

*SP*  
*max*

(NASA-CR-132226) BYPASS CONTROL VALVE  
SEAL AND BEARING LIFE CYCLE TEST REPORT  
(Aerojet-General Corp., Sacramento,  
Calif.) ~~57~~ p HC \$4.75 CSCL 13I

N73-24526

Unclas  
G3/15 17720

ABSTRACT

The objective of this report is to document the results of the BCV Seal and Bearing Life Cycle Tests. Data from the initial assembly, leak, torque and deflection tests are included along with the cycle life tests results and conclusions.

*52*

BYPASS CONTROL VALVE  
SEAL AND BEARING LIFE CYCLE TEST REPORT

Project 122

*Werner*  

---

*DRA*

April 1972

*A.V. Lundback*

A. V. Lundback, Project Engineer  
Valve and Actuator Section

**ORIGINAL CONTAINS  
COLOR ILLUSTRATIONS**

6

ABSTRACT

The objective of this report is to document the results of the BCV Seal and Bearing Life Cycle Tests. Data from the initial assembly, leak, torque and deflection tests are included along with the cycle life tests results and conclusions.

ii

**ORIGINAL CONTAINS  
COLOR ILLUSTRATIONS**

## TABLE OF CONTENTS

	<u>Page</u>
I. INTRODUCTION	1
II. DISCUSSION OF RESULTS	2
A. INITIAL ASSEMBLY AND SEAL LEAKAGE TESTS	2
B. PROOF AND DEFLECTION TESTS	4
C. SEAL AND BEARING LIFE CYCLE TESTS	5
III. SUMMARY AND CONCLUSIONS	9
IV. RECOMMENDATIONS	10

## ENCLOSURES

	<u>Page</u>
1. BCV - MAJOR COMPONENT PARTS	11
2. BCV - SUPPORT PLATE, TRUNNION AND VISOR ASSY.	12
3. BCV ASSEMBLY - INLET PORT VIEW	13
4. SEAL ASSEMBLY	14
5. DIAL INDICATOR MOUNTING - OUTLET PORT	15
6. DIAL INDICATOR MOUNTING - BODY REMOVED	16
7. LIFE CYCLE TEST SETUP	17
8. SEAL ASSEMBLY - POST LIFE CYCLE TEST	18
9. VISOR - POST LIFE CYCLE TEST	19
10. VISOR BEARING, INNER RACE - POST LIFE CYCLE TEST	20
11. VISOR BEARING, OUTER RACE - POST LIFE CYCLE TEST	21
12. BEARING, BALL - POST LIFE CYCLE TEST	22

## TABLE OF CONTENTS (cont.)

### FIGURES

<u>No.</u>		<u>Page</u>
1.	BCV Seal Leakage and Cycle Life Test Schematic	23
2.	BCV Visor $\Delta P$ vs Torque and Leakage (Initial Tests)	24
3.	BCV Visor $\Delta P$ vs Torque and Leakage (after 200 Cycles)	25
4.	BCV Measurement Data Point Locations	26
5.	Deflection - Center of Visor (Data Point 6 ) - Body Installed	27
6.	Deflection - Center of Visor (Data Point 6 ) - Without Body Installed	28
7.	Deflection - Support Trunnion (Data Point 5 )	29
8.	Deflection - Support Plate (Data Point 4 )	30
9.	Deflection - Support Plate Inboard of Trunnion (Data Point 3 )	31
10.	Deflection - Support Trunnion (Data Point 2 )	32
11.	Deflection - Shaft Coupling (Data Point 1 )	33
12.	BCV Visor $\Delta P$ vs Torque (Barden Brgs Installed)	34
13.	BCV Bearing and Seal Life Cycle Test	35

### APPENDIX

Assembly Procedure for Bypass Control Valve Shutoff Seal and Bearing Tester, N8400:71:P194, dtd 24 Nov., 1971.

DRAWING: Valve, By-pass Control - Shutoff Seal and Bearing Tester (BCV)  
P/N 1139785

I. INTRODUCTION

The purpose of this test program was to measure the operating characteristics of the BCV under simulated operation conditions. The test data were to be used to improve the BCV design and the accuracy of performance predictions. Because of the cancellation of the NERVA program and subsequent limited time available for conducting tests the scope of this test program was limited to evaluation of seal leakage, torque, deflection and life cycle tests of the visor seal and bearings in a non-cryogenic environment.

## II. DISCUSSION & RESULTS

### A. INITIAL ASSEMBLY AND SEAL LEAKAGE TESTS

The configuration of the BCV during this test program was as shown on drawing 1139785, a copy of which is included in Appendix A. Photographs of the BCV tested are shown in Enclosures (1), (2), and (3). Enclosure (1) reveals the major component parts of the BCV. Enclosure (2) shows the support plate, trunion and visor assembly and Enclosure (3) is the BCV assembly as viewed from the inlet port.

Assembly of the BCV was conducted in accordance with: "Assembly Procedure for the Bypass Control Valve Shutoff Seal and Bearing Tester, P/N 1139785." A copy of this document, N8400:71:P194, is included in Appendix A.

During initial assembly of the valve it was noted that the P/N 1139779, S/N 880001 seal contacted the visor sphere on one side with a gap of approximately .012 inch between the seal and sphere 180° from the point of contact. Rough calculations disclosed that approximately .035 inch of material would have to be removed from the seal flange radius to allow the seal to center itself on the sphere. A review of SDAR 40098 also disclosed that the runout between the seal and seal flange was .022 inch compared to an allowable runout of .010 inch. Therefore, it was decided to remove .030 inch radially and recheck the fit.

Following the rework the seal was reassembled in the BCV and even contact was obtained at points around the seal. However, due to irregularities in the spherical surface of the visor (i.e., the surface was not a perfect sphere) there was not a continuous line of contact at all points between the seal and the sphere. Also, during the initial assembly commercial bearings, Federal P/N 1207, were used in place of the gold plated Barden bearings P/N 1139777 because the Barden bearings had not been received.

Assembly of the valve was completed and the test closures were installed.

To facilitate the measurement of torque and provide a means for rotating the valve visor an actuator simulator assembly, P/N 1139953, was assembled and installed on the valve.

The initial leak tests were conducted using  $\text{GN}_2$  as the test fluid. The BCV was set up for test as shown on Figure 1 except that the gear motor was not installed for the initial leak and torque tests. The valve was pressurized upstream of the visor and the leakage rate was measured using Brooks Model 1110 rotameters with a calibrated accuracy of  $\pm 1\%$  of full scale from 100% to 10% of scale reading. The torque to rotate the visor was measured using a Snap-On Model TE-12FU 0-50 in.-lb torque wrench. The torque and leakage values recorded during the test were then plotted against differential pressure across the visor and the results are shown on Figure 2. It should be noted here that all torque values presented in this report are net values which are the result of subtracting the actuator simulator torque from the gross torque required to rotate the visor. A maximum  $\text{GN}_2$  leakage rate of 496 scc/sec, which corresponds to the maximum range of the largest rotameter, was recorded at a differential pressure of 88 psid. This leakage rate converts and extrapolates to approximately  $3.5 \times 10^4$  scim  $\text{GH}_2$  at 400 psid which is well below the  $3.4 \times 10^6$  scim limit requirement in Specification No. EC-90122B. Because of the high degree of non linearity, extrapolation of the torque data to 400 psid was not credible.

Following the initial leak and torque tests the BCV tester was disassembled and the shutoff seal was removed and examined. A photograph of the seal, Enclosure (4), shows the burnished areas on the sealing surface where contact between the seal and gate occurred.

The valve was reassembled using the same shutoff seal and subjected to 200 full stroke cycles ( $0^\circ$  to  $123^\circ$  to  $0^\circ$  visor rotation per cycle) to determine if the seal would wear in to match the contour of the visor. No significant change in leakage rate occurred although the trend was toward decreasing leakage. The results of a torque and leakage test following the 200 full stroke cycles is shown in Figure 3.

## B. PROOF AND DEFLECTION TESTS

To prepare for proof testing the valve body the visor and seal assembly was removed and the test closure flanges were installed. The valve body was filled with distilled water and pressurized to 1320 psig for 5 minutes. No leakage was noted at any of the external joints and there was no evidence of permanent distortion following the test.

The valve was then disassembled and all parts were dehydrated. The seal and visor assembly was installed and proof tested to 500 psid for 5 minutes using  $\text{GN}_2$ .

Following the proof tests a dial indicator was mounted on the outlet end of the valve body, as shown in Enclosure (5), with an extension rod from the dial indicator to the center of the visor. This measurement point is referred to as data point 6 on the visor, seal, and trunnion assembly cross section schematic in Figure 4.

The seal and visor assembly was then pressurized to 500 psig in 50 psi increments. The deflection was recorded from the dial indicator and the results plotted as shown on Figure 5.

The valve body was then removed, as shown on Enclosure (6), to facilitate measurement of deflection at the trunnion bearing and support plate locations. A recheck of the deflection at data point 6, Figure 6, disclosed an increase in deflection up to approximately 45% when the supporting effect of the valve body was removed. Deflection measurements at the support trunnions, support plate and shaft coupling are shown on Figures 7, 8, 9, 10, and 11.

An attempt was made to correlate the deflection data with the BCV Preliminary Stress Analysis (report N8120R:71-016). However, the report did not contain enough information to provide a meaningful correlation.

### C. SEAL AND BEARING LIFE CYCLE TESTS

The purpose of the life cycle test was to evaluate the torque, leakage, and wear characteristics of the visor seal and support bearings. Since full flow testing with hydrogen was beyond the scope of this test program a simulation test was conducted in which the visor was rotated from 0° to 4.5° to 0° with a helium inlet pressure of 375 psig. Therefore, the seal and bearings were subjected to engine operating loads in a helium atmosphere for the full required cycle life of 120 thousand cycles.

Prior to the life cycle tests the Barden gold plated bearings P/N 1139777 had been received and installed. A torque test was then conducted and the results plotted as shown in Figure 12. The torque to rotate the visor with the Barden bearings installed was approximately 11% lower at 375 psid than the torque measured with the Federal bearings installed. It was estimated that the tighter tolerances of the Barden bearings as opposed to the commercial Federal bearings provided better load distribution within the bearings and thus lower torque to rotate under load.

The BCV was set up for the life cycle tests with the small gear motor installed as shown on the schematic in Figure 1. By adjusting the position of the gear motor and actuating arm with respect to the visor shaft extension the visor was set to rotate 0° to 4.5° to 0° per cycle. At approximately 4.5° flow is initiated through the slot cutout in the visor which maintained a helium atmosphere in the BCV tester throughout the life cycle tests. Therefore, the valve was essentially closed during these tests so that the full  $\Delta P$  loads could be applied to the visor. Plans had been made to evaluate the effects of the seal sliding over the visor cutout, however, time did not permit this evaluation.

Power to operate the Consolidated Controls gear motor, P/N 2880-3, was supplied by a Invertron AC power supply, Model No. 501 T. Leakage rates up to 300 sec/sec were measured using the Brooks Model 1110 Rotameters while leakage rates greater than 300 sec/sec were measured using a .047 diameter flow nozzle. Torque was measured with Model TE-12FU and TE-50 FU Snap-On tool torque wrenches.

The general test procedure for the life cycle test was as follows:

1. With the crank lockbolt loosened (Reference Figure 1) rotate the visor counterclockwise (CCW) from 0° to 4.5° and clockwise (CW) from 4.5° to 0°. Record the maximum torque required to rotate the visor in each direction.
2. Increase the pressure from 0 to 100 psid and record the maximum torque as in step 1. With the visor at the fully closed or 0° position record the maximum visor seal leakage rate.
3. Repeat step 2 at pressures of 200, 300, and 375 psid.
4. Cycle the valve 10 full stroke (0° to 123° to 0°) cycles.
5. Adjust the gear motor and arm position so that with the crank lock bolt tightened the visor will rotate from 0° to 4.5° to 0° when power is applied to the gear motor.
6. Adjust the AC power supply voltage to obtain  $60 \pm 5$  (0° to 4.5° to 0°) cycles per minute.
7. After 200 short stroke cycles have been completed turn off the power supply and repeat steps 1 thru 3.
8. Repeat steps 4 thru 7 for the following cycle schedule:

<u>Full Cycles</u>		<u>Powered Cycles</u>	
<u>Additional</u>	<u>Cumulative</u>	<u>Additional</u>	<u>Cumulative</u>
10	20	300	500
10	30	500	1K
20	50	2K	3K
50	100	7K	10K
100	200	20K	30K
150	350	30K	60K
150	500	30K	90K
160	660	30K	120K

The life cycle test was completed per the above procedure and the results were plotted as shown in Figure 13. A photograph of the test setup taken during the tests is shown in Enclosure (7).

The test data reflects a gradual decrease in the maximum fully closed leakage rate to less than 60 scc/sec at 375 psid after approximately 45 thousand cycles. This reduction is attributed to a gradual wearing in of the phosphor bronze visor seal to conform to the electrolyzed A-286 visor. There was also a gradual increase in torque required to rotate the visor which is attributed to an increase in friction coefficient between the seal and visor plus an increase in torque required to rotate the bearings. This will be explained in more detail later in the discussion.

During the cycle tests an anomaly occurred at 49603 cycles which was not included in the data presented in Figure 13. At this point the gear motor stalled and power was immediately shut off. The crank lock bolt was disengaged and a torque wrench was installed on the visor shaft extension. Approximately 500 in.-lbs was required to initiate movement of the visor at 375 psid. However, after movement occurred the torque level decreased to 320 in.-lb which was approximately what the torque average should have been after 49000 cycles based on the test data to that point. The only other major change noted in the data was a considerable decrease in the leakage rate at the 4.5° position during cycling. It was postulated that as seal wear occurred the seal contact width increased allowing less leakage flow thru the slot at the 4.5° position. This in turn probably caused an increase in seal surface temperature resulting in slight galling between the seal and visor with a corresponding increase in torque.

For the rest of the life cycle test the visor position was adjusted to open to approximately 4.8° to allow more leakage flow. The torque required to rotate the visor did not exceed 370 in.-lb throughout the remainder of the cycle tests which tends to verify the postulation stated above.

The maximum torque of 370 in.-lb recorded during the tests exceeds the predicted 350 in.-lb maximum valve load that the BCV actuator transmission

was designed for. However, it is estimated that this life cycle test environment was more severe than engine operation in terms of conditions tending to cause wear, galling and higher torque for the following reasons: (1) All of the wear occurred on a small segment of the visor and bearing race surfaces due to the 0° to 4.5° to 0° cycling restriction. During engine operation the wear would occur over a larger segment of the surfaces with less degradation of the visor surface finish. (2) The visor to seal surface interface temperature was higher during the ambient cycling tests than it would be during cryogenic engine operation. In turn the higher temperature results in greater wear and more of a tendency toward metal transfer and galling.

Following the life cycle tests the valve was completely disassembled. Photographs were taken of the major component parts subjected to wear. A visual examination of the seal, Enclosure (8), and the visor, Enclosure (9), disclosed a scored wear pattern at the seal to visor interfaces. Based on measurements of the phosphor bronze seal the wear depth was approximately .002 inch. The electroplated A-286 visor surface was scored but not worn through. Examination of the visor bearing races revealed that the balls had worn through the gold plating in the race grooves on the loaded side of the bearings as shown in the photographs on Enclosures (10) and (11). The balls were slightly scored at the points of maximum load as shown in the photograph in Enclosure (12).

No evidence of significant wear or damage was noted on any of the other valve parts in the tester assembly.

### III. SUMMARY & CONCLUSIONS

The initial leak and torque test results revealed that if the visor seal is aligned with the visor the specification leakage requirements will be satisfied even though total sealing interface conformance has not been achieved. Initial cycling tests indicated that far more than 200 cycles would be required to improve conformance by wearing in the seal to match the visor surface.

