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 FACIL: 50-410 Nine Mile Point Nuclear Station, Unit 2, Niagara Moha 05000410
 AUTH. NAME AUTHOR AFFILIATION
 MANGAN, C. V. Niagara Mohawk Power Corp.
 RECIP. NAME RECIPIENT AFFILIATION
 ADENSAM, E. G. BWR Project Directorate 3

SUBJECT: Forwards response to BNL questions re 10CFR50.55(e) rept on MSIV actuators & related info, per 861106 telcon request.

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November 17, 1986
(NMP2L 0939)

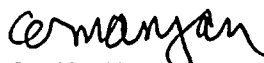
Ms. Elinor G. Adensam, Director
BWR Project Directorate No. 3
U.S. Nuclear Regulatory Commission
7920 Norfolk Avenue
Washington, DC 20555

Dear Ms. Adensam:

Re: Nine Mile Point Unit 2
Docket No. 50-410

This letter transmits the information requested during a telephone call between the Staff, its consultant and Niagara Mohawk on November 6, 1986. This material included the response to ten questions asked by BNL reviewers regarding the 50.55(e) report on the Main Steam Isolation Valve (MSIV) actuators, together with three attachments: 1) Crosby Test Report No. 4330, Revision 1, regarding cycle time for MSIV actuators, 2) IOM, C. E. Crocker to E. R. Klein, "Target Rock SOV Seismic Qualification," dated October 26, 1986, 3) Crosby Material Description Specification for Crosby Part Number 801858.

Very truly yours,

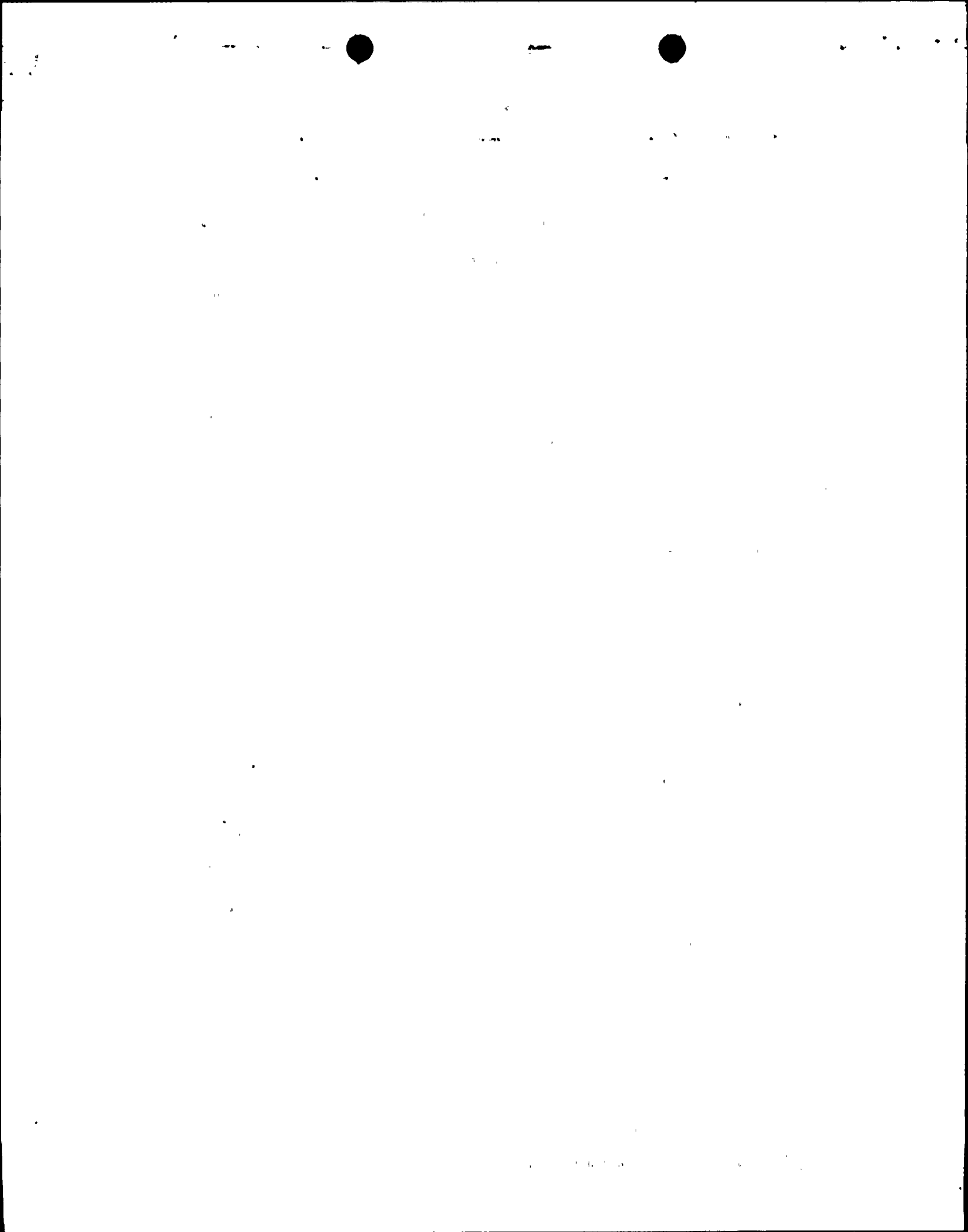

C. V. Mangan
Senior Vice President

TEL/RAC/pns
2237G-2
Enclosures

xc: W. A. Cook, NRC Resident Inspector
Project File (2)

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of]
Niagara Mohawk Power Corporation] Docket No. 50-410
(Nine Mile Point Unit 2)]

AFFIDAVIT

C. V. Mangan, being duly sworn, states that he is Senior Vice President of Niagara Mohawk Power Corporation; that he is authorized on the part of said Corporation to sign and file with the Nuclear Regulatory Commission the documents attached hereto; and that all such documents are true and correct to the best of his knowledge, information and belief.

C. Mangan

Subscribed and sworn to before me, a Notary Public in and for the State of New York and County of Onondaga, this 17th day of November, 1986.

Beth A. Menikheim
Notary Public in and for
Onondaga County, New York

BETH A. MENIKHEIM
Notary Public in the State of New York
Qualified in Onondaga County No. 4804074
My Commission Expires August 31, 1988

My Commission expires:

8/31/88

1. The first part of the document
is a list of the names of the
persons who were present at the
meeting on the 15th of the
month of June, 1962.

1. REQUEST: (4,1.1) Justification for the corrective action to resolve the actuator problem is based in part on the use of "the testing results to date". Please explain or reference by existing documentation these "testing results to date".

RESPONSE: Testing to validate the modified initiation system includes dynamic requalification of the Target Rock Solenoid Operated Valve for its modified service and the testing of the modified actuator to assure reliability and conformance to specification requirement. The SOV dynamic qualification is discussed in the response to Request Number 5. The closure testing that demonstrates actuator specification conformance is contained in Crosby Test Report 4330, Revision 1 (Attachment 1).

2. REQUEST: (5,1.2) "The problem resolution presented in this report includes sufficient testing and analyses to demonstrate that the MSIV's will close reliably". Please explain or reference by existing documentation the role of testing in this demonstration.

RESPONSE: The report referenced in the response to Request Number 1 describes the tests performed to demonstrate reliable operation. Additional preoperational tests as discussed in Response Number 10 will also be performed.

3. REQUEST: (5,1.2) "The design modifications which have been made to the actuating mechanism have been thoroughly evaluated and tested to ensure the operability and reliability of the MSIV's".

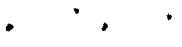


Please explain or reference by existing documentation the role of testing in providing this assurance, including the "rigorous operability testing program at the manufacturer's facility."

RESPONSE: The referenced actuator testing is documented in Crosby Test Report 4330, Revision 1 (Attachment 1).

4. REQUEST: (24,4.2.1) Considerable testing and analysis had already been done with the original mechanical latch actuator. The revised design of the actuator from mechanical to a hydraulic latch "contains very little substantive change". Therefore, the safety evaluation of the revised actuator takes advantage of the testing and analysis already performed. Please provide testing related results which support this position.

RESPONSE: To demonstrate the operability of the modified MSIV actuator during seismic/dynamic events, no additional dynamic testing of the entire assembly was required. Static testing of the solenoid operated valves has been performed to demonstrate operability during a seismic/dynamic event, as discussed in Item 5 below. SWEC has analytically demonstrated that variations in weights and stiffness due to replacement of the mechanical latch components (solenoid spring plungers, pivot door, latch arm and roller bearing) with additional hydraulic components (jockey pump, accumulators, flow control valve, and pressure switches) has an insignificant effect on the original seismic/dynamic qualification testing results for the MSIV actuator.

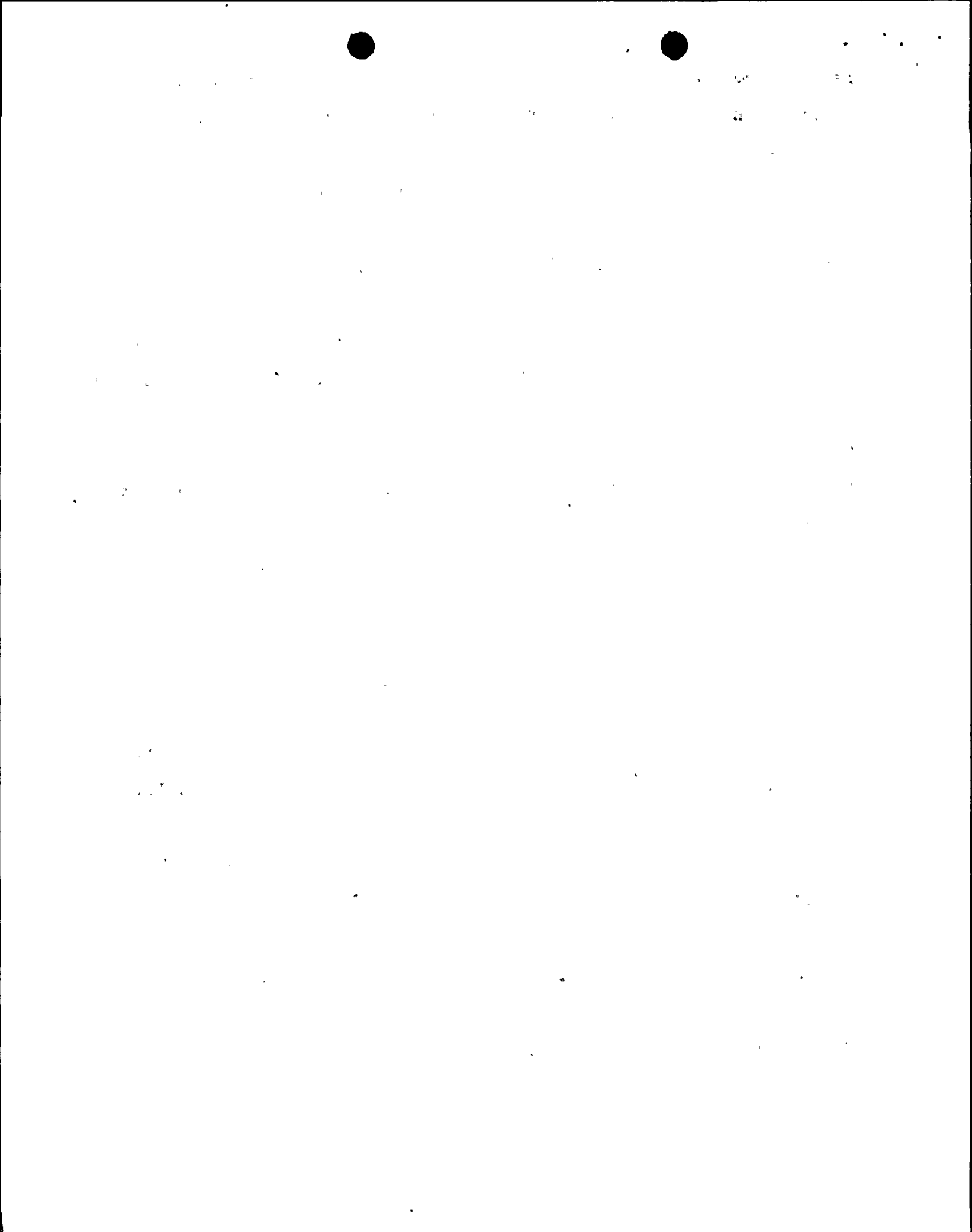


5. REQUEST: (25,4.2.1.1) Seismic "qualification of the solenoid operated valves (SOV's) will include the results of existing analysis and tests, and new operability testing... will be completed prior to fuel load". Please provide the test results data. If not yet available, please provide data when expected.

RESPONSE: The seismic/dynamic qualification and operability of 2" diameter Target Rock solenoid operated valve (SOV) has been demonstrated by testing and similarity analysis in an addendum to the Target Rock Qualification Report, summarized in Attachment 2. The results of the supplemental operability test (static pull test) has demonstrated that the SOV response meets acceptance criteria. However, a minor modification to the SOV was required. Spacers were required to increase spring force. This is documented in the above referenced report. The actuator was tested at the vendor facility with the modified solenoid valves as described in Crosby Report 4330, Revision 1 (Attachment 1).

6. REQUEST: (26,4.2.1.2) "Functional operability testing of each new (hydraulic) cylinder at the vendor's facilities has been performed and documented". Please provide the documentation.

