum activation energy found (ϕ = 0.79eV) should be used to establish aging parameters via Arrhenius equation for future qualification testing.

W H Haslett
W. H. Haslett
Evaluation & Analysis

LABORATORY REPORT

REFERENCES

1. Educational document by Floyd D. Jury, "Using the Activation Energy Concept for Accelerated Aging of Elastomeric Materials". August 25, 1980

2. M. L. Blaketon, et al, "The Testing of Elastomers for Channel Seal Plugs in a Steam Generating Heavy Water Nuclear Reactors", 8th International Conference on Fluid Sealing, September 11-13, 1978.

3. T. C. P. Lee, et al, "Thermal Stability of Elastomeric Networks at High Temperatures", Journal of Applied Polymer Science, Vol. 10, pp 1831-1836, (1966)

4. R. R. Dixon, "Constructing an Arrhenius Plot with Only One Data Point", SPE - Annual Technical Conference, May 1981.

5. H. A. Pfisterer, et al, "Assessing the Performance of Oil Resistant Vulcanizates at High Temperatures, J. Elastomers & Plastics, Vol. 7, No. 4, pp 427-55 (October '75).

6. Dupont literature

7. J. Mandel, et al, "Measurement of the Aging of Rubber Vulcanizates", Rubber Chemistry & Technology - National Bureau of Standards, Nov 8-13, 1959 - International Rubber Conference, Washington, D.C.

8. E. A. Salazar, et al, "Physical and Chemical Stress Relaxation of a Fluoroelastomer", J. of Applied Polymer Science, Vol. 21, pp 1597-1605 (1977).

9. K. T. Gillen "A Method for Combined Environmental Accelerated Aging", Sandia Laboratories Report SAND-78-0501C.

Table I SUMMARY OF MATERIALS TESTED, / CONDITIONS, AND TESTS RUN

Item No.	Test Material	Material Reference No.	Part No.	Specimen Description	Tests Run	Test Temps. (°F)	Max. Test Times (Days)
1	Small cross-section (½"x½") EPDM T-rings used in Type 9280	06AC	K1241605553	Extruded stock 8" length	Tensile (Ult.Elong) Hardness	250 275 300	30 14 7
2	Large cross-section (7/8"x1") EPDM T-rings used in Type 9280	06BC	K1106405553	8" length of extruded cross-section	Tensile (Ult.Elong) Hardness	250 275 300	30 14 7
3	Nitrile rubber O-rings, as used in Types 667 & 470	050F (DS-52-4)	1R752806562	O-ring 2¼"x2½"x1/8"	Tensile (Ult.Elong) Hardness	200 225 250 275	30 30 14 7
4	Viton O-rings, as used in Types 667NS, 470 and 95	065E (DS-52-5)	1N332506382	O-ring 1-7/8"x2-1/8"x1/8"	Tensile (Ult.Elong) Hardness	475 500 525	30 21 7
5	EPDM O-rings, as used in Type 9280	065H (DS-52-7)	10A3329X012	O-ring 2-3/16"x2-3/8"x3/32"	Tensile (Ult.Elong) Hardness	250 275 300 325	30 14 7 4
6	Nitrile/Nylon diaphragms, as used in NS actuators	0220 (FMS17E44)	2E859702202	pieces cut from molded diaphragm (Size 60)	Mullen Burst Hardness	225 250 275	30 14 7
7	Nitrile/Nylon diaphragms, as used in 67FR regulators	0205 (FMS17E39)	1B798102052*	pieces cut from 17E39 stock	Mullen Burst Hardness	225 250 275 300	30 14 7 7
8	Viton/Dacron diaphragms, as used in 67FR regulators	0233 (FMS17E53)	1V107802332*	pieces cut from 17E53 stock	Mullen Burst Hardness	425 450 475	30 14 7
9	Neoprene gaskets, as used in 67FR regulator	0301 (FMS17G1)	1C128003012*	tensile bars cut from 17G1 stock	Tensile (Ult.Elong) Hardness	225 250 275	30 14 7

* Typical finished part number

Table II - Summary of Test Results

ACTIVATION ENERGY STUDY

Material Description	Temperature Range (°F)	Activation Energy eV	(Kcal./gmole)	Property Tested
1. EPDM Extruded T-rings 1/2" x 1/2" section	250 - 300	1.07	(24.8)	Elongation
		1.04	(23.9)	Tensile Strength
		0.95	(22.0)	Hardness
2. EPDM Extruded T-rings 7/8" x 1" section	250 - 300	.80	(18.5)	Elongation
		.81	(18.6)	Tensile Strength
		.84	(19.4)	Stiffness
		.92	(21.1)	Hardness
5. EPDM O-rings 2 3/16" x 2 3/8" x 3/32"	250 - 325	1.38	(31.9)	Elongation
		1.22	(28.1)	Hardness
3. Nitrile Rubber O-rings 2 1/8" x 2 1/2" x 1/8"	200 - 275	0.88	(20.3)	Elongation
6. Nitrile/Nylon Diaphragm Material (FMS 17E44)	225 - 275	0.80	(18.3)	Mullen Burst Str.
		0.79	(18.2)	Hardness
7. Nitrile/Nylon Diaphragm Material (FMS 17E39)	225 - 300	0.94	(21.8)	Hardness
		Could not determine		Mullen Burst Str.
9. Neoprene Gasket Material (FMS-17G1)	225 - 275	1.00	(23.0)	Elongation
		1.02	(23.4)	Hardness
4. Viton O-rings 1 7/8" x 2 1/8" x 1/8"	475 - 525	2.06	(47.5)	Elongation
		1.81	(41.7)	Hardness
8. Viton/Dacron Diaphragm Material (FMS 17E53)	425 - 475	1.35	(31.1)	Mullen Burst Str.
		1.35	(31.2)	Hardness

/pkg
8-31-81

Table III

Activation Energies For Material Types

Material	Average Value	Minimum Value
A. EPDM	1.00 eV	0.80 eV
B. Nitrile Rubber	0.85	0.79
C. Neoprene	1.01	1.00
D. Viton		
(1) Viton alone	1.94	1.81
(2) Viton/Dacron (Dacron probably controlling)	1.35	1.35
ALL TESTS	1.11	0.79

/pkg
8-31-81

Table IV

Summary of Literature Data

Material Type	Activation Energy φ, (eV)	Property Tested	Reference Number
EPDM	0.93	Elongation	4
	0.93	Elongation	4
	1.05	Elongation, Hardness, Modulus, Tensile Strength	5
	0.83 - 1.32	Tensile Strength	6
	0.95	Hardness, Compression Set, Volume Change	2
	1.02	Elongation, Tensile Strength, Hardness	This Study
	0.84	Hardness & Modulus	This Study
	1.30	Elongation,Hardness	This Study
Nitrile Rubber	1.30	Elongation	4
	1.31	Elongation	4
	0.80 - 0.96	Elongation	7
	0.96 - 0.98	Elongation	5
	0.88	Elongation	This Study
	0.795	Burst Str., Hardness	This Study
	0.94	Hardness	This Study
Neoprene	1.16	Elongation	4
	1.27	Elongation	4
	0.84	Elongation	7
	0.91	Elongation	8
	1.01	Elongation,Hardness	This Study
Viton (Fluroelastomer)	1.05	Seal	4
	1.55	Stress Relaxation	8
	1.34	-	6
	1.94	Elongation,Hardness	This Study
Dacron (Polyester)	1.27	Tensile Strength	4
	1.35	Burst Str.,Hardness	This Study

/pkg
8-31-81

APPENDIX

Table of Contents

/pkg
8-31-81

FISHER CONTROLS COMPANY
MARSHALLTOWN, IOWA

PROB. 1685-3
REPORT 11
PAGE A-1
DATE 8-28-81

LABORATORY REPORT

ACTIVATION ENERGY STUDY — (1) EPDM EXTRUDED T-RING (1/2" x 1/2" section)

TEST TEMP. (°F)	TIME AT TEMP. (HRS.)	No. OF SPECIMENS	HARDNESS (SHORE "A") avg. (std. dev.)	MAX TENSILE LOAD (LBS.)	TENSILE ELONGATION (INCHES)	REMARKS
R.T. CONTROL	—	4	72.0 (.7)	>197	>7.8	No Break
250	48	4	77.2 (.4)	—	—	
	168	4	79.8 (.8)	—	—	
	336	4	78.0 (.7)	>324 (8)	>6.0 (.05)	No Break
	672	4	83.0 (.7)	328 (14)	5.2 (.4)	
275	24	4	76.5 (1.1)	—	—	
	72	4	81.5 (.5)	>283 (3)	>5.6 (.2)	No Break
	168	4	85.5 (.9)	274 (29)	4.5 (.5)	
	336	4	87.8 (.8)	172 (14)	2.3 (.1)	
300	24	4	78.8 (.8)	>217 (15)	>5.7 (.4)	No Break
	72	4	81.8 (.8)	212 (44)	4.2 (1.0)	
	168	4	83.5 (.9)	194 (50)	4.2 (1.6)	

FISHER CONTROLS COMPANY
MARSHALLTOWN, IOWA

PROB. 1685-3
REPORT 11
PAGE A-2
DATE 8-28-81

LABORATORY REPORT

ACTIVATION ENERGY STUDY ② EPDM EXTRUDED T-RING (7/8"x1")

TEST TEMP. (°F)	TIME AT TEMP. (HRS.)	No. OF SPECIMENS	HARDNESS (SHORE "A") avg. (std. dev.)	MAX. TENSILE LOAD (LBS.) avg. (std. dev.)	TENSILE ELONGATION (INCHES) avg. (std. dev.)	STIFFNESS SLOPE OF LOAD/EXT. CURVE
R.T. CONTROL	—	4	71.0 (.7)	>250 *	>6.0	
250	48	4	77.8 (.4)	—	—	
	168	4	79.8 (1.6)	—	—	
	336	4	81.2 (.8)	>249 (14)*	>5.6 (.05)	.35 (.02)
	672	4	85.0 (1.2)	233 (19)	4.8 (.3)	.44 (.02
275	24	4	76.2 (.4)	—	—	
	72	4	80.8 (.8)	—	—	
	168	4	84.8 (.4)	>266 (32)*	>5.6 (.07)	.39 (.02)
	336	4	88.0 (.7)	214 (19)	3.55 (.25)	.49 (.02)
300	24	4	79.8 (1.3)	—	—	
	72	4	83.0 (1.2)	>234 (20)*	>5.0 (.2)	.35 (
	168	4	81.5 (.5)	220 (20)	4.3 (1.3)	.48 (8)

* NO BREAK

FISHER CONTROLS COMPANY

MARSHALLTOWN, IOWA

PROB. 1685-3
REPORT 11
PAGE A-3
DATE 8-28-81

LABORATORY REPORT

ACTIVATION ENERGY STUDY — ③ NITRILE RUBBER O-RINGS

TEST TEMP. (°F)	TIME AT TEMP. (HRS.)	No. OF SPECIMENS	HARDNESS (SHORE "A") avg. (std. dev.)	TENSILE STRENGTH (PSI) avg. (std. dev.)	ELONGATION AT FAIL (%) avg. (std. dev.)
R.T. CONTROL	—	4	73.5 (1.7)	1232 (120)	164 (15)
200	72	4	75.8 (2.2	1162 (119)	130 (13)
	168	4	81.2 (.8)	1218 (42)	113 (5)
	336	4	84.8 (.4)	1198 (79)	94 (5)
	672	4	92.5 (1.5)	1243 (260)	55 (13)
225	24	4	78.8 (.8)	1349 (118)	158 (3)
	168	4	84.5 (1.8)	1016 (163)	74 (16)
	336	4	87.2 (.8)	1167 (223)	54 (10)
	672	4	91.5 (1.7)	1122 (212)	26 (5)
250	24	4	76.5 (2.3)	1074 (61)	132 (2)
	72	4	81.0 (.7)	980 (105)	77 (8)
	168	4	88.0 (.7)	912 (58)	44 (2)
	336	4	89.2 (1.9)	876 (129)	22 (4)
275	24	4	77.8 (1.8)	916 (37)	84 (1)
	72	4	88.8 (1.1)	697 (33)	25 (8)
	168	4	95-100	130 (6)	6 (1)

FISHER CONTROLS COMPANY
MARSHALLTOWN, IOWA

PROB. 1685-3
REPORT 11
PAGE A-4
DATE 8-28-81

LABORATORY REPORT

ACTIVATION ENERGY STUDY (4) VITON O-RINGS

TEST TEMP. (°F)	TIME AT TEMP. (HRS.)	No. OF SPECIMENS	HARDNESS (SHORE "A") avg. (std. dev.)	TENSILE STRENGTH (PSI) avg. (std. dev.)	ELONGATION AT FAIL (%) avg. (std. dev)	
R.T. CONTROL	—	4	74.0 (1.3)	1464 (89)	196 (11)	
475	24	3	75.7 (.5)	1334 (260)	164 (19)	
	72	3	79.0 (1.0)	1577 (34)	181 (6)	
	168	3	75.0 (0)	1443 (8)	183 (4)	
500	72	4	82.0 (.7)	1394 (45)	183 (10)	
	168	4	83.8 (.8)	1077 (126)	143 (21)	
	336	4	87.5 (1.8)	755 (24)	58 (12)	
	504	4	92.5 (.9)	714 (71)	19 (5)	
525	24	2	77.0 (0)	1118 (34)	194 (4)	
	168	3	95-100	954 (8)	19 (9)	

FISHER CONTROLS COMPANY
MARSHALLTOWN, IOWA

PROB. 1685-3
REPORT 11
PAGE A-5
DATE 8-28-81

LABORATORY REPORT

ACTIVATION ENERGY STUDY (5) EPDM O-RINGS

TEST TEMP. (°F)	TIME AT TEMP. (HRS.)	No. OF SPECIMENS	HARDNESS (SHORE "A") avg. (std. dev.)	TENSILE STRENGTH (PSI) avg. (std. dev.)	ELONGATION AT FAIL (%) avg. (std. dev.)
R.T. CONTROL	—	4	71.5 (1.1)	1735 (127)	298 (15)
250	48	4	77.5 (5.7)	1567 (130)	234 (45)
	168	4	81.5 (7.7)	1680 (55)	209 (64)
	336	4	81.5 (6.3)	1614 (33)	198 (66)
	672	4	81.0 (5.3)	1562 (152)	212 (82)
275	24	3	80.5 (5.5)	1466 (124)	206 (13)
	72	3	82.7 (6.6)	1810 (47)	222 (60)
	168	3	85.0 (5.1)	1829 (226)	180 (63)
	336	3	85.3 (5.0)	1504 (55)	118 (73)
300	24	4	77.8 (6.5)	1884 (145)	254 (66)
	72	4	95 (9.3)	1633 (92)	119 (69)
	168	4	90.0 (2.5)	1504 (138)	52 (57)
325	8	3	83.0 (12.0)	1403 (92)	191 (74)
	24	3	87.3 (10.4)	1253 (55)	152 (87)
	48	3	89 (14)	1200 (129)	132 (80)
	96	3	96 (.5)	970 (16)	152 (6)

FISHER CONTROLS COMPANY

MARSHALLTOWN, IOWA

PROB. 1685-3
REPORT 11
PAGE A-6
DATE 8-28-81

LABORATORY REPORT

ACTIVATION ENERGY STUDY ⑥ NITRILE/NYLON DIAPHRAGMS (FMS 17E44)

TEST TEMP. (°F)	TIME AT TEMP. (HRS.)	No. OF SPECIMENS	HARDNESS (SHORE "A") avg. (std. dev.)	BURST STRENGTH (PSIG) avg. (std. dev.)		
R.T. CONTROL	—	4	62 -	761 (2)		
225	24	3	66	782 (15)		
	168	4	66	768 (24)		
	336	4	72	776 (4)		
	672	3	79	830 (8)		
250	24	3	66	762 (15)		
	72	3	68	772 (8)		
	168	3	75	787 (17)		
	336	3	82	865 (12)		
275	24	3	65	753 (2)		
	72	3	72	783 (17)		
	168	3	80	843 (12)		

FISHER CONTROLS COMPANY
MARSHALLTOWN, IOWA

PROB. 1685-3
REPORT 11
PAGE A-7
DATE 8-26-81

LABORATORY REPORT

ACTIVATION ENERGY STUDY (7) NITRILE/NYLON DIAPHRAGM MAT'L (FMS 17E39)

TEST TEMP. (°F)	TIME AT TEMP. (HRS.)	No. of SPECIMENS	HARDNESS (SHORE "A") avg. (std. dev.)	BURST STRENGTH (PSIG) avg. (std. dev.)		
R.T. CONTROL	—	4	78 —	545 (21)		
225	24	4	80	502 (18)		
	168	4	78	505 (15)		
	336	4	82	516 (16)		
	672	4	85	488 (16)		
250	24	4	81	490 (15)		
	72	4	83	498 (13)		
	168	4	84	512 (10)		
	336	4	86	501 (13)		
275	24	4	82	506 (13)		
	72	4	82	504 (16)		
	168	4	86	499 (11)		
300	8	4	78	505 (19)		
	24	4	79	507 (16)		
	72	4	95-100	561 (26)		
	168	4	TOO BRITTLE	TO TEST		

FISHER CONTROLS COMPANY
MARSHALLTOWN, IOWA

PROB. 1685-3
REPORT 11
PAGE A-8
DATE 8-28-81

LABORATORY REPORT

ACTIVATION ENERGY STUDY (8) VITON/DACRON DIAPHRAGM MAT'L. (FMS 17E53)

TEST TEMP. (°F)	TIME AT TEMP. (HRS.)	No. OF SPECIMENS	HARDNESS (SHORE "B") avg. (std. dev.)	BURST STRENGTH (PSIG) avg. (std. dev.)		
R.T. CONTROL	—	4	79	505 (4)		
425	72	4	80	339 (7)		
	168	4	81	194 (17)		
	336	4	82	150 (12)		
	672	4	82	108 (11)		
450	24	4	80	321 (6)		
	72	4	80	296 (8)		
	168	4	82	170 (14)		
	336	4	83	116 (17		
475	24	4	78	198 (88)		
	72	4	83	171 (13)		
	168	4	85	42 (11)		

FISHER CONTROLS COMPANY
MARSHALLTOWN, IOWA

PROB. 1685-3
REPORT 11
PAGE A-9
DATE 8-28-81

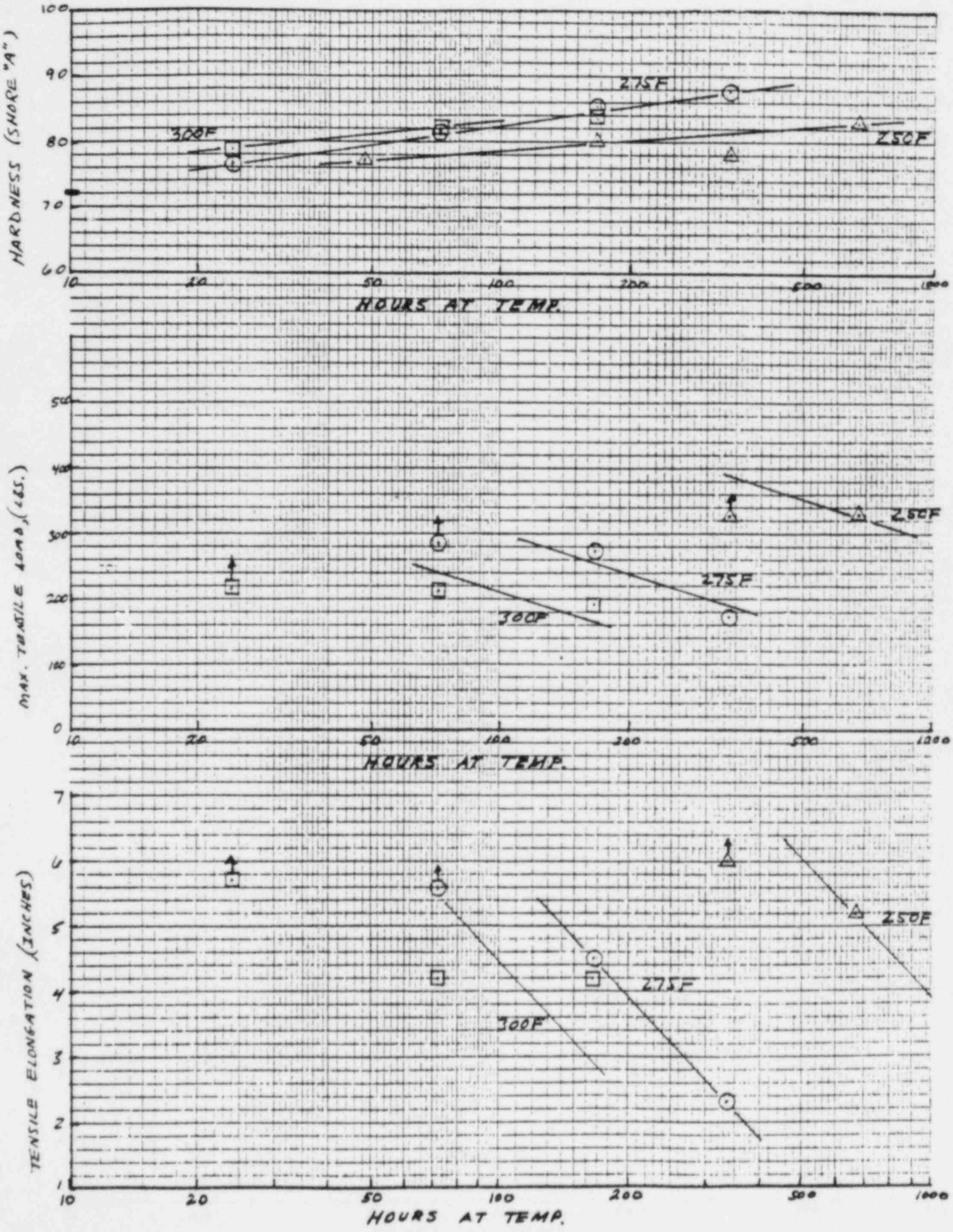
LABORATORY REPORT

ACTIVATION ENERGY STUDY ⑨ NEOPRENE GASKET MAT'L. (FMS 13G1)