The proof and deflection tests disclosed that the basic structural design is adequate to withstand design proof pressures without failure or permanent distortion. Correlation between the deflection data obtained and the preliminary stress analysis was not possible because of a lack of information.

The seal and bearing life cycle tests were completed and the planned cycle life of 120 thousand cycles was obtained. The visor seal GHe leakage rate decreased during the tests to several orders of magnitude lower than the specification requirements. Although the measured torque was higher than predicted the tests were concluded to be more severe, in terms of factors tending to increase torque, than would be experienced during engine operation. It is speculated that even though the seal would be riding over the visor cutout for the most part during engine operation the visor surface degradation would not be as severe because of the cryogenic environment. Therefore, the torque to rotate the visor would be lower. The leakage rate, however, would probably increase because of a more uneven wear of the sealing surface.

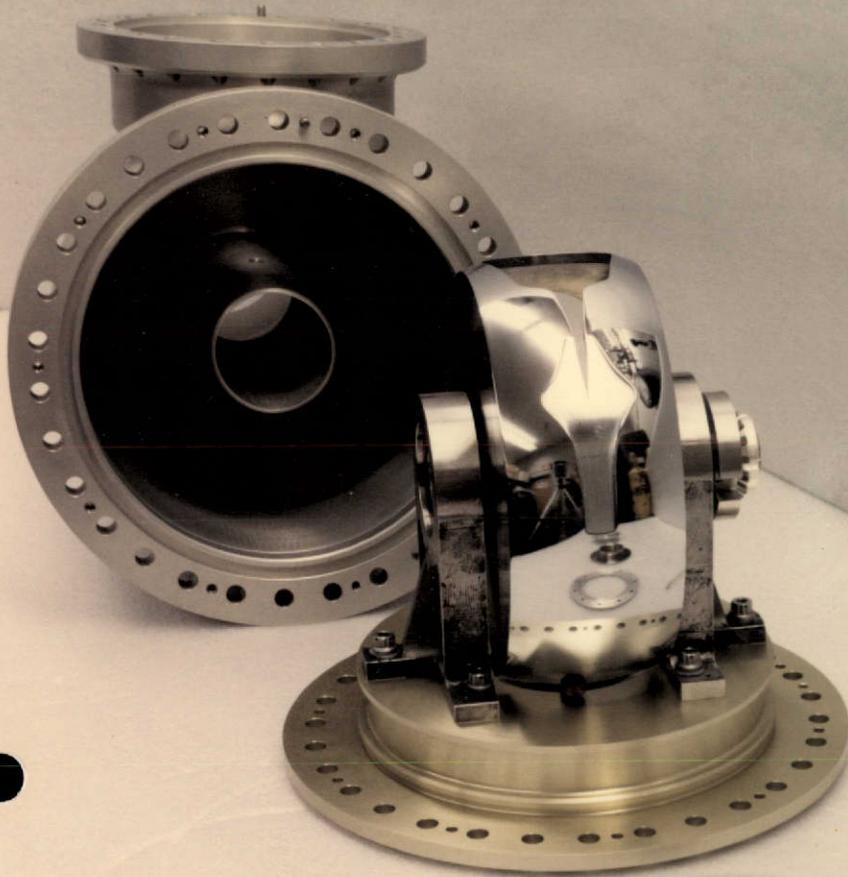
Disassembly of the valve revealed no part failure or galling. Scoring occurred at the seal to visor sealing interface and at points of maximum load where the bearing balls had worn thru the gold plated race surfaces. The wear on all other valve parts was insignificant.

The results of the tests completed thus far indicate that with some development the basic BCV design would fulfill the intended engine operating requirements.

#### IV. RECOMMENDATIONS

Prior to utilization of the BCV Design in any reduced scale NERVA or other applicable engine system the following Recommendations are offered:

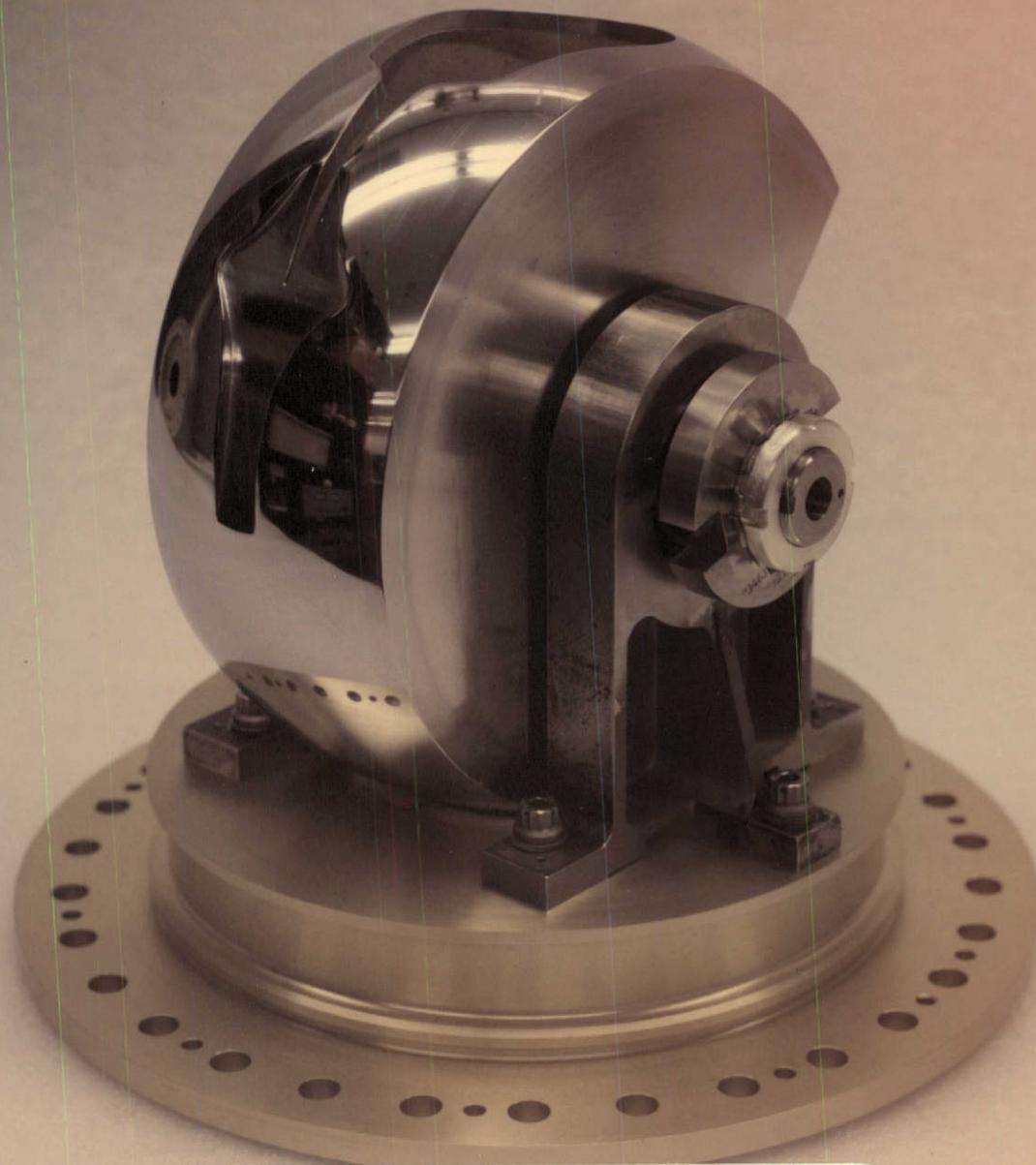
1. Improve the visor fabrication process to obtain a more uniform spherical surface or develop a lapping procedure to assure conformance of the visor seal interface to the visor.
2. Conduct ambient air or GN<sub>2</sub> flow tests to ascertain the correlation between the predicted vs. actual hydrodynamic torque and loss coefficient.
3. Conduct a cryogenic life cycle test at pressures, temperatures flowrates and control positions expected during engine operation. The results of the test should then be correlated with the ambient life cycle tests to determine the extent of further development and redesign if required.



Bill Edwards  
Bill Edwards

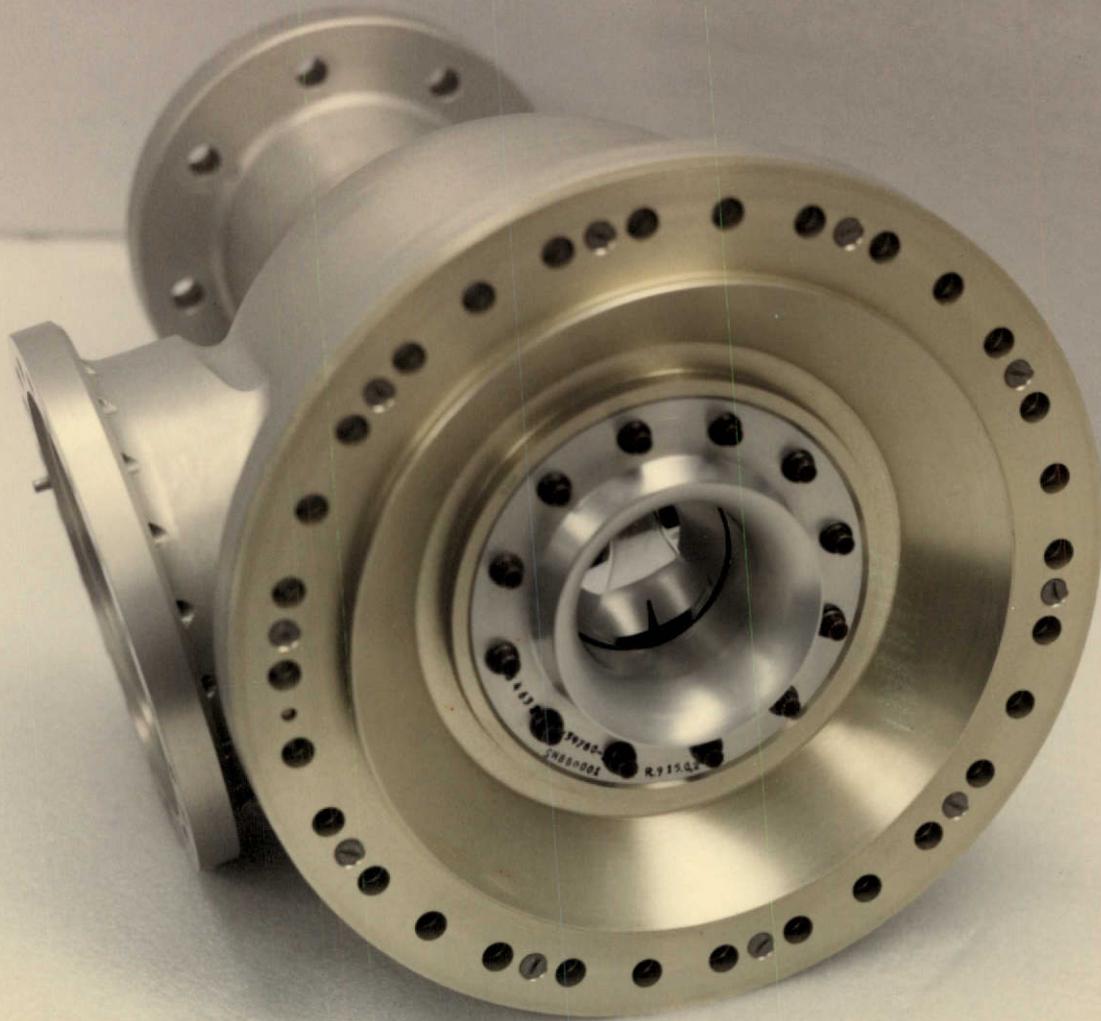
Enclosure (1) - Page 11  
BCV - MAJOR COMPONENT PARTS

Reproduced from  
best available copy.



Enclosure (2) - Page 12

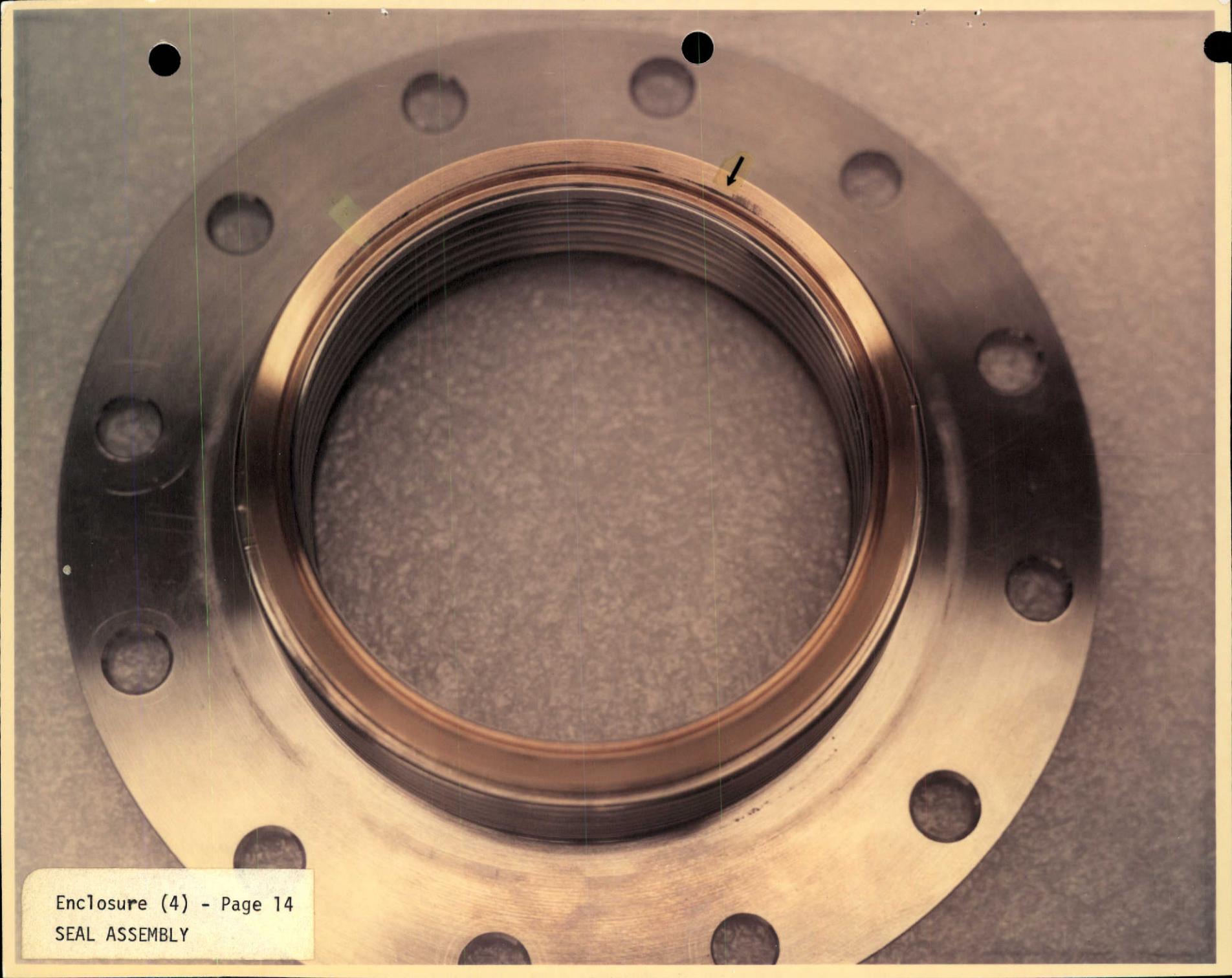
BCV - SUPPORT PLATE, TRUNNION AND VISOR ASSY.