RESPONSE: The original hydraulic cylinders are being replaced with new cylinders which have been enhanced by the addition of a lip seal piston, a mechanical end stop and an enlarged exhaust port. Crosby Test Report 4330, Revision 1 (Attachment 1) documents



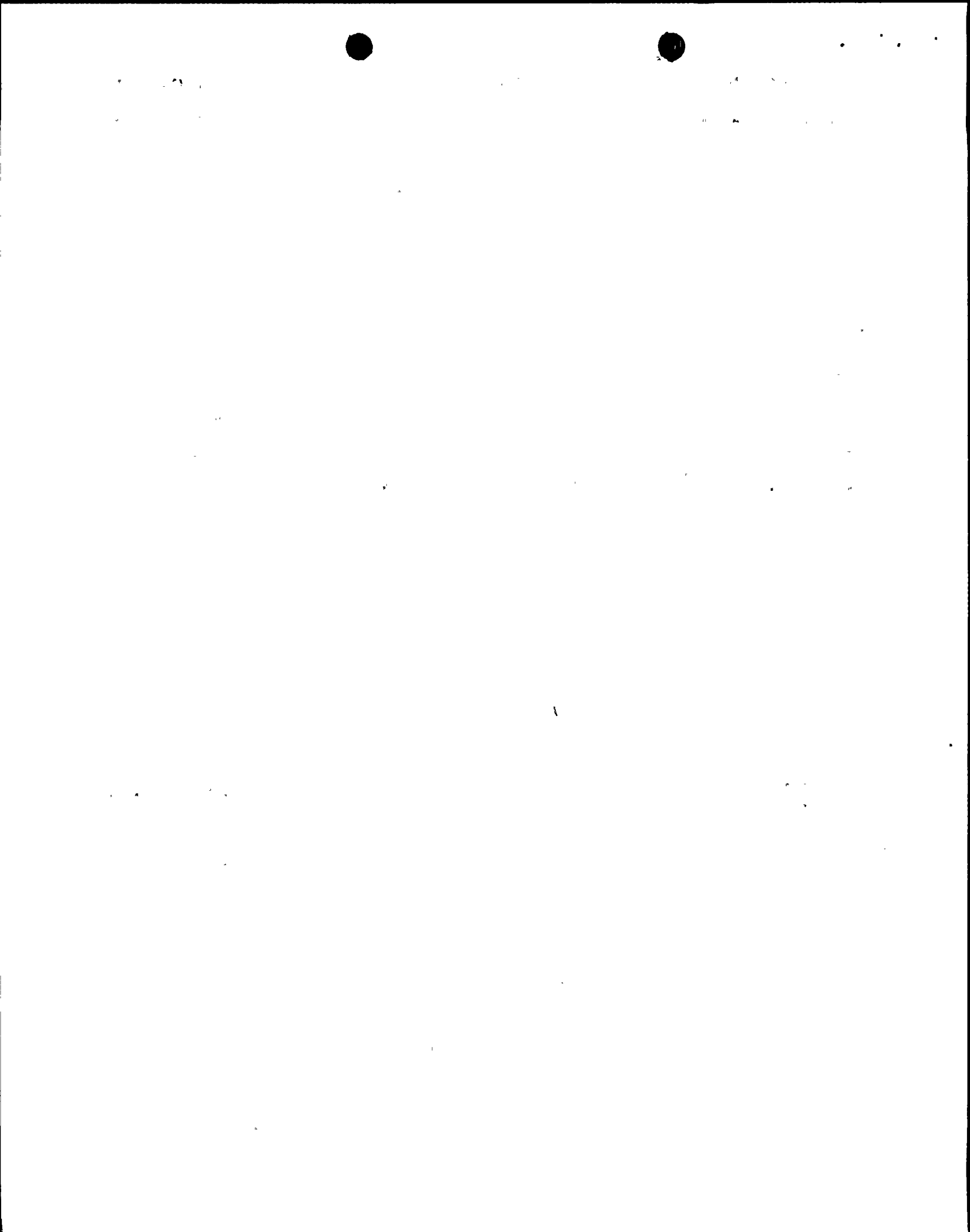
testing performed on a test actuator equipped with an enhanced cylinder which successfully demonstrated that the actuator equipped with the enhanced cylinders will meet the specified 3 to 5 second performance requirement. In addition, each cylinder has been tested at the cylinder manufacturer's facility; the procedure for and results of this testing are included in Attachment 3.

7. REQUEST: (27,4.2.2.) "Initial testing of the hydraulic latch design on the prototype revealed that the original SOV's...were not capable of opening quickly enough to support the 3 to 5 second MSIV closure requirement". The cause is attributed to sticking O-ring seals in the SOV's with resultant redesigned SOV seat disc and ring materials being tested. "Based on the successful test results on the prototype actuator... the valve was modified..." Please provide the test results.

RESPONSE: The modified SOV has been held closed against pressure for periods in excess of eleven (11) days with successful test results. A summary of the SOV testing on the test actuator is presented in Crosby Test Report 4330, Revision 1 (Attachment 1).

8. REQUEST: (28,4.2.3) "Ongoing testing will provide additional verification of system design parameters, including pump cycle times and actuator trip times". Please provide the test results. If not yet available, please provide dates when expected.

RESPONSE: The latest actuator trip time, on October 27, 1986,

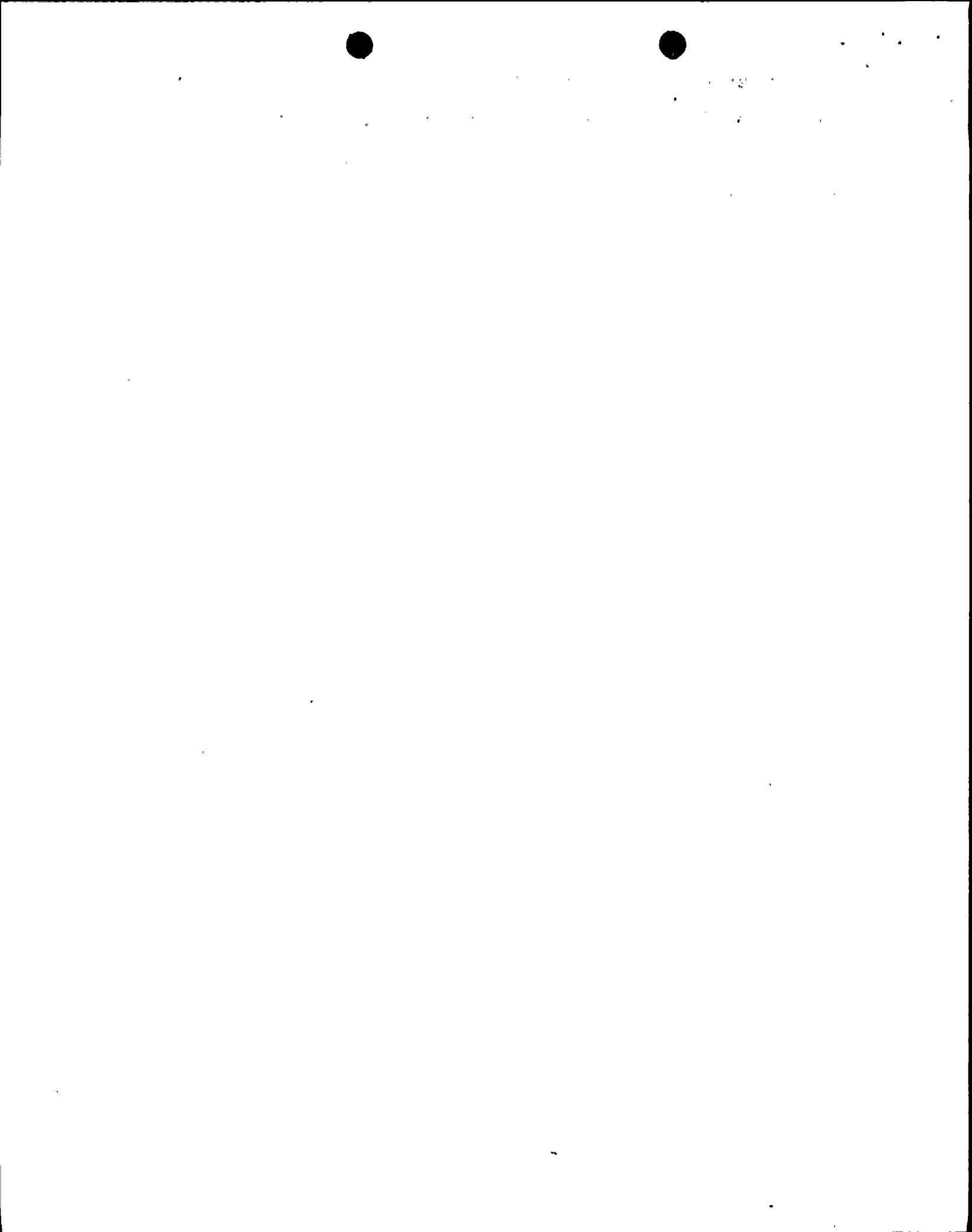


was 3.3 seconds. This test was performed with the SOV's modified with a spacer to increase the spring force. Prior to this test, the actuator was held in the open position (by the hydraulic system) in excess of eleven (11) days; the jockey pump cycled once during this period. Additional test results are provided in Crosby Test Report 4330, Revision 1 (Attachment 1).

9. REQUEST: (32,5.0) As part of Additional Confirmatory Testing, "A prototype test program is being developed. This test configuration will duplicate the valve and actuator configuration installed at NMP2". According to Section 6.2.4 of the NMP2 Final Report on MSIV Leakage entitled "Initial Prototype Test Program", "...full closure tests at high steam flow rate at operating pressure and temperature..." will be conducted. Will these prototype tests, which are scheduled to be completed by April 1, 1987, represent the first time that closure time of the new "hydraulic latch" design (with the MSIV's reduced leakage modification) is tested against the Technical Specifications closure time requirements?

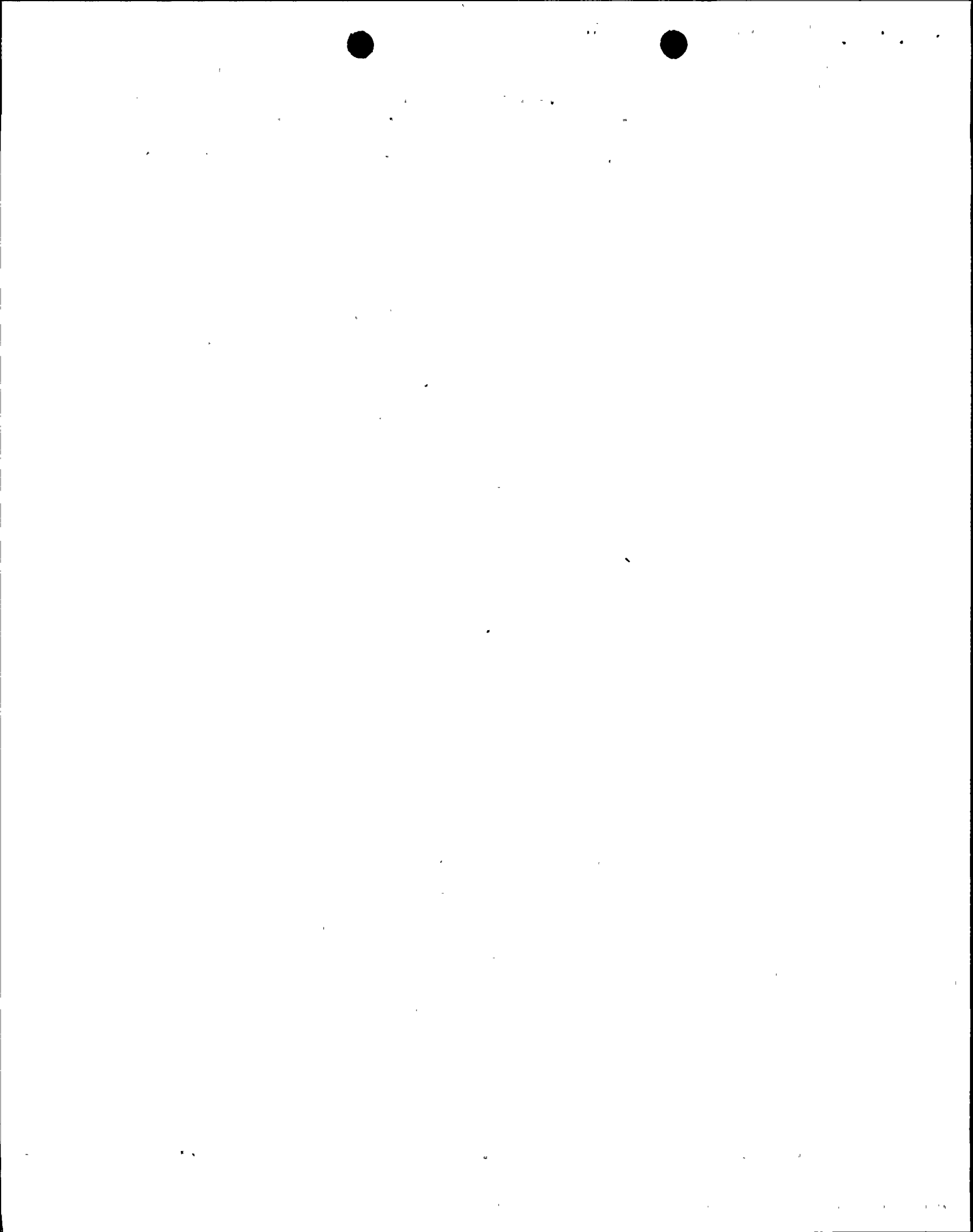
RESPONSE: No, each valve undergoes preoperational testing after reassembly in the plant to assure compliance with the Technical Specification closure time requirements.

10. REQUEST: (32,6.0) "When the modifications discussed in this report have been completed and the valves successfully passed their preoperational tests, the MSIV's will be appropriate for normal operation of the plant". According to the September 24,



1986 presentation handout, entitled "NRC NMP2 MSIV MEETING" testing was scheduled for performance October 21 through November 3, 1986. Also according to the handout, the "MSIV ACTUATOR/TESTING RESULTS" provided "RESPONSE TIMES WITHIN 5 SECOND VALVE CLOSURE REQUIREMENT". Also see Item 7 above. Please provide the test requirements and results of the MSIV related preoperational tests, when available.

RESPONSE: These tests will be completed prior to plant heat up and the test requirements and results will be forwarded immediately upon completion and issuance of the final test results.



