PAP-510
OPERATIONAL TESTS FOR
AMES 6-INCH PRESSURE REDUCING VALVE

by

Jerry R. Fitzwater

PAP-510

Form DFC-11
(12-61)
Bureau of Reclamation

INFORMATIONAL ROUTING

D-1531
PAP file

Memorandum
Chief, Mechanical Branch
Chief, Water Conveyance Branch

Chief, Hydraulics Branch

Denver, Colorado
February 2, 1987

Laboratory Investigation of Ames Pressure Reducing Valve

The laboratory investigations for the subject valve have been completed. The attached report entitled "Operational Tests for Ames 6-Inch Pressure Reducing Valve" by Jerry R. Fitzwater summarizes the results of the tests.

Although the valve we tested would not initially regulate the downstream set pressure, after replacement of the internal spring and regulator pilot, it performed as expected. Figures 11 and 12 in the report present the results of tests to determine the Cv curve for various valve openings with the standard and V-port shut-off plates. As noted in the report, we were unable to conduct the cycling test as planned due to time and funding limitations.

•U.S. GPO: 1985-577-

Philip H. Burgi

Attachment

Copy to: D-253
D-253 (Dusenbury)
D-272 (Kinney)
D-430 (Yocum)
D-1530
D-1531 (PAP file)
D-1532
D-1532 (Fitzwater)
(with attachment to each)

OPERATIONAL TESTS FOR AMES 6-INCH PRESSURE REDUCING VALVE

by

Jerry R. Fitzwater

Purpose

The purpose of this study is to test a new type of pressure reducing valve for possible use in irrigation delivery pipelines. The Mechanical and Water Conveyance Branches requested assistance from the Hydraulics Branch to test a 6-in Ames pressure reducing valve. The OCCS Committee supported the effort and provided funding for the tests. It was requested that tests be conducted to determine the responses of the pilots, check the Cv value for the standard shut-off plate and the V-port shut-off plate, and conduct cycling tests. The cycles would range from a closed position to 40 percent valve opening to closed again. The cycling tests would help determine the adequacy of the seal design and durability of the valve.

Test Facility and Instrumentation

To perform the tests, the modulating valve was supplied with the following features:

1. 6-inch, class 150
2. Pressure reducing - 50 lb/in^2 (Regulator Pilot, Fig. 1)
3. Flow control - 1,800 gal/min
4. Solenoid control (Fig. 1)
   a. 120 VAC
   b. Normally closed; energized open
5. Limited opening (approximately 20 percent) until downstream pressure builds up to 10 lb/in^2 gauge (First and second-stage pilots, Fig. 1)
6. Position indicator - manual (Measured with L.V.D.T., Fig. 3)
7. Opening and closing speed control
8. Vulcanized type seal on poppet (Standard shut-off plate, Fig. 4)
9. V-port type poppet (V-port shut-off plate, Fig. 4)

The valve was installed in the high head pump facility where it could be tested to the rated pressure of the valve (150 lb/in^2). The static pressure transducers were installed: one upstream 13 diameters, and one downstream 8 diameters. An L.V.D.T. (linear variable differential transducer) was installed on the position indicator of the valve to record the valve opening. The data from the instrumentation were recorded on a stripchart recorder. All instrumentation was calibrated prior to installation. Figures 1, 2, 3, 4, and 5 show the test facility, instrumentation, and features of the valve.

Test Procedures

The primary purpose of this valve is to maintain a constant downstream pressure under changing flow conditions. During these tests the upstream pressure, downstream pressure, valve position, time intervals during test, and the flows were recorded. The flow was measured with a Venturi meter on the test facility (Fig. 2). The flow was controlled with an 8-inch motor-operated control valve downstream from the test installation (Fig. 3).

During testing Cv factors were determined for the standard shut-off plate and the V-port shut-off plate (Fig. 4). These factors are used by the designer to specify the valve required for the field installation, ($Cv = Q/\sqrt{\Delta p}$). The Cv factors for partial openings are useful, since the manufacturer's literature only lists Cv for a fully open valve (Cv = 575 for a 6-inch Ames valve).