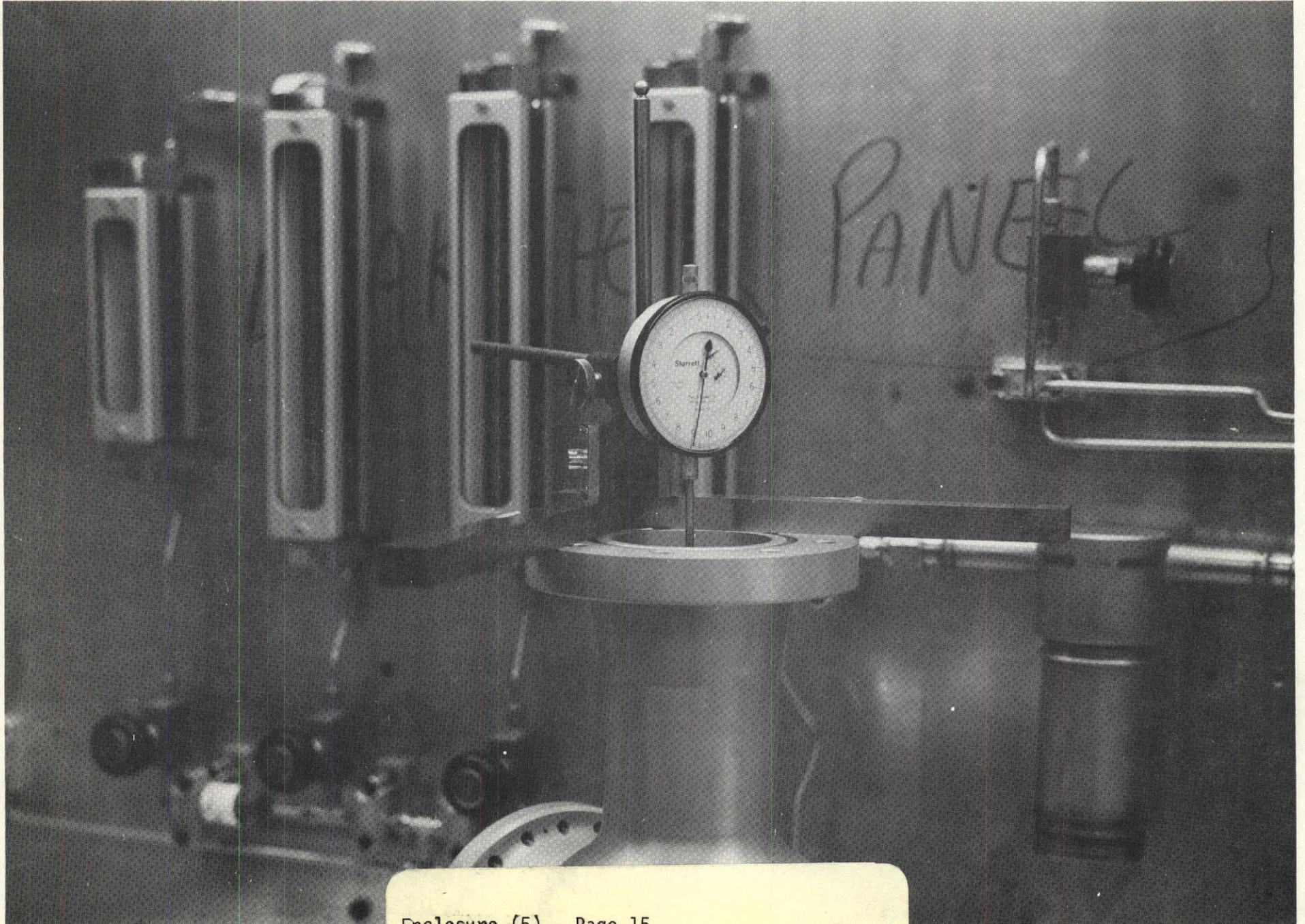
Reproduced from  
best available copy.