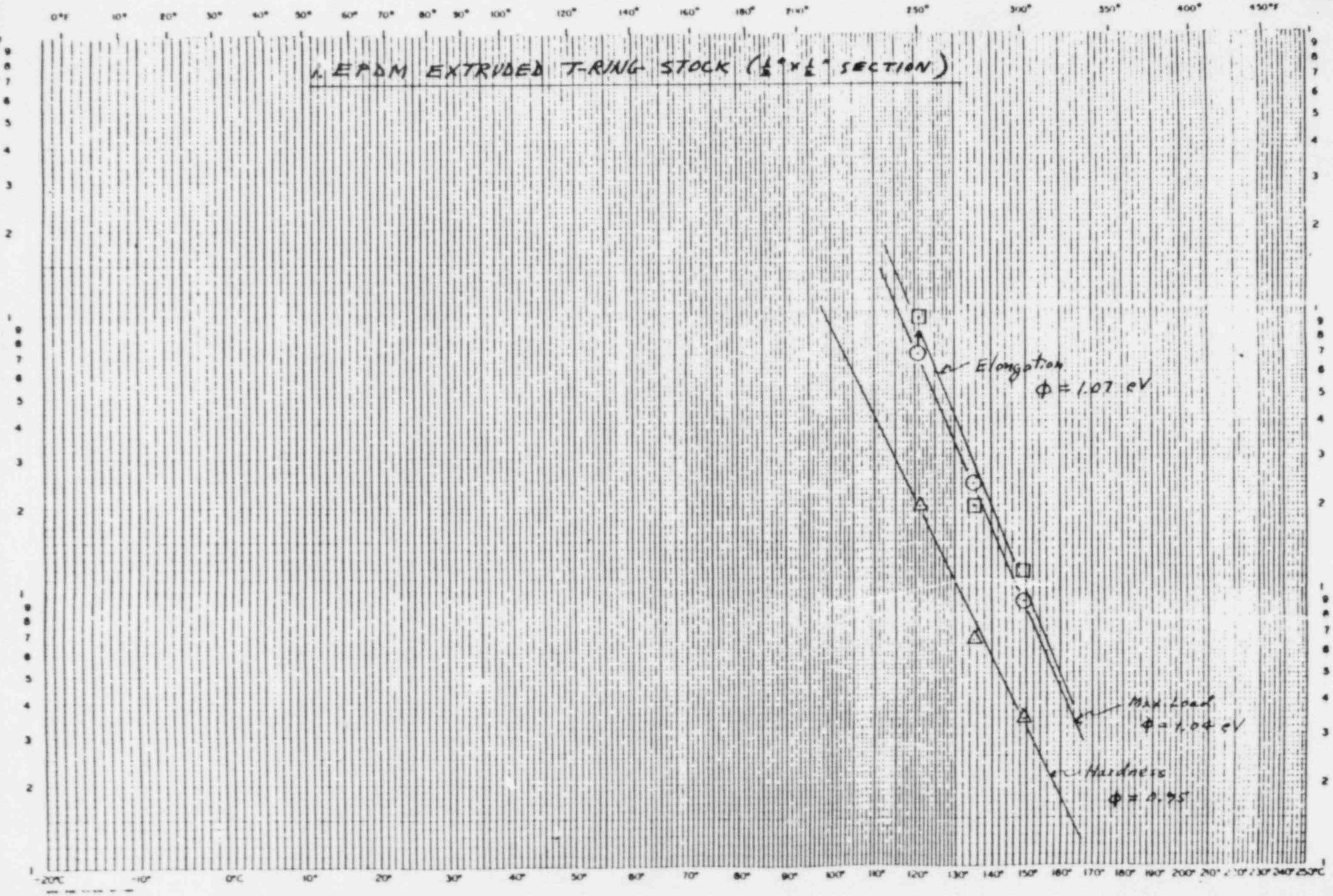
TEST TEMP. (°F)	TIME AT TEMP. (HRS.)	No. OF SPECIMENS	HARDNESS (SHORE "A") avg. (std. dev.)	TENSILE STRENGTH (PSI) avg. (std. dev.)	ELONGATION AT FAIL (%) avg. (std. dev.)	
R.T. CONTROL	—	4	74	1108 (33)	126 (11)	
225	24	4	74	1140 (30)	122 (4)	
	168	4	81	1168 (68)	95 (11)	
	336	4	82	1090 (19)	85 (11)	
	672	4	90	1255 (59)	52 (8)	
250	24	4	76	1182 (54)	110 (7)	
	72	4	84	1302 (25)	76 (4)	
	168	4	87	1312 (15)	56 (4)	
	336	4	92	1605 (281)	14 (4)	
275	24	4	82	1190 (90)	80 (6)	
	72	4	86	1113 (143)	62 (8)	
	168	4	—	—	10	

PROB. 1685-3
REP. 11
FIG. A-1

① EPDM EXTRUDED T-RING (½" x ½" SECTION)

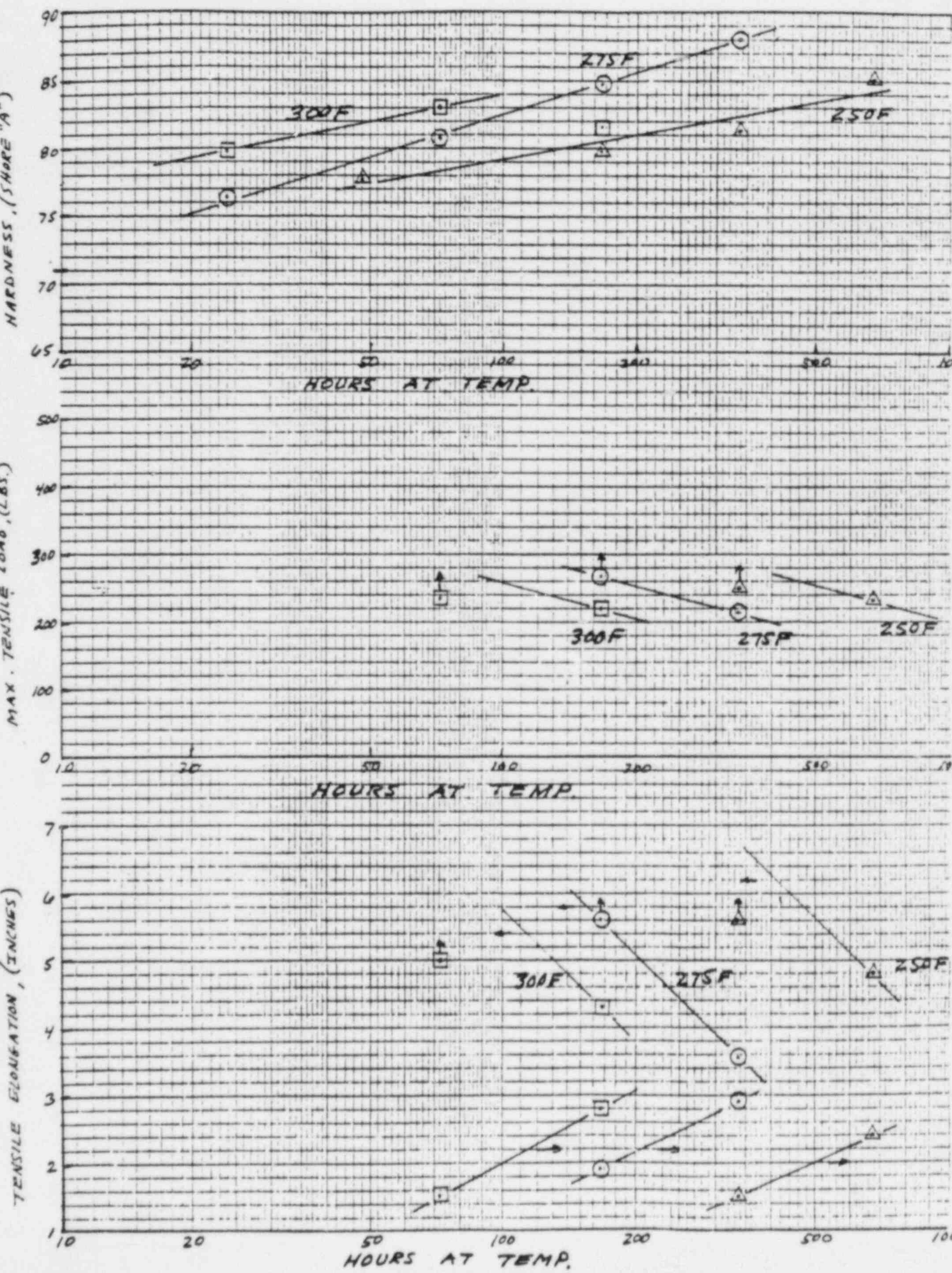


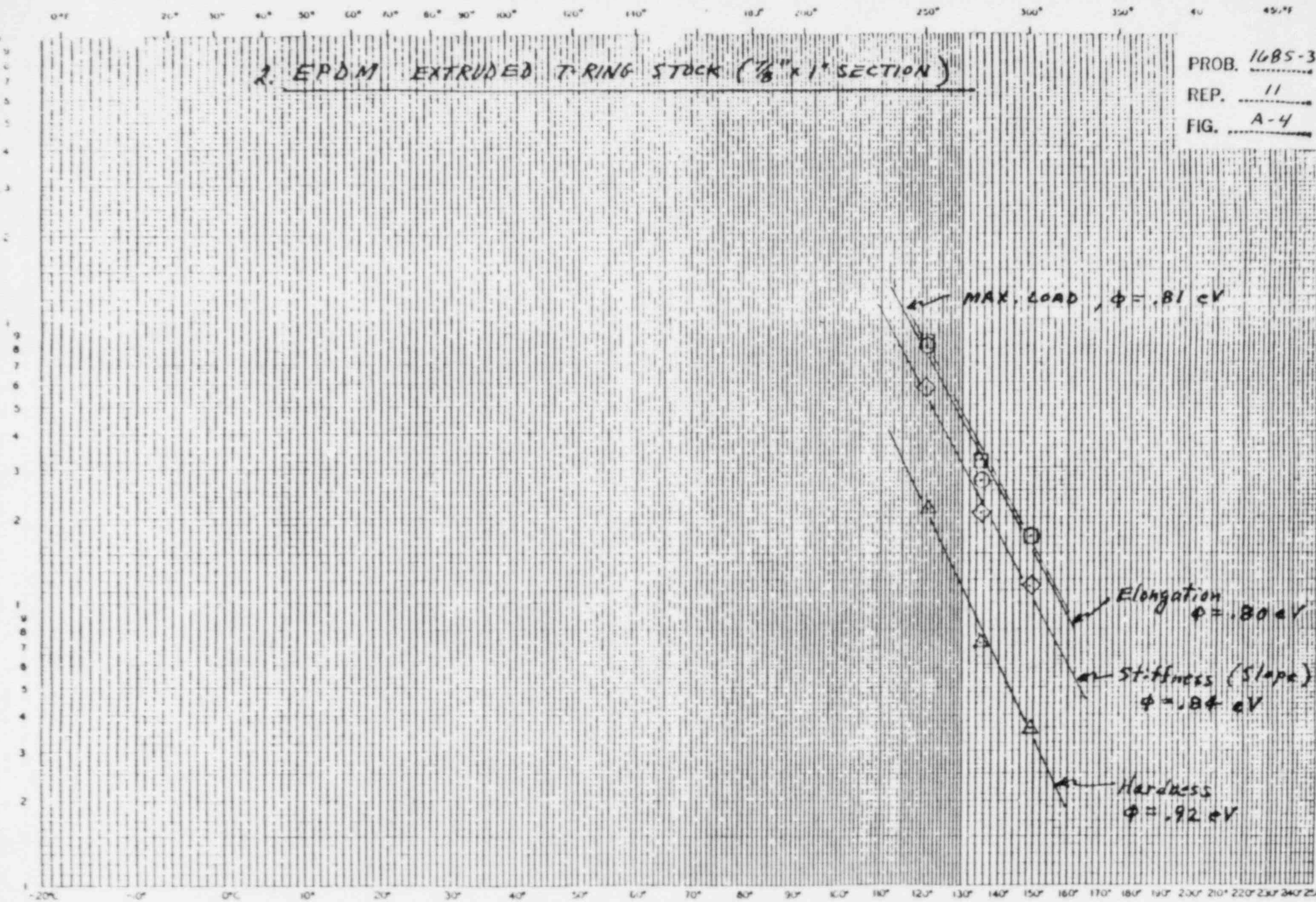
PROB. 1685-3
REP. 11
FIG. A-2



PROB. 1685-3
REP. 11
FIG. A-3

② EPDM EXTRUDED T-RING (7/8" x 1" SECTION)