Test Results

Early testing indicated a problem with the L.V.D.T. on the valve position indicator. Closer inspection indicated a manufacturing problem with the indicator connection. The problem was solved by machining a new connection. The first series of data were taken with the downstream regulated pressure (P2) set at 25 lb/in^2, while increasing and decreasing the upstream pressure (P1). During the tests, the valve did not return the downstream set pressure to its original pressure of 25 lb/in^2. Another series of data were taken, with a downstream set pressure of 50 lb/in^2. Again, the downstream pressure did not return to the set pressure (Fig. 6).

After working with the manufacturer's representative, it was determined that the valve needed a new internal spring (which was defective from the factory) and a new regulator pilot. The new regulator pilot (50-125 lb/in^2) and internal spring were installed and the valve functioned much better. Another series of data were taken with a downstream set pressure (P2) of 75 lb/in^2 (fig. 7). Results of one cycle from open to close, to open again was recorded and plotted (fig. 8). The downstream pressure quickly returned to the set pressure.

Similar tests were also run on the V-port shut-off plate using the new parts. Results of these tests were recorded and plotted (figs. 9 and 10). The valve responded well during these tests also.

Using the results from the tests a Cv curve was developed for the standard shut-off plate and the V-port shut-off plate (figs. 11 and 12). These curves provide data for selecting a modulating valve. The Cv values provided in the manufacturer's literature are for a full open valve.

Time and funding limitations precluded cycling tests.

Conclusions

1. The valve as supplied would not regulate the downstream set pressure.

2. Initial setup, adjustment, and troubleshooting of the valve were difficult to complete, based on the instructions and schematic diagrams supplied.

3. After replacement of the internal spring and regulator pilot, the valve maintained the downstream set pressure as the upstream pressure was changed and as the downstream flow demand was changed.

4. Cv curves were developed for various valve openings for the standard shut-off plate and for the V-port shut-off plate.

5. Cycling tests were not conducted, due to time and funding limitations.

Recommendation

A field installation could be monitored periodically to determine durability of the valve and the seals under continual operations.