Enclosure (3) - Page 13  
BCV ASSEMBLY - INLET PORT VIEW

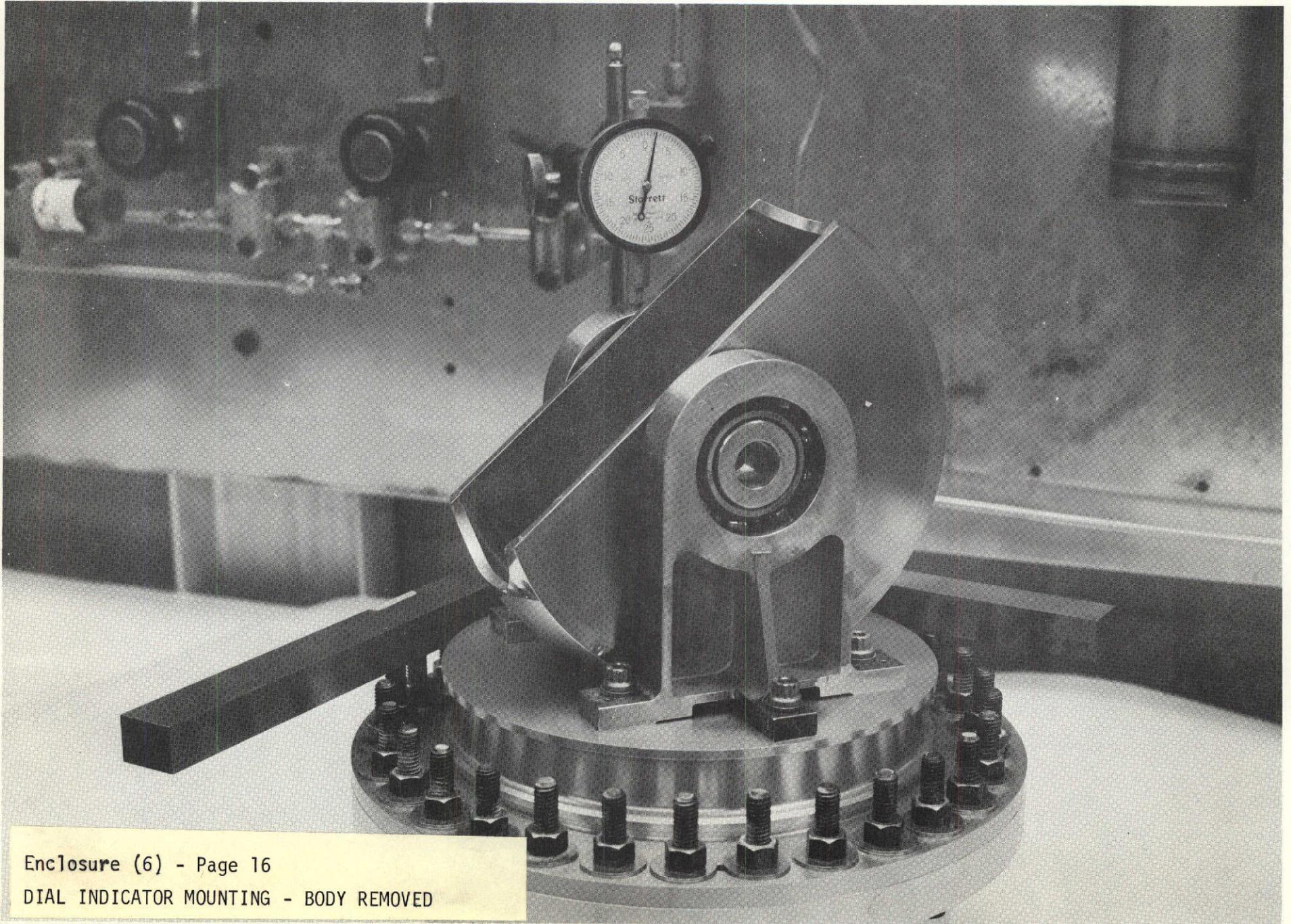


Enclosure (4) - Page 14  
SEAL ASSEMBLY



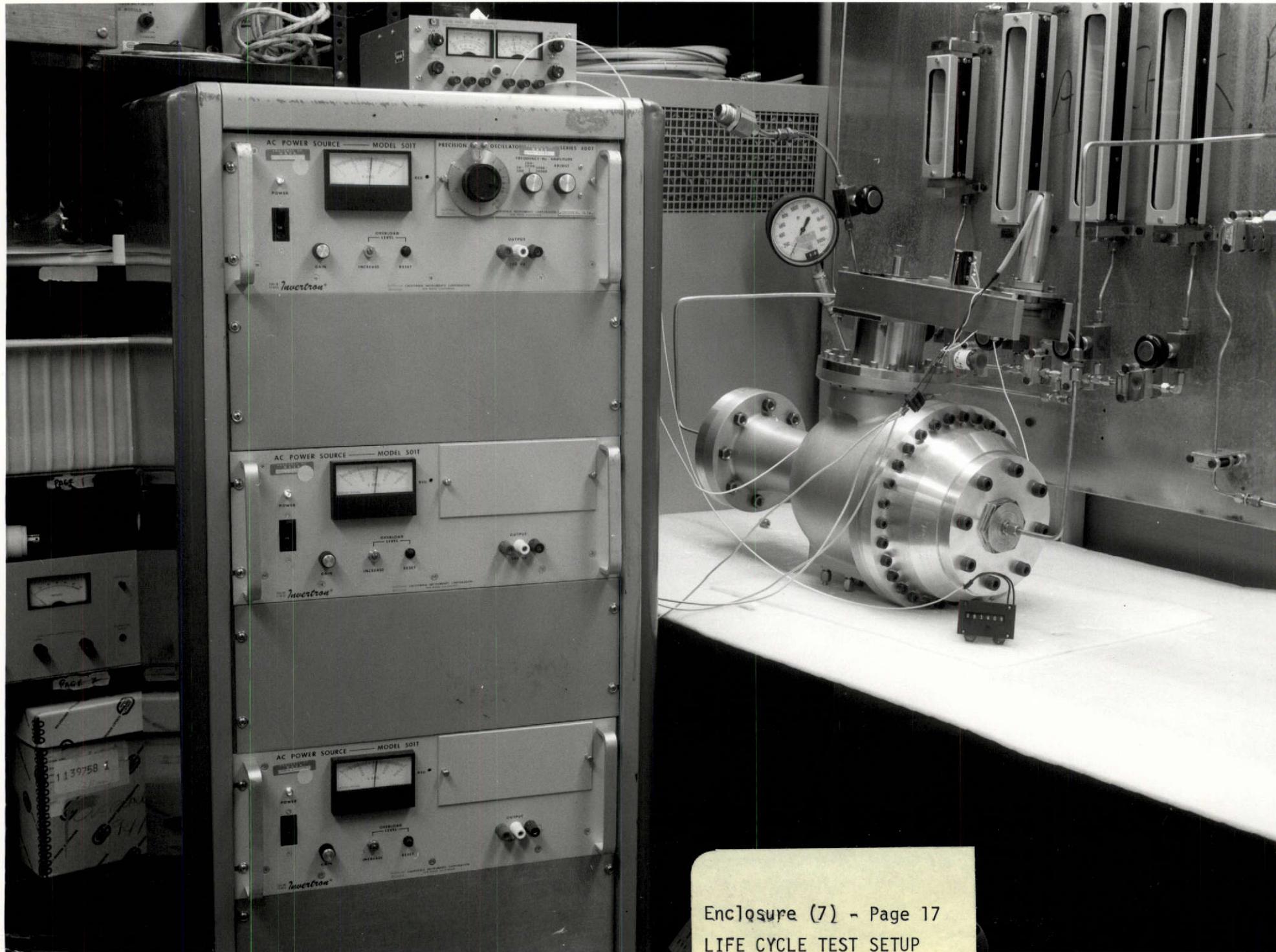
Enclosure (5) - Page 15

DIAL INDICATOR MOUNTING - OUTLET PORT



Enclosure (6) - Page 16

DIAL INDICATOR MOUNTING - BODY REMOVED

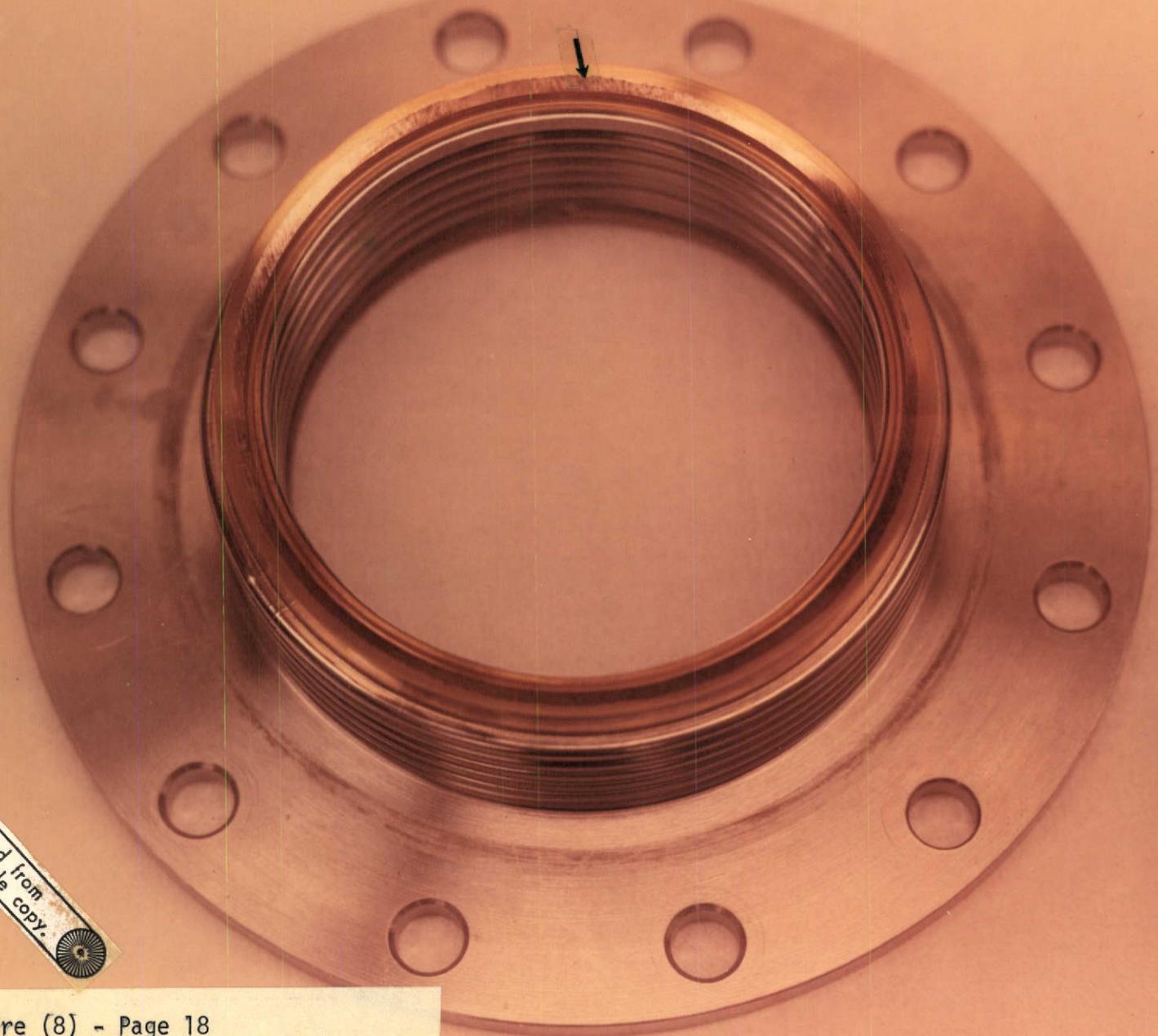


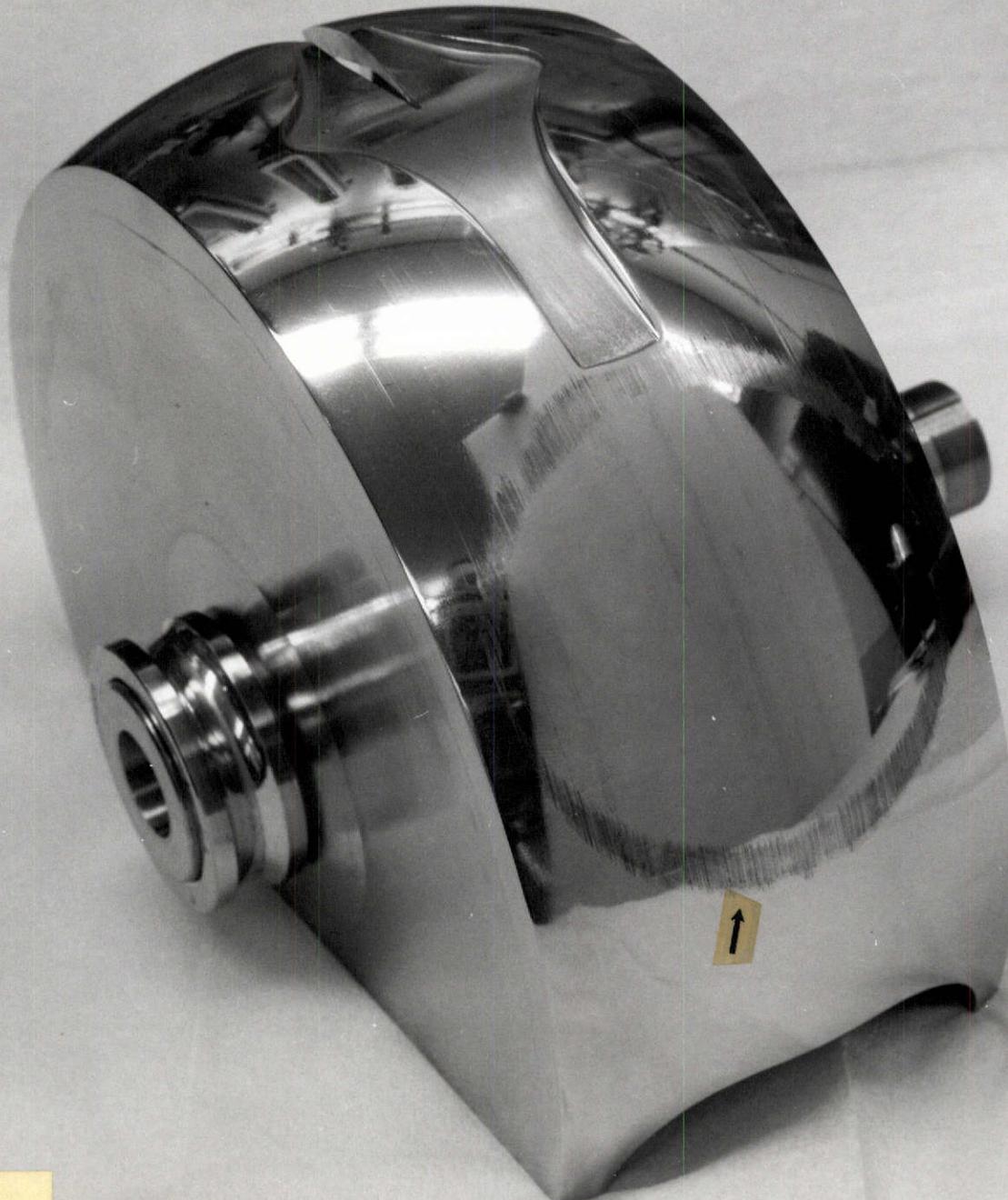
Enclosure (7) - Page 17  
LIFE CYCLE TEST SETUP

Reproduced from  
best available copy.



Enclosure (8) - Page 18  
SEAL ASSEMBLY - POST LIFE CYCLE TEST





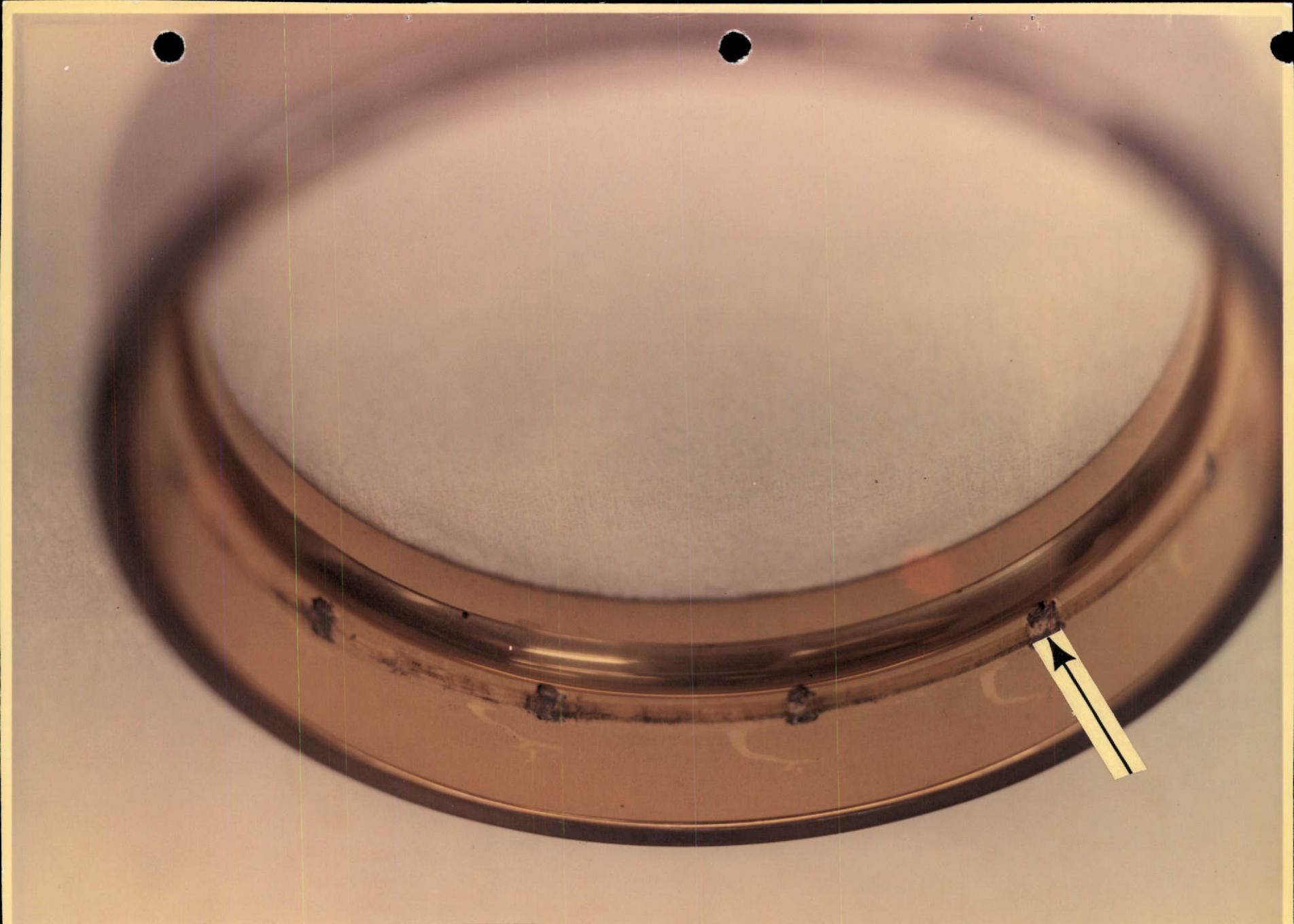
Enclosure (9) - Page 19  
VISOR - POST LIFE CYCLE TEST



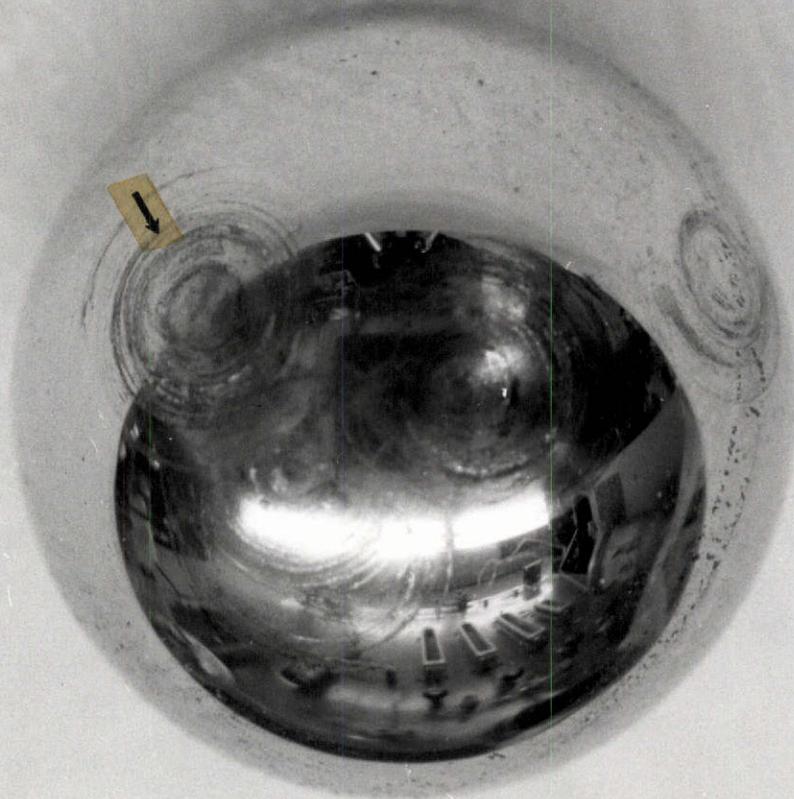
Enclosure (10) - Page 20  
VISOR BEARING, INNER RACE - POST LIFE CYCLE TST

Reproduced from  
best available copy.





Enclosure (11) - Page 21  
VISOR BEARING, OUTER RACE - POST LIFE CYCLE TEST



Enclosure (12) - Page 22

BEARING, BALL - POST LIFE CYCLE TEST

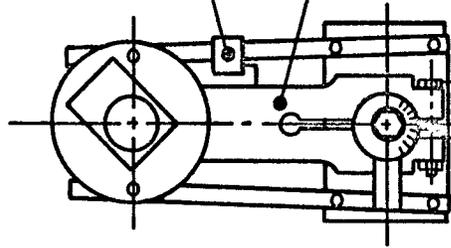
Reproduced from  
best available copy.



# BCV SEAL LEAKAGE AND CYCLE LIFE TEST SCHEMATIC

CYCLE COUNTER  
SET UP TO INCREASE  
1 PER CYCLE

ACTUATING ARM



CRANK LOCK BOLT

PROTRACTOR TO INDICATE  
VISOR POSITION

## CONSOLIDATED CONTROLS

GEAR MOTOR  
FOR CYCLE TESTS

VISOR SHAFT EXTENSION  
(TORQUE MEASURED HERE  
WITH CRANK LOCK SCREW  
DISENGAGED)