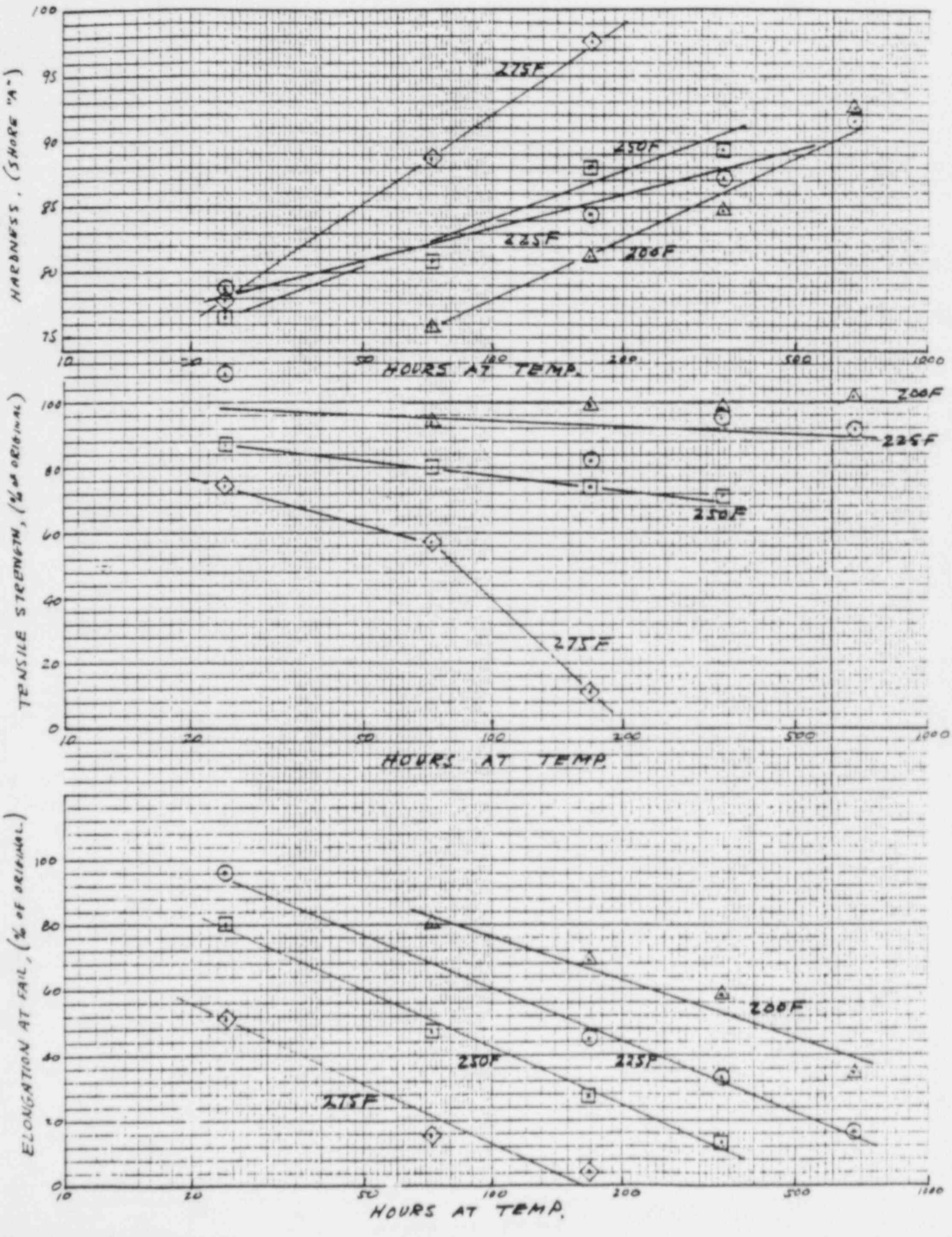


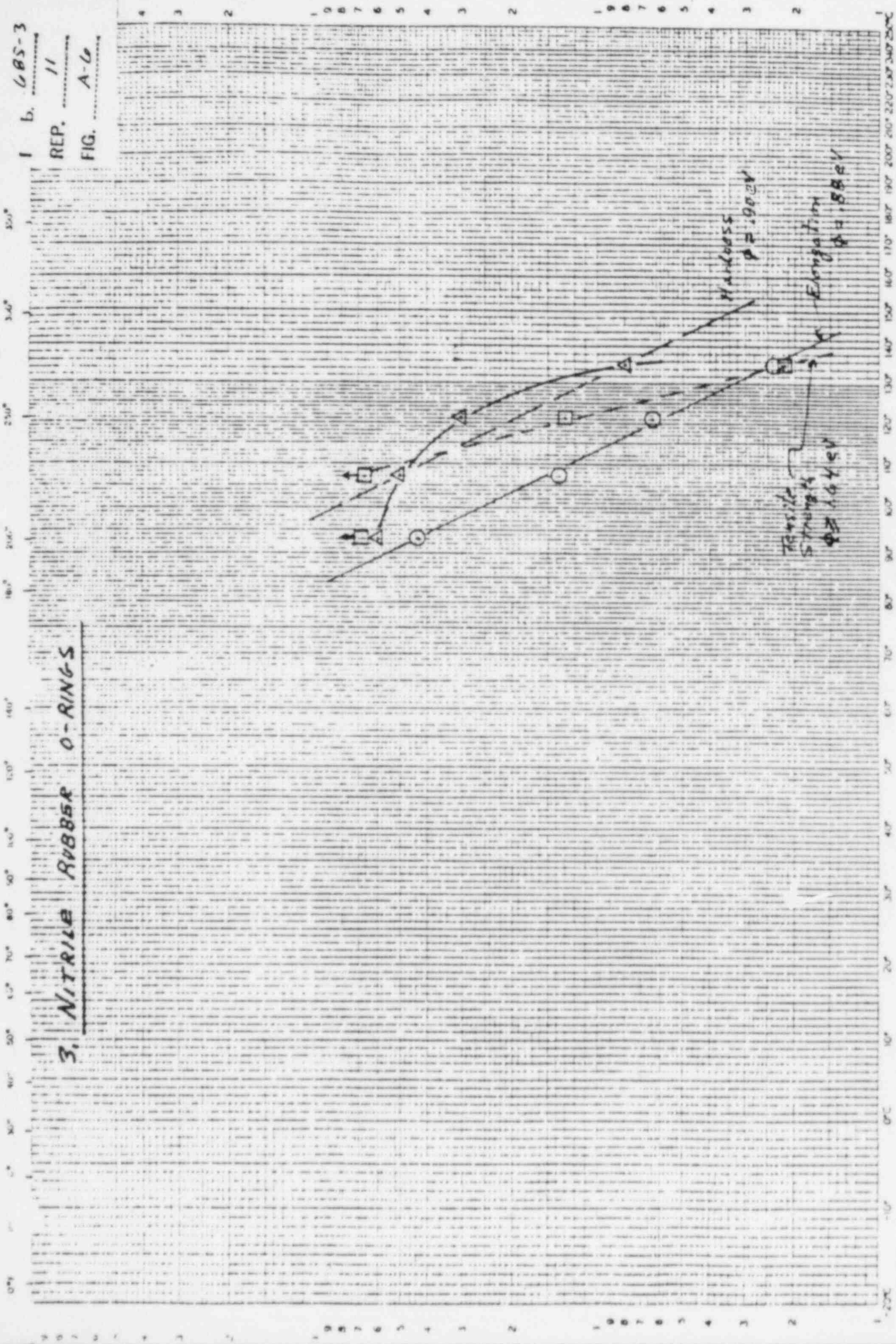


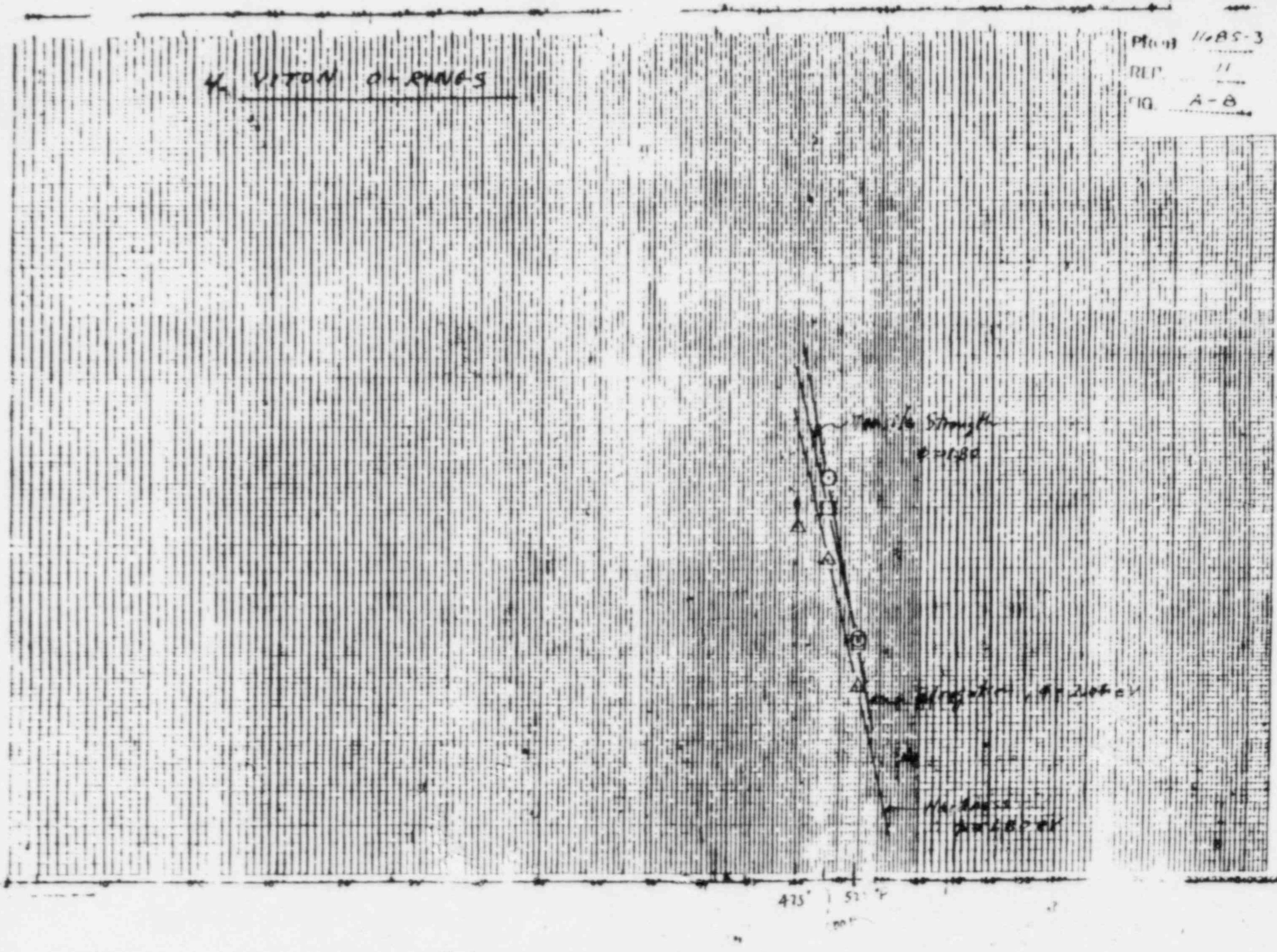
2. EPDM EXTRUDED T-RING STOCK (7/8" x 1" SECTION)
PROB. 16BS-3
REP. 11
FIG. A-4
MAX. LOAD, φ = .81 eV
Elongation φ = .80 eV
Stiffness (Slope) φ = .84 eV
Hardness φ = .92 eV

PROB. 1685-3
REP. 11
FIG. A-5

(3) NITRILE RUBBER O-RINGS

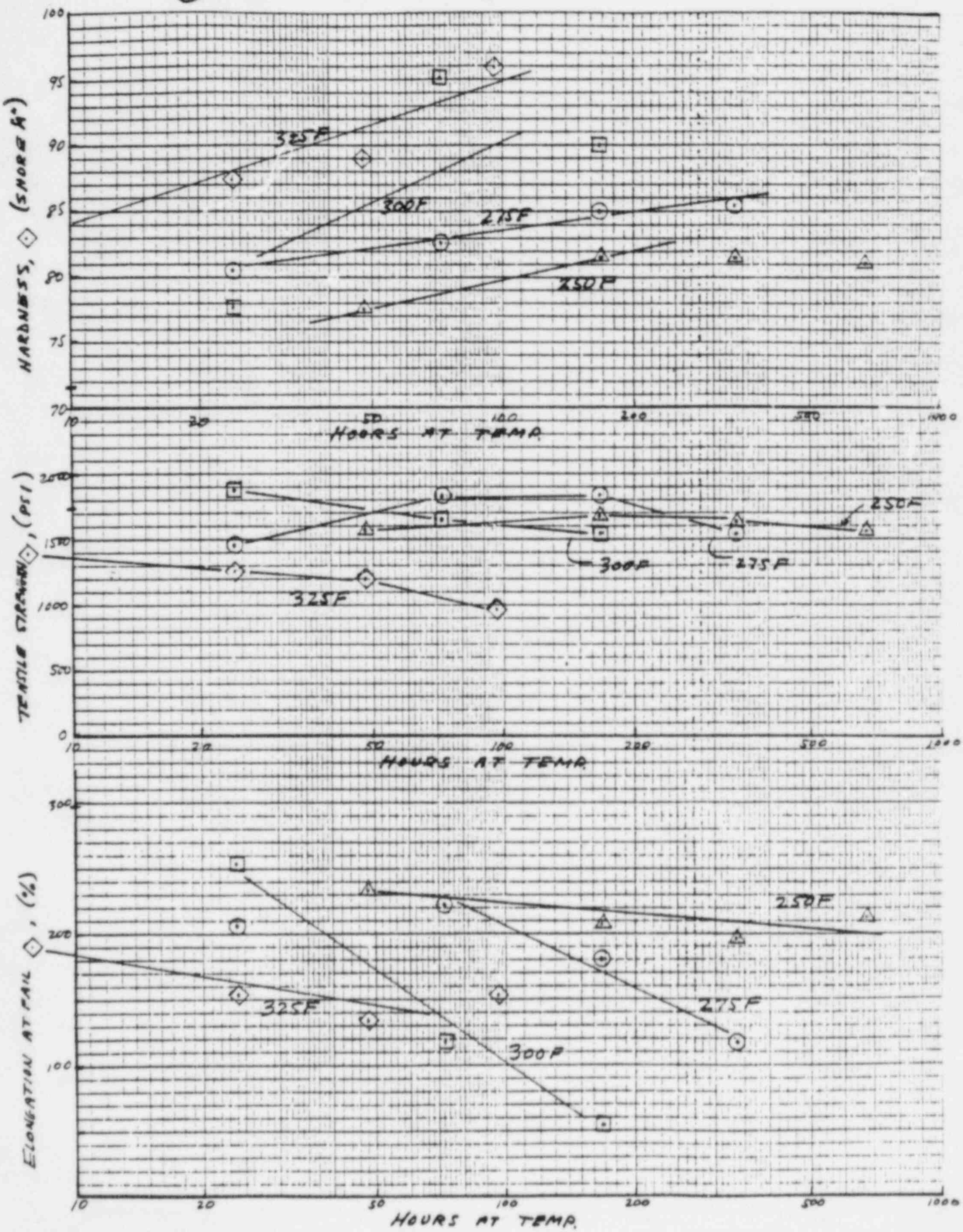


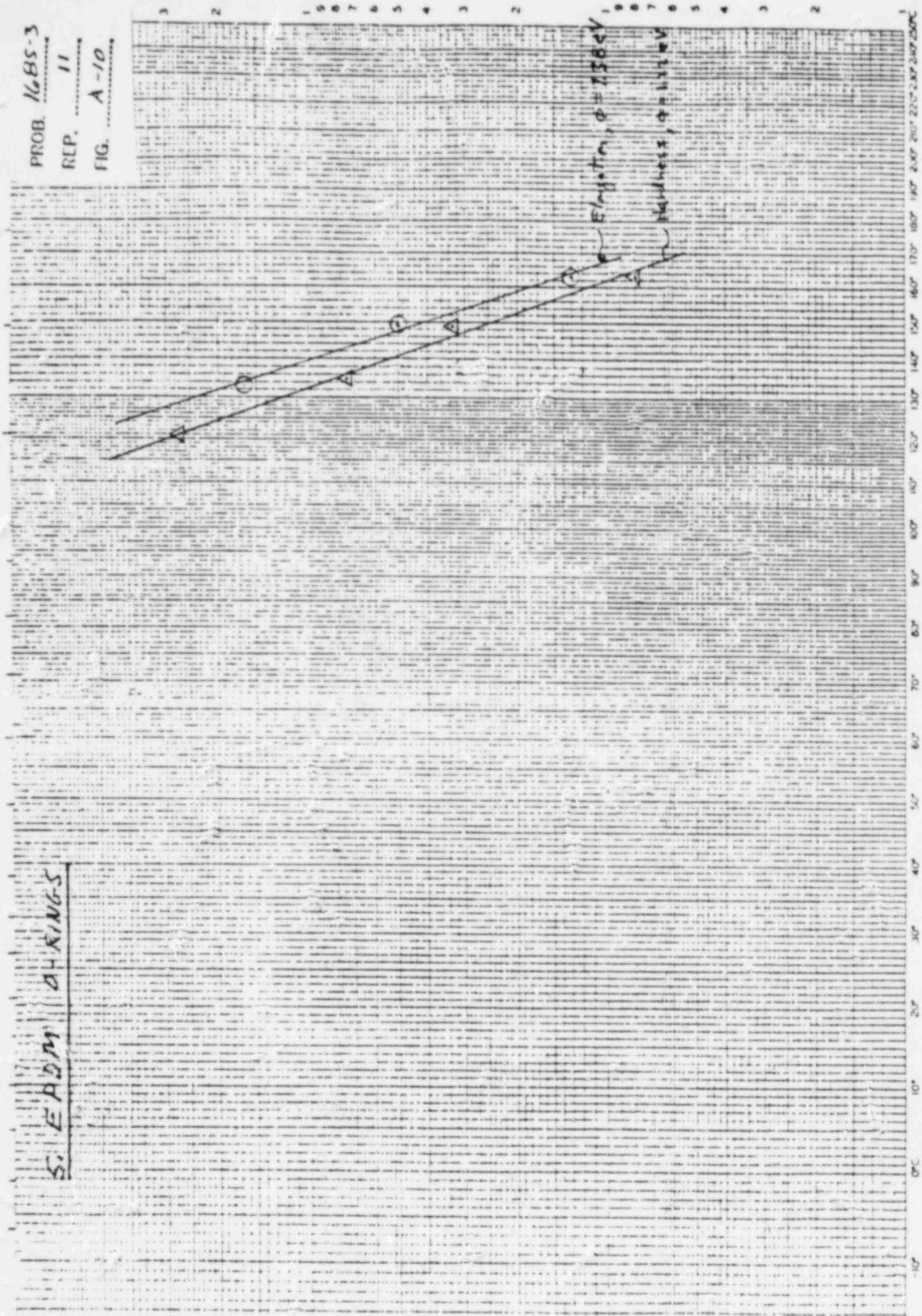

Lb. 6BS-3
REP. 11
FIG. A-6
3. NITRILE RUBBER O-RINGS
Hardness φ=190eV
Elongation φ=188eV
Tensile Strength φ=164eV


Plant 11-85-3
REP. 11
FIG. A-8
VITON O-RINGS
Tensile Strength
Elongation
Hardness

PROB. 1685-3
REP. 11
FIG. A-9

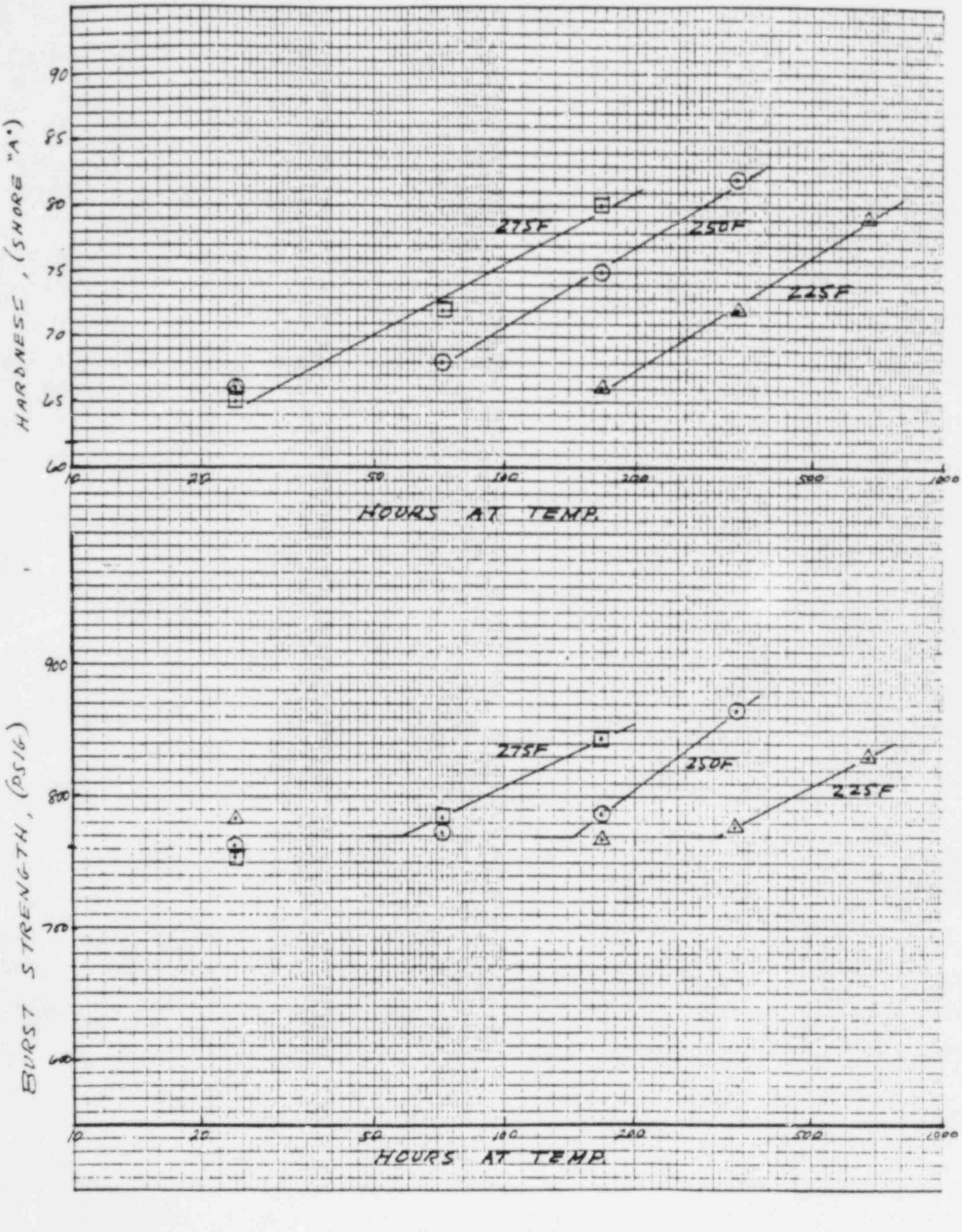
⑤ EPDM O-RINGS

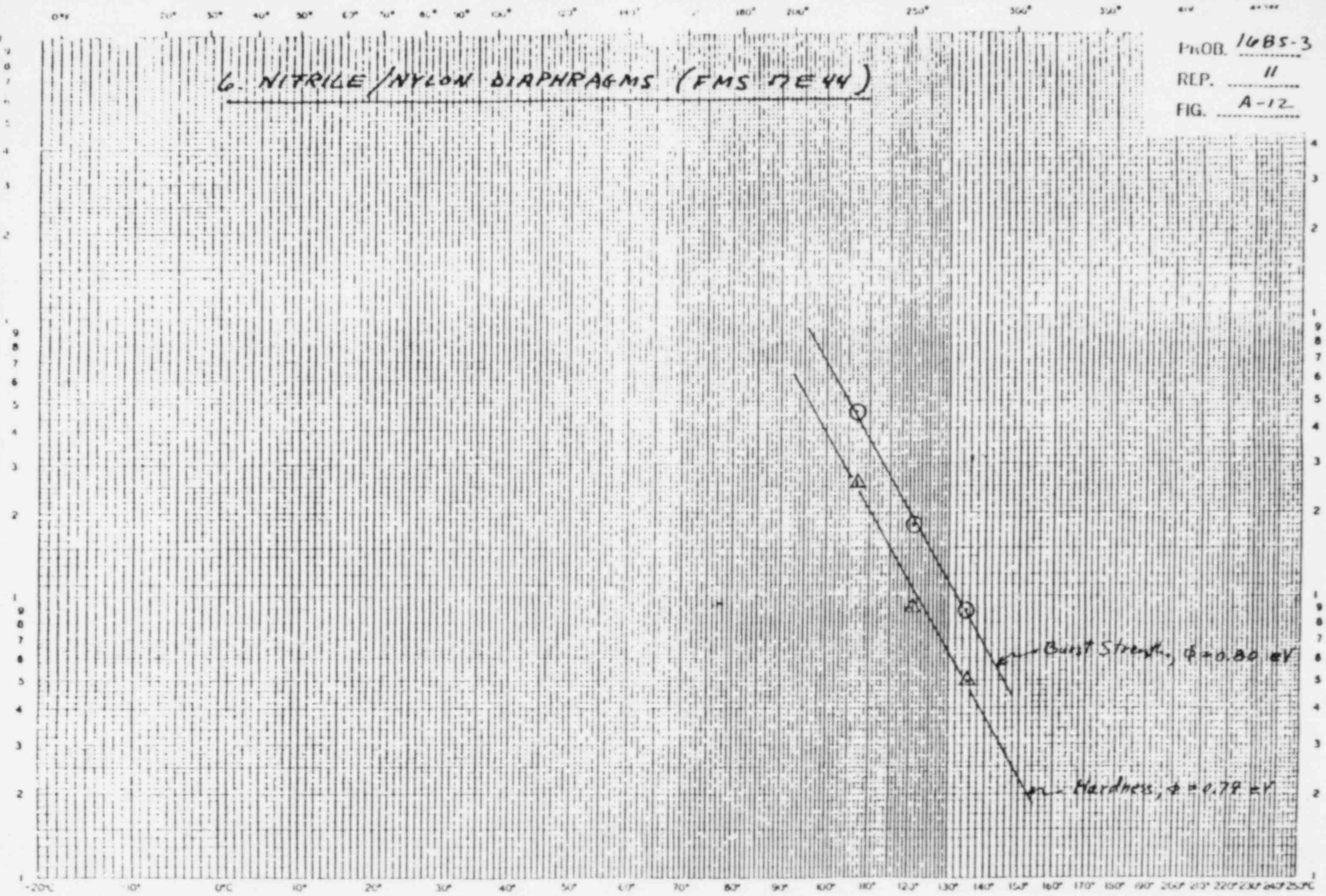



PROB. 1685-3
REP. 11
FIG. A-10
Elongation, φ=7.58eV
Hardness, φ=...eV
S. EADM O-RINGS