CROSBY

**CROSBY VALVE & GAGE COMPANY
WRENTHAM, MASS**

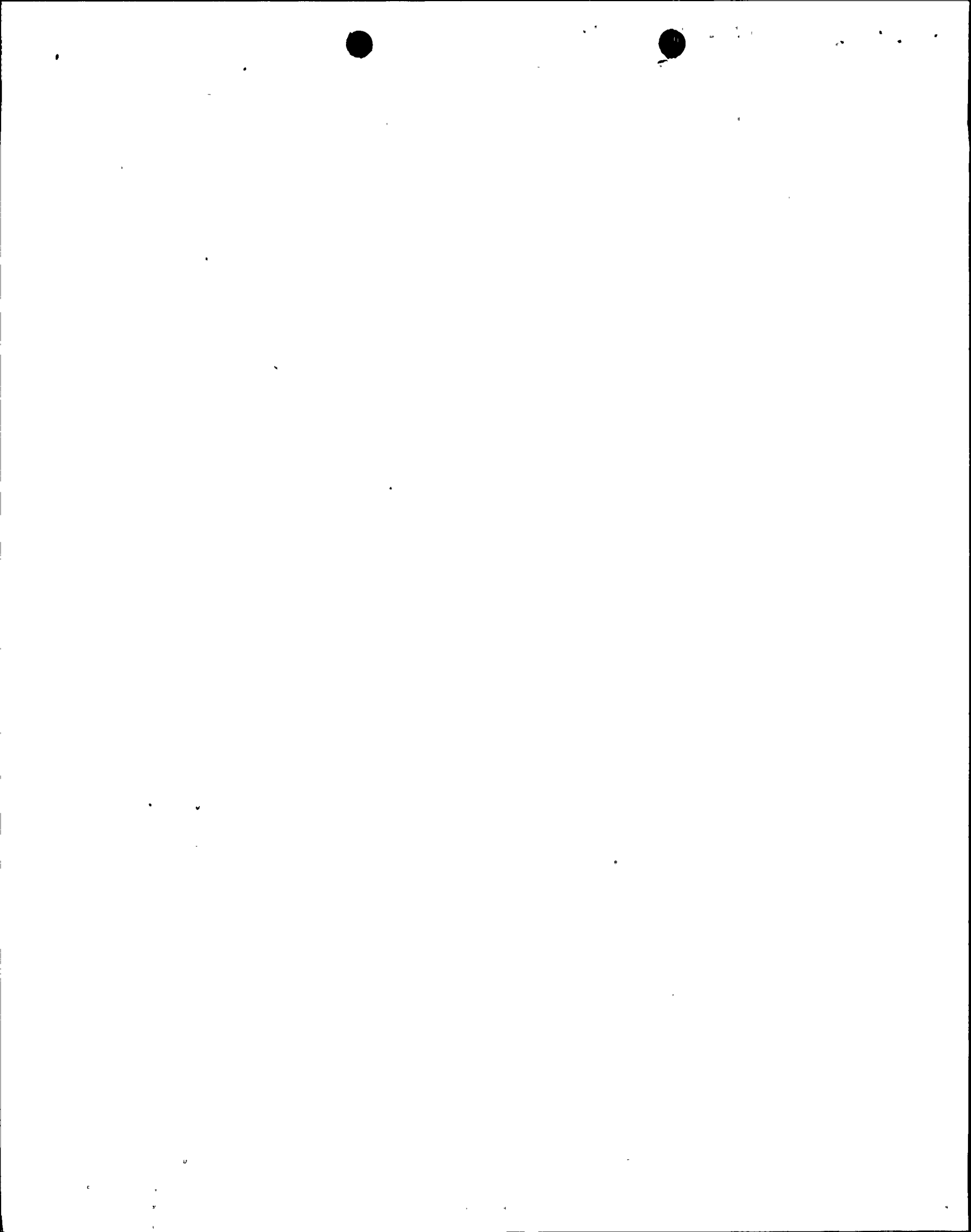
TEST REPORT NO. 4330, REVISION 1

CYCLE TIME FOR MSIV ACTUATORS
AT
NIAGARA MOHAWK POWER CORPORATION
NINE MILE POINT NUCLEAR STATION, UNIT 2

TESTED BY: J. D. MacAFEE .

DATE OF TEST: OCTOBER 28, 1986

J. D. MacAfee 3 Nov 86
W. D. Greenlaw (JDM) 3 Nov 86



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WRENTHAM, MASS**

Test Report No. 4330, Revision 1

Page 2

1. Objectives

The objectives of the test were to locate the cause of excessive cycle time of the modified Gulf & Western Series-600 Actuator designed for use with the 24" MSIV's at Nine Mile Point Nuclear Station, Unit 2 and to bring the cycle time within the 3 to 5 second time frame required.

2. Test Actuator and Background

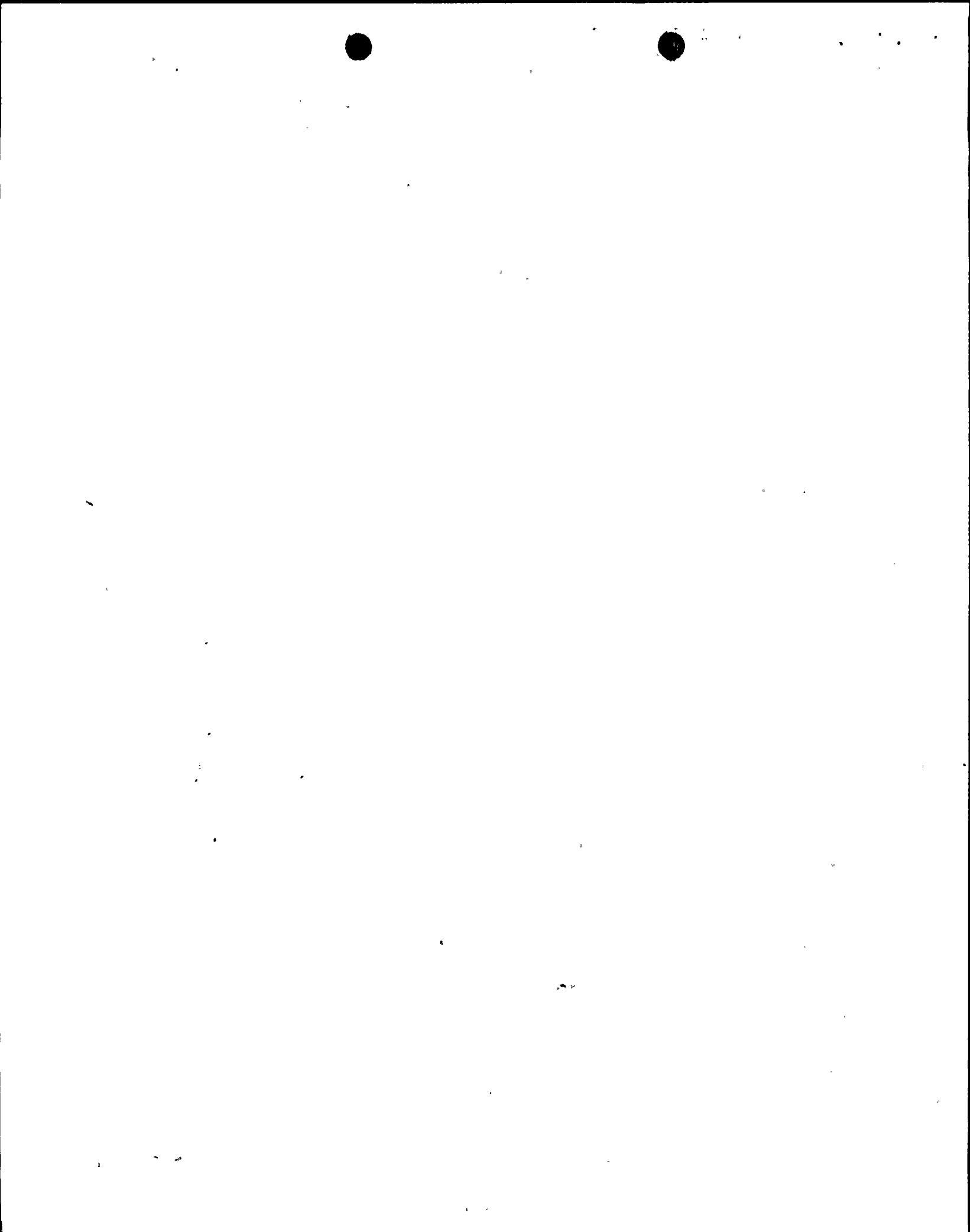
The testing was performed on the actuator in the possession of Crosby Valve & Gage Company in Wrentham, Massachusetts. The actuator design had undergone dynamic operability testing at Wyle Laboratories, documented in Wyle Test Report No. 46912-2 dated November 14, 1983.

As a result of problems encountered during the preliminary and pre-operational testing at the site, a decision was made to modify the actuator by eliminating the mechanical latch and, instead, hold the actuator/valve assembly open with continuous hydraulic pressure.

3. Description of Problem

The installation of a make-up pump and accumulator in the test actuator was followed by a number of cycles to verify acceptable performance. During those cycles it was observed that the cycle time measured from loss of electrical signal to end of stroke was dependent upon the length of time the system had been held under pressure. The tests showed the actual stroke time remained a constant 3.5 seconds plus or minus 0.2 seconds, but the solenoid operated valve trip time between signal loss and start of stroke varied from less than 1.0 seconds to greater than 4.0 seconds, depending upon the length of time between cycles. Figures 1 and 2 display the results of two such representative tests. Figure 1 is the recorder trace of a cycle after the actuator had been held open for approximately 18 hours. Figure 2 is the trace of the fourth cycle run in approximately 30 minutes.

In addition to the extended cycle times, the system's internal leakage resulted in the make-up pump cycling more frequently than was deemed acceptable.



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WRENTHAM, MASS**

Test Report No. 4330, Revision 1

Page 3

4. Investigation

The main actuating cylinder, produced by Hydro-Line Corporation, was modified by the addition of an adjustable piston stop screw in the end cap and the installation of EPR piston seals in place of the iron piston rings originally installed. The hydraulic fluid discharge ports in the test unit had previously been enlarged to minimize pressure drop during the closing cycle. The make-up pump cycle time went from 15 minutes to 8 days following the installation of the new piston seals.

The solenoid operated valves were disassembled and the sealing face of the discs were remachined to assure that hang-up time was not related to seat wadging. At the same time new EPR O-ring disc seals were installed. Fourteen cycles were run following varying dwell times, testing the valves singly and simultaneously. There was no appreciable effect on the performance.

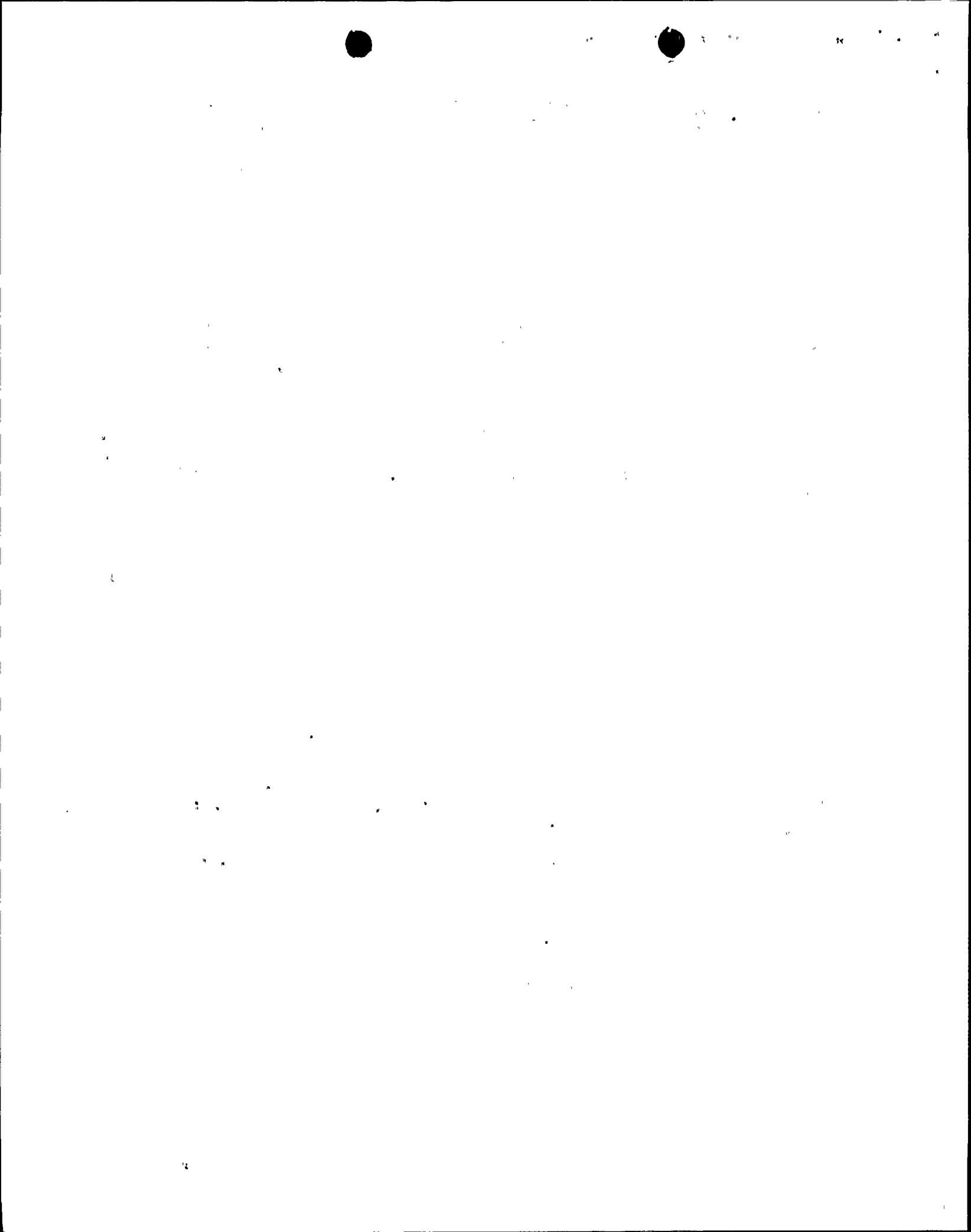
Two new discs were installed in the valves using solid TFE disc seals. A series of nine tests with pressurization times of up to four (4) days resulted in solenoid operated valve trip times never exceeding 1.3 seconds.