BROOKS ROTAMETERS  
MODEL III0

VENTS TO  
ATMOSPHERE

2000 PSIG  
GN<sub>2</sub> & GH<sub>e</sub>  
SUPPLY

INLET PRESSURE GAGE  
0-600  
PSIG

ACTUATOR SIMULATOR  
1139953-1

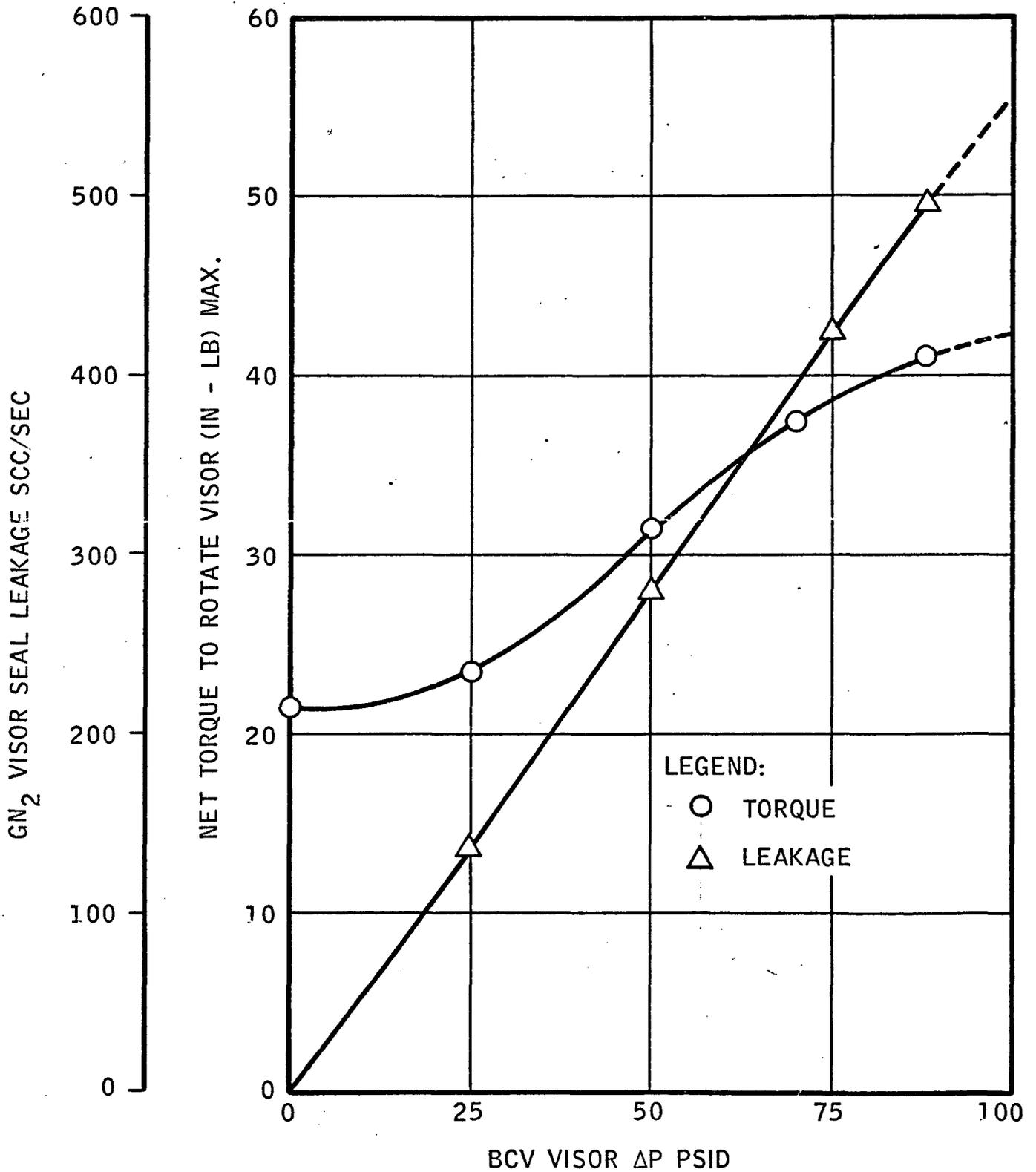
0-1000 PSIG  
REGULATOR

1139956-3  
ADAPTERS

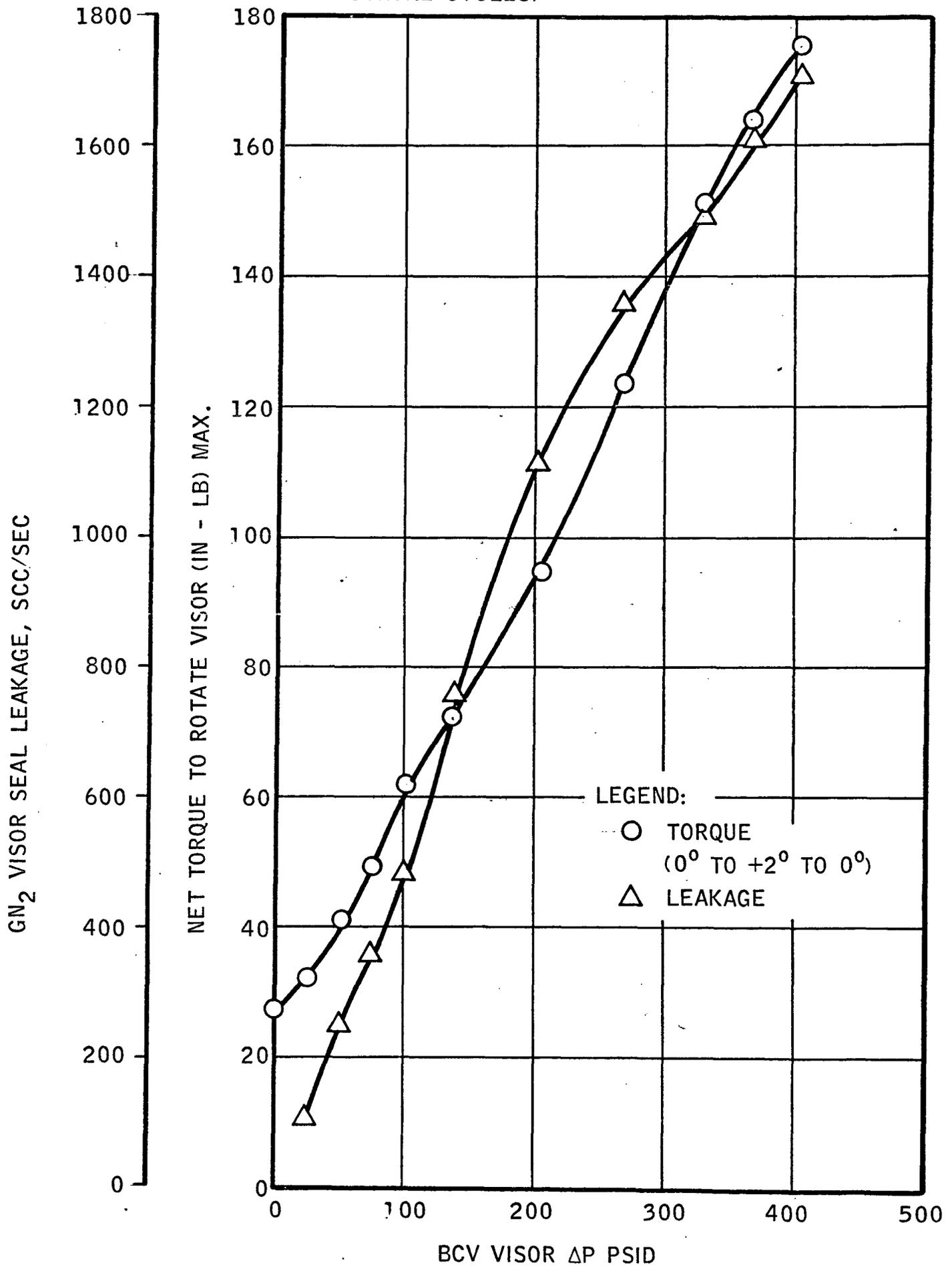
1139785 SHUT OFF SEAL  
AND BEARING TESTER

VENT VALVE

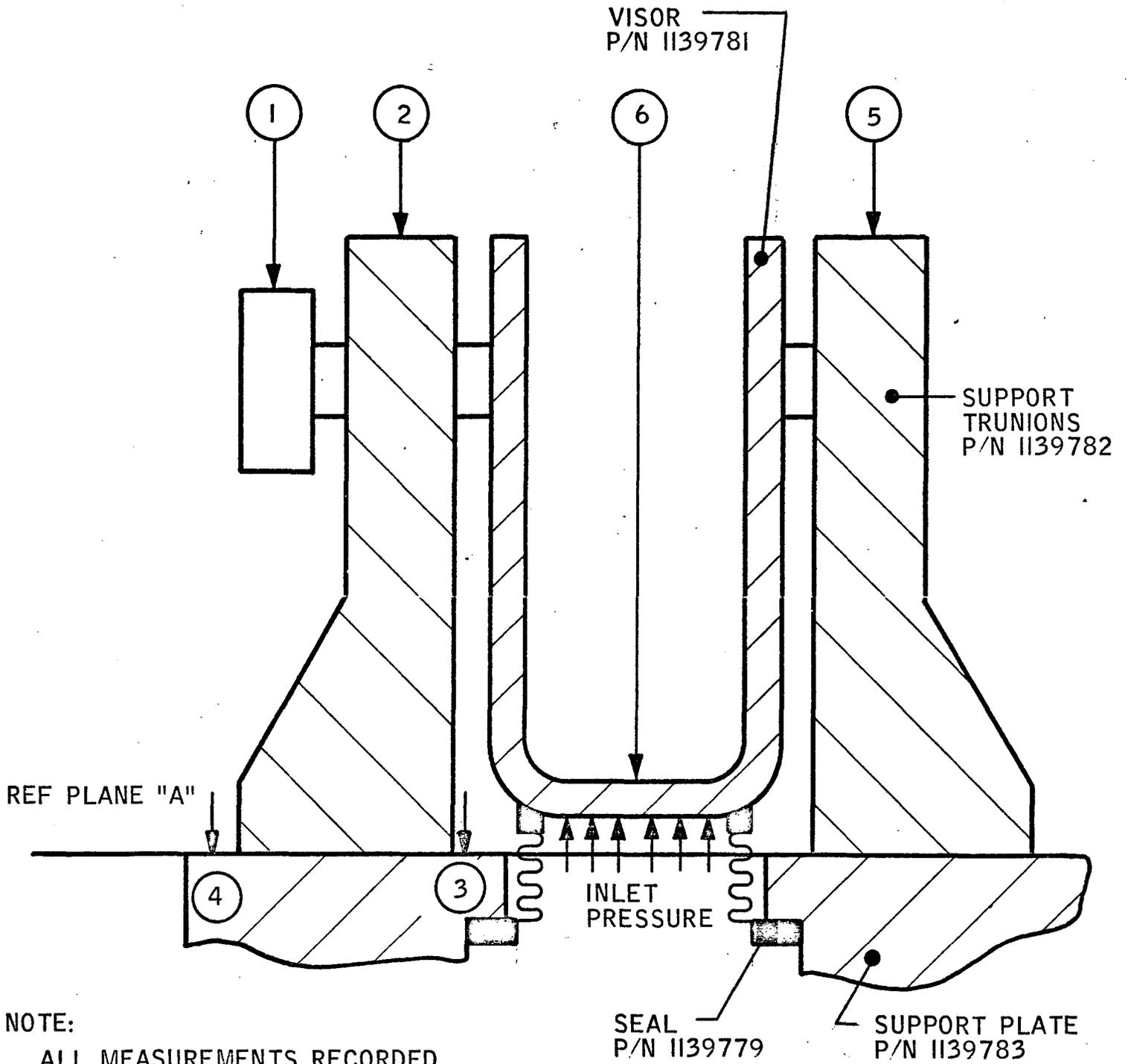
BCV VISOR  $\Delta P$  VS TORQUE AND LEAKAGE  
(INITIAL TESTS)



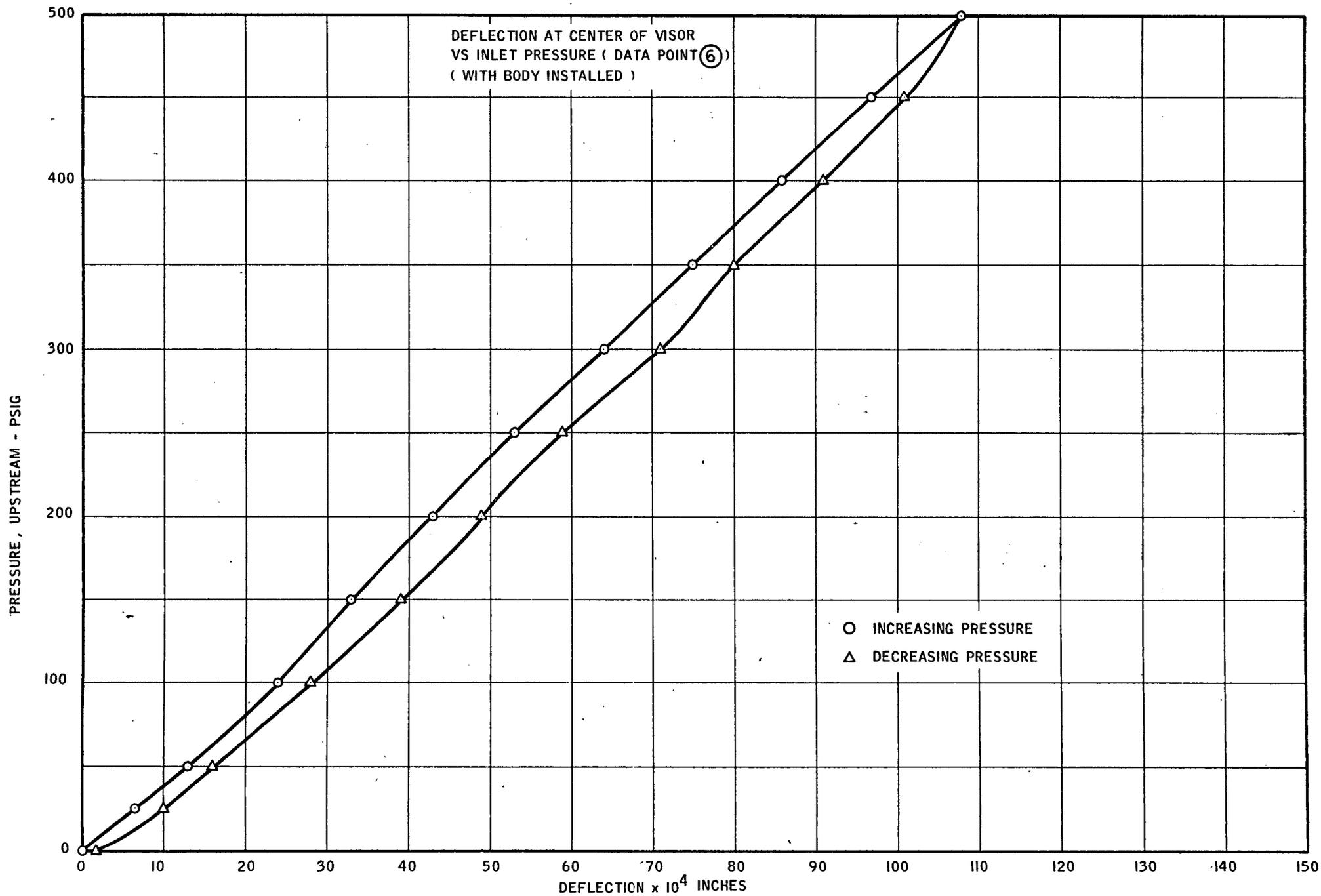
BCV VISOR  $\Delta P$  VS TORQUE AND LEAKAGE (AFTER 200 FULL STROKE CYCLES)