PROB. 1685-
REP. 11
FIG. A-11

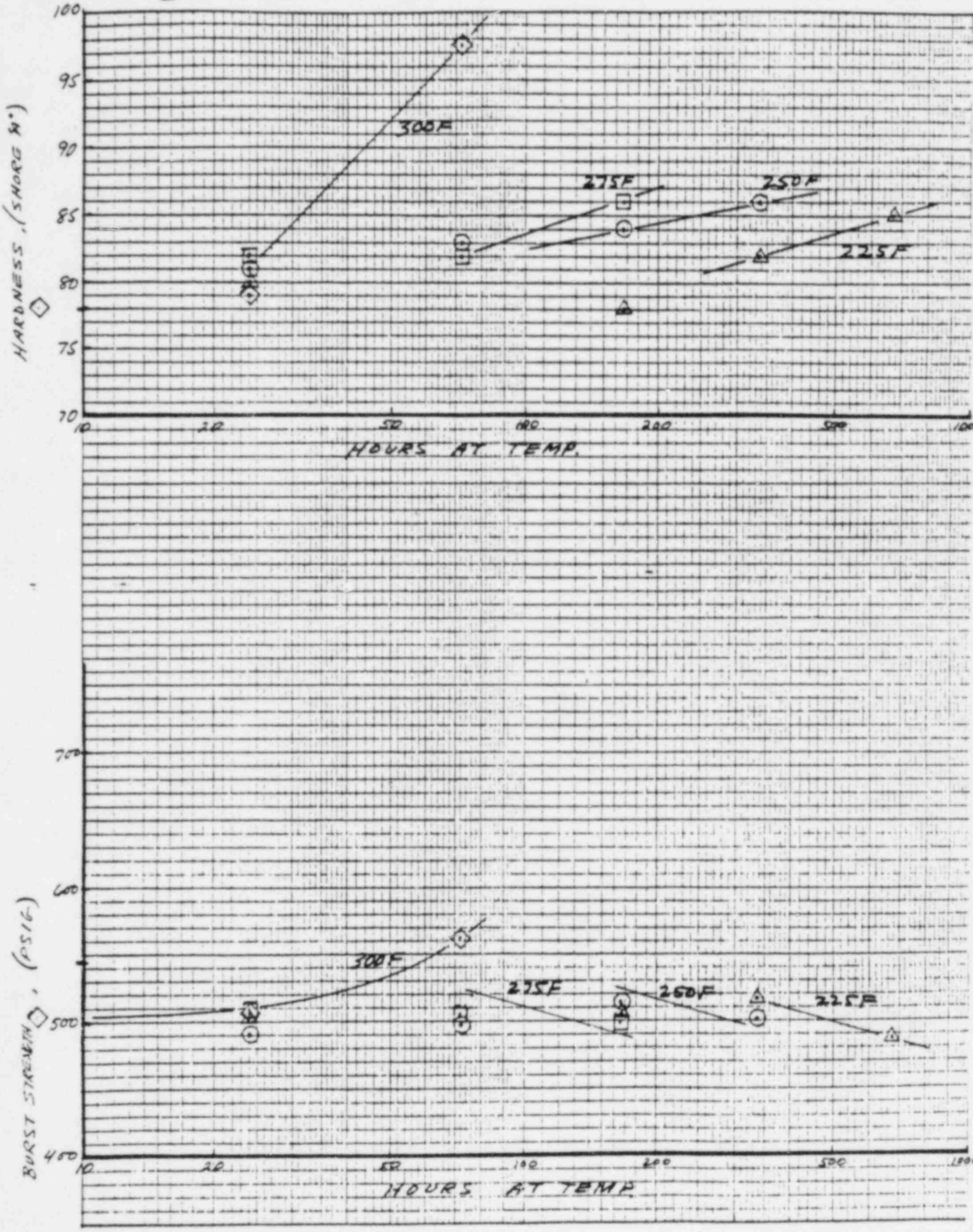
⑥ NITRILE/NYLON DIAPHRAGMS (FMS 17E44)

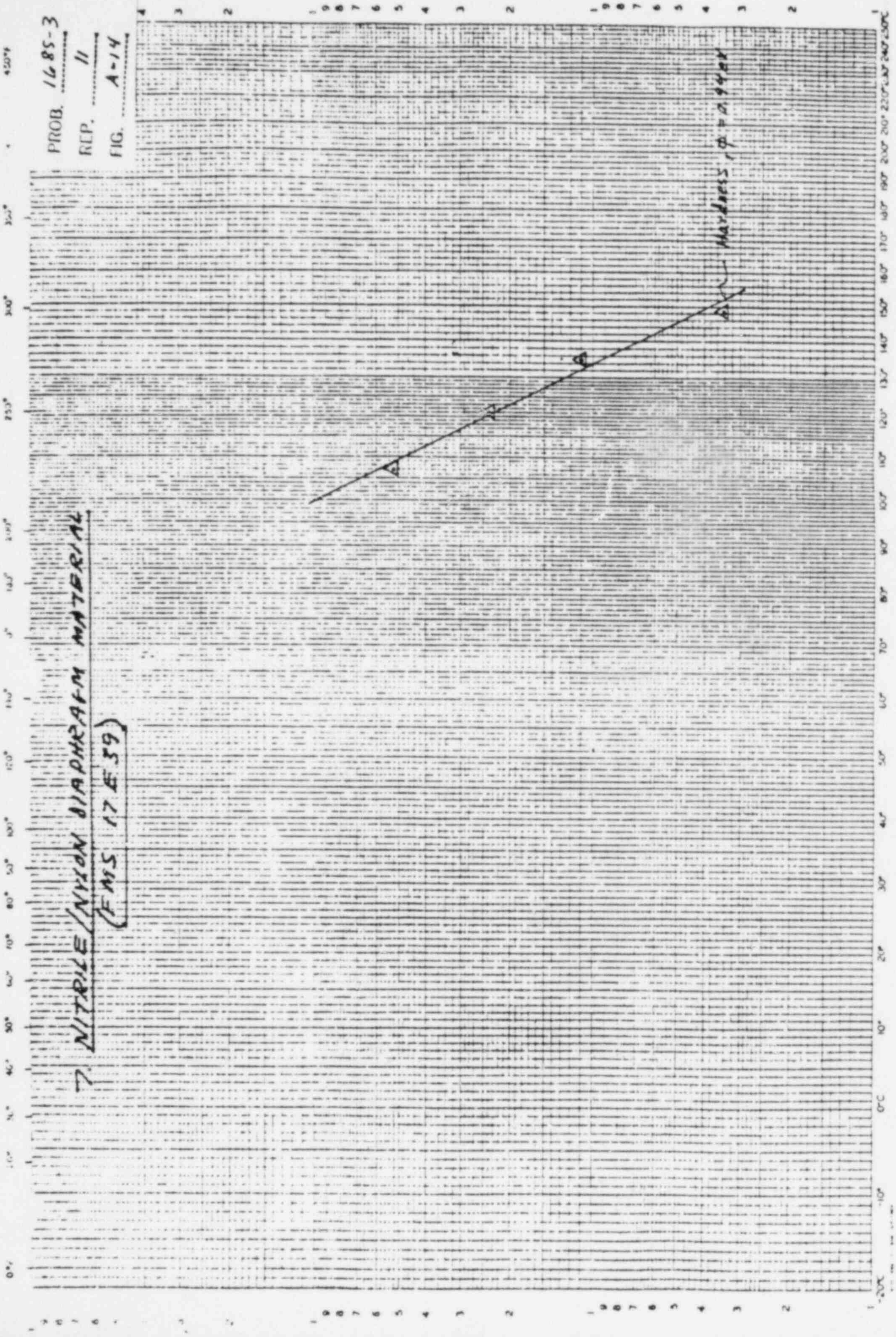



6. NITRILE/NYLON DIAPHRAGMS (FMS 17E44)
PROB. 16B5-3
REP. 11
FIG. A-12
Burst Strength, φ = 0.80 eV
Hardness, φ = 0.79 eV

PROB. 1685
REP. 11
FIG. A-13

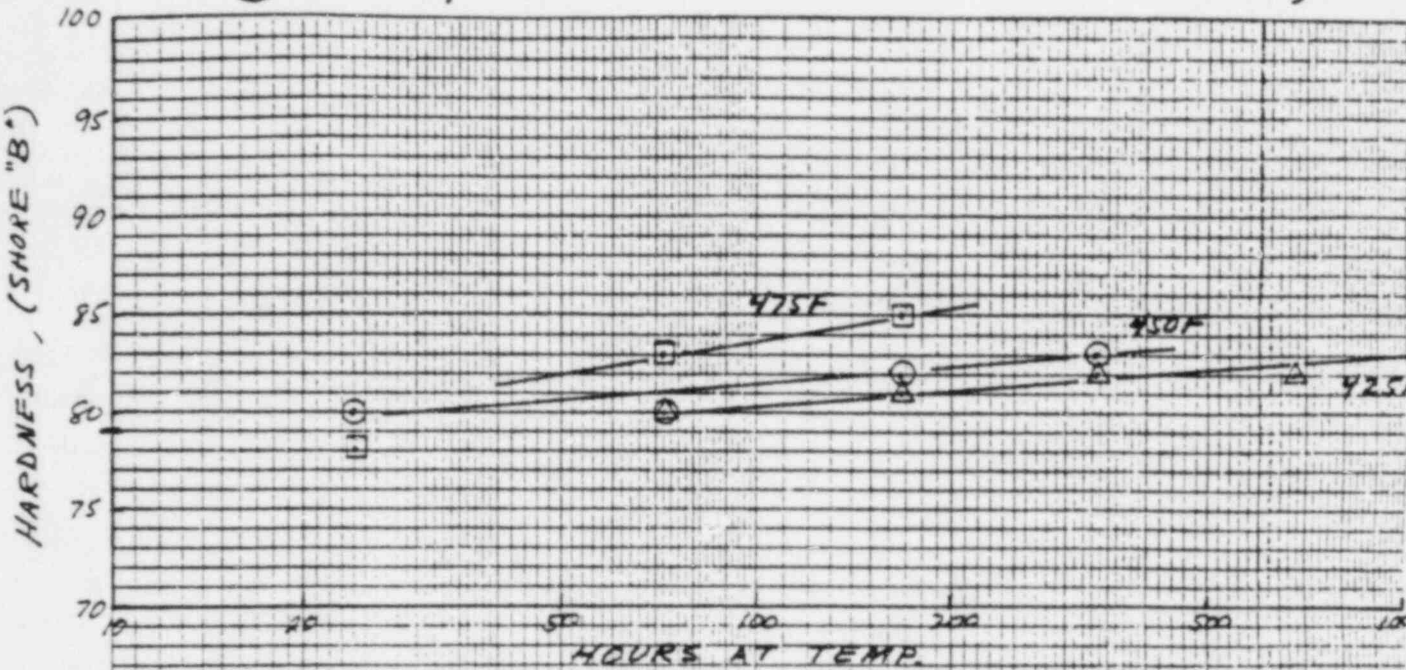
⑦ NITRILE/NYLON DIAPHRAGM MATL. (FMS 17E39)

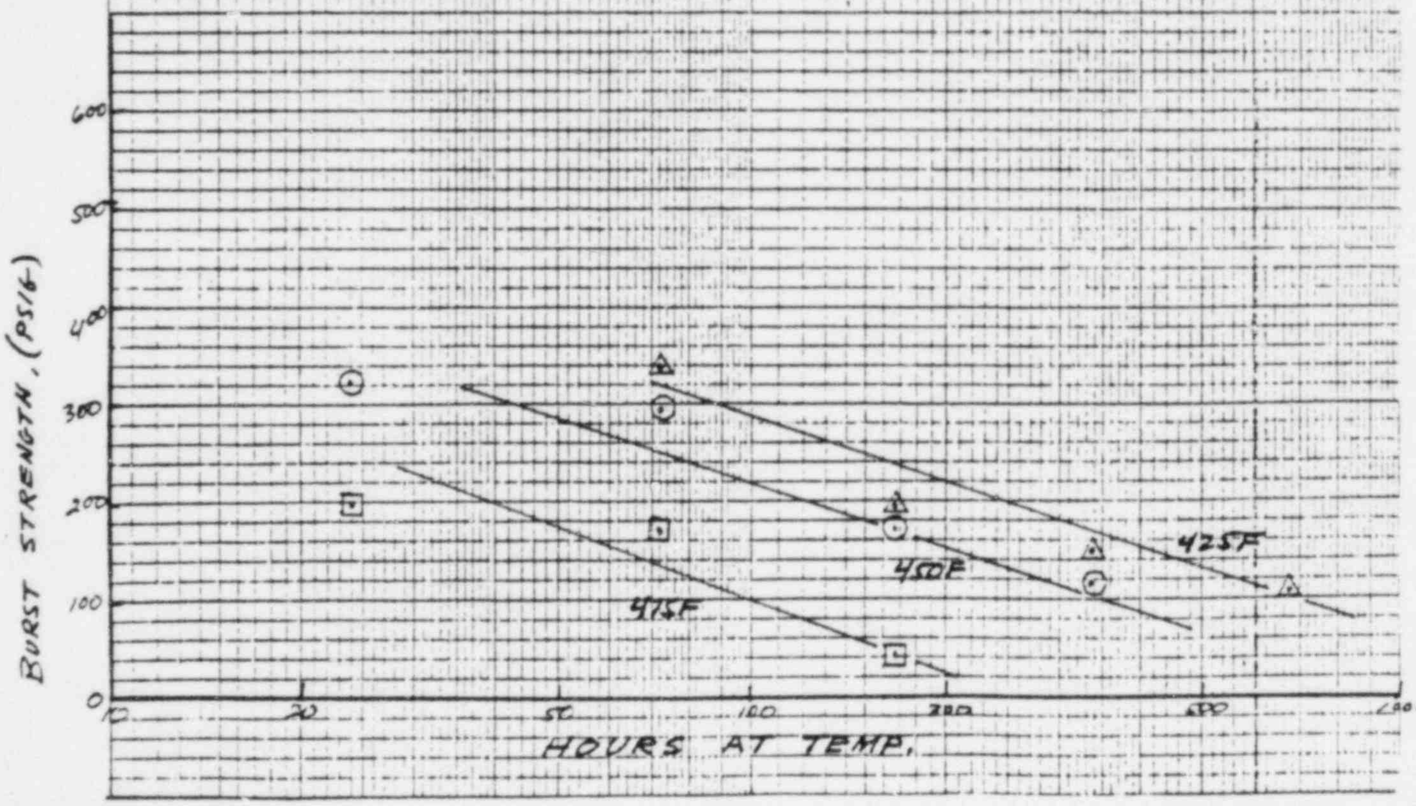



PROB. 1685-3
REP. 11
FIG. A-14
7. NITRILE/NYLON DIAPHRAGM MATERIAL
(FMS 17E59)
Hardness

PROB. 16B5-
REP. 11
FIG. A-15

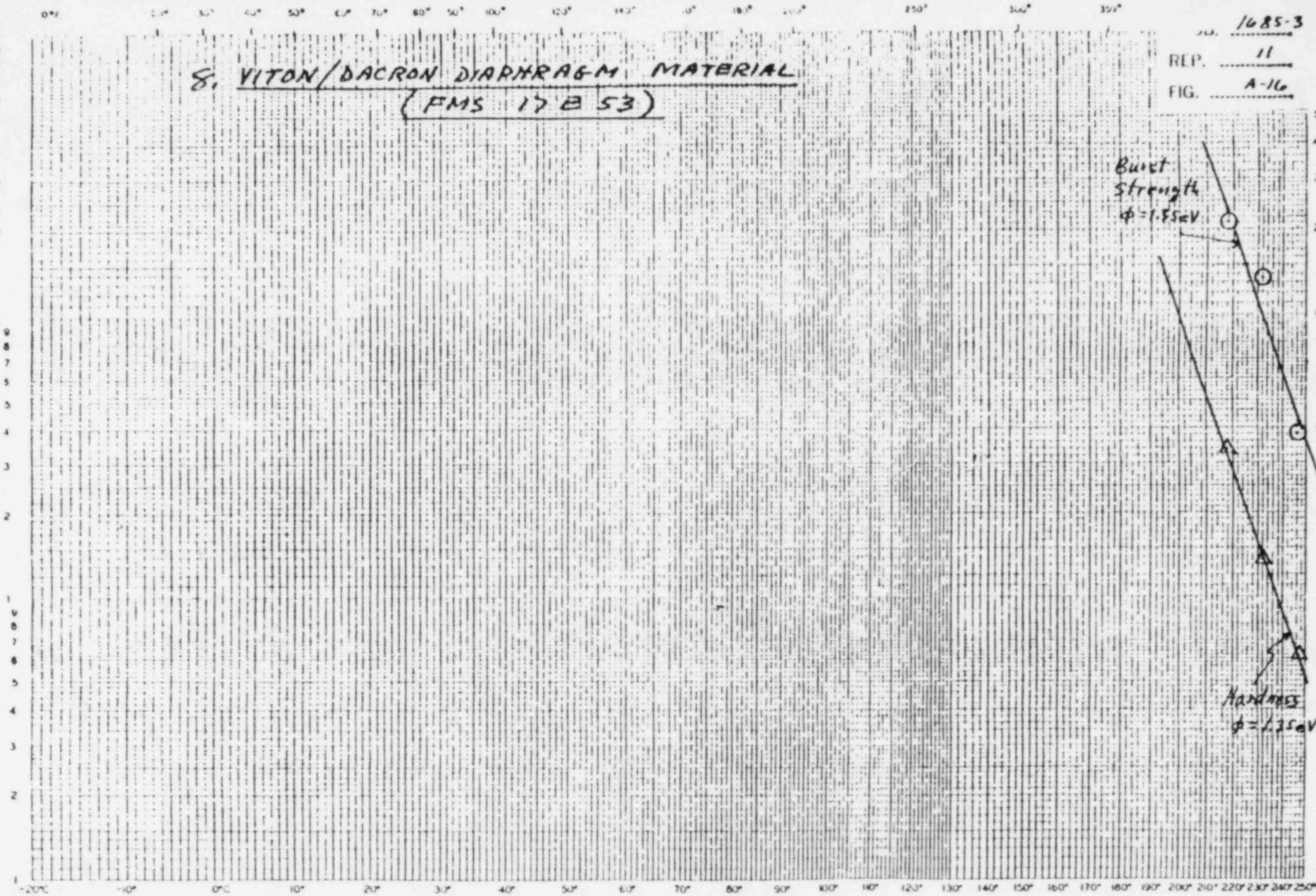
(8) VITON/DACRON DIAPHRAGM MAT'L. (FMS 17E53)