A different set of discs were installed in the valves. This set had Stellite No. 6 faces and seals consisting of EPR O-rings with carbon filled TFE cover rings. The use of Stellite was an attempt to lengthen the useful life of the valve seat. This combination actually prevented the valves from opening until the pressure was dropped substantially. It was suspected that the friction of the disc/seat material combination and not the seal materials caused this behavior.

The previously used discs (which are 17-4PH steel) were machined to accept the combination EPR/TFE seals. After holding pressure for approximately 17 hours, the valves cycled with a trip time of 0.4 seconds. See Figure 3 for a trace of that test.

To assure that nothing unrecognized had changed, the previously installed EPR O-rings were reinstalled in these discs and tested for four (4) cycles. After a four (4) hour dwell time there was a 2.4 second solenoid operated valve trip time.

Next, EPR O-rings with Tefzel cover rings were installed in the same discs. Tefzel was of interest because of its greater resistance to radiation. The valves failed to open under pressure using this seal combination.



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WRENTHAM, MASS**

Test Report No. 4330, Revision 1

Page 4

4. Investigation (Continued)

The EPR/TFE combination was again installed in the discs. After sixteen (16) hours under pressure the delay was 0.4 seconds. After three (3) days, after five (5) days and after twelve (12) days the solenoid operated valve trip time was 0.3 seconds.

During a test of the valves at the manufacturer's (Target Rock Corporation) laboratory it was demonstrated that the application of a high side load, simulating seismic loads, would result in a slow valve opening. The installation of a spacer in the disc return spring cavity solved the problem at that site. Duplicate spacers were installed in the valves on the test actuator in Wrentham. Following a 6.5 hour dwell time at pressure the solenoid operated valve trip time was less than 0.2 seconds. The actuator is presently undergoing a thirty-eight (38) day test under pressure after which the trip time will again be measured.

5. Conclusions

The primary contributor to the variation in speed of actuation of the solenoid operated valves appears to be the friction of the disc seals.

Tests of the original EPR O-ring disc seal showed that cycle times exceed the required 3 to 5 seconds.

EPR seals on the main cylinder's piston substantially reduce the operating frequency of the make-up pump.

Tests using an EPR O-ring with TFE cover ring in the solenoid operated valve disc results in operating cycle times within the required 3-5 seconds.

Increased spring force on the disc results in equally fast or faster response than the unmodified spring.



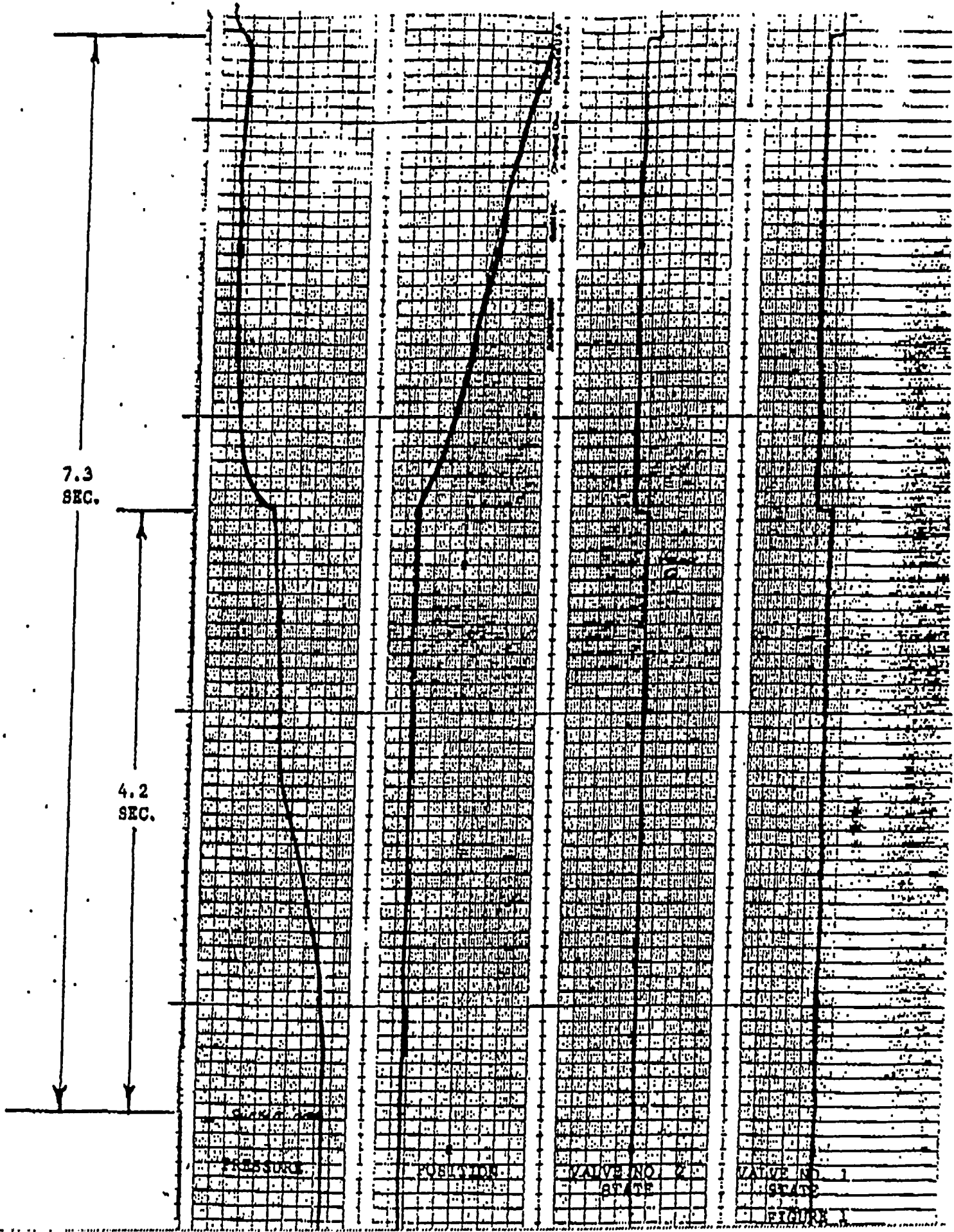
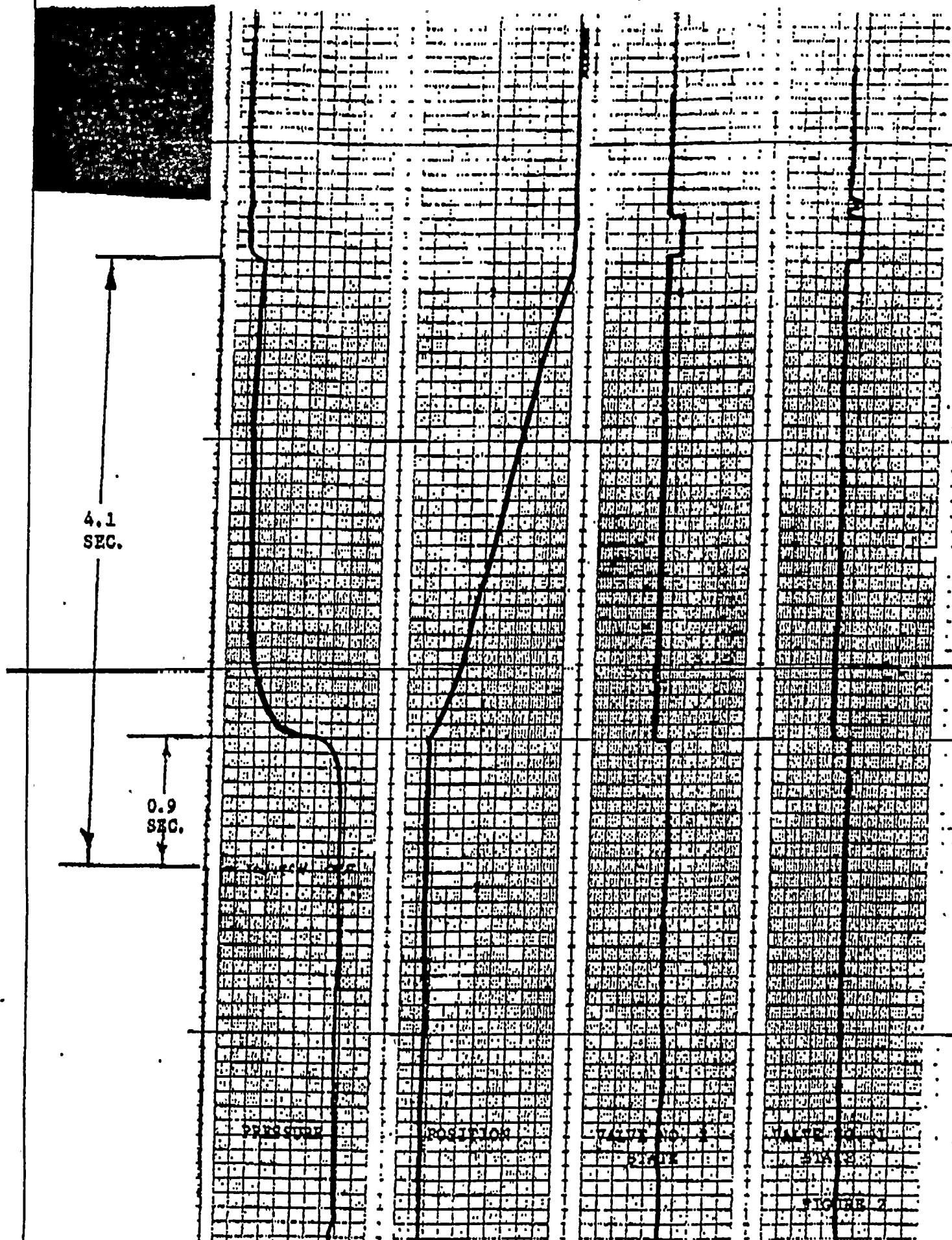
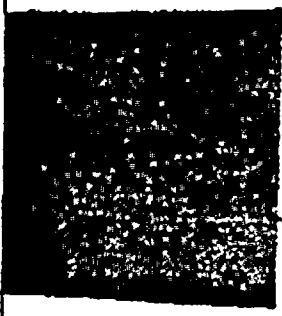