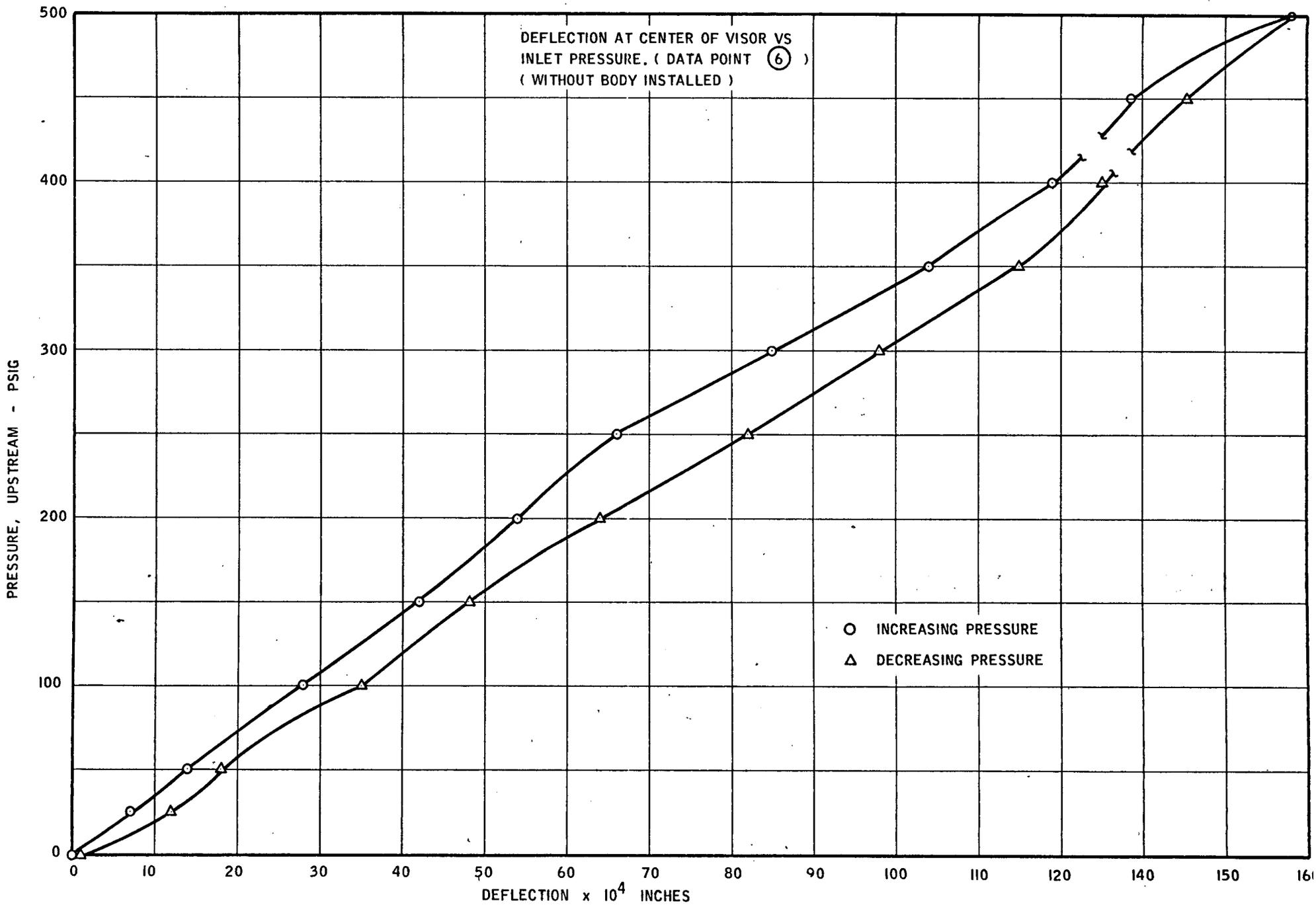


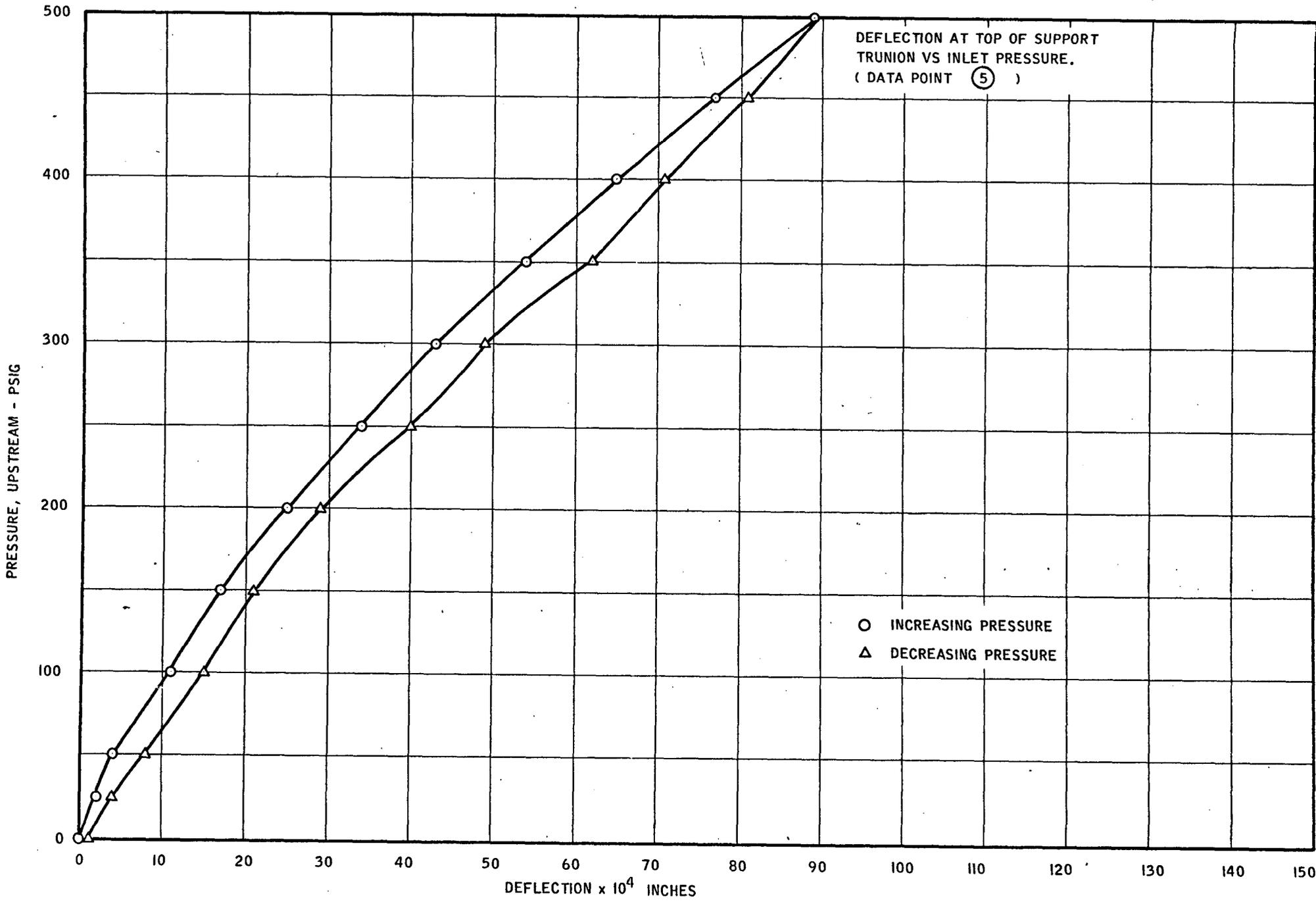
# BCV MEASUREMENT DATA POINT LOCATIONS

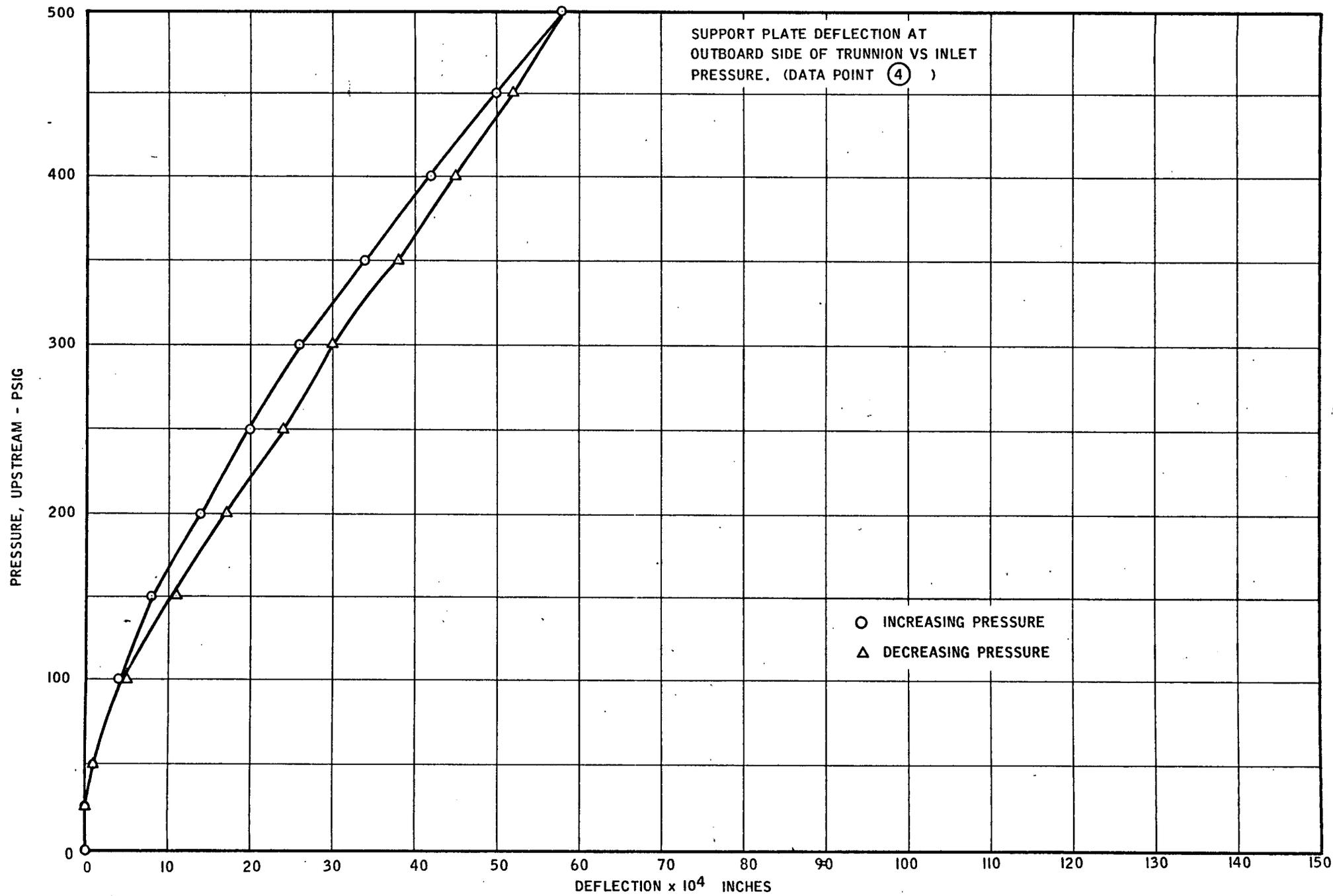


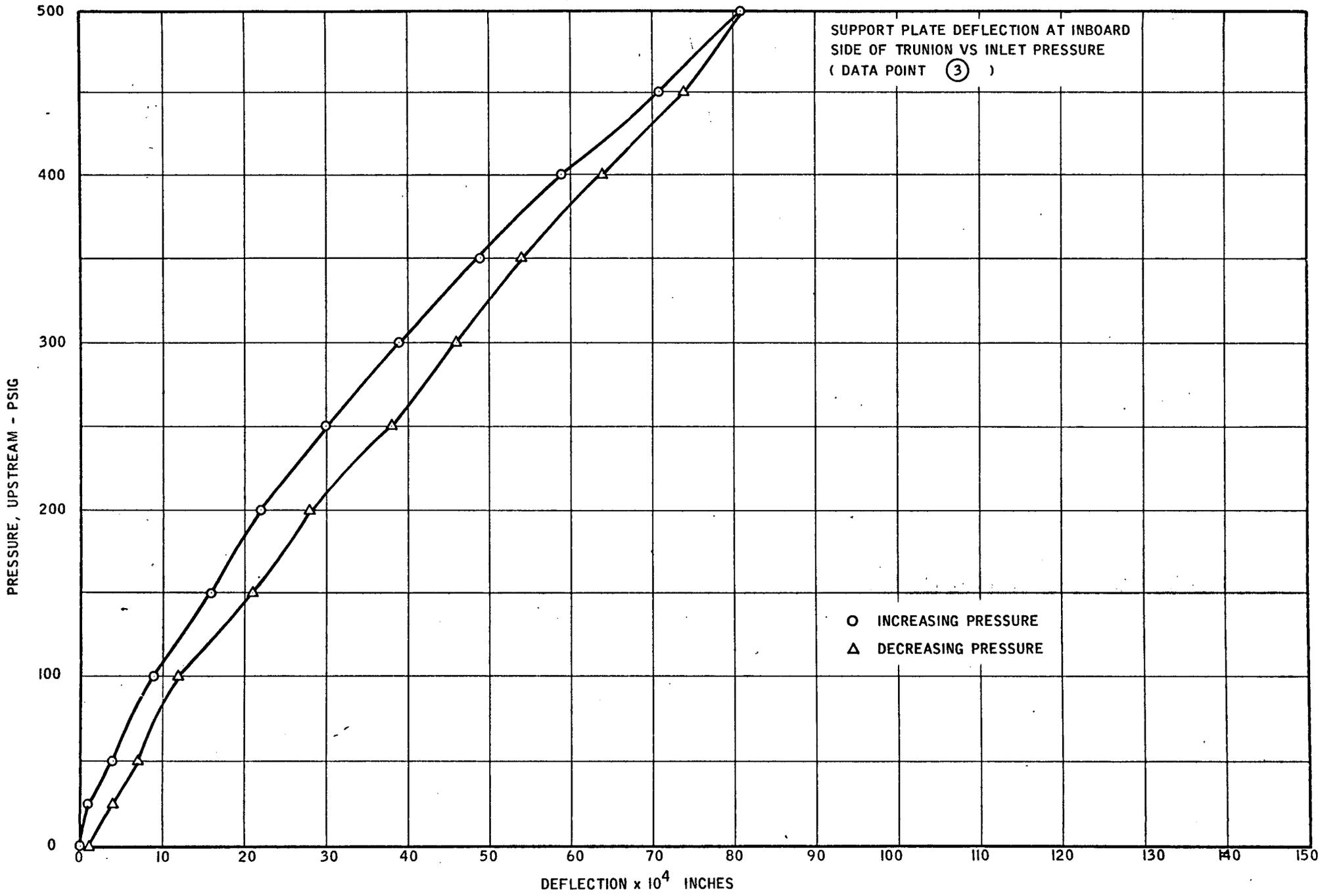
NOTE:  
ALL MEASUREMENTS RECORDED  
WITH RESPECT TO REFERENCE  
PLANE "A".