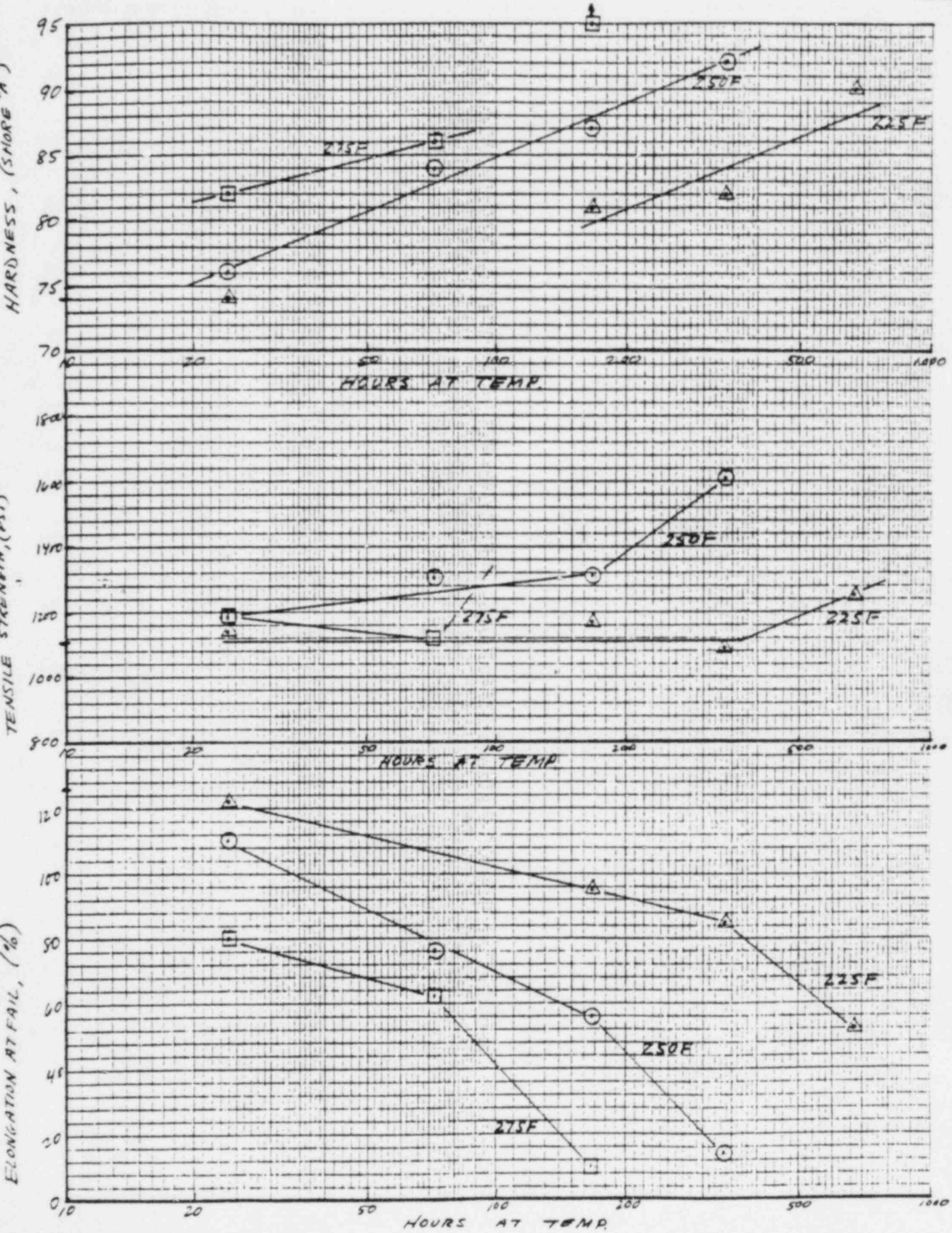
No. 1685-3
REP. 11
FIG. A-16

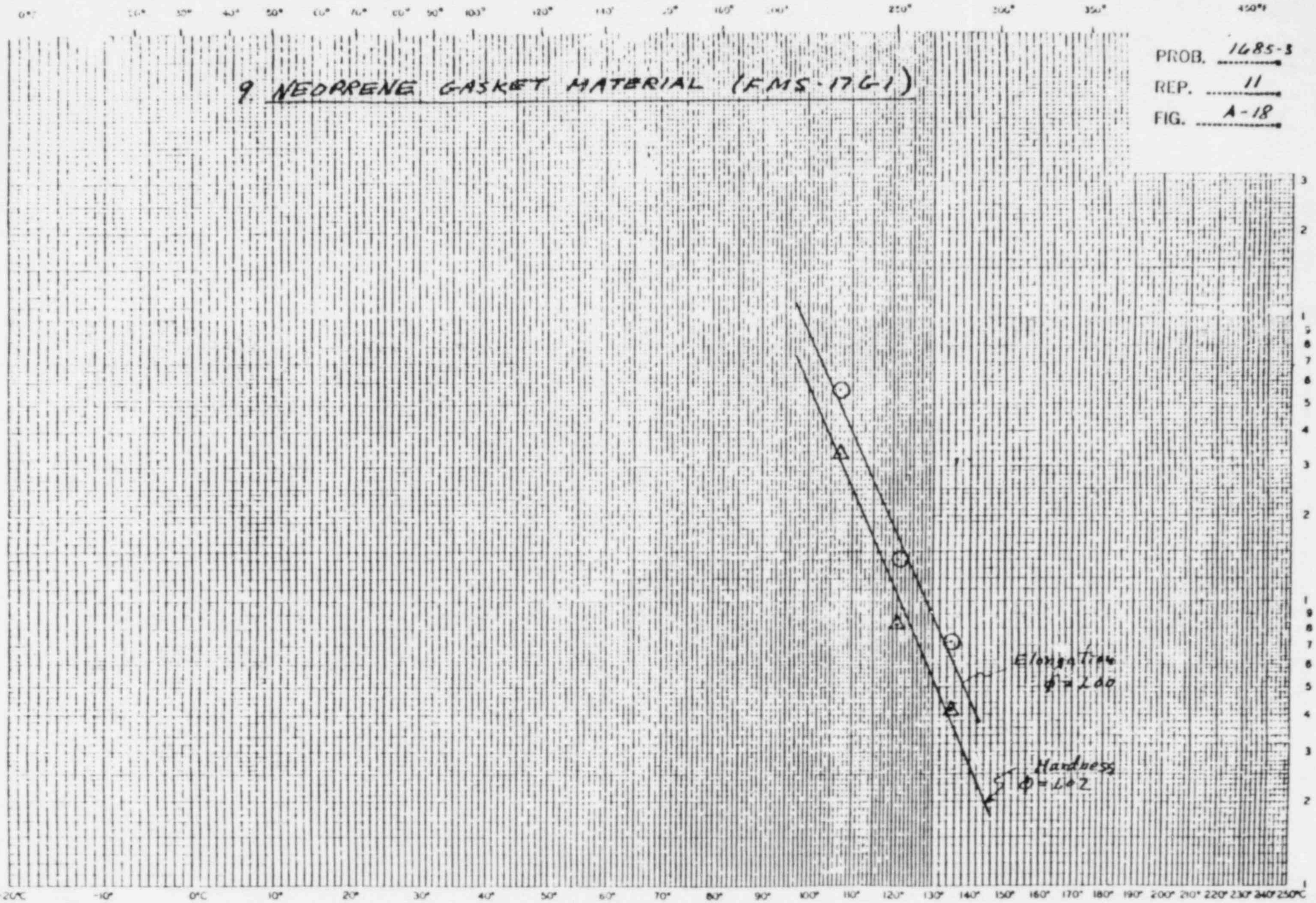
8. VITON/DACRON DIAPHRAGM MATERIAL
(FMS 17B53)



PROB. 1685-3
REP. 11
FIG. A-17

(9) NEOPRENE GASKET MATERIAL (FMS 1761)




9. NEOPRENE GASKET MATERIAL (FMS-17G-1)
PROB. 1685-3
REP. 11
FIG. A-18
Elongation
ϕ=200
Hardness
ϕ=202

Rev. B

Attachment A-8

to

Vogtle Qualification Report, FQP-11A

Arrhenius Rate Equation Calculations

Arrhenius Rate Equation Calculations

The Arrhenius rate equation as referencd in IEEE 382 can be expressed as follows:

$$\frac{t_1}{t_2} = e^{\frac{\Phi}{K}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)}$$

where:

t_1 = service life

t_2 - test duration

T_1 - service temperature

T_2 = test temperature

ϕ = activation energy

K = Boltzman's constant = 0.8617×10^{-4} eV/K

Values determined by the aging segment of the Wyle Test Report No. 45088-1, Fisher Lab Problem 1685-3, Report 11, and Bechtel Specification X5AC03, Appendix EA, result in the following numbers:

t_2 = 28.5 days

T_1 = 126 °F = 325 K

T_2 = 227.8 °F = 382 K

ϕ = 0.79 eV

hence:

$$t_1 = (t_2)\, e^{\frac{\Phi}{K}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)}$$

$$t_1 - (28.5) \text{ days } e^{\frac{(0.79)\text{eV}}{(0.8617\times10^{4})\text{eV/K}}\left(\frac{1}{(325)\text{K}} - \frac{1}{(382)\text{K}}\right)}$$

t_1 - 1855 days = 5 years 30 days

ARRHENIUS ACCELERATED-AGING RULE TEMPERATURE CALCULATION
of
MAXIMUM-ALLOWABLE NORMAL-SERVICE TEMPERATURE
to
ASSURE FOUR-YEAR LIFE OF NUCLEAR-SERVICE EQUIPMENT ELASTOMERIC MATERIALS
(Limited to ethylene propylene T-rings and graphoil packing)

This calculation is based on an accelerated-aging high-temperature test conducted by Fisher Controls Company. The test temperature was held constant at 227.8°F for the complete 28.5-day test. The four-year life calculation, below, utilizes the activation energy constant for ethylene propylene (0.79 eV) which is the most limiting of the regular nuclear-service butterfly-valve materials.

The unknown-time form of Arrhenius accelerated-aging equation is given below:

$$t_1 = (t_2)e^{\frac{\phi}{K}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]}$$

where:

ϕ (activation energy constant) = 0.79 eV
K (Boltzman's constant) = 0.8617×10^{-4}
t_1 (normal service-temperature life) = 4 years = 1461 days
t_2 (test duration) = 28.5 days
T_1 (maximum allowable service temperature) = unknown
T_2 (test temperature) = 227.8°F

Rearranging the equation to the inverse-temperature form:

$$\frac{1}{T_1} = \frac{1}{T_2} + \frac{K}{\phi} \ln \frac{t_1}{t_2}$$

Substituting above values into equation:

$$\frac{1}{T_1} = \frac{1}{382} + \frac{0.8617 \times 10^{-4}}{0.79} \ln \frac{1461}{28.5}$$

Solving for the four-year life temperature:

$$T_1 = 328.17°K = 131.3°F$$

ATTACHMENT A-9

to

VOGTLE QUALIFICATION REPORT, FQP-11A

Effects of Gamma Radiation Exposure to 200 Mrads

on 20 Inch Type 9220 Valve with Bettis Actuator

9510-AX5AC03-5068-4 556

DISTRIBUTION RESTRICTED
- W. H. Haslett

FISHER CONTROLS COMPANY
MARSHALLTOWN, IOWA

Project 78EC07

PROB. 1685-3
REPORT 8
PAGE 1
DATE 2-17-81

LABORATORY REPORT

EFFECTS OF GAMMA RADIATION EXPOSURE TO 200 Mrads ON 20" TYPE 9220 VALVE WITH BETTIS ACTUATOR

ABSTRACT

The SNUPPS environmental test valve (20" Type 9220 with Bettis T420B-SR2) was exposed to a total of 200 Mrads of Cobalt-60 (gamma) radiation. Testing was performed after completion of the qualification testing per FQP-19 without changing or readjusting the T-ring. A dramatic increase in air leak rate occurred between 10 Mrads and 100 Mrads exposure over the entire test range (2.5 psid to 75 psid). With the addition of another 100 Mrads, the leak rate at the low ΔP again increased sharply. However, at the high end of the ΔP range there was essentially no further change in leak rate.

INTRODUCTION

1.0 - This report covers work performed at Isomedix Inc., Parsippany, New Jersey on the SNUPPS Environmental Test Valve. The test valve was a 20" Type 9220 with a Bettis T-420B-SR2 actuator and associated appurtenances. Prior to this test sequence, the valve assembly had undergone the entire test sequence described in Fisher Controls Environmental Qualification Plan FQP-19 (reference 1) up to, but not including, the post-DBE (Design Basis Event) Radiation Exposure Test (see Section 9.3, p. 28, of above mentioned document). In addition, the valve assembly was subjected to an extra thermal exposure of 400°F for 15 minutes in an air oven, in accordance with FGS 14A2 (reference 1). The testing reported here essentially completes the intent of FQP-19 and extends the radiation testing by an additional 100 Mrads. The procedures were modified somewhat due to factors described below.

LABORATORY REPORT

During the post-DBE functional testing (Section 9.2, FQP-19), the Versa valve remained in the exhaust mode (the fail-safe position) thus preventing the opening of the test valve. Since the remaining tests were for information only, it was decided to eliminate the stroking time tests and to monitor leak rates only in determining radiation effects. Also, since no test chamber was available at Isomedix, the leak rates were determined at ambient conditions instead of at 120°F as called for in FQP-19. This necessitated running an additional baseline leak test prior to irradiation. There was no readjustment of the EPDM T-ring nor had there been since the post-thermal aging adjustment early in the testing sequence. In other words, the elastomeric seal ring had been adjusted for zero leakage at 75 psid and ambient temperature after a 50 day thermal and humidity aging sequence and then the valve assembly had undergone (1) 10 Mrads of gamma radiation, (2) seismic vibration testing, and (3) a design basis event (DBE) which consisted of a 30 day loss-of-coolant-accident (LOCA) simulation, and now, with this study, two additional doses of gamma radiation (90 Mrads and 100 Mrads) without touching the T-ring adjustment.

TEST PROCEDURE

2.0 - A complete description of the SNUPPS environmental test valve can be found in FQP-19, Rev. F (reference 1). The condition of the valve assembly at the start of this test sequence and details of prior testing can be found in Wyle Labs Test Reports No. 45088-1 and No. 45390-1 (references 2 and 3). The test valve was shipped directly from Wyle Labs, Huntsville, Alabama to Isomedix Inc., Parsippany, New Jersey. The two spool flanges had been removed prior to shipment.

PREPARATION FOR TESTING

2.1 - The two spool flanges with blind flanges already attached were rebolted across the test valve. The bolting was torqued to 540 ft-lbs, which was the same torque used previously at Wyle Labs.

BASELINE LEAK TEST

2.2 - Throughout this test sequence the valve assembly was oriented in the same manner as in the LOCA chamber (i.e., the disc was horizontal with the inlet side up). (See Figure 3.) The inlet air line was connected from a portable air compressor through a regulator to the top blind flange. The outlet air line was connected to the bottom blind flange with the other end submerged in water. Air leak rates were measured by noting the time required to displace a known quantity of water with air when an inverted water-filled container was held over the end of the outlet air line. This technique worked well for all the baseline leak tests. One problem was encountered with the test setup regulator in that its maximum output was about 35 psig. To obtain leak rates above 30 psig, the regulator was removed from the inlet air line and the inlet pressure was "controlled" using a needle valve located at the compressor volume tank.

FISHER CONTROLS COMPANY
MARSHALLTOWN, IOWA

PROB 1685-3
REPORT 8
PAGE 4
DATE 2-17-81

LABORATORY REPORT

PREPARATION FOR RADIATION EXPOSURE (90 Mrad Dose)

2.3 - The two blind flanges were removed from the inlet and outlet spool flanges to prepare the valve assembly for irradiation. The two spool flanges were left on the valve. At this point the valve assembly was turned over to Isomedix for radiation exposure.

RADIATION EXPOSURE

2.4 - The radiation exposure of 90 Mrads equivalent air dose was carried out as described in FGS14C1 (reference 4) and as reported in Isomedix letter dated February 3, 1981 (see Appendix C).

POST-RADIATION LEAK TESTS

2.5 - On completion of the radiation exposure the valve assembly was removed from the radiation chamber and the two blind flanges were reinstalled. Air leak tests were run using the same technique described in Paragraph 2.2. However, at high flow rates the technique was modified to a dry-fill measurement. (i.e., The outlet air flow was collected in a collapsed plastic bag. The time to inflate the bag to a known volume was measured.) Also, at the high leak rates it became obvious that the pressure drop in the outlet air line was significant. Hence, the pressure (P_2) at the outlet blind flange was measured for several tests and these values were plotted to obtain correction factors for the other leak tests. (See plot in Appendix A.)

PREPARATION FOR SECOND RADIATION EXPOSURE (100 Mrad Dose)

2.6 - The procedure was identical to that described in Paragraph 2.3.

FISHER CONTROLS COMPANY
MARSHALLTOWN, IOWA

PROB.	1685-3
REPORT	8
PAGE	5
DATE	2-17-81

LABORATORY REPORT

RADIATION EXPOSURE

2.7 - The radiacion exposure of 100 Mrads equivalent air dose was carried out as described in FGS14C2 (reference 5) and as reported in Isomedix letter dated February 3, 1981 (See Appendix C).

POST-RADIATION LEAK TESTS

2.8 - On the completion of the radiation exposure, the valve assembly was removed from the radiation chamber and the two blind flanges were reinstalled. Air leakage was measured by two techniques: (1) the water displacement technique described in paragraph 2.2 and (2) using an orifice well flowmeter. The calibration curves for the orifice sizes used are included in Appendix B.

INSPECTION

2.9 - At the completion of the leak testing, the two spool flanges were removed and the valve assembly inspected for visual damage. The valve disc was rotated to the open position by applying air pressure directly to the actuator cylinder. (i.e., Bypassing the solenoid and the Versa valve.)

3.0 - DISCUSSION OF RESULTS

AIR LEAK RATE TESTS

3.1 - The air leak rate test results for the baseline test and the two post-radiation tests are summarized in Table I. The individual data sheets for each test are included in Appendix A. In Figure 1, the leak rates are

FISHER CONTROLS COMPANY
MARSHALLTOWN, IOWA

PROB. 1685-3
REPORT 8
PAGE 6
DATE 2-17-81

LABORATORY REPORT

plotted versus the differential pressure for all three runs. (The use of log-log plot is for convenience only and is not otherwise significant.) The four different curves for the 200 Mrads data represent four different "fresh starts" (i.e., starting at zero pressure and increasing P_1 incrementally). Both post-radiation tests (100 Mrad & 200 Mrad total dosage) showed a pronouced leakage increase over the entire pressure range as compared with the baseline test (10 Mrad level). Additionally, for the 200 Mrad test there was a certain amount of instability in the 10 to 20 psig inlet pressure range with the leak rate starting high and then dropping down to a lower level in a matter of minutes. This was probably due to a slight movement of the disc into a more favorable position in the seal ring. For 30 psid and above the leak rates after 100 Mrads and 200 Mrads were practically identical.

In Figure 2, the leakage at 2.5 psid is plotted versus total radiation dose. Here again, there is the obvious radiation effect, but compared with the SNUPPS post-DBE leakage criteria (reference 1) only the 200 Mrad test exceeds the allowable leakage level. If this test had been performed at 100°F instead of less than 70°F it might well have been within the allowable level.

VISUAL INSPECTION

3.2 - The entire valve assembly was visually inspected for obvious damage. There was much rust and scale on almost every surface. Very little of the original paint was intact. A photograph of the general condition of the valve assembly is shown in Figure 3. Actually most, if not all, of the degradation reported here was due to the thermal/humidity aging and the LOCA simulation.

FISHER CONTROLS COMPANY
MARSHALLTOWN, IOWA

LABORATORY REPORT

Removing the spool flanges revealed much evidence of corrosion on the valve internals. Figure 4 is a photo of the inlet side of the disc showing much rust and scale. Also, Figure 5 is a close-up of the scale and debris that was in the sealing area, first noticed when the valve was stroked open. The only damage to the T-ring was a small cut in one of the "rub" areas near the shaft (see Figure 6). There was some wear, but it was not really excessive for the 1000 plus open/close cycles the valve had been subjected to. There was a very pronounced "permanent set" to the T-ring due to the disc pressing into the rubber T-ring throughout most of the test sequence. (See Figures 7 and 8). Again, this phenomenon was not due to radiation exposure alone, but to the sum total of the thermal/humidity aging, the LOCA simulation and the radiation.

CONCLUSION

4.0 - While the test sequence was performed for information only, it is important to note that after 100 Mrads total radiation dose, the leak rate at 2.5 psid was still within the SNUPPS acceptance criteria for the post-DBE leakage as specified on Page 39.1 in FQP-19 (reference 1). Also, after 200 Mrads, the 2.5 psid leak rate was only moderately larger than this same acceptance level, which was specified for 100°F. Had the post-200 Mrad test been performed at 100°F instead of less than 70°F, the actual leakage would have been less and probably would have been close to the allowable 2944 cc/minute.

FISHER CONTROLS COMPANY
MARSHALLTOWN, IOWA

PROB. 1685-3
REPORT 8
PAGE 8
DATE 2-17-81

LABORATORY REPORT

It is also important to note that there was a dramatic radiation effect, with the greatest change occurring in the 10 to 20 psid range between the baseline (10 Mrads) and the 100 Mrads dose.

RECOMMENDATION

5.0 - In the past, 10 Mrads of radiation dosage was considered a safe maximum level for valve or appurtenances containing elastomeric materials (including Ethylene-propylene rubber [EPDM]). The results of this test sequence would tend to substantiate this 10 Mrad limit. In any application where a valve might receive greater than 10 Mrads total radiation, the customer should be cautioned that a certain loss of pressure retaining properties would be expected.