FIGURE 1



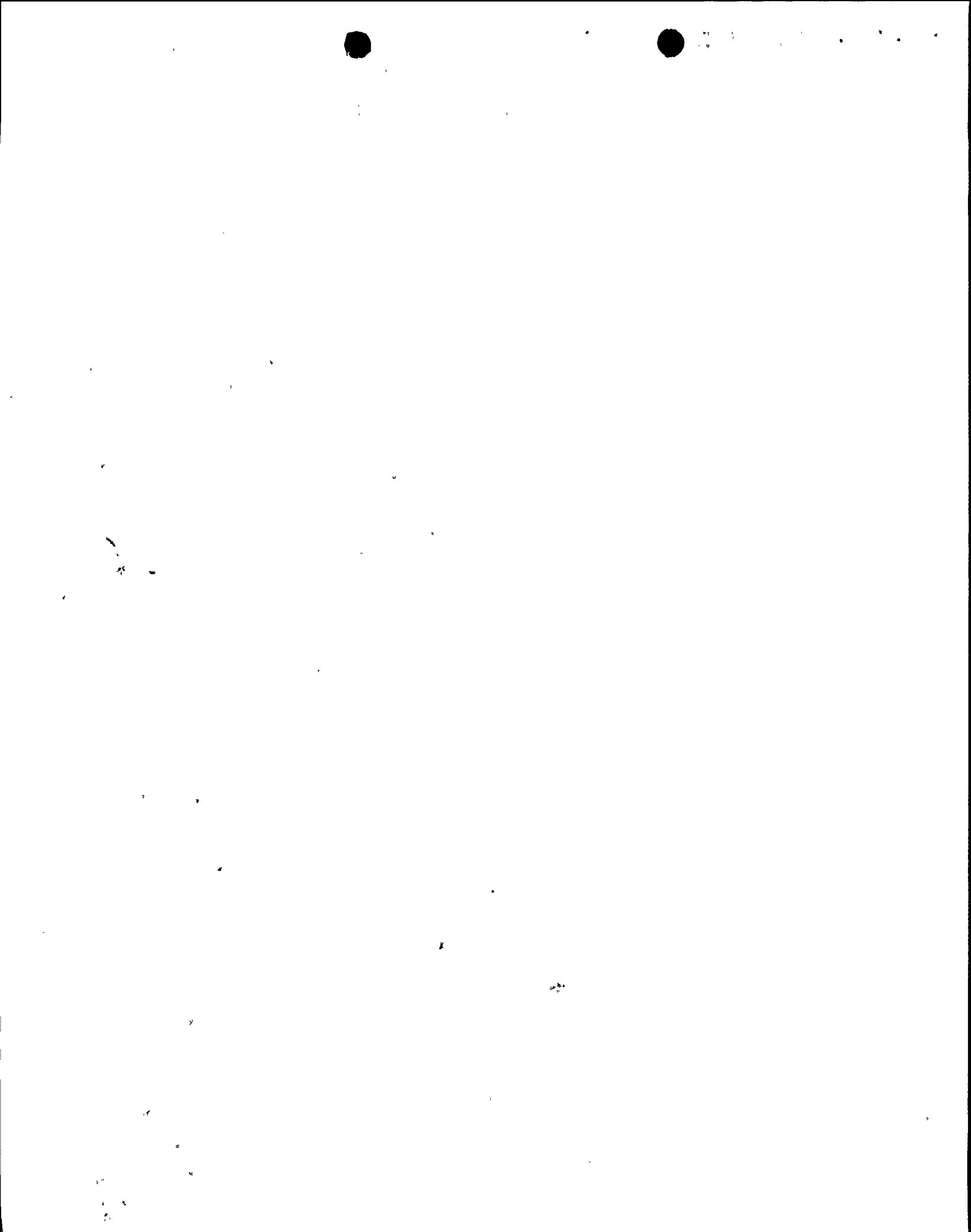


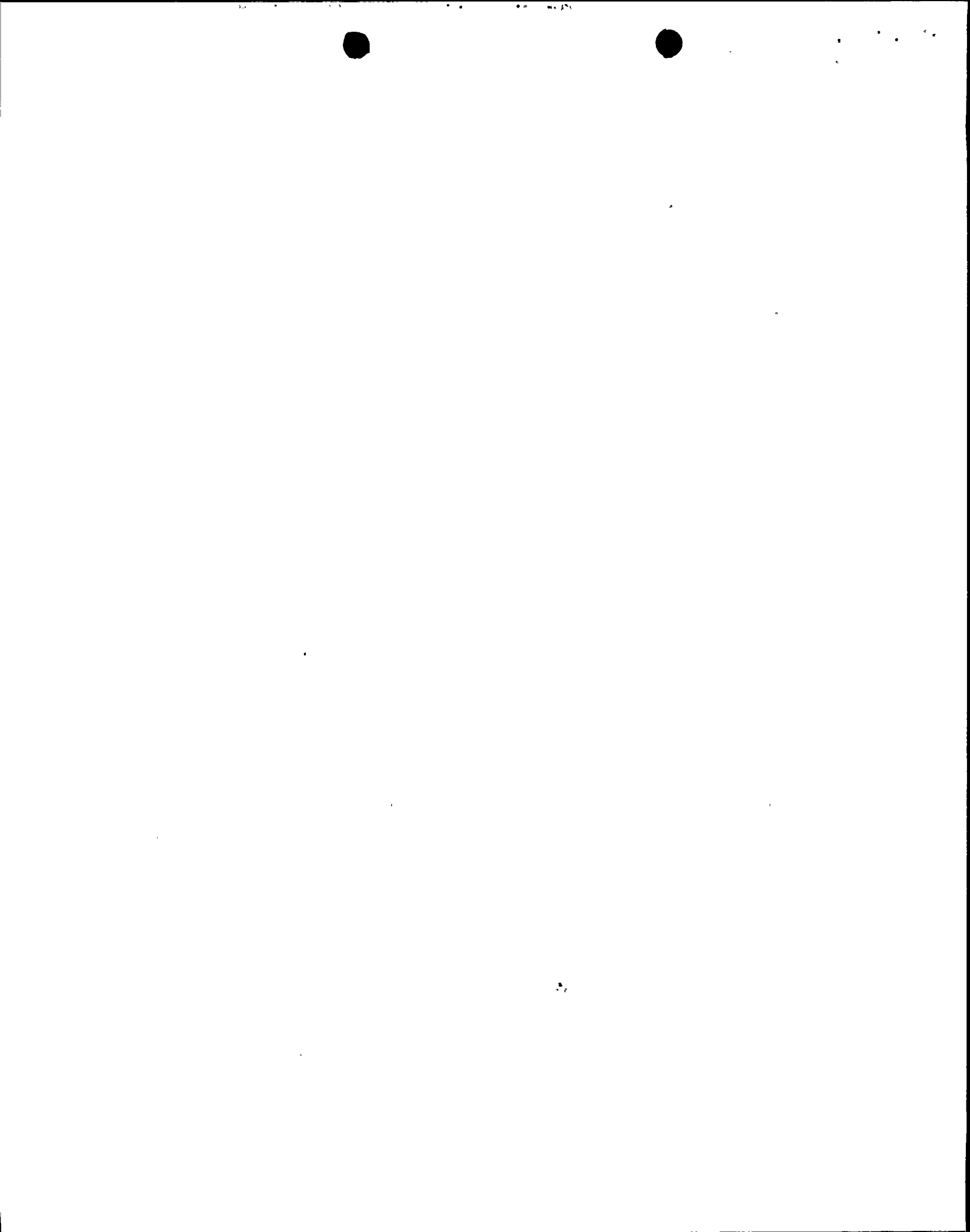
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INTEROFFICE MEMORANDUM

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SUBJECT TARGET ROCK SOV SEISMIC QUALIFICATION

DATE October 26, 1986

FROM C.E. Crocker

TO E.R. Klein

CC M. Fachada
M. Durka
General Files/cmK

As you requested, provided below is a summary of the seismic/dynamic qualification of the 2 inch Target Rock solenoid operated valve. This is provided to document closure of the open item in Section 4.2.1.1 of the Final 50.55(e) Report on the Hydraulic Actuator.

The original MSIV actuator assembly was qualified by test under the vendor's qualification program. It was determined that the modification done to the MSIV actuator assembly did not jeopardize the seismic/dynamic qualification test. The variation in weights and stiffness will not significantly affect the dynamic response of the actuator assembly, and thus the seismic/dynamic qualification of the modified MSIV actuator assembly has been maintained.


The original MSIV actuator assembly did contain Target Rock 2 inch SOVs and was part of the qualification testing. However, the SOV originally was not required to function during a DBE. The qualification testing verified that the SOV did function before and after DBE. Since the present design requires the SOV to function during the DBE, a qualification of the operability of the SOV had to be established.

To establish the qualification and operability of the 2 inch SOV, SWEC has developed the seismic/dynamic requirements at the SOV location, utilizing both the qualification recorded test data and analytical methods. Target Rock has established the seismic/dynamic qualification and operability of the 2 inch SOV by tests and similarity analysis. In order to envelope the NMP2 seismic/dynamic loads, an additional operability test was required. The operability of the SOV was demonstrated by subjecting the SOV to design pressure, with an equivalent static load applied, and then actuating the SOV under these conditions.

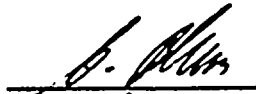
This test has determined that the insertion of a spacer is required in the SOV which will increase the spring pre-load and improve the response time. The operability test was repeated with the spacer in place and successfully demonstrated the operability of the SOV with a response time less than 1 second.

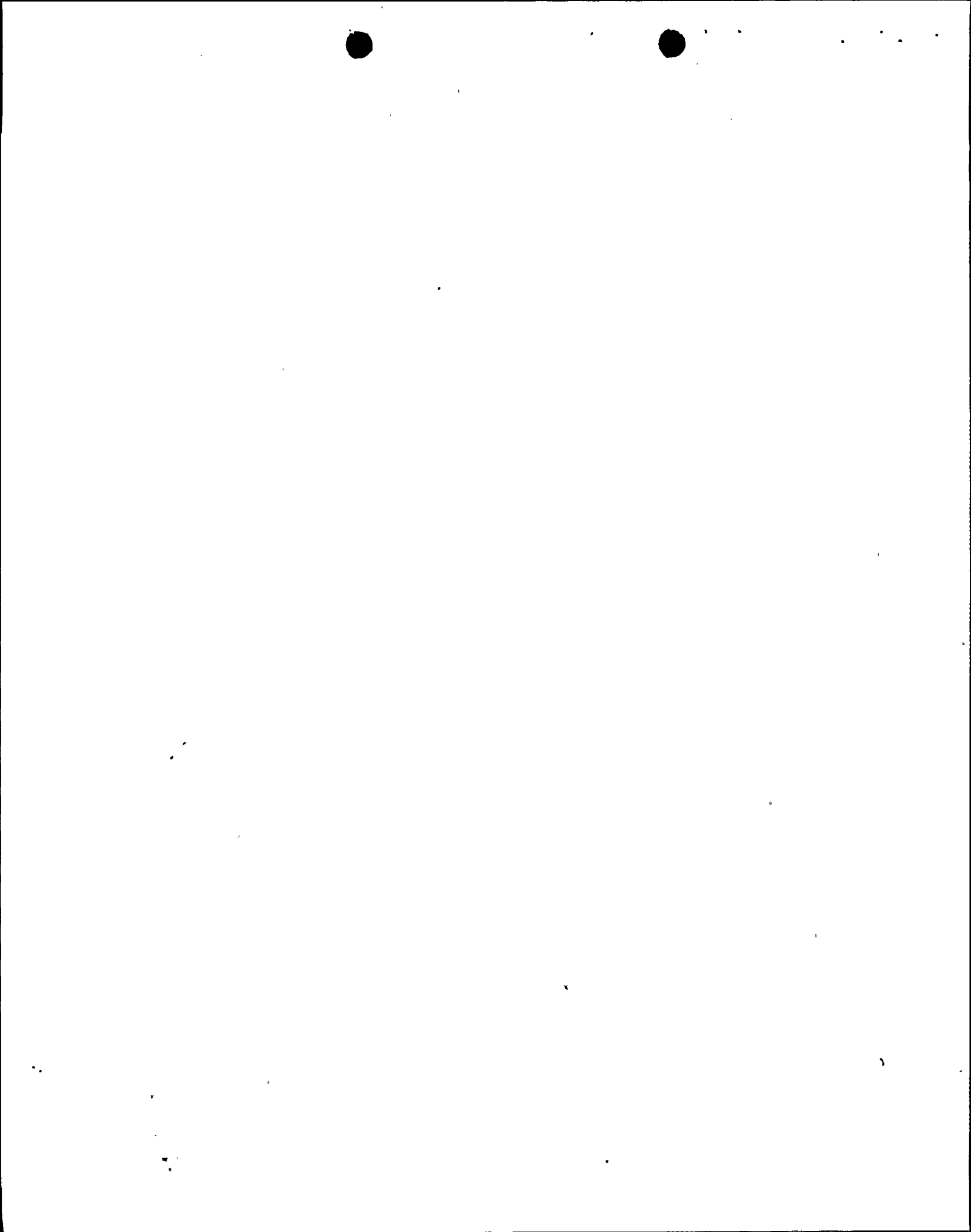


The above establishes the seismic/dynamic qualification and operability of the Target Rock 2 inch solenoid valve. Calculations and test reports are available for review.


C.E. Crocker
Project Engineer

Concurrence:


A. Blum
Head Seismic Qualification Engineer





CROSBY VALVE & GAGE COMPANY
WRENTHAM, MASS

TITLE: MATERIAL DESCRIPTION SPECIFICATION

Crosby Part Number 801858

1. Description

- 1.1 Hydraulic Cylinder Assembly manufactured by Hydro-Line Manufacturing Company, Rockford, Illinois per Hydro-Line Drawing HL-E-269, Revision E.
- 1.2 Hydraulic Cylinder Assembly for EFCO 600 Nuclear Valve Actuators.
- 1.3 Piston shall incorporate two (2) nylon 6/6 wear strips.
- 1.4 Rod bushing shall incorporate two (2) nylon 6/6 wear strips.
- 1.5 Inlet and discharge paths shall have 2.3 square inches minimum cross sectional area.
- 1.6 Drawing HL-E-269 shall be approved by Crosby. No changes shall be made without Crosby approval.

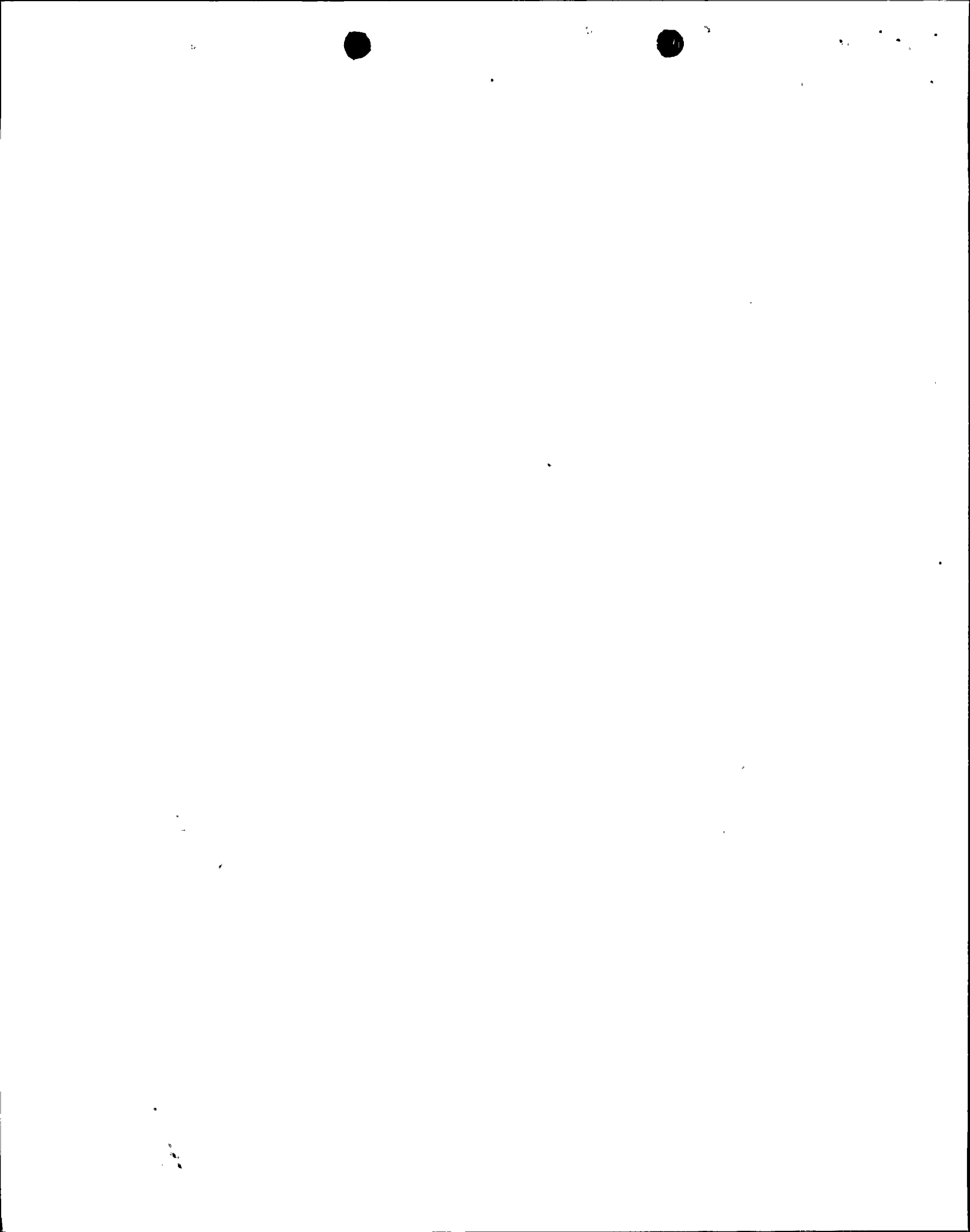
2. Procedures

- 2.1 Painting shall be manufacturer's standard.
- 2.2 Cylinders shall be packed in individual wooden boxes to Hydro-Line standard procedure. Cylinders shall be drained and steel pipe plugs shall be installed in all ports for shipping.
- 2.3 Welding shall be by welder qualified in accordance with ASME Section IX. Welding procedure shall be submitted to Crosby prior to manufacture.