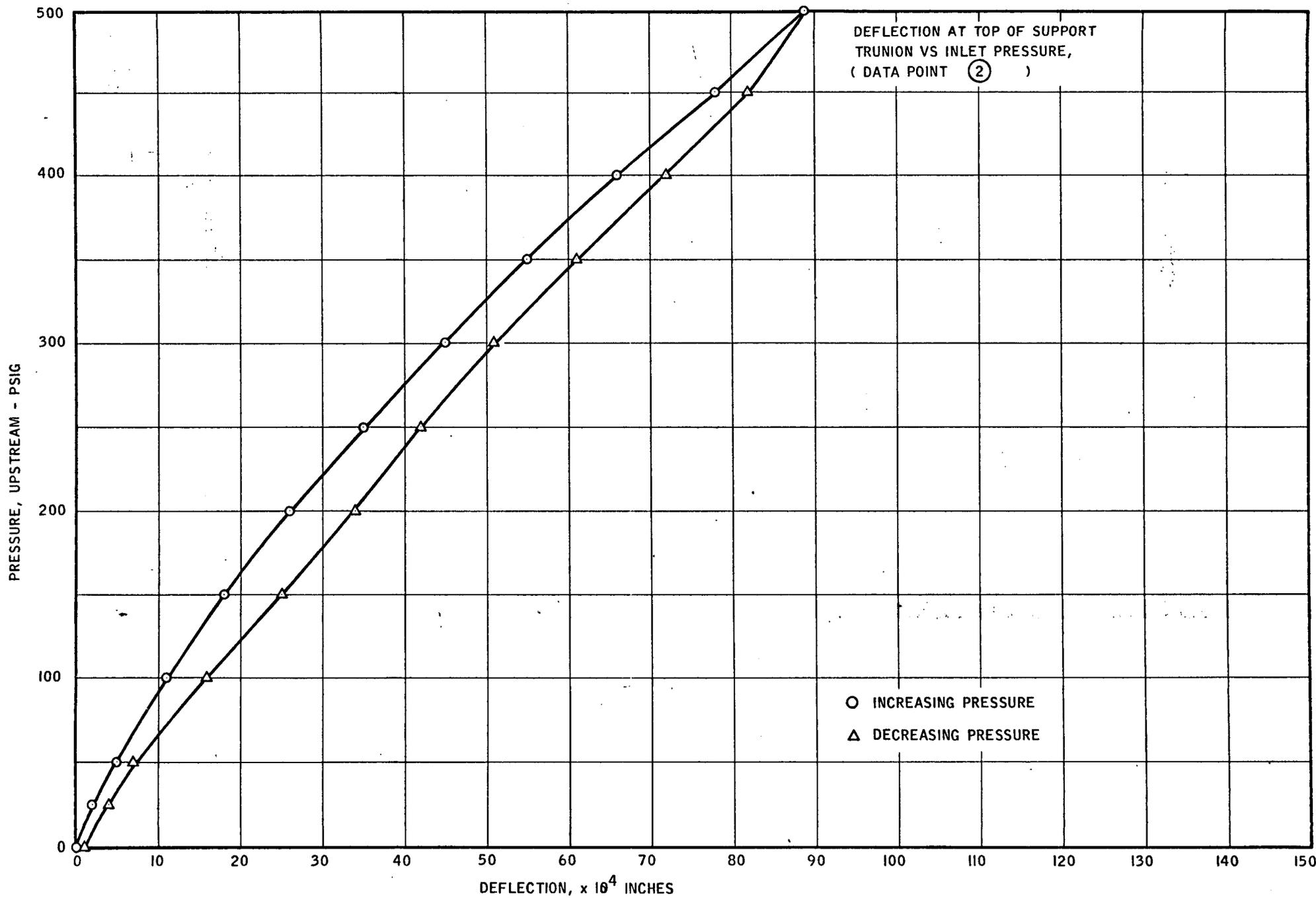


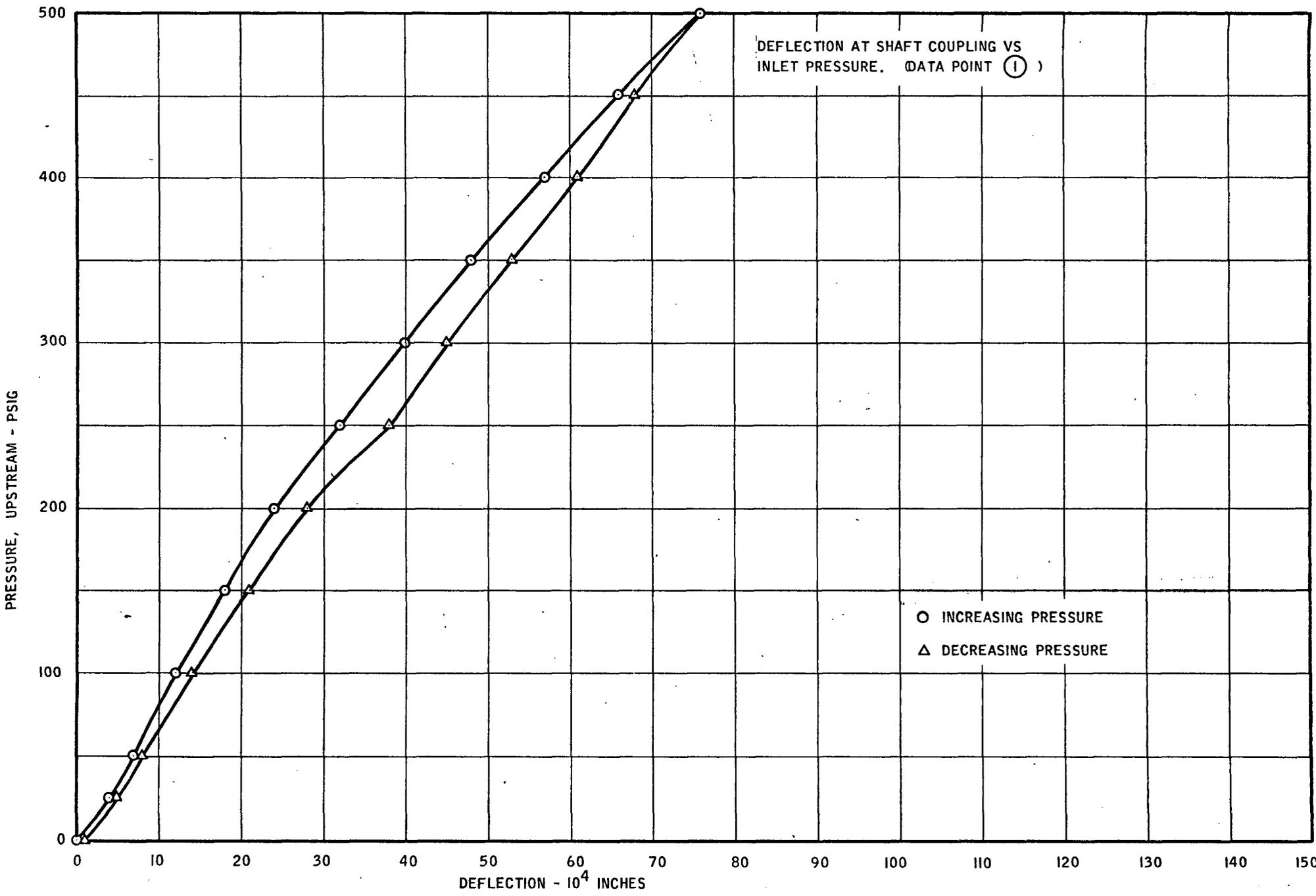




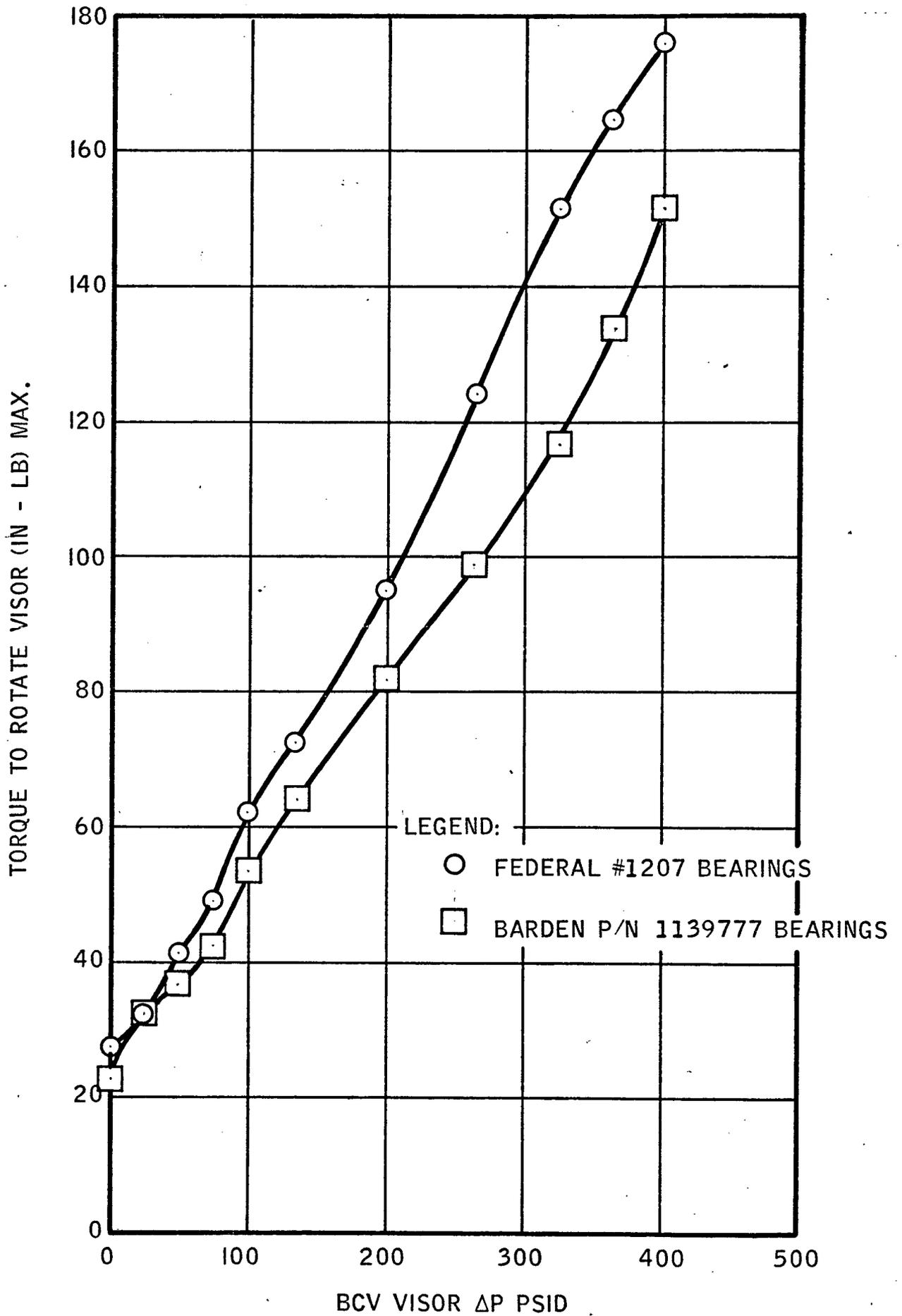




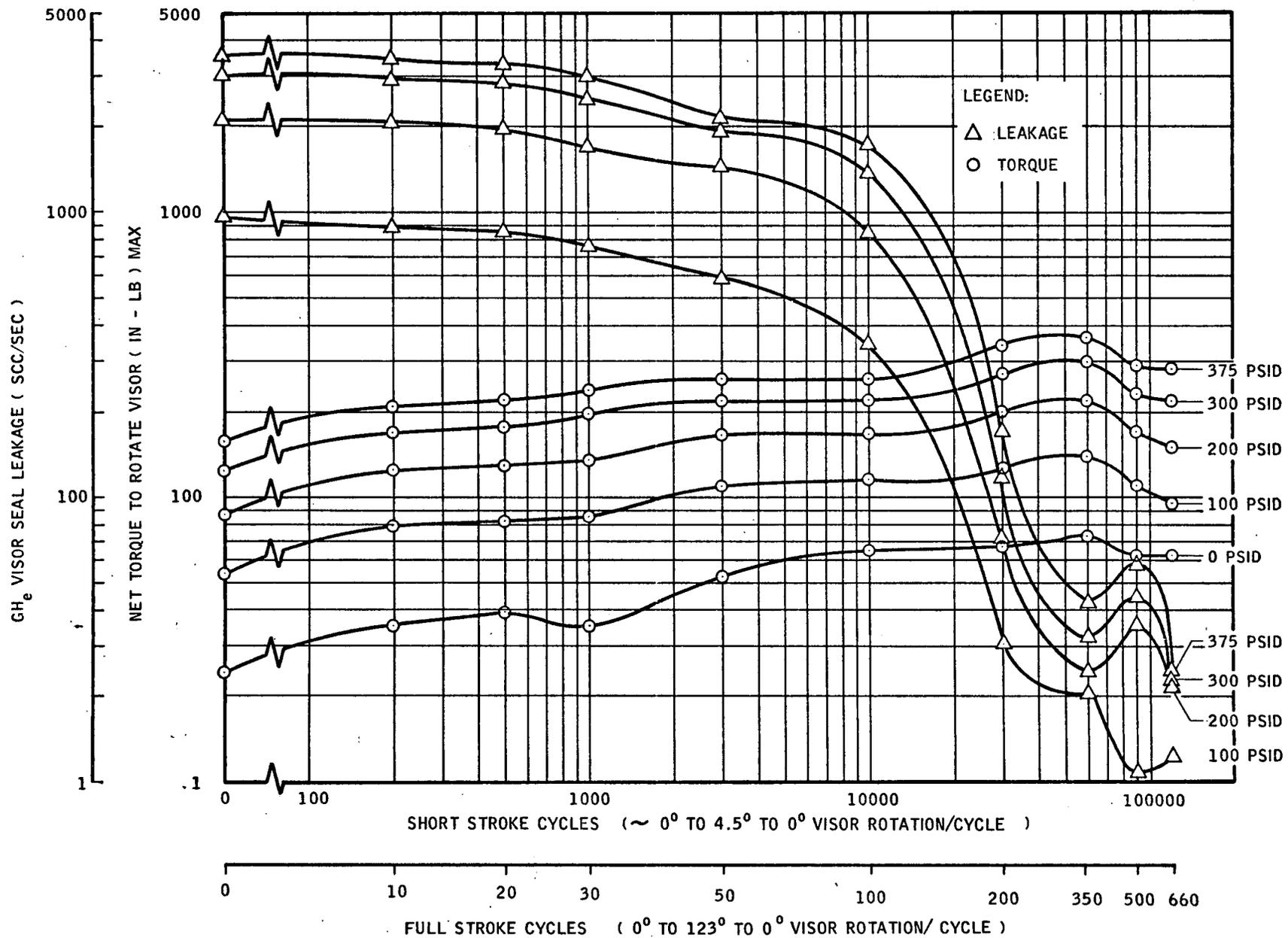




BCV VISOR  $\Delta P$  VS TORQUE  
(FOLLOWING INSTALLATION OF BARDEN BEARINGS)



BCV VISOR BEARING AND SEAL LIFE CYCLE TEST



N8400:71:P194

ASSEMBLY PROCEDURE  
FOR  
BYPASS CONTROL VALVE SHUTOFF SEAL & BEARING TESTER

P/N 1139785

Project 122

24 November 1971

Prepared:

*-for-* A. Lundback  
D. W. Pangburn  
Valve/Actuator Design Section

Approved:

E. A. Shearer  
E. A. Shearer, Supervisor  
Valve/Actuator Design Section

L. D. Johnson  
L. D. Johnson, Manager  
Valves/Actuators Department

F. E. Porter  
for F. E. Porter, Manager  
Quality Assurance Section

TABLE OF CONTENTS

	<u>Page</u>
I. INTRODUCTION . . . . .	1
II. GENERAL . . . . .	1
III. ASSEMBLY . . . . .	2
A. Fit Check and Bearing Installation . . . . .	2
B. Visor Installation . . . . .	3
C. Seal Installation . . . . .	6

## I. INTRODUCTION

Assemble 1139785 "Bypass Control Valve (BCV), Shutoff Seal and Bearing Tester: per this procedure. The BCV is a visor type valve with a metallic dynamic seal. Flow through the wide open valve is in a straight line from the blocking valve bolted to the upstream face of the BCV to the 3.625 inch inside diameter exit line. Control is obtained by rotation of the visor which contains a cutout configured to produce the desired flow resistance vs visor position. All of the active valve components are mounted on an aluminum support plate which is removable from the aluminum housing.

The dynamic seal is loaded against the visor partly by the spring force of the integral metal bellows and partly by the differential pressure across the valve. Sealing is accomplished at the inside diameter of the conical surface on the phosphor bronze seal.

The polished external spherical surface of the visor and the conical surface on the bronze seal are critical sealing surfaces that should not be contacted by anything other than the mating surfaces at assembly. Very close tolerances and fine surface finishes characterize this valve design and, therefore, extreme care must be exercised during the assembly.

## II. GENERAL

1. Assembly of the valve will be performed under the cognizance of a Department N8400 engineer. Assembly operations will be conducted in the Actuator Development Laboratory, or other suitable location agreed to by Engineering and Quality Assurance.
2. During assembly, each component is to be inspected for irregularities which might impair the valve performance. Each unique condition shall be recorded on an Engineering/Quality Event Record, reviewed for acceptability, and dispositioned by the cognizant engineer.
3. Prior to use in the assembly, all parts shall be visually inspected.

- 4. The serial number of each part used in this assembly shall be recorded on the "Assembly Parts List".
- 5. All measurements made during assembly are to be recorded to the nearest .0001.

III. ASSEMBLY

A. BEARING INSTALLATION

Start Buildup Date

- 1. Record weight of all parts on Assembly Parts List. Accuracy requirements on seal + 5 mg. All other parts + 2 gm.
- 2. Press the 1139777 bearings onto the 1139781 visor shafts applying pressure on the inner race only. Support the visor by the side closest to the bearing being pressed to prevent collapsing forces on the visor. Install the bearings with the side facing outboard which has the largest inside diameter of the outer race. See Figure 1. If alternate bearings are used, record manufacturers name and part number. Either side may face outboard on alternate bearings.

Actuator-side Bearing

Mfg. \_\_\_\_\_ P/N \_\_\_\_\_ S/N \_\_\_\_\_.

Other-side Bearing

Mfg. \_\_\_\_\_ P/N \_\_\_\_\_ S/N \_\_\_\_\_.

## B. VISOR INSTALLATION

1. Assemble 1139782 supports to 1139781 visor leaving out all 1139786 spring washers. Install on 1139783 plate with 6 each AS4012-5 washers and 6 each AS4099-05-006 H bolts. Apply light force in outboard direction on support to take up clearance on dowel pins while tightening screws finger tight.

Actuator-side Support S/N \_\_\_\_\_.

Other-side Support S/N \_\_\_\_\_.

2. Measure end clearance between 1139782 supports and 1139777 (or alternate) bearings using a dial indicator as follows: Set up the indicator so it measures the axial motion of the visor with respect to the plate. Slide visor and bearings axially from one extreme position to the other. Record distance travelled below. (Check to see that visor is not contacting the plate at the extreme positions).

Total End Clearance \_\_\_\_\_

3. Remove the AS4099-05-006H bolts and slide the 1139782 supports off the bearings.
4. Three spring washers are to be installed between the bearing and 1139782 support on each side of the visor. Record the stock thickness and free height of each spring washer and the free height of each pack of 3 washers.