W. H. Haslett

W.H. Haslett
Evaluation & Analysis Department

FISHER CONTROLS COMPANY
MARSHALLTOWN, IOWA

PROB 1685-3
REPORT 8
PAGE 9
DATE 2-17-81

LABORATORY REPORT

REFERENCES

1. Fisher Controls Environmental Qualification Plan, FQP-19, Rev. F, dated April 14, 1980 modified by "Change of Scope to P.O. 217770" - dated October 28, 1980. Further modified by Fisher Controls Test Program FGS14A2, dated October 28, 1980. Referenced to P.O. No. 220272, Test Part No. 1R0101X0022.

2. Wyle Laboratory Report No. 45088-1, dated November 21, 1980.

3. Wyle Laboratory Report No. 45390-1, dated November 7, 1980.

4. Fisher Controls General Specification, FGS 14C1, Rev. A dated November 20, 1980. "Subcontracted Services, Isomedix Inc. Environmental Performance Testing (90 Mrad) 20" Type 9220 with Bettis T420B-SR2".

5. Fisher Controls General Specifications, FGS 14C2, Rev. A., dated November 20, 1980. "Environmental Performance Testing 100 Mrad Radiation Exposure 20" Type 9220 with a Bettis T420B-SR2".

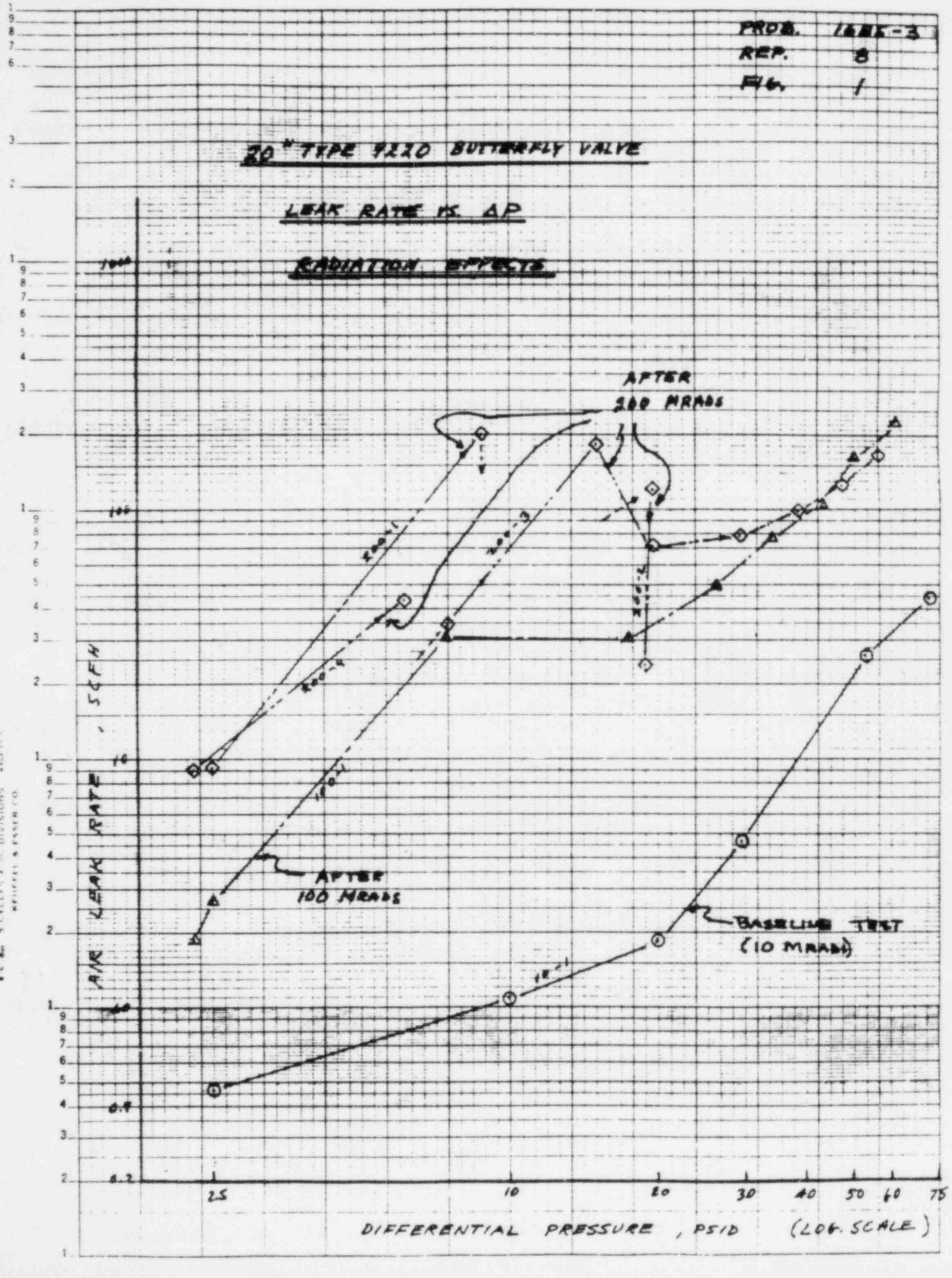
TABLE I. - SUMMARY OF POST-DBE (RADIATION EFFECTS) LEAK TESTS

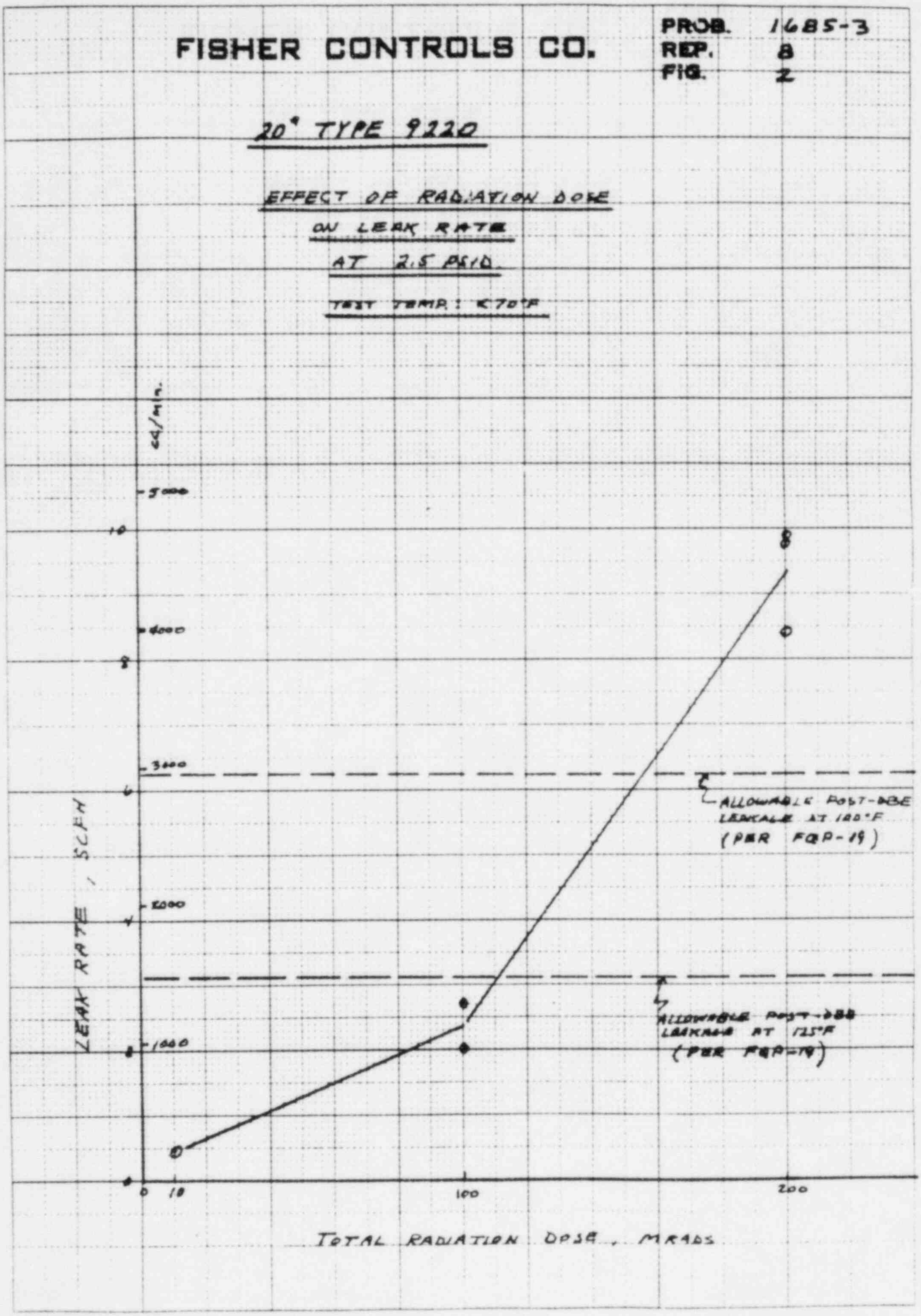
TESTS PERFORMED AT ISOMEDIX, INC., PARSIPPANY, N.J.

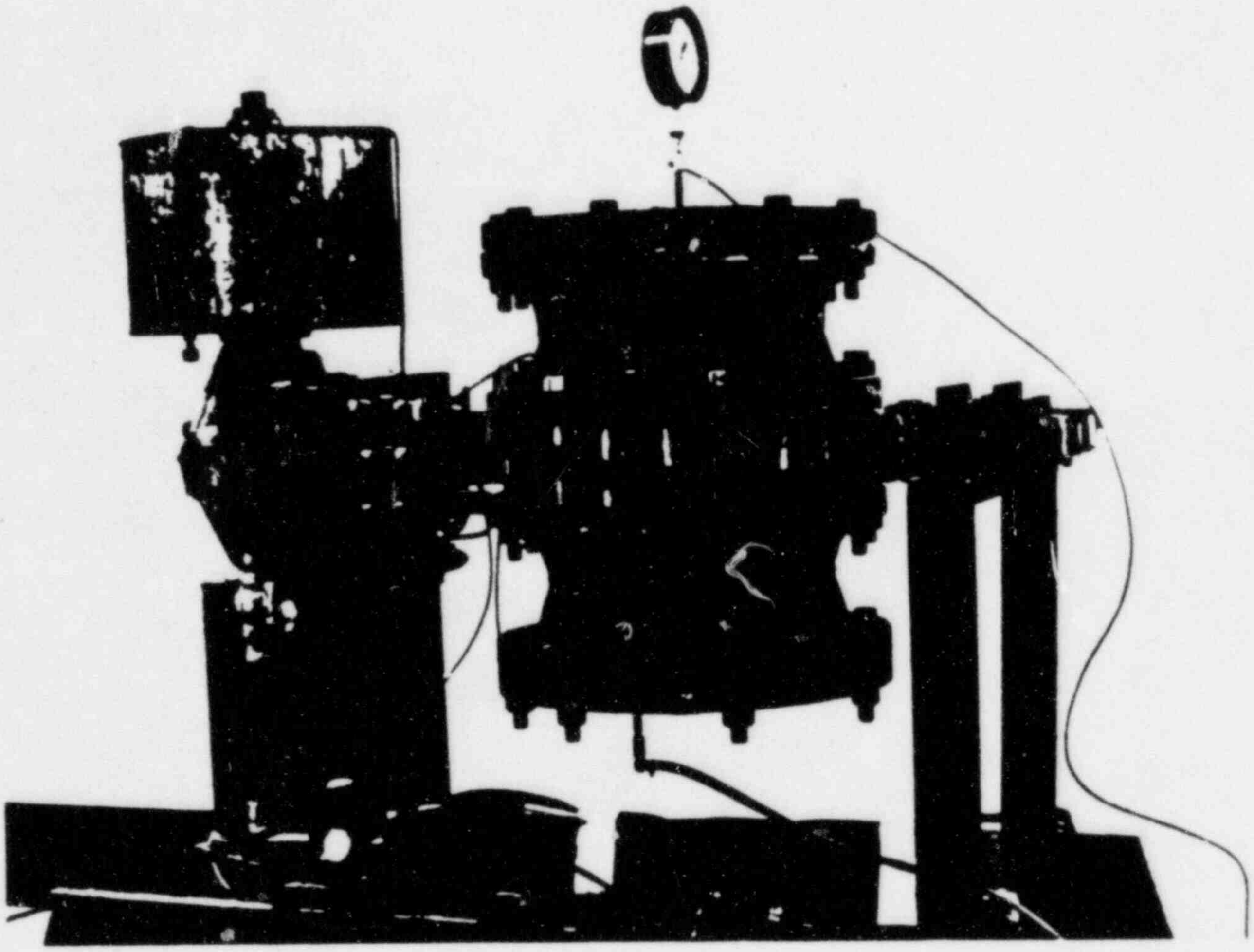
TEST FLUID: AIR TEST TEMP.: ROOM AMBIENT (~65°F)

P_1 INLET PRESSURE	BASELINE (10 MRADS PREV. DOSE)				AFTER ADD'TL. 90 MRADS (100 TOTAL)				AFTER ADD'TL. 100 MRADS (200 TOTAL)			
	P_2 AT OUTLET	ΔP	LEAK RATE		P_2 AT OUTLET	ΔP	LEAK RATE		P_2 AT OUTLET	ΔP	LEAK RATE	
psig	psig	psid	cc/min.	SCFH	psig	psid	cc/min.	SCFH	psig	psid	cc/min.	SCFH
2.5	0	2.5	215	0.46	0.2	2.3	875	1.85	0 0.2	2.5 2.3	4315 4250	9.1 9.0
2.8	—	—	—	—	0.3	2.5	1270	2.7	—	—	—	—
10	0.1	9.9	510	1.08	2.6	7.4	14,400	30.6	1.2 2.5 3.9	8.8 7.5 6.1	94,400 16,300 20,300	200 34.5 43
20	0.2	19.8	884	1.87	2.6	17.4	14,300	30.3	0.4 1.25 5.0 0.75	19.6 18.75 15.0 19.25	56,600 11,300 86,400 33,500	120 24 183 71
30	0.5	29.5	2160	4.57	3.8	26.2	23,100	48.9	0.9	29.1	36,800	78
40	—	—	—	—	6.0	34.0	36,400	77.2	1.5	38.5	46,300	98
50	—	—	—	—	7.2	42.8	49,400	105	2.4	47.6	58,300	124
55	2.3	52.7	12,250	26.0	—	—	—	—	—	—	—	—
60	—	—	—	—	10.0	50.0	76,900	163	3.9	56.1	76,500	162
75	3.6	71.4	21,000	44.5	14.0	61.0	107,800	228	—*	—	—	—

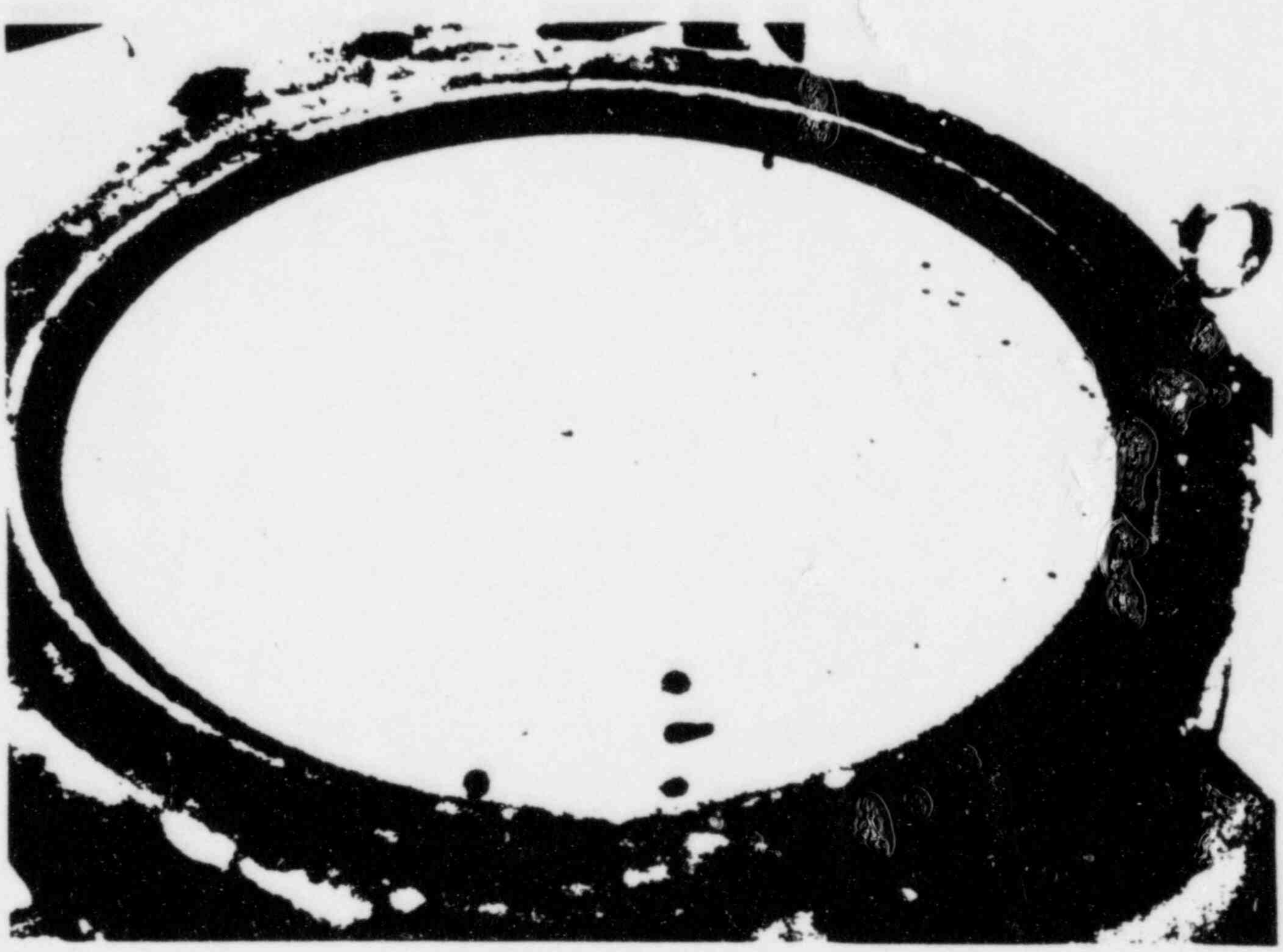
* MAX. PRESSURE POSSIBLE WAS 62 PSIG DUE TO LIMITATIONS OF THE AIR COMPRESSOR.