2.4 Testing

- 2.4.1 Testing to be performed on hydraulic test stand using Dow Corning 200-100 hydraulic fluid or equivalent.
- 2.4.2 Hydrostatically test rod and cap end of cylinder assembly at 2250 psi for one (1) minute. No visible leakage allowed.
- 2.4.3 Cycle cylinder 100 times for break-in. Hold 1500 psi pressure at end of each stroke and examine rod end. Oil collar on rod shall not exceed 1/32" width.

	NAME	TITLE	SIGNATURE	DATE	MDS-4845	0
PREPARED BY	J. MacAfee	Prin. Engr.	<i>J. MacAfee</i>	10/8/86	NUMBER	REV
APPROVED BY	R. G. Friend	Chief Engr.		10/8/86	SHEET 1	OF 3



CROSBY**CROSBY VALVE & GAGE COMPANY
WRENTHAM, MASS****2. Procedures (Continued)****2.4 Testing (Continued)**

- 2.4.4 Attach cylinder to load simulator and cycle through pull stroke maintaining 1500 psi throughout full stroke. Cycle five (5) times. Examine outside of cylinder thoroughly; no external leakage is permissible.

Upon completion of five (5) cycles, attach a tube from the cap port of cylinder to a graduated beaker. Fill the tube with the test fluid. Pressurize the head port to 1500 psi. Measure flow through the tube for five (5) minutes. Flow into beaker shall not exceed 0.5 cubic inches per minute.

- 2.4.5 Each cylinder shall be marked with a unique serial number.

- 2.4.6 Hydro-Line shall submit a test report including the following information with each cylinder shipped:

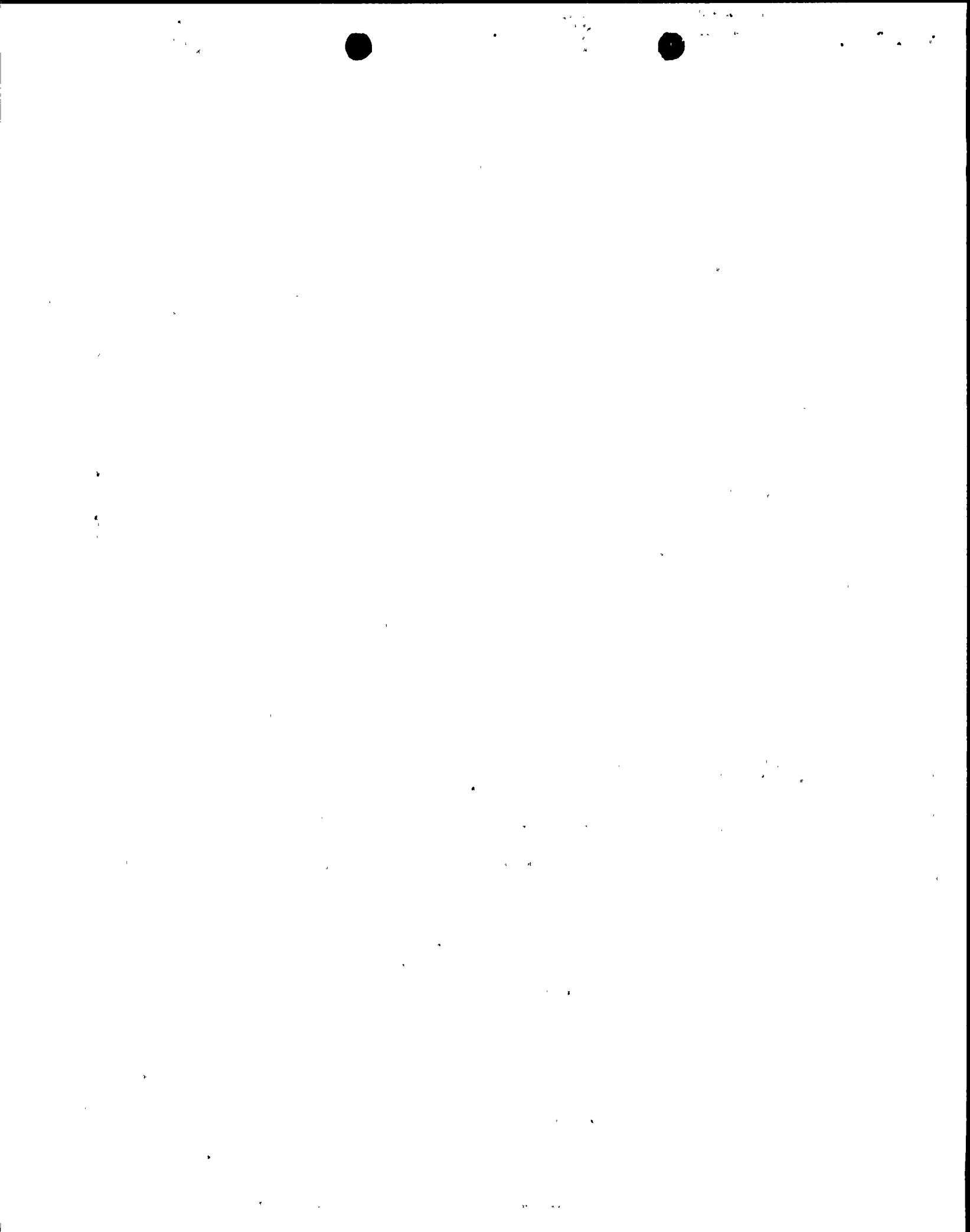
- Tester's signature and date
- Customer purchase order number and cylinder serial number
- Hydraulic fluid used during test
- Results of hydrostatic test
- Results of 100 cycle break in
- Results of five (5) cycle load test
- Actual leakage observed following load test

The pressure boundary integrity shall be observed and recorded verifying no leakage following each test.

3. Quality Assurance

- 3.1 A Certificate of Compliance of materials is required with each cylinder. Certificate shall reference cylinder serial number.
- 3.2 Test report required (reference Paragraph 2.4.6).
- 3.3 10CFR21 applies.

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PROCEDURE NO.	REV.
SHEET <u>2</u> OF <u>3</u>	



1. Testing to be performed on hydraulic test stand using Dow Corning #200-100 fluid or equivalent.
2. Hydrostatically test rod and cap end of cylinder assembly at 2250 psi for one (1) minute. No visible leakage allowed.
3. Cycle cylinder 100 times for break-in. Hold 1500 psi pressure at end of each stroke and examine rod end. Oil collar on rod shall not exceed 1/32" width.
4. Attach cylinder to load simulator and cycle through pull stroke maintaining 1500 psi throughout full stroke. Cycle five (5) times. Examine outside of cylinder thoroughly - no external leakage is permissible.

After five (5) cycles, attach a tube from the cap port of cylinder to a graduated breaker. Pressurize the head port to 1500 psi. Measure flow through the tube for one (1) minute. Flow into beaker shall not exceed one-half (.5) cubic inches per minute over a five minute period.

5. Each cylinder shall be marked with a unique serial number.
6. Hydro-Line shall submit a test report Engineering Aid #26 including the following information with each cylinder shipped:
 - Tester's signature and date
 - Customer purchase order number and cylinder serial number
 - Type of silicon fluid used during test
 - Results of hydrostatic test
 - Results of 100 cycle break-in
 - Results of five (5) cycle load test
 - Actual leakage observed following load test

The pressure boundary integrity shall be observed and recorded verifying no leakage following each test.

7. Each cylinder to have a number stamped after the serial number (i.e. -01B-1, -01B-2, -01B-3, etc.) to distinguish each cylinder. Test reports must be marked accordingly.

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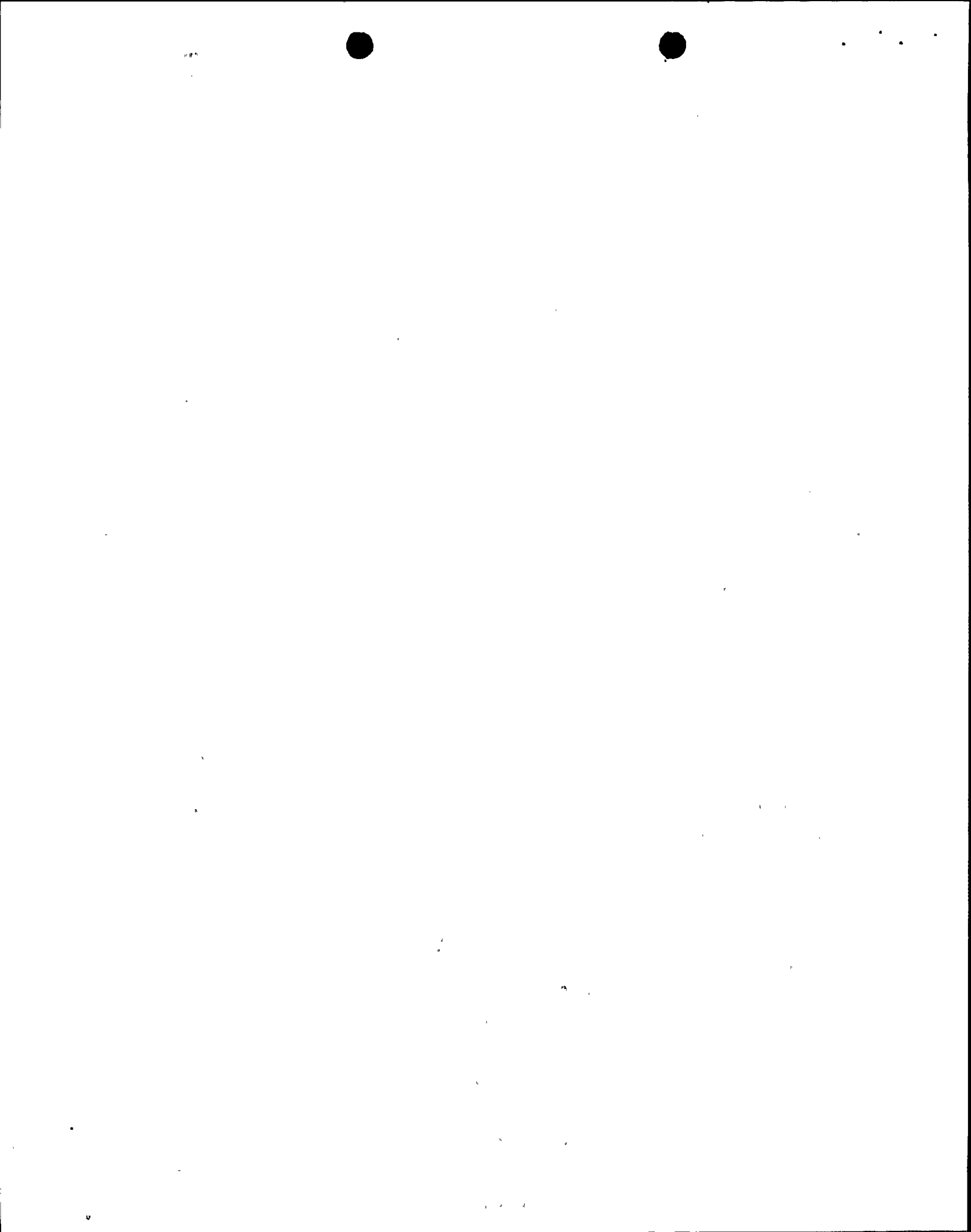
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AND WILL BE RETURNED UPON
ANY INFORMATION CON-
BE KEPT CONFIDENTIAL
WITHOUT THE
THE CONSENT OF

DECIMAL TOLERANCES	
ONE PLACE =	±.005
TWO PLACES =	±.000
THREE PLACES =	±.000
FOUR PLACES =	±.000
UNLESS SPECIFIED	

GEOMETRIC TOL. SYMBOLS		EXAMPLE
	FLAT	1 A .000
	STRAIGHT	
	SQUARENESS	TOL.
	PARALLELISM	REF. PLANE
	CONCENTRICITY	SYMBOL

NOV 04 '86 12:43 SLET AT CROSSBY



FINAL CHECK LIST BEFORE SHIPPING

SERIAL NO. ~~1E8703-1314-11B-8~~ → 1E8703-1314-11B-8
 DATE 10-13-86 CUST. CROSBY VALVE (U.P. SEAL)

ASSEMBLY CHECK

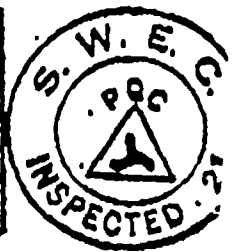
- | | | |
|---|-------------------------------------|--------------------------|
| 1. ROD END & EXTENSION..... | O.K. | REJ. |
| 2. MOUNTING DIMENSIONS (INCLUDING TIE ROD)..... | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| 3. PORT LOCATION..... | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| 4. CUSHION LOCATION..... | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| 5. GENERAL APPEARANCE..... | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