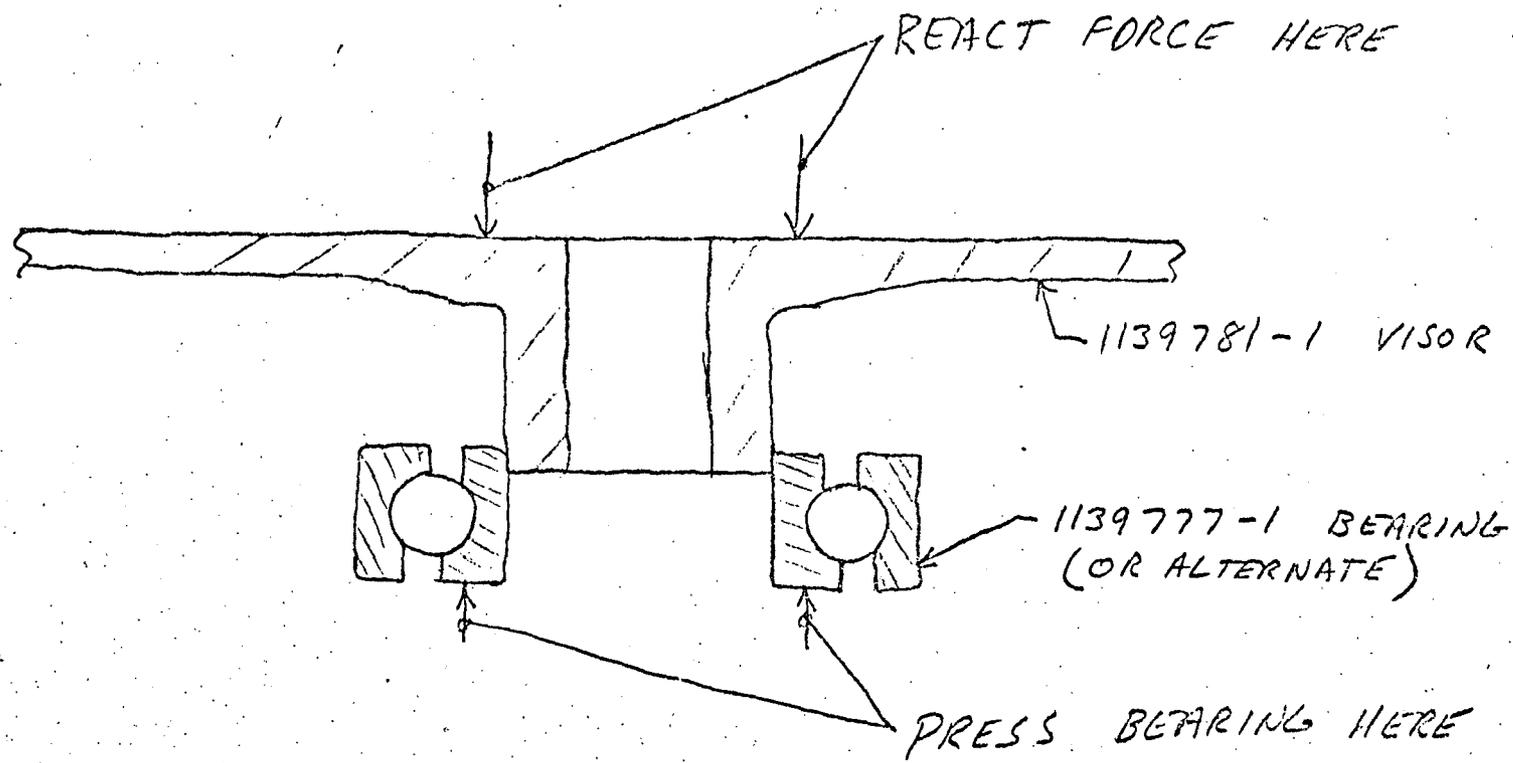


FIG. 1

Actuator Side	Thickness	Free Height
#1	_____	_____
#2	_____	_____
#3	_____	_____
Pack	_____	_____
Other Side	Thickness	Free Height
#1	_____	_____
#2	_____	_____
#3	_____	_____
Pack	_____	_____

5. Install washer packs in the supports and the supports on the bearings. Using a large C-clamp and appropriate spacers, compress the supports together compressing the spring washers just enough to allow assembly to the plate. Apply AGC-44159 lubricant to the bolt threads and both sides of the washer. Install the washers and bolts, but do not tighten yet. Loosen the C-clamp slightly (approx. 01 inch) before tightening the bolts. Torque bolts to  $115 \pm 5$  in.-lb. Install lockwire (unless directed otherwise by the cognizant engineer for assemblies not to be used for endurance tests or flight).

CAUTION: The visor can rotate freely at this time and care should be exercised to prevent injury.

6. Install 1139763-1 spline for use with 1139734 actuator or 1139953-9 spline for use with 1139953-1 actuator simulator as directed by the cognizant engineer. (Angular indexing

of the spline is not important). Apply AGC 44159 lubricant to threads on visor shaft and to the nut surface facing the MS 19070-053 washer. Install MS 19070-053 tab washer and 1139749-1 nut. Chamfered side of nut faces tab washer. Torque nut to  $310 \pm 15$  in.-lb and bend washer tabs to lock. React the torque against a clean non-marring block inserted between the aft face of the support plate and the flat back side of the visor.

### C. SEAL INSTALLATION

1. Temporarily install the body over the support plate and visor assembly. Move the assembly so that it overhangs the work table about 2 inches allowing screws to be installed from below. Install two NAS 1221-3C4 screws finger tight 180 degrees apart. Rotate the valve assembly slowly over so that the visor rotates gently against the closed-position stop and the inlet end of the valve is facing up. Secure the valve so it won't get knocked over.
2. At the valve centerline, measure with a depth micrometer and record the distance from the surface on the 1139783 plate which contains the static seal groove to the 4.2 inch spherical radius on the visor. (Approx. distance .4 inch). See Figure 2.

Distance \_\_\_\_\_

- 7 -

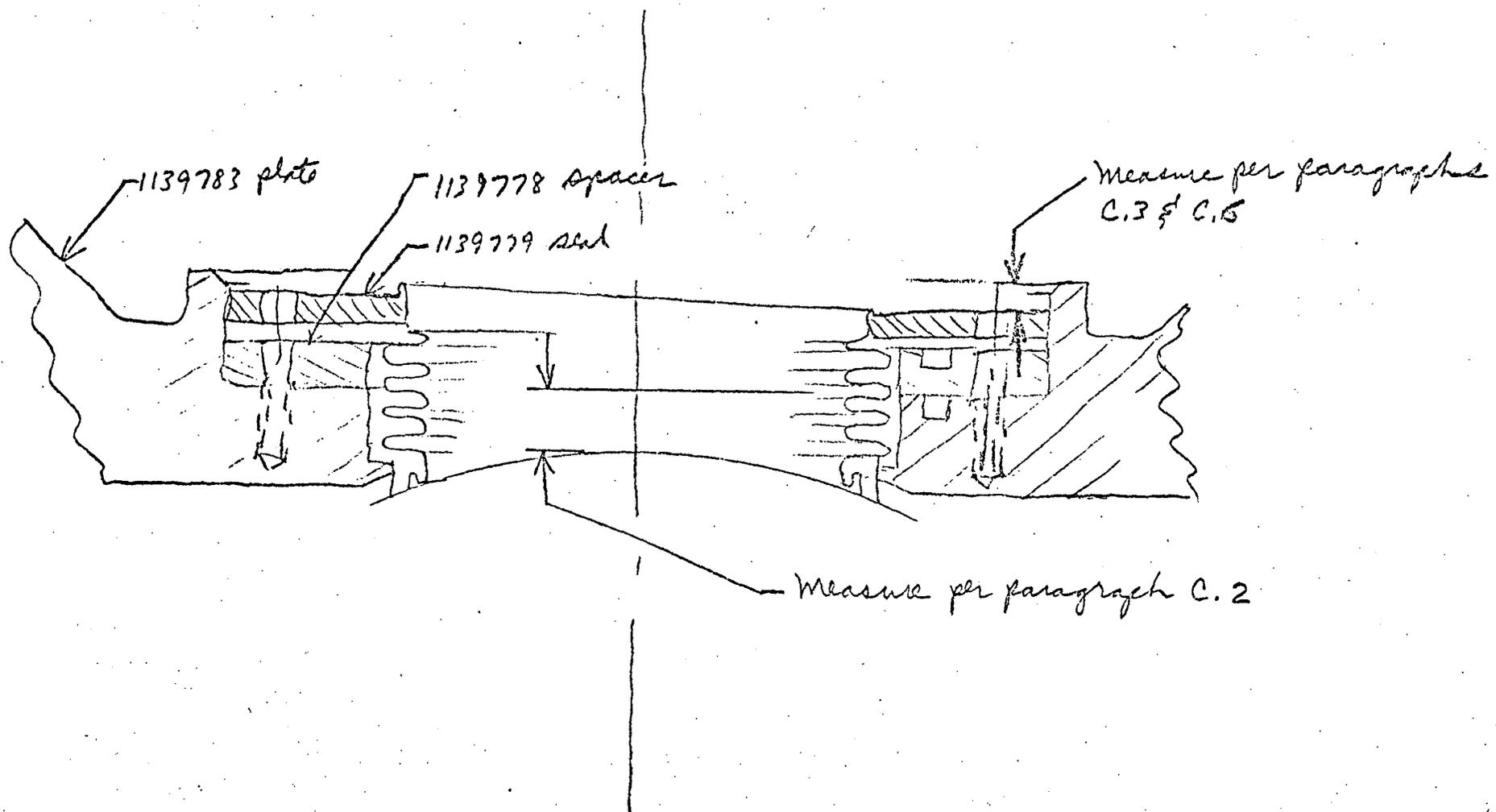


FIGURE 2

3. Install 1139778-4 spacer and 1139779 seal leaving out static seals and screws. Measure, using a depth mike and record the distance indicated on Figure 2 from the seal flange to adjacent plate face at 3 equally spaced points. (To be used later in calculating seal deflection. See step 6).

Distance

1 \_\_\_\_\_

2 \_\_\_\_\_

3 \_\_\_\_\_

Average \_\_\_\_\_

4. Measure and record thickness of fairing flange at 3 equally space points.

Thickness \_\_\_\_\_

1 \_\_\_\_\_

2 \_\_\_\_\_

3 \_\_\_\_\_

Average \_\_\_\_\_

5. Remove spacer and seal and reinstall with 2 each 23003FA3625 seals and 1139780-1 and fairing. Apply AGC 44159 lubricant to threads of 12 each MS 21288-14 bolts and both sides of AS 4012-3 washers. Install, draw up evenly and torque to  $27 \pm 2$  in.-lb. Alternately, for non-nuclear testing as directed by cognizant engineer, use MS 9068-239 O-rings instead of 23003FA3625 seals. P/N of static seals used. \_\_\_\_\_.

Install lockwire.

6. Measure, using a depth mike, and record distance from fairing flange to adjacent plate face at three equally space positions.

Distance

1 \_\_\_\_\_

2 \_\_\_\_\_

3 \_\_\_\_\_

Average \_\_\_\_\_

Calculate seal deflection.

Seal deflection = Ave. 3 + Ave. 4 - Ave. 6

= \_\_\_\_\_ + \_\_\_\_\_ - \_\_\_\_\_ = \_\_\_\_\_

7. Remove the two screws securing the support plate to the body installed at C.1 and withdraw the support plate assembly from the body. Contact between the visor and valve body is permissible providing the visor is in the closed position. Visually inspect the 1139779 seal to 1139781 visor contact line with a light. Can light be seen through the contact line? \_\_\_\_\_

8. Install 22024 FA 9375 K seal in groove in body. Insert support plate assembly. Apply AGC 44159 lubricant to threads of 10 each NAS 1221-3C4 screws. Install and torque to  $27 \pm 2$  in.-lb. Use alternate seal P/N 373-11307 for non-nuclear testing if so directed by cognizant engineer.

P/N of seal used \_\_\_\_\_

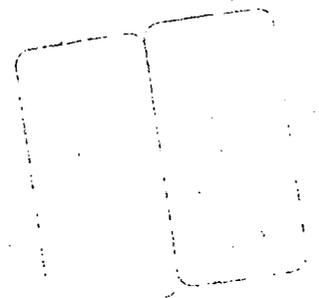
9. Affix protective closures or mating components.

8 7 6 5 4 3 2 1

REV	DATE	BY	DESCRIPTION
A			SEE DCN

NOTED

1. INTERPRET DRAWING PER MIL-STD-100, MIL-D-1000 FORM 3 AND USAS 714.3.
2. DIMENSIONS PER AGC-STD-9007, LEVEL II.
3. PARTS PER FABRICATION ORDER INSTRUCTIONS, INCLUDE PROTECTIVE COATINGS.
4. SUPPLIER ITEM - SEE ENVELOPE DRAWING
5. SELECT PART DASH NO. PER FABRICATION ENGR. NOMINAL DESIGN IS 1139780-A
6. REMOVED
7. REMOVED
8. TORQUE SEQUENCE PER ASD-5276.
9. REMOVED
10. SAFETY WIRE PER MS3310.
11. REMOVED
12. ALTERNATES PERMISSIBLE FOR NON-NUCLEAR TESTING, SEE TAB BLOCK.
13. REMOVED
14. PROOF AND LEAK TEST WITH VALVE CLOSED AND PRESSURE ON UPSTREAM SIDE.
  - PROOF TEST AT TBD ± 180 PSIG FOR TBD ± TBD MINUTES. LEAK TEST AT TBD ± 180 PSIG FOR TBD MINUTES MINIMUM.
  - NO PERMANENT SET AND NO INTERNAL LEAKAGE IN EXCESS OF TBD.
  - TEST MEDIUM TBD.
15. WITH THE VISOR TBD ± TBD DEGREES FROM THE CLOSED STOP AND THE VALVE PRESSURIZED WITH TBD ON THE UPSTREAM SIDE TO TBD PSIG THE STATIC BREAKAWAY TORQUE REQUIRED TO INITIATE VISOR ROTATION SHALL BE TBD ± TBD IN EACH DIRECTION. WHEN UNPRESSURIZED THE TORQUE SHALL BE TBD ± TBD.
16. PROOF AND LEAK TEST WITH VALVE OPEN.
  - PROOF TEST AT TBD ± 180 PSIG FOR TBD ± TBD MINUTES. LEAK TEST AT TBD ± 180 PSIG FOR TBD MINUTES MINIMUM.
  - NO PERMANENT SET AND NO LEAKAGE IN EXCESS OF TBD.
  - TEST MEDIUM TBD.



I	207 K	21335
I	3207X1	43334
I	6207	52676
II	1139953-7	
28	MS9068-279	
24	373-11307	86579
ITEM NO. ALTERNATE CODE		
REF. PART NO. IDENT		
ACCEPTABLE ALTERNATES		

Reproduced from  
best available copy.

REV	DATE	BY	DESCRIPTION	QTY
			LUBRICANT AGC-44159	31
			LOOKWIRE	30
				29
			K SEAL	28
				27
				26
				25
			K SEAL	24
			WASHER	23
				22
			PIN	21
			WASHER	20
			BOLT	19
				18
				17
			BOLT	16
			WASHER	15
			SCREEN	14
				13
			NUT	12
			SPLINE	11
			SPRING	10
			BODY	9
				8
			SUPPORT PLATE	7
			SUPPORT	6
				5
			VISOR	4
			EVITANCE PLATING	3
			SEAL	2
			SPACER	1
			BEARING	1

REV	DATE	BY	DESCRIPTION
A			SEE DCN

REV	DATE	BY	DESCRIPTION
2			REV STATUS OF SHEETS
1			ISSUED

REV	DATE	BY	DESCRIPTION
A			SEE DCN

REV	DATE	BY	DESCRIPTION
E			34632
			1139785

10

1139780

A