PROB.
REP. 8
FIG. 1
20" TYPE 9220 BUTTERFLY VALVE
LEAK RATE VS. ΔP
RADIATION EFFECTS
AFTER 200 MRADS
AFTER 100 MRADS
BASELINE TEST (10 MRADS)
AIR LEAK RATE, SCFH
DIFFERENTIAL PRESSURE, PSID (LOG. SCALE)
1000
100
10
1.0
0.4
0.2
2.5
10
20
30
40
50
60
75
SEMI-LOGARITHMIC 46 6212
K&E

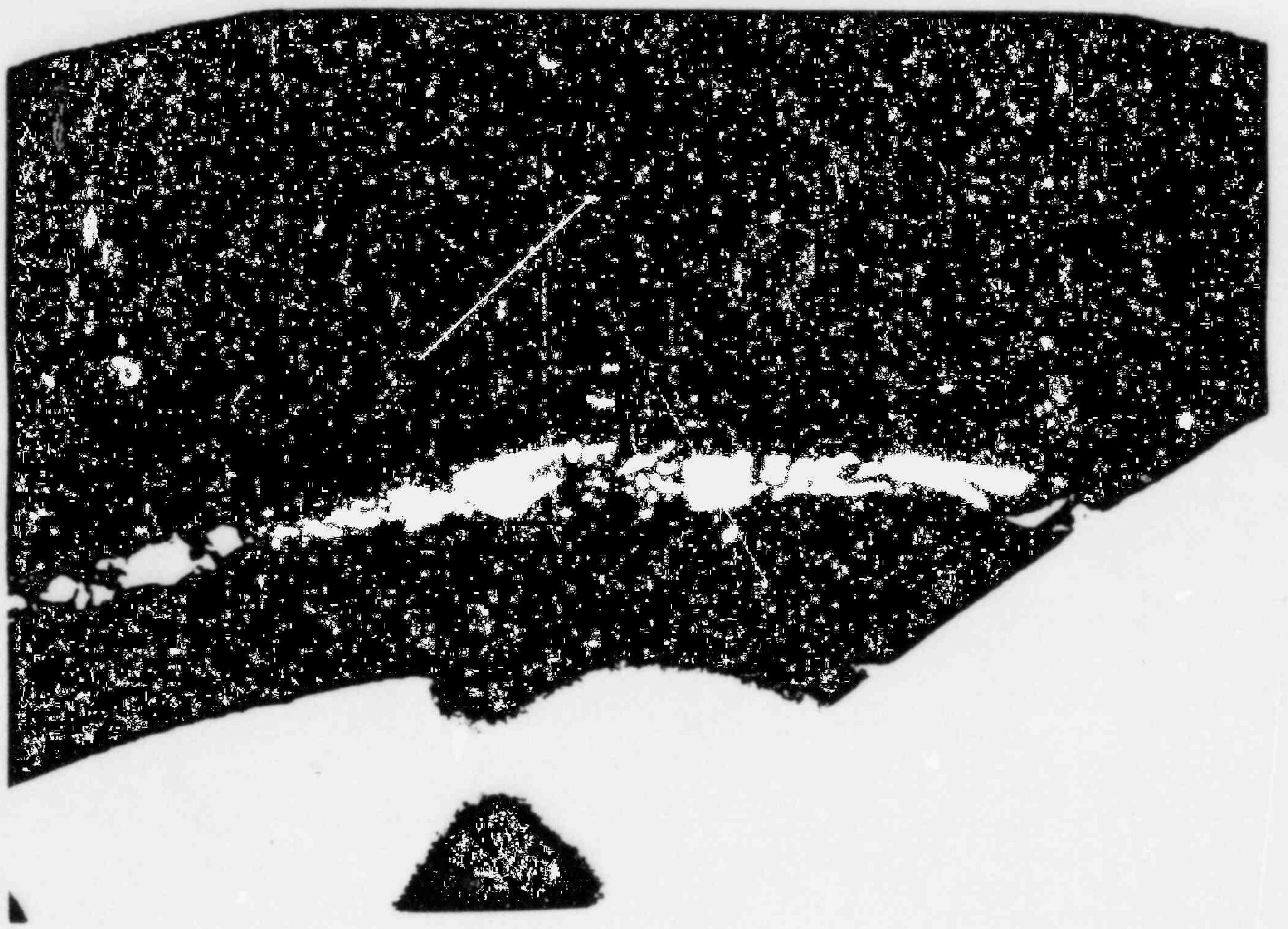

FISHER CONTROLS CO.
PROB. 1685-3
REP. 8
FIG. 2
20" TYPE 9220
EFFECT OF RADIATION DOSE
ON LEAK RATE
AT 2.5 PSID
TEST TEMP: <70°F
cc/min.
5000
4000
3000
2000
1000
10
8
6
4
2
0
LEAK RATE, SCFH
ALLOWABLE POST-DBE LEAKAGE AT 180°F (PER FQP-19)
ALLOWABLE POST-DBE LEAKAGE AT 125°F (PER FQP-19)
0
10
100
200
TOTAL RADIATION DOSE, MRADS



Overall view of valve assembly with spool flanges attached.



Photograph of inlet side of disc after radiation. Corrosive damage due primarily to previous test conditions. (Thermal/humidity aging and loss-of-coolant-accident, LOCA.)



Close-up of sealing area with disc open.

View showing small cut in T-ring.

Same view as Figure 6, but with different lighting to show "permanent set" of T-ring.

Another close-up of T-ring showing indentation or "permanent set".

APPENDIX A

Data Sheets and Correction Curves

FISHER CONTROLS COMPA[NY]
MARSHALLTOWN, IOWA
LABORATORY REPO[RT]

PROB. 16. -3
REPORT 8
SHEET A-1
DATE 11-21-80
BAROMETER ____ IN. HG.

PRE-RADIATION (BASELINE) LEAK TEST (10 MRADS PREVIOUS EXPOSURE, BEFORE DBE)
20" BETTIS OPERATED TYPE 9200 VALVE
TEST PERFORMED AT ISOMEDIX, INC., N.J.
TEST FLUID: AIR AT AMBIENT TEMP. ~65°F

P_1 INLET PRESSURE PSIG	P_2 OUTLET PRESSURE PSIG	ΔP PSID	LEAK VOLUME cc	TIME OBSERVED SEC	CALCULATED LEAK RATE cc/min.	CALCULATED LEAK RATE SCFH	
2.5	(0)	(2.5)	200	60	200	0.42	(0.46 avg.)
"	"	"	230	60	230	0.49	
10	(0.1)	(9.9)	500	60	500	1.06	(1.08 avg.)
"	"	"	520	60	520	1.10	
20	(0.2)	(19.8)	700	47	894	1.89	(1.87 avg.)
"	"	"	700	48	875	1.85	
30	(0.5)	(29.5)	700	19	2210	4.68	(4.57 avg.)
"	"	"	700	20	2100	4.45	
55 *	(2.3)	(52.7)	700	3	14,000	29.7	(26.0 avg.)
"	"	"	700	4	10,500	22.2	
75 *	(3.6)	(71.4)	700	2	21,000	44.5	
"	"	"	700	2			

* Regulated air pressure by manually adjusting air supply at compressor. (Max. regulator output was 35 psig)
( ) = Estimated from leak rate vs. P_2 plot

FORM 7XX

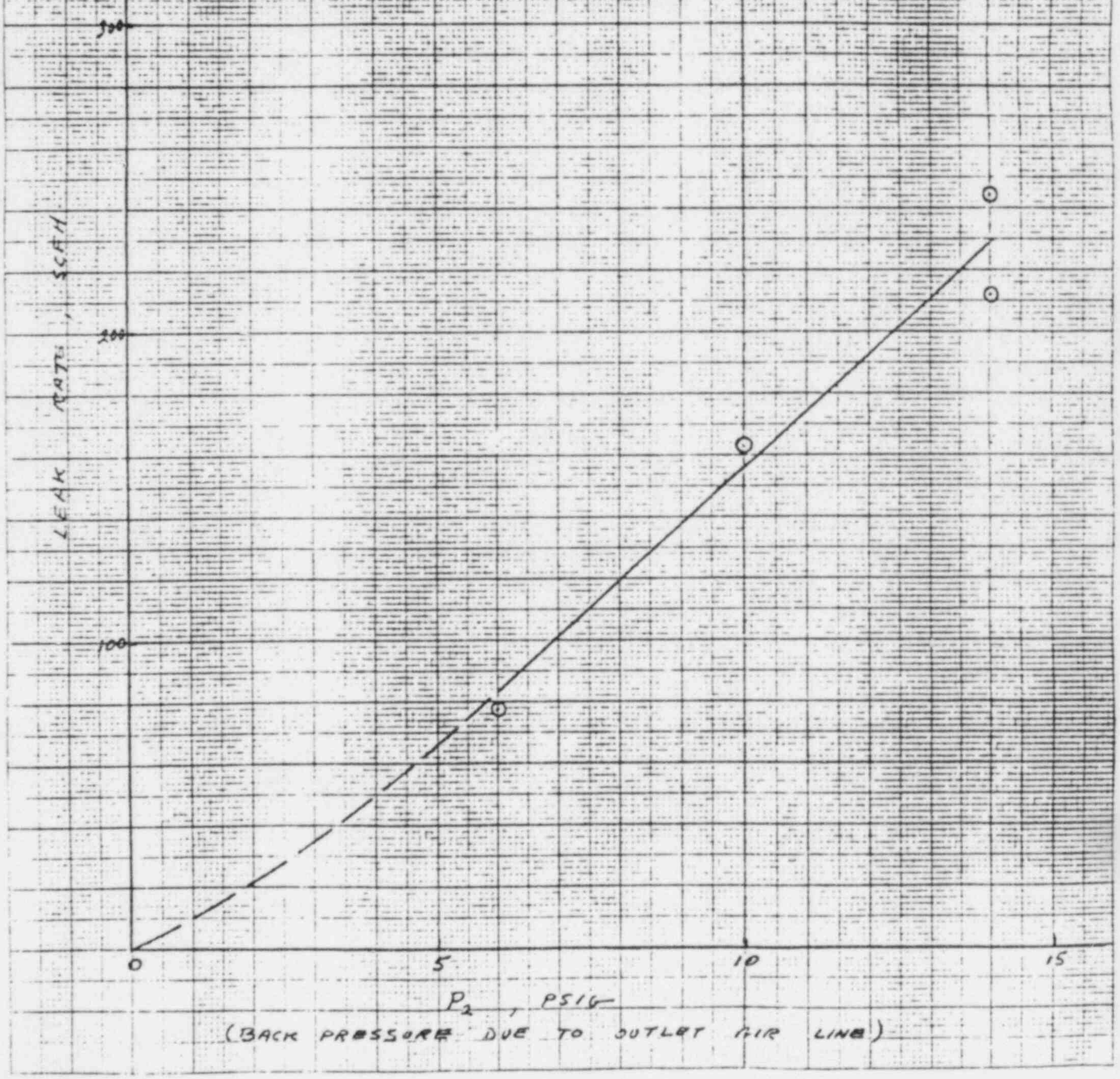
OBSERVED BY W. HASLETT, S. HANZLIK

FISHER CONTROLS CO.

PROB. 1685-3
REP. 8
FIG. A-1

20" TYPE 9200 BUTTERFLY VALVE

P_2 VS. LEAK RATE



APPENDIX B

Calibration Curves for Orifice Gauge

FISHER GOVERNOR COMPANY
MARSHALLTOWN, IOWA

PROB. 1285
REPORT 10
PAGE 1
DATE 2-24-69

LABORATORY REPORT

CALIBRATION CURVES FOR 2" ORIFICE WELL

Calibration tests were conducted for nine orifices in the 2" orifice well flowmeter at inlet pressures from inches water column to 10 psig. The following orifice sizes were checked: .0625; .125; .1875; .250; .3125; .375; .500; .625; and .750. Curves appear on Figures 1 thru 18 respectively.

The air flows were metered by means of a sharp-edged orifice in the 2" flow line.

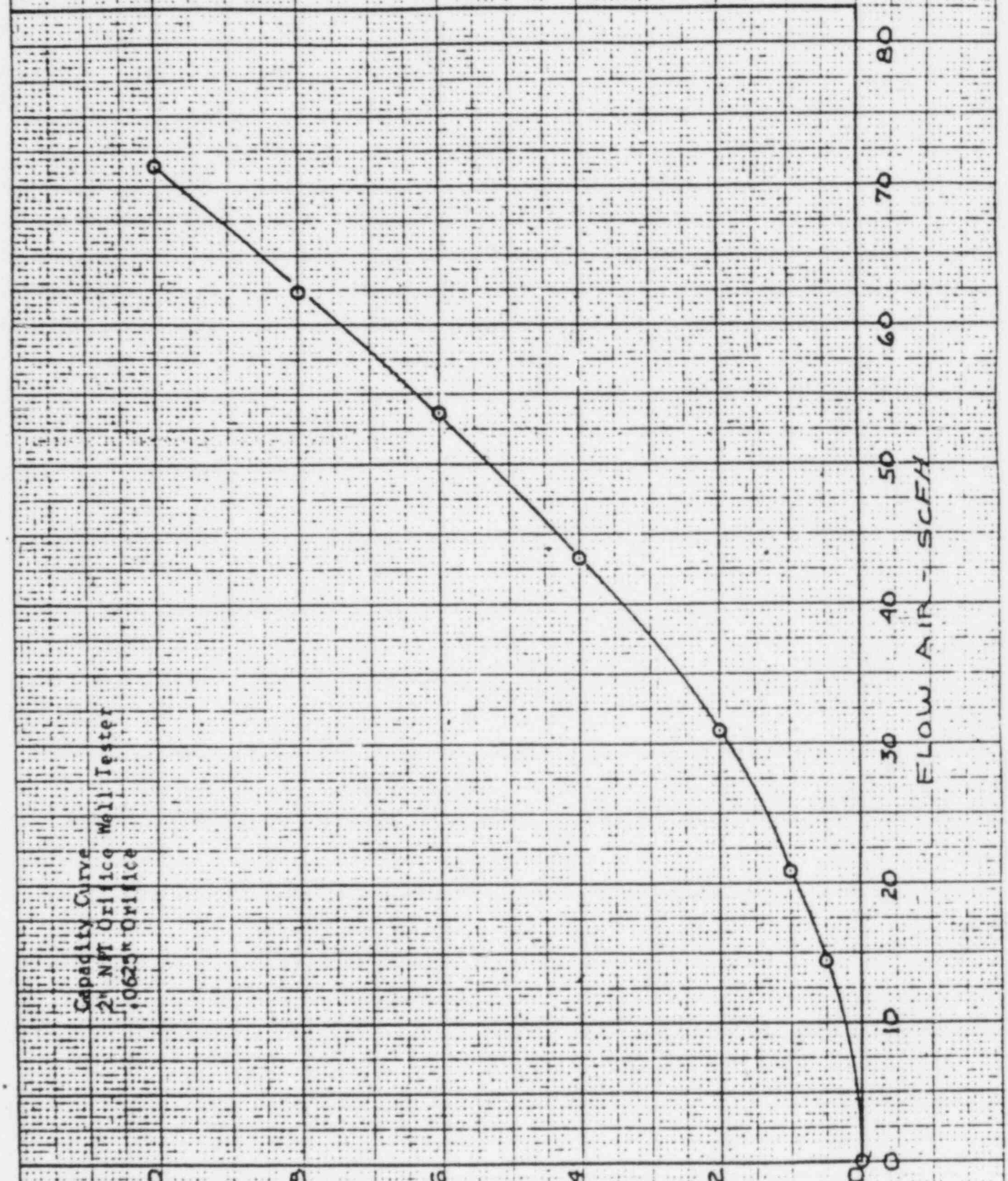
Paul E. Heckman
Paul E. Heckman
Research Department

9510-AX5AC03-5068-4 579

19 FEB 60
P.E.H.

FISHER GOVERNOR CO.

PROB. 1285
REP. 10
FIG. 2

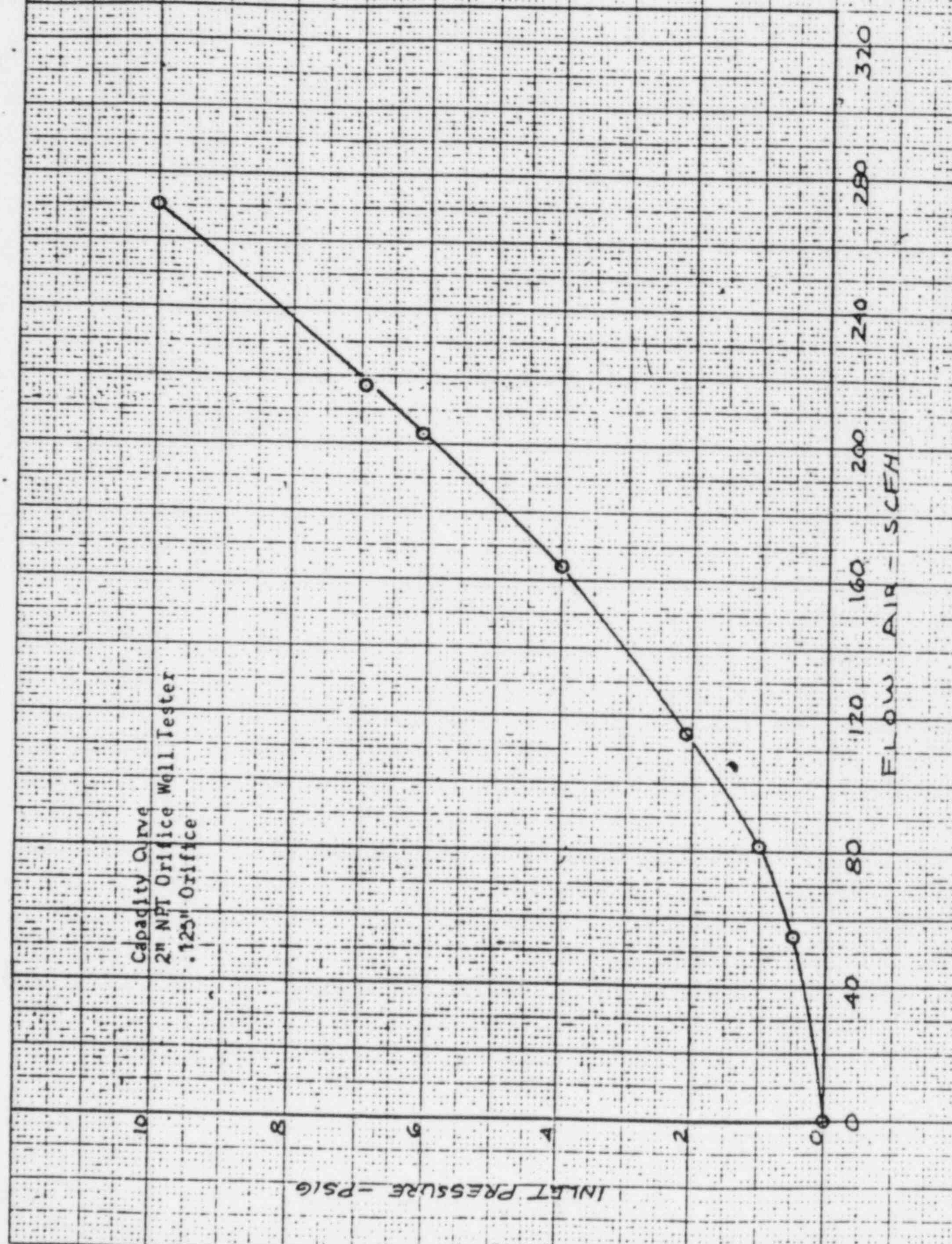


9510-AX5AC03-5068-4 580

19 FEB 69

FISHER GOVERNOR CO.

PROB. 1285
REP. 10
FIG. 4



APPENDIX C

Iso edix Letter Report, dated Feb. 3, 1981

ISOMEDIX

February 3, 1981

Mr. Steve Hanzlik
Fisher Controls Company
P.O. Box 190
Marshalltown, Iowa 50158

Dear Mr. Hanzlik:

This will summarize parameters pertinent to the irradiation of one (1) 20" butterfly valve and actuator and two (2) each of 20" spools and blind flanges, as per your Purchase Order #220409. This is Wyle Job #45088.

The unit was exposed for a total of 189 hours at a dose rate of 0.49 megarads and received a dose of 90 megarads. It was then removed from the irradiator, tested by Fisher Controls personnel, and placed back into the radiation field for 206 hours at a dose rate of 0.49 megarads receiving an additional 100 megarads. This was the same unit previously exposed to 11 megarads (see July 22, 1980 certification to E. Campbell, Wyle Labs). Hence the total dose from all exposures was 201 megarads.

Dosimetry was performed using Harwell Red 4034 Perspex dosimeters, utilizing a Bausch and Lomb Model 710 spectrophotometer as the readout instrument. This system is calibrated directly with NBS, with the last calibration being November 11, 1980. A copy of the dosimetry correlation report is available upon request.

Irradiation was conducted in air at ambient temperature and pressure. Radiant heat from the source heated the samples somewhat, but the temperature did not exceed 100 degrees F, as indicated by previous measurements on an oil solution in the same relative position.

Isomedix Inc. • 25 Eastmans Road, Parsippany, New Jersey 07054 • (201) 887-2666

Irradiation was initiated on December 12, 1980 and was completed on December 23, 1980.

Very truly yours,

ISOMEDIX, INC.