PRESSURE TEST

- | | | | |
|--|--|-------------------------------------|--------------------------|
| 1. LOW PRESSURE - AIR OIL | P.S.I. AIR 10 - OIL 125 | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| 2. HIGH PRESSURE AIR OIL | P.S.I. AIR 90 - OIL | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| 3. STROKE..... | J.O. 12187.50
P.O. 2882-21015 | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| 4. CHECK FOR LEAKAGE..... | STOCK & WEIGHT FILE | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| A. PORTS..... | Nine Mile Point #2 | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| B. CARTRIDGE..... | 5/8 1E8703-1314-11B-1,2,3,4,5,6,7,8,
Hydro-Line Manufacturing Co.
25212323, IL | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| C. END CAP SEAL..... | | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| D. CUSHION & BALL CHECK..... | NA | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. CUSHION CHECK, NO PRESSURE..... | NA | <input type="checkbox"/> | <input type="checkbox"/> |
| ROTATE ROD 360° WITH CUSHION SEATED..... | NA | <input type="checkbox"/> | <input type="checkbox"/> |
| TO SEE NO BIND OCCURS..... | NA | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| 6. GENERAL CYLINDER OPERATION..... | | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

7. REMARKS: 2250 P.S.I. HYDRAULIC OK PD 10-14-86
 * 100 cycle break in OK PD 10-14-86
 * 5 cycle load test OK PD 10-14-86
 * leakage test 25ml (1.53 lbs) per 5 minutes
 * OK PD 10-14-86
 * HYDRAULIC OIL USED DURING OPERATION - Dev-Gardine 200 (Silicone Fluid) 100 CS

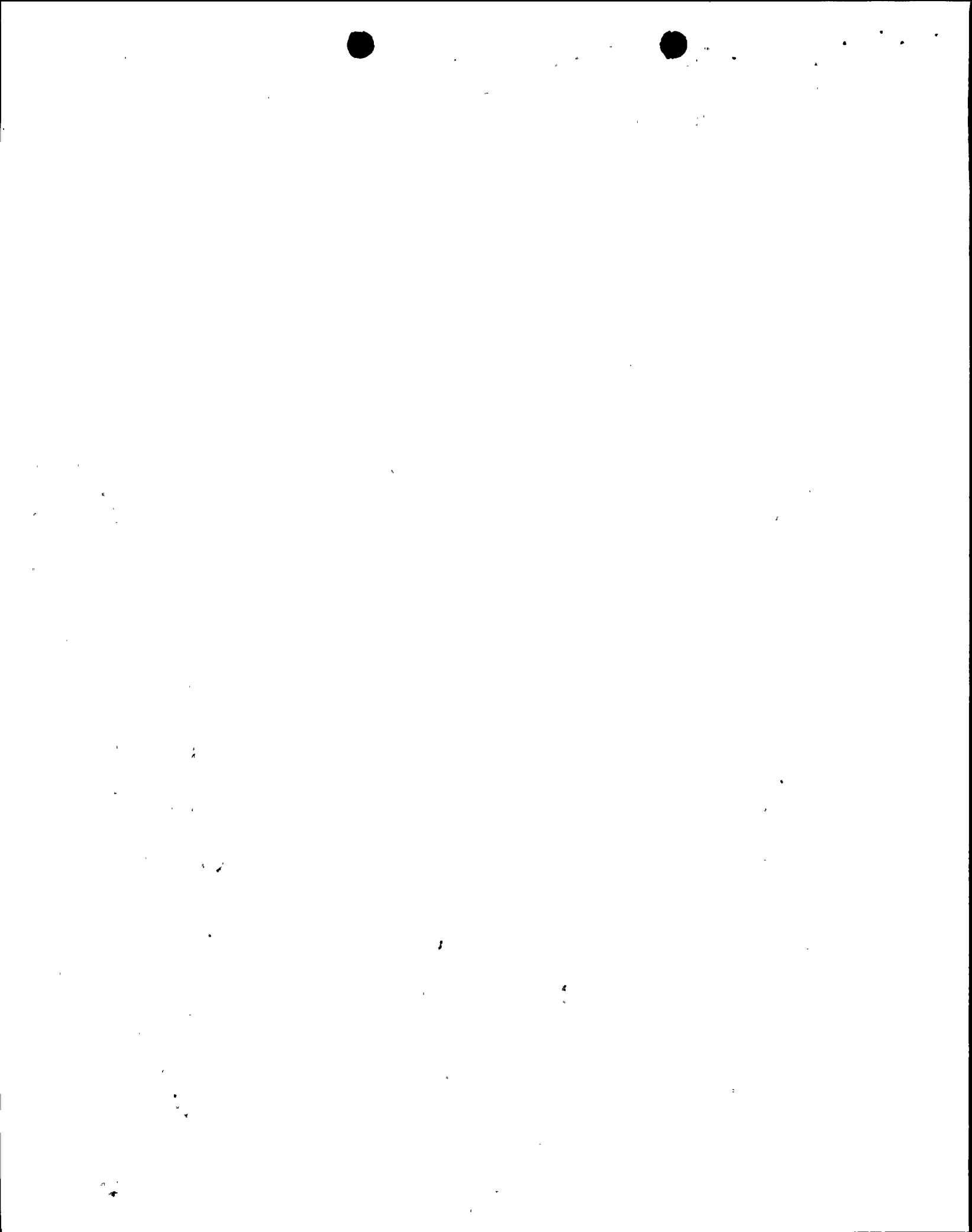
TOTAL ASSEMBLED	
O.K.	REJ.
X	



* ITEMS TO BE GIVEN SPECIAL ATTENTION
 ASSEMBLED BY David A. Sauer DATE 10/13/86
 CHECKED BY Paul Sauer DATE 10/14/86

Q.A. Approval [Signature] ENGINEERING COPY
 NOV 10 1986 ENGINEERING ID 26

ENGINEERING ORIC



FINAL CHECK LIST BEFORE SHIPPING

SERIAL NO. 159703-13/4-1B-7
 DATE 10-14-86

CUST. CROSSBY VALVE (C.P. SEALS)

ASSEMBLY CHECK

OK	REJ.
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>

1. ROD END & EXTENSION.....
2. MOUNTING DIMENSIONS (INCLUDING TIE ROD).....
3. PORT LOCATION..... NA
4. CUSHION LOCATION.....
5. GENERAL APPEARANCE.....

PRESSURE TEST

1. LOW PRESSURE AIR OIL P.S.I. AIR 10 - OIL 125
2. HIGH PRESSURE AIR OIL P.S.I. AIR 90 - OIL 125
3. STROKE.....
4. CHECK FOR LEAKAGE.....
- A. PORTS.....
- B. CARTRIDGE.....
- C. END CAP SEAL.....
- D. CUSHION & BALL CHECK.....
5. CUSHION CHECK NO PRESSURE.....
- ROTATE ROD 360° WITH CUSHION SEATED.....
- TO SEE NO BIND OCCURS.....
6. GENERAL CYLINDER OPERATION.....

<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>

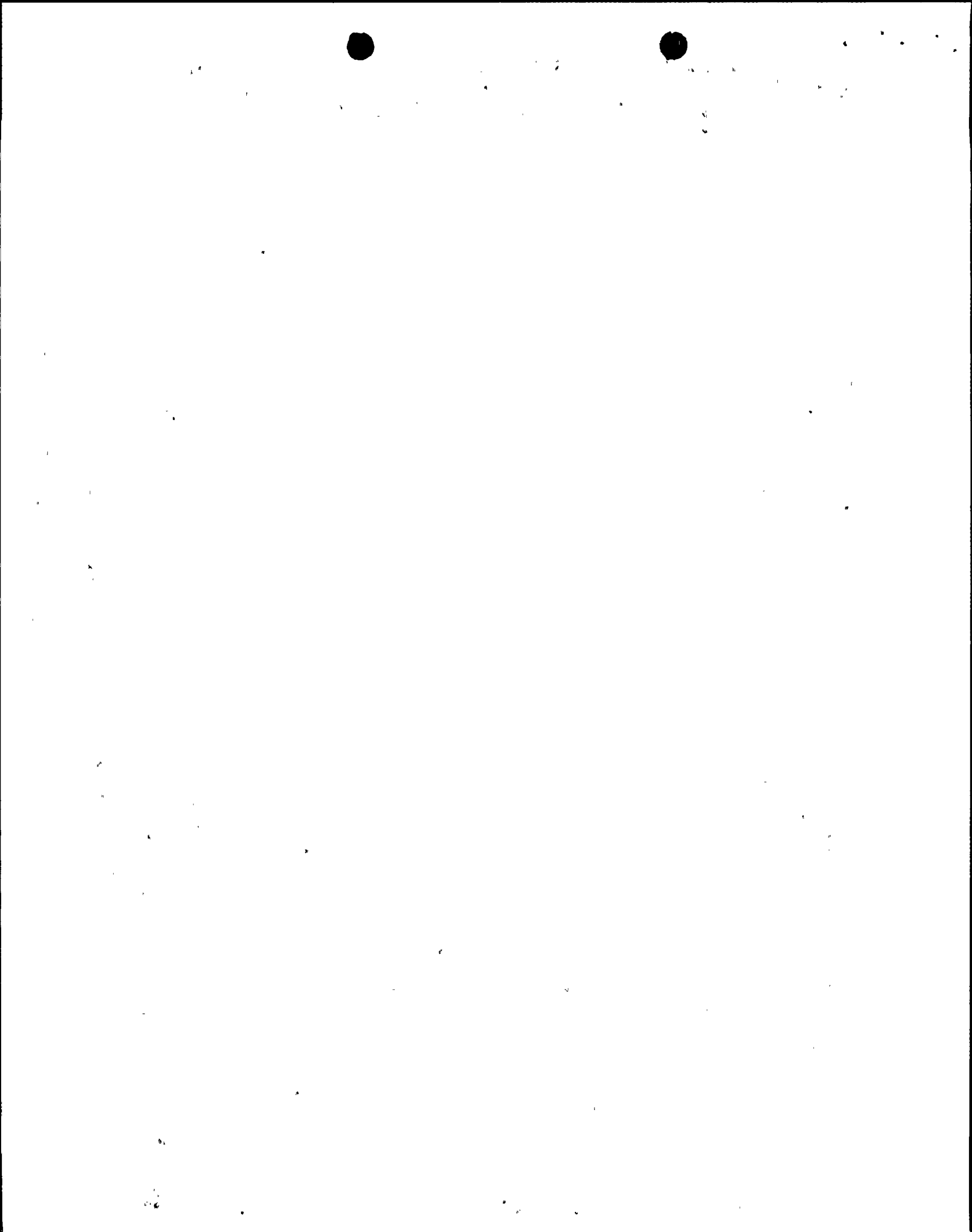
7. REMARKS 2250 P.S.I. HYDRAFLIC OK 10-14-86
100 cycle break in OK 10-14-86
5 cycle load test OK 10-14-86
leakage test 22 ml (1.34 in³) in 5 minutes
OK 10-14-86
 * HYDRAFLIC OIL MUST BE IN DYNAMIC STATE = Dow Corning 200 (Silicone Fluid) 100 CS

TOTAL ASSEMBLED	
OK <input checked="" type="checkbox"/>	REJ. <input type="checkbox"/>



* ITEMS TO BE GIVEN SPECIAL ATTENTION

ASSEMBLED BY [Signature] DATE 10-13-86
 CHECKED BY [Signature] DATE 10-14-86



FINAL CHECKLIST BEFORE SHIPPING

SERIAL NO. 168703-1314-2A-4

DATE 10-10-86 CUST. GROSSY VALVE (C.P. SEALS)

ASSEMBLY CHECK

- | | O.K. | REJ. |
|---|-------------------------------------|--------------------------|
| 1. ROD END & EXTENSION..... | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| 2. MOUNTING DIMENSIONS (INCLUDING TIE ROD)..... | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| 3. PORT LOCATION..... | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| 4. CUSHION LOCATION..... | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. GENERAL APPEARANCE..... | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

PRESSURE TEST

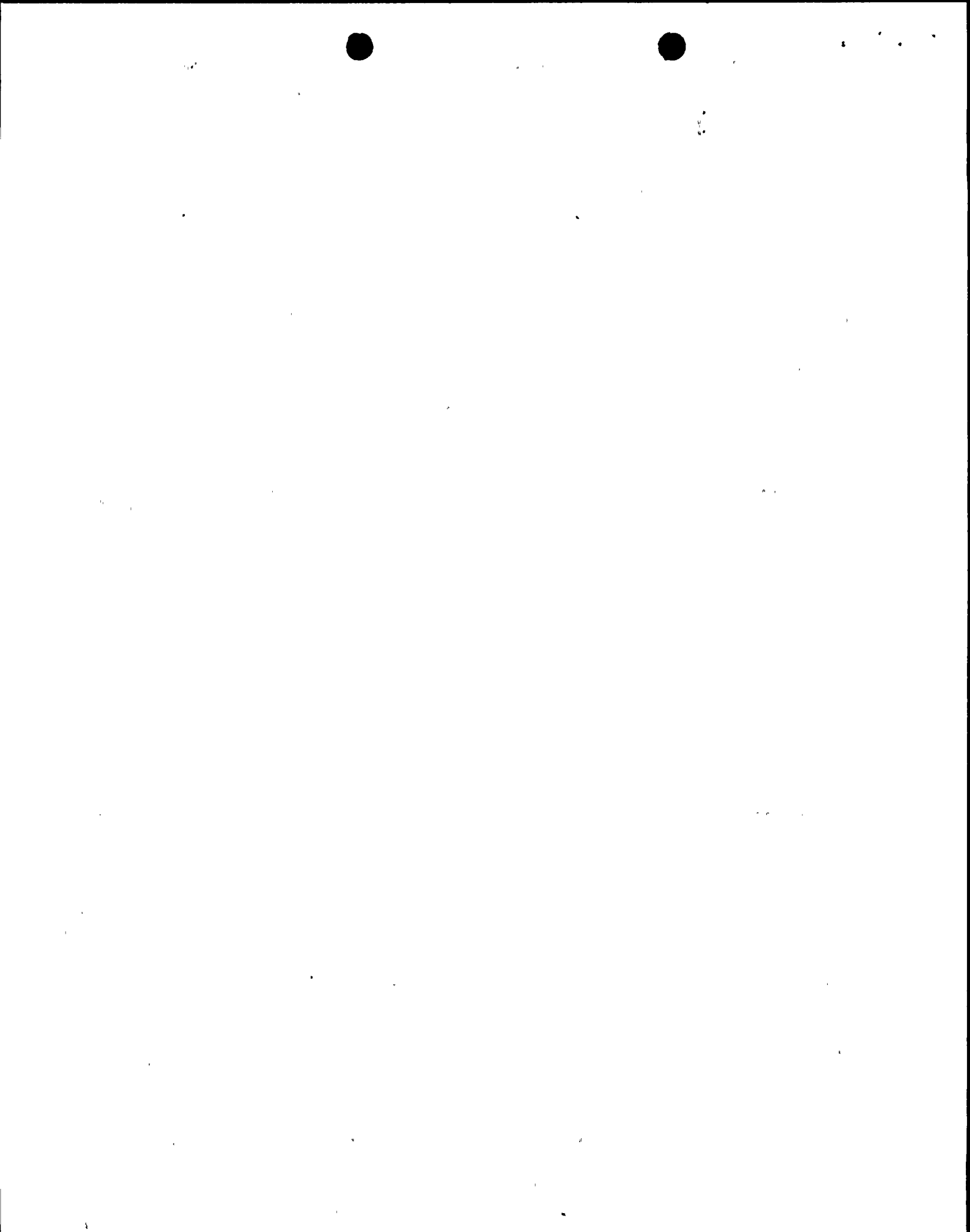
- | | O.K. | REJ. |
|--|-------------------------------------|--------------------------|
| 1. LOW PRESSURE * AIR OIL P.S.I. <u>AIR 10 - OIL 125</u> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| 2. HIGH PRESSURE AIR OIL P.S.I. <u>AIR 90 - OIL</u> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| 3. STROKE..... | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| 4. CHECK FOR LEAKAGE..... | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| A. PORTS..... | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| B. CARTRIDGE..... | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| C. END CAP SEAL..... | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| D. CUSHION & BALL CHECK..... | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. CUSHION CHECK, NO PRESSURE..... | <input type="checkbox"/> | <input type="checkbox"/> |
| ROTATE ROD 360° WITH CUSHION SEATED..... | <input type="checkbox"/> | <input type="checkbox"/> |
| TO SEE NO BIND OCCURS..... | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. GENERAL CYLINDER OPERATION..... | <input type="checkbox"/> | <input type="checkbox"/> |

7. REMARKS 2250 P.S.I. HYDROSTATIC 10-10-86 OK
 * 100 cycle break in OK 10-10-86
 * 3 cycle load test OK 10-10-86
 * leakage test.....
 * 1/4 Cu. In. for 5 minutes OK 10-10-86
 * Hydraulic oil used during dynamic test = Dow Corning 200 (Silicone Fluid) 100 CS

TOTAL ASSEMBLED	
O.K. <input checked="" type="checkbox"/>	REJ. <input type="checkbox"/>



* ITEMS TO BE GIVEN SPECIAL ATTENTION
 ASSEMBLED BY [Signature] DATE.....
 CHECKED BY [Signature] DATE 10-10-86



FINAL CHECK LIST BEFORE SHIPPING

SERIAL NO. 1A. 870.3-1314-1A-6

DATE 10-13-86

CUST. CROSBY VALVE (C.P. SEAL)

ASSEMBLY CHECK

- 1. ROD END & EXTENSION.....
- 2. MOUNTING DIMENSIONS (INCLUDING TIE ROD).....
- 3. PORT LOCATION.....
- 4. CUSHION LOCATION..... NA
- 5. GENERAL APPEARANCE.....

O.K.	REJ.
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>

PRESSURE TEST

- 1. LOW PRESSURE * AIR OIL P.S.I. AIR 10 - OIL 125
- 2. HIGH PRESSURE AIR OIL P.S.I. AIR 90 - OIL See No. 7 Remarks
- 3. STROKE..... J.O. 12187.50
- 4. CHECK FOR LEAKAGE..... F.O. MDZ-73030
STONE & WEBSTER ENGINE
Nine Mile Point #2
A. PORTS..... 2 1/2 128703-1314-1A-1,2,3,4,5,6,7,8
- B. CARTRIDGE..... Hydro-Line Manufacturing Co.
- C. END CAP SEAL..... ROCKFORD, IL
- D. CUSHION & BALL CHECK..... NA
- 8. CUSHION CHECK, NO PRESSURE..... NA
ROTATE ROD 360° WITH CUSHION SEATED..... NA
TO SEE NO BIND OCCURS.....
- 6. GENERAL CYLINDER OPERATION.....

<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>

7. REMARKS 2250 P.S.I. HYDRAFRAX OK 10-13-86
* 100 cycle break in OK 10-13-86
* 5 cycle load test OK 10-13-86
* leakage test 15ml (.92 in³) per 5 minutes
* OK 10-13-86

TOTAL ASSEMBLED	
OK	REJ.
<input checked="" type="checkbox"/>	<input type="checkbox"/>



* HYDRAFRAX OIL USED DURING HYDRAFRAX TEST - 200 (Sillcoor Fluid) 100 CS

* ITEMS TO BE GIVEN SPECIAL ATTENTION

ASSEMBLED BY Johnny W. Little DATE 10-10-86

CHECKED BY Paul Johnson DATE 10-13-86

Approval Stewart Johnson ENGINEERING COPY

ENGINEERING ORIGINAL



FINAL CHECK LIST BEFORE SHIPPING

SERIAL NO. JE8703-1314-2-3
 DATE October 10, 1986

CUST. CROSBY VALVE (C.P. SEALS)

ASSEMBLY CHECK

1. ROD END & EXTENSION.....
2. MOUNTING DIMENSIONS (INCLUDING TIE ROD).....
3. PORT LOCATION.....
4. CUSHION LOCATION.....
5. GENERAL APPEARANCE.....

O.K.	REJ.
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>

PRESSURE TEST

1. LOW PRESSURE = AIR OIL P.S.I. AIR 10 - OIL 125
2. HIGH PRESSURE AIR OIL P.S.I. AIR 90 - OIL See No. 7 Remarks
3. STROKE.....
4. CHECK FOR LEAKAGE.....
 - A. PORTS.....
 - B. CARTRIDGE.....
 - C. END CAP SEAL.....
 - D. CUSHION & BALL CHECK.....
5. CUSHION CHECK, NO PRESSURE.....
 - ROTATE ROD 360° WITH CUSHION SEATED.....
 - TO SEE NO BIND OCCURS.....
6. GENERAL CYLINDER OPERATION.....

<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>

7. REMARKS 2250 P.S.I. HYDRAULIC OK Paul Johnson 10-10-86
 * 100 cycle break in OK P.P.
 * 5 cycle load test OK P.P.
 * leakage test 18ml (1.1 in³) per 5 minutes P.P.
 * Hydraulic oil used during dynamic test = Dev-Cross 300 (444grams fluid) 100 CS

TOTAL ASSEMBLED	
O.K. <input checked="" type="checkbox"/>	REJ. <input type="checkbox"/>



* ITEMS TO BE GIVEN SPECIAL ATTENTION

ASSEMBLED BY John Talbot DATE 10-9-86
 CHECKED BY Paul Johnson DATE 10-10-86



FINAL CHECK LIST BEFORE SH. PING

SERIAL NO. 1E8703-1314-02-2

DATE 10-10-86

CUST. CROSBY VALVE (R.P. SEALS)

ASSEMBLY CHECK

1. ROD END & EXTENSION.....
2. MOUNTING DIMENSIONS (INCLUDING TIE ROD).....
3. PORT LOCATION.....
4. CUSHION LOCATION..... *NA*
5. GENERAL APPEARANCE.....

O.K.	REJ.
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>

PRESSURE TEST

1. LOW PRESSURE * AIR OIL P.S.I. AIR 10 - OIL 125
2. HIGH PRESSURE AIR OIL P.S.I. AIR 90 - OIL *See No. 7 Remarks*
3. STROKE.....
4. CHECK FOR LEAKAGE.....
 - A. PORTS.....
 - B. CARTRIDGE.....
 - C. END CAP SEAL.....
 - D. CUSHION & BALL CHECK..... *NA*
5. CUSHION CHECK, NO PRESSURE..... *NA*
 - ROTATE ROD 360° WITH CUSHION SEATED..... *NA*
 - TO SEE NO BIND OCCURS..... *NA*
6. GENERAL CYLINDER OPERATION.....

<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>

7. REMARKS *2250 P.S.I. HYDROSTATIC OK - 10-13-86*
 * 100 CYCLES BREAK IN *OK PS 10-10-86*
 * 2 cycle load test *OK PS 10-13-86*
 * leakage test *11 ml (1.67 in³) per 5 minutes*
 * *OK PS 10-13-86*

TOTAL ASSEMBLED	
O.K.	REJ.



* HYDRAULIC OIL HARD SURFACE ROTATION TEST - 200 (81116998 Fluid) 100 CS

* ITEMS TO BE GIVEN SPECIAL ATTENTION
 ASSEMBLED BY *Johnnie T. Latta* DATE 10-10-86
 CHECKED BY *Paul Johnson* DATE 10-13-86



HYDRO-LINE MFG, CO.

FINAL CHECK LIST BEFORE SHIPPING

SERIAL NO. J.E. 2703-1314-01-5

DATE 10-13-86

CUST. CROSBY VALVE (C.P. AZALE)

ASSEMBLY CHECK

1. ROD END & EXTENSION.....
2. MOUNTING DIMENSIONS (INCLUDING TIE ROD).....
3. PORT LOCATION.....
4. CUSHION LOCATION..... NA
5. GENERAL APPEARANCE.....

O.K.	REJ.
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>

PRESSURE TEST

1. LOW PRESSURE - AIR OIL P.S.I. AIR 10 - OIL 125
2. HIGH PRESSURE AIR OIL P.S.I. AIR 90 - OIL See No. 7 Remarks
3. STROKE..... J.O. 12187.50
P.O. 2002-23030
4. CHECK FOR LEAKAGE..... STROKE & VELOCITY TEST
Nine Mile Point #2
S/N 128705-1214-12-1, 2, 3, 4, 5, 6, 7, 8,
Hydro-Line Manufacturing Co.
Rockford, IL
- A. PORTS.....
- B. CARTRIDGE.....
- C. END CAP SEAL.....
- D. CUSHION & BALL CHECK..... NA
- E. CUSHION CHECK, NO PRESSURE..... NA
ROTATE ROD 360° WITH CUSHION SEATED..... NA
TO SEE NO BIND OCCURS.....
6. GENERAL CYLINDER OPERATION.....

<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>

7. REMARKS 2250 P.S.I. HYDRAULIC OK PG 10-14-86
 * 100 cycle break in OK PG 10-14-86
 * 5 cycle load test OK PG 10-14-86
 * leakage test 7 ml (1.04 in³) per 5 minutes
 * OK PG 10-14-86

TOTAL ASSEMBLED	
O.K. <input checked="" type="checkbox"/>	REJ. <input type="checkbox"/>



* HYDRAULIC OIL HARD DURING DYNAMIC TEST - Ray Sealair 200 (Silicone Fluid) 100 CS

* ITEMS TO BE GIVEN SPECIAL ATTENTION

ASSEMBLED BY Paul Johnson DATE 10-13-86

CHECKED BY Paul Johnson DATE 10-14-86

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FINAL CHECK LIST BEFORE SHIPPING

SERIAL NO. 2E6503-1314-1B-1

DATE 10-15-86

CUST. CROSBY VALVE (X.P. SEALS)

ASSEMBLY CHECK

1. ROD END & EXTENSION.....
2. MOUNTING DIMENSIONS (INCLUDING TIE ROD).....
3. PORT LOCATION.....
4. CUSHION LOCATION..... *N.A.*
5. GENERAL APPEARANCE.....

O.K.	REJ.
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>

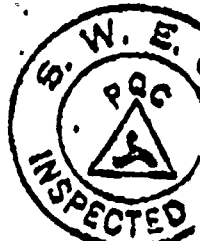
PRESSURE TEST

1. LOW PRESSURE * AIR OIL P.S.I. AIR 10 - OIL 225
2. HIGH PRESSURE AIR OIL P.S.I. AIR 90 - OIL *See No. 7 Remarks*
3. STROKE..... *J.O. 12187, 30*
4. CHECK FOR LEAKAGE..... *P.O. J002-23010*
STONE & WEBSTER ENCL.
New Mile Point, IL
S/N 128703-1314-1B-1, 2, 3, 4, 5, 6, 7, 8.
Hydro-Line Manufacturing Co.
Rockford, IL
- A. PORTS.....
- B. CARTRIDGE.....
- C. END CAP SEAL.....
- D. CUSHION & BALL CHECK..... *N.A.*
- E. CUSHION CHECK, NO PRESSURE..... *N.A.*
 ROTATE ROD 360° WITH CUSHION SEATED..... *N.A.*
 TO SEE NO BIND OCCURS..... *N.A.*
6. GENERAL CYLINDER OPERATION.....

<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>

7. REMARKS *2250 P.S.I. HYDRAULIC P.M. OK 10-15-86*
 * 100 cycle break in *P.M. OK 10-15-86*
 * 5 cycle load test *P.M. OK 10-15-86*
 * leakage test / oil per 5 min. *OK via Torque & Seal*

TOTAL ASSEMBLED	
OK	REJ.
<input checked="" type="checkbox"/>	<input type="checkbox"/>



* HYDRAULIC OIL USED DURING PRESSURE TEST = DOWCORNING 220 (MILWAUKEE FLUID) 100 CS

* ITEMS TO BE GIVEN SPECIAL ATTENTION

ASSEMBLED BY *[Signature]* DATE 10-14-86

CHECKED BY *[Signature]* DATE 10-15-86



1968