David P. Constantine

David P. Constantine
Production Manager

DC:ns
cc: Mr. G. Dietz

ATTACHMENT A-10

to

VOGTLE QUALIFICATION REPORT, FQP-11A

Correspondence Relevant to NOA #4, NA-29
(see Attachment A-2)

9510-AX5A003-5068-4 585

TRANSMITTAL FORM FOR SUPPLIER DOCUMENTS

DATE 2/27/85

*STATUS

1 - WORK MAY PROCEED
2 - REVISE AND RESUBMIT. WORK MAY PROCEED SUBJECT TO INCORPORATION OF CHANGES INDICATED.
3 - REVISE AND RESUBMIT. WORK MAY NOT PROCEED.
4 - INFORMATION ONLY.
M - RESUBMIT - NOT ACCEPTABLE FOR MICROFILM; WORK MAY PROCEED
S - SUPERSEDED BY LATER SUBMITTAL V - VOID
( ) - DRAWING INVOICE PAYMENT CODE

CC: D. R. E) N(

DATE DUE 3/27/85 PLANT VOGTLE-UN 1&2 PKG. NO. 22859

UNIT	BECHTEL ASSIGNED DOCUMENT IDENTIFICATION	*STATUS	SUPPLIER'S DOCUMENT IDENTIFICATION	REV.	DOC. CAT.	SEE NOTE	TITLE
A	J X5A- C03- 5068(1)- 3	2	FQP-11A	B	N/A	P	QUALIFICATION REPORT FQP-11A (ENV. SUPP. TO FQP-11C & 11F

NOTE:
"C" INDICATES SUBMITTAL COMPLETES SPECIFICATION REQUIREMENT FOR THIS DOCUMENT CATEGORY.
"P" INDICATES SUBMITTAL PARTIALLY COMPLETES SPECIFICATION REQUIREMENT

IMPORTANT
Permission to proceed does not constitute acceptance or approval of design details, calculations, analyses, test methods or materials developed or selected by the supplier and does not relieve supplier from full compliance with contractual obligations.

BY 2/26/85 P. Morgan 2/26/85 2/27

TO
Fisher Controls
9645 Telstar Ave.
El Monte, Ca. 91734 0808

Attn: G. Clark
X5A003 PAV-5750

FROM
BECHTEL POWER CORPORATION
TERMINAL ANNEX, P.O. BOX 60860,
LOS ANGELES, CA 90060
ATTN: DRAWING AND DATA CONTROL

09510-001

BFT NO. 47520

PF-6187 (9510) 11/84

9510-AX5AC03-5068-4 586

DISTRIBUTION TO: FOR: REVIEW	INFO.
• MECHANICAL	
HVAC	
NSSS	
BOP	
• CONTROL SYSTEMS ✓	
• ELECTRICAL	
WIRING	
CONDUIT	
• HAZARDS	
• CIVIL/STRUCTURAL	
• NUCLEAR	
• STRESS/PLANT DESIGN	
CODES AND STANDARDS	
• ARCHITECTURAL	
• STARTUP	
• CONSTRUCTION	
• NOT REQ'D BY ENGRG	
• CLIENT	
• EQUIP. QUALIFICATION ✓	
• M & QS	
• WESTINGHOUSE ✓	✓
•	
•	

Att. A - 9 only

IDENTIFYING TITLE OF THIS DOCUMENT: Qualification Report EQP 11A (Env. Supp. to EQP 11C & EQP 11AB)

Bechtel Log No 9510 AX5AC03-5068-3

IMPORTANT

Permission to proceed does not constitute acceptance or approval of design details, calculations, analyses, test methods or materials developed or selected by the supplier and does not relieve supplier from full compliance with contractual obligations.

DATE RECEIVED 1-16-85

SIGNED [signature]

DOCUMENT STATUS

1 ☐ WORK MAY PROCEED

2 ☒ REVISE AND RESUBMIT. WORK MAY PROCEED SUBJECT TO INCORPORATION OF CHANGES INDICATED

3 ☐ REVISE AND RESUBMIT. WORK MAY NOT PROCEED

4 ☐ [illegible] DISTRIBUTION REQUIRED [illegible]

5 ☐ RESUBMITTAL NOT ACCEPTABLE [illegible] WORK MAY [illegible]

DATE 2/23/85

BECHTEL

PF-5984 9510 9-84

VOGTLE ELECTRIC GENERATING PLANT	JOB NO. 9510

EQUIPMENT TAG NO. Various

STARTUP DESIGNATION NO. Various

ACTIVITY NO. NA

SYSTEM NO. Various

CATEGORY NO. EQ 48/49

RETROFITTING REQUIRED ☐ YES ☒ NO

MICROFILM QUALITY ACCEPTABLE

PROPRIETARY

9510-7510-AXSAC03-5068-3 00A

FISHER QUALIFICATION
REPORT FQP-11A
(ENV. SUPP. TO FQP-11C
& FQP-11AB)

Pg. 1 of 1

1. AS WAS DISCUSSED IN THE 2/12/85 MEETING WITH FISHER CONTROLS, PLEASE PROVIDE AN ADDENDUM SHEET TO THE REPORT FOR CERTIFICATION TO REV. 10 OF THE BECHTEL SPEC.

2. ATT. A-2, NA-29, PAGE 3, NOA #4 - PROVIDE FQP-23-B1 AND FQP-23-B15, REFERENCED, SUPPORTING FISHER'S POSITION REGARDING NOT HAVING TO CHANGE ACTUATOR-TO-BRACKET MOUNTING BOLTS.

FISHER

Memorandum

To: Doug Pothast

From: Jon Whitesell

cc: John Dresser
Dave Stanze

Date: May 9, 1985

Subject: Qualification Plan FQP-11A

Enclosed are three (3) copies of the following documents: Bechtel's Transmittal Form (Log No. 9510-AX5AC03-5068-3) dated 2-27-85 concerning the status of FQP-11A, a one page excerpt from Fisher Controls letter dated 5-2-83 to Mr. Bob Albrecht, Bechtel Power Corporation, Gaithersburg, Maryland which was in response to Bechtel's Transmittal No. 28089 and concerns the actuator-to-bracket mounting bolts, and Bechtel's letter to D. Pothast dated 7-7-83 which indicates that Bechtel concurs with the Fisher resolution about the bolting. Also enclosed are three (3) copies of relevant excerpts from Qualification Reports FQP-23-B1 and FQP-23-B15 relating to the Wyle Seismic Test Reports for SNUPPS production valve-actuator configurations. These reports show that no actuator bolting problems were experienced with properly-matched valve-actuator assemblies as sold.

This correspondence will be referenced and included in the soon-to-be revised Qualification Plan FQP-11A.

NOA #4

Problem 1: Following is an expanded reiteration of information furnished in NA-29. Since the information is already available in the referenced SNUPPS documents, no change should be required in NA-29.

The seismic test sequence was performed on the environmental test valve only for the purpose of providing seismic aging for the T-ring seal, since the same actuator and an identical body had both previously been properly seismically qualified. (The Bettis actuator was subjected to 160 bi-axial test runs at inputs to 3.0 g's and frequencies from 1 to 40 Hz as described in Wyle Test Report 44500-11 and Fisher Report FQP-23-B15.) (An identical 20" valve body with a Bettis T316B-SR2-M3-12 actuator that was much smaller and lighter than the environmental valve actuator, was seismically tested during 179 test runs at inputs up to 4.5 g's and frequencies from 1 to 40 Hz as described in Wyle Test Report 44500-7 and Fisher Report FQP-23-B1.)

Consequently, the seismic aging sequence initiated on the environmental test valve, to age the T-ring seal, was started with inputs to 4.5 g's without recognizing the great added strain that the heavy actuator would be placing on the mounting bolts.

As recorded on NOA #4, page IX-13 and IX-14 of Wyle Report 45088, actuator-to-mounting bracket and mounting bracket-to-body bolts loosened repeatedly during the first 59 test runs. With the large Bettis T-420B-SR2-12 actuator on the relatively small 20" valve body, input amplification was so great that the bolts mentioned were yielding during the 4.5 g input loading. Input levels were thereafter limited to 3.0 g's for the rest of the test sequence, to prevent damage to the unit. However, once again, this seismic sequence was only for T-ring seal aging purposes and was not a legitimate seismic test on the rest of the assembly because the body and actuator components had already been satisfactorily qualified by the test mentioned, and because of the irregular size combination of body and actuator assembled for the enviornmental test. Rationale for the selection of the environmental test valve components is presented in Section 2.0 of the environmental qualification Report FQP-23-A.

Problem 2: (See introductory note for Problem 1 above. No change required for NA-29.

The seismic qualification testing of the actuator was complete and satisfactory, as described in Wyle Report 44500-11 and Fisher Report FQP-23-B15. 160 bi-axial test runs were performed at inputs to 3.0 g's and frequencies from 1 to 40 Hz. There was no problem with the tubing during this test program. However, the excessive amplification during the first 59 runs of the environmental sequence performed to seismically age the environmental test valve T-ring seal, plus the remaining 110 test runs to 3.0 g's, plus the initial 160 test runs (during the actuator seismic qualification) caused fatiguing of the tubing at the tubing connection and created the leakage noted in paragraph 1D of NOA #4. As stated in NA-29, the leakage did not affect capability of the valve to perform its safety-mode function.

9510-AX5AC03-5068-4 590

Bechtel Power Corporation

Engineers — Constructors

15740 Shady Grove Road
Gaithersburg, Maryland 20877-1454
301 — 258-3000

Mr. D. Pothast
Fisher Control International, Inc.
205 South Center Street
Marshalltown, Iowa 50158

JUL 0 7 1983

File: J-605A, M-236, M-237
Bechtel Job Number 10466
SNUPPS Project
<u>Environmental Qualification</u>
<u>Documentation FQP-23A</u>

Ref: 1. Fisher Letter Dated 5/2/83

Dear Mr. Pothast:

Reference 1 transmitted Fishers resolutions to the Bechtel comments to the subject report. Bechtel concurs with the Fisher resolutions with the exceptions noted below:

A. The statement provided in NOA #4, Problem 2 should be included in the Fisher resolution. Fisher should identify that the failure of the tubing was a result of the excessive fatigue incurred as a result of the seismic aging of the actuator during the environmental test plus the previous seismic qualification testing of the same actuator.

B. Additional analysis is required to assure that the cracking of the Hoffman junction box will not occur following a seismic event. Fisher should compare the accelerations experienced by the environmental test specimen to those experienced by the 18 inch and 36 inch seismic test specimen (test valves XV and XVI). Also, if the junction box had been seismically qualified by previous testing (ref. Fisher response to NOA #4, problem 2) then this should be identified. If neither of the above actions provide a satisfactory resolution then Fisher should be prepared to provide the maximum length of unsupported cable the junction box conduit interface will tolerate.

Fisher is directed to revise the subject report incorporating the resolutions Bechtel has accepted. A response to items A and B above is requested within two weeks of the date of this letter.

Very truly yours,

D. R. Quattrociocchi
Project Engineer, Systems

JU:ek
cc: N. A. Petrick

ATTACHMENT 2
to
SNUPPS QUALIFICATION REPORT FQP-23-B1

Wyle Dynamic Test Report No. 44500-7

Dated October 16, 1979

(Includes Revision A,
dated December 6, 1979)

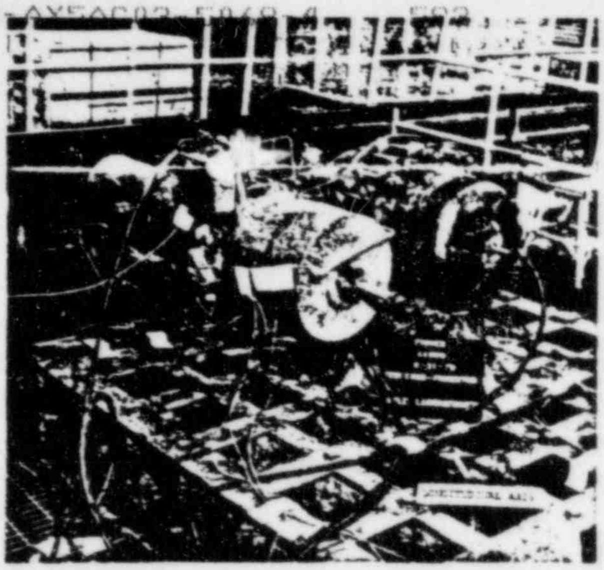
SEISMIC TEST PROGRAM

ON A

20" TYPE 9220 VALVE
WITH A BETTIS MODEL
T-316B-SR2-M3-12 ACTUATOR
SPECIMEN 1
PROJECT 79WA02

FOR

FISHER CONTROLS COMPANY, INC.
205 SOUTH CENTER STREET
MARSHALLTOWN, IOWA 50158



SEISMIC SIMULATION
Test Report

REPORT NO. 44500-7

WYLE JOB NO. 44500-04

CUSTOMER P. O. NO. H-212262

PAGE 1 OF 132 PAGE REPORT

DATE October 16, 1979

SPECIFICATION (S) See References in Section 7.0

1.0 CUSTOMER Fisher Controls Company, Inc.

ADDRESS 205 South Center Street, Marshalltown, Iowa 50158

2.0 TEST SPECIMEN 20" Type 9220 Valve (Serial No. BF239774) with a Bettis Model T-316B-SR2-M3-12 Actuator

3.0 MANUFACTURER Fisher Controls Company, Inc.

4.0 SUMMARY

A 20" Type 9220 Valve with a Bettis Model T-316B-SR2-M3-12 Actuator, hereinafter called the specimen, was subjected to a Seismic Simulation Test Program as required by the Fisher Controls Company, Inc., Purchase Order Number H-212262 and the Fisher Controls Company Seismic Qualification Plan FQP-23, Revision 5. This test program was performed on August 21 and 22, 1979.

The test program consisted of resonance search testing and single frequency (sine beat) testing in each of two test orientations. Additionally, the specimen was tested for leakage and a position deviation cycle was performed prior to and after the simulated seismic excitation. The specimen was instrumented with accelerometers and was electrically and pneumatically powered and monitored for functional operation during the test program.

The specimen demonstrated sufficient integrity to withstand, without compromise of structure, electrical function, or mechanical function, the prescribed simulated seismic environment.

Ala. Professional Eng. Reg. No. 6363

STATE OF ALABAMA
COUNTY OF MADISON } ss

James W. Foreman, being duly sworn, deposes and says: The information contained in this report is the result of complete and carefully conducted tests and is to the best of his knowledge true and correct in all respects.

SUBSCRIBED and sworn to before me this 24th day of October, 1979

Notary Public in and for the State of Alabama at large.

My Commission expires June 13, 1983

PREPARED BY Bobby L. Quinn

APPROVED BY

WYLE Q. A. for M. Kimbrell

WYLE LABORATORIES
SCIENTIFIC SERVICES AND SYSTEMS GROUP
HUNTSVILLE, ALABAMA

Rev. A

ATTACHMENT 2

to

SNUPPS QUALIFICATION REPORT FQP-23-B15

Wyle Dynamic Test Report No. 44500-11

Dated January 21, 1980

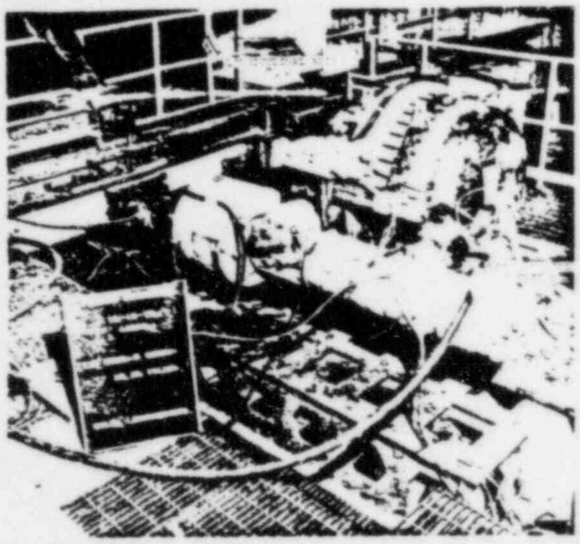
SEISMIC TEST PROGRAM

ON A

36" TYPE 9220 VALVE
WITH A BETTIS MODEL
T-420B-SR2-M3-12 ACTUATOR
SPECIMEN XV
PROJECT 79WA02

FOR

FISHER CONTROLS COMPANY, INC.
205 SOUTH CENTER STREET
MARSHALLTOWN, IOWA 50158



SEISMIC SIMULATION
Test Report

REPORT NO. 44500-11

WYLE JOB NO. 44500-04

CUSTOMER P. O. NO. H-212262

PAGE 1 OF 148 PAGE REPORT

DATE January 21, 1980

SPECIFICATION (S) See References in Section 7.0

1.0 CUSTOMER Fisher Controls Company, Inc.

ADDRESS 205 South Center Street, Marshalltown, Iowa 50158

2.0 TEST SPECIMEN 36" Type 9220 Valve (Serial No. BF241001) with a Bettis Model T-420B-SR2-M3-12 Actuator

3.0 MANUFACTURER Fisher Controls Company, Inc.

4.0 SUMMARY

A 36" Type 9220 Valve with a Bettis Model T-420B-SR2-M3-12 Actuator, hereinafter called the specimen, was subjected to a Seismic Simulation Test Program as required by the Fisher Controls Company, Inc., Purchase Order Number H-212262 and the Fisher Controls Company Seismic Qualifiation Plan FQP-23, Revision 6. This test program was performed on December 12 and 13, 1979.

The test program consisted of resonance search testing and single frequency (sine beat) testing in each of two test orientations. Additionally, the specimen was tested for leakage prior to and after the simulated seismic excitation. The specimen was instrumented with accelerometers and was electrically and pneumatically powered and monitored for functional operation during the test program.

The specimen demonstrated sufficient integrity to withstand, without compromise of structure, electrical function, or mechanical function, the prescribed simulated seismic environment.

STATE OF ALABAMA
COUNTY OF MADISON } ss

Ala. Professional Eng.
Reg. No. 5683

T. Hampton Smith, being duly sworn, deposes and says: The information contained in this report is the result of complete and carefully conducted tests and is to the best of his knowledge true and correct in all respects.

SEAL T. Hampton Smith

SUBSCRIBED and sworn to before me this 24th day of January, 1980

Virginia R. Dort

Notary Public in and for the State of Alabama at large

My Commission expires June 13, 1983

PREPARED BY Bobby L. Quinn
Bobby L. Quinn

APPROVED BY Hayskel D. Jordan

WYLE Q. A. [signature]
M. Kimbrell

WYLE LABORATORIES
SCIENTIFIC SERVICES AND SYSTEMS GROUP
HUNTSVILLE, ALABAMA

ATTACHMENT 5

Includes:

Fisher Qualification Report FQP-11AB-7

(BPC Log # X5AC03-5151-2)

ATTACHMENT 5

DISTRIBUTION TO: FOR: REVIEW	INFO.
• MECHANICAL	
HVAC	
NSSS	
BOP	
• CONTROL SYSTEMS	✓
• ELECTRICAL	
WIRING	
CONDUIT	
• HAZARDS	
• CIVIL/STRUCTURAL	
• NUCLEAR	
• STRESS/PLANT DESIGN	
CODES AND STANDARDS	
• ARCHITECTURAL	
• STARTUP	
• CONSTRUCTION	
• NOT REQ'D BY ENGRG	
• CLIENT	
• EQUIP. QUALIFICATION R.B. Linderman	✓
• M & QS	
• WESTINGHOUSE J. Vota	✓
• ~~Al Hartman~~ ✓	→ no Comments R. J. Hartman 10/18/85
• H. Quasany	✓

IDENTIFYING TITLE OF THIS DOCUMENT:
QUALIFICATION REPORT
EQP-11AB-7

Bechtel Log No. 9510
AX5AC03-5151-2

IMPORTANT

Permission to proceed does not constitute acceptance or approval of design details, calculations, analyses, test methods or materials developed or selected by the supplier and does not relieve supplier from full compliance with contractual obligations.

DATE RECEIVED 11-15-85

SIGNED [signature]

DATE 1-29-86

DOCUMENT STATUS

1☐ WORK MAY PROCEED
2☒ REVISE AND RESUBMIT WORK MAY PROCEED SUBJECT TO INCORPORATION OF CHANGES INDICATED
3☐ REVISE AND RESUBMIT WORK MAY NOT PROCEED
4☐ INFORMATION ONLY DISTRIBUTION REQ'D ☐ YES
M☐ RESUBMIT – NOT ACCEPTABLE FOR MICROFILM WORK MAY PROCEED

BECHTEL

PF-5986 (9510) 9/84

VOGTLE ELECTRIC GENERATING PLANT	JOB NO. 9510
EQUIPMENT TAG NO. VARIOUS	
STARTUP DESIGNATION NO. VARIOUS	
ACTIVITY NO. N/A	
SYSTEM NO. VARIOUS	
CATEGORY NO. 48/49/55/56	
RETROFITTING REQUIRED ☐ YES ☒ NO	

MICROFILM QUALITY ACCEPTABLE

PROPRIETARY

A X5AC03-5152-2 00A

COMMENT TO VENDOR

(1) VERIFY THAT ALL DC POWERED EQUIPMENTS CAN OPERATE SATISFACTORILY OVER A VOLTAGE RANGE OF 100 TO 140 V DC CONTINUOUSLY.