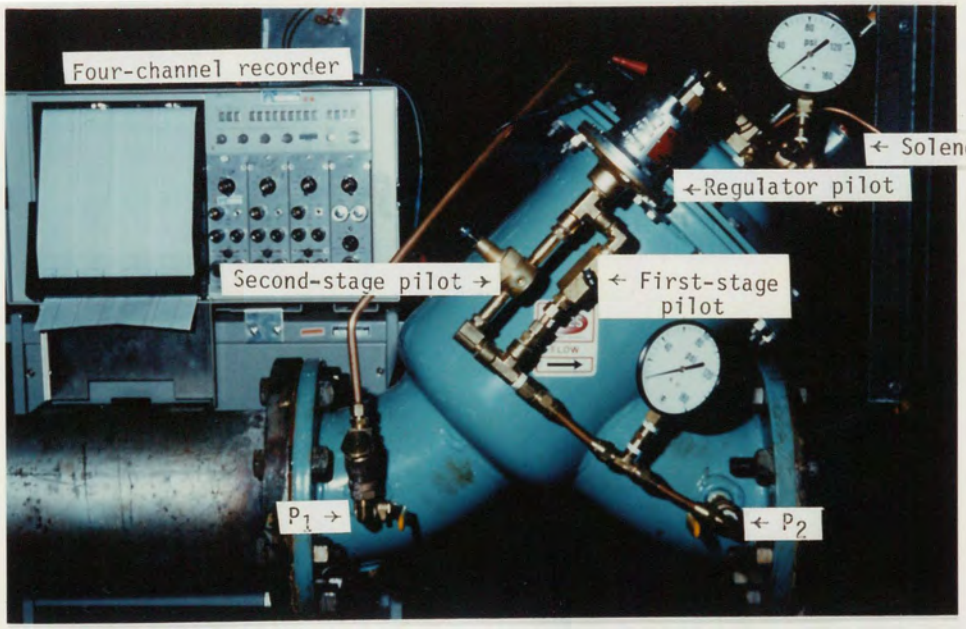

Figure 1

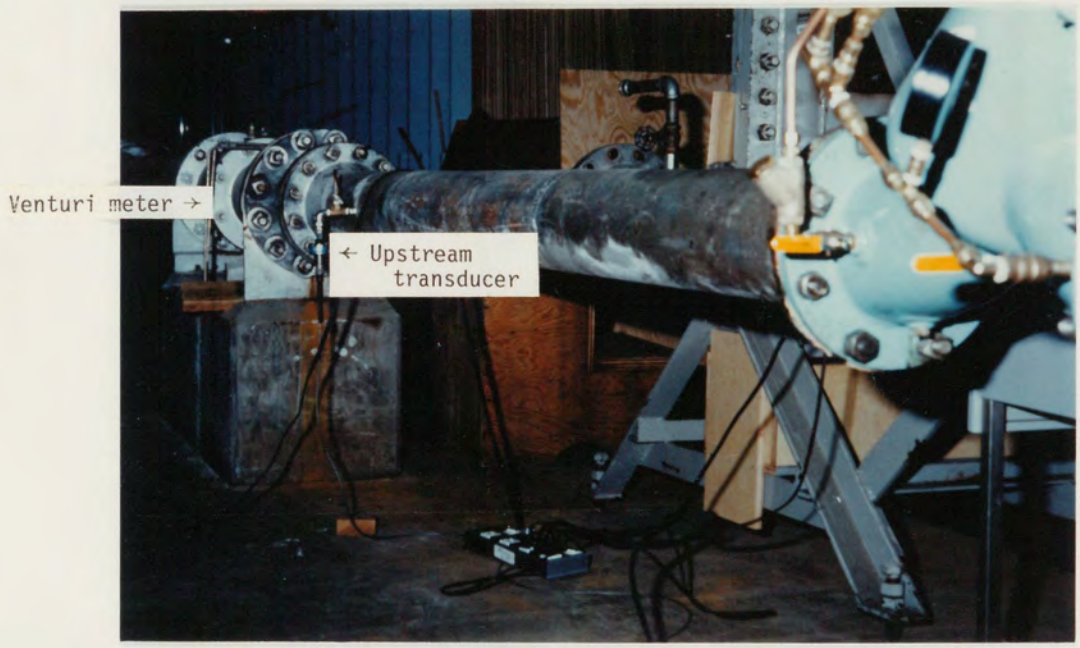

Figure 2

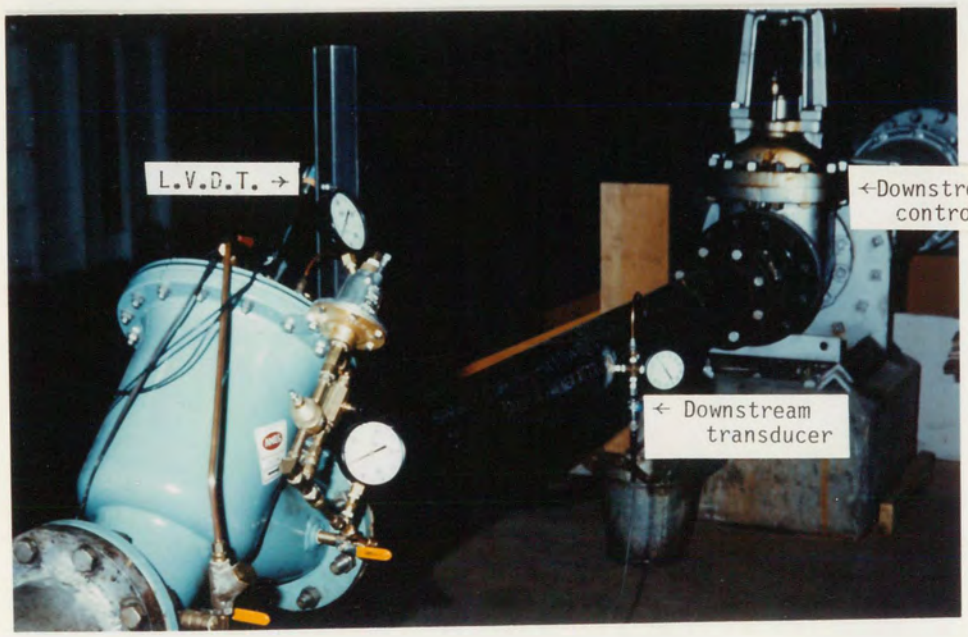

Figure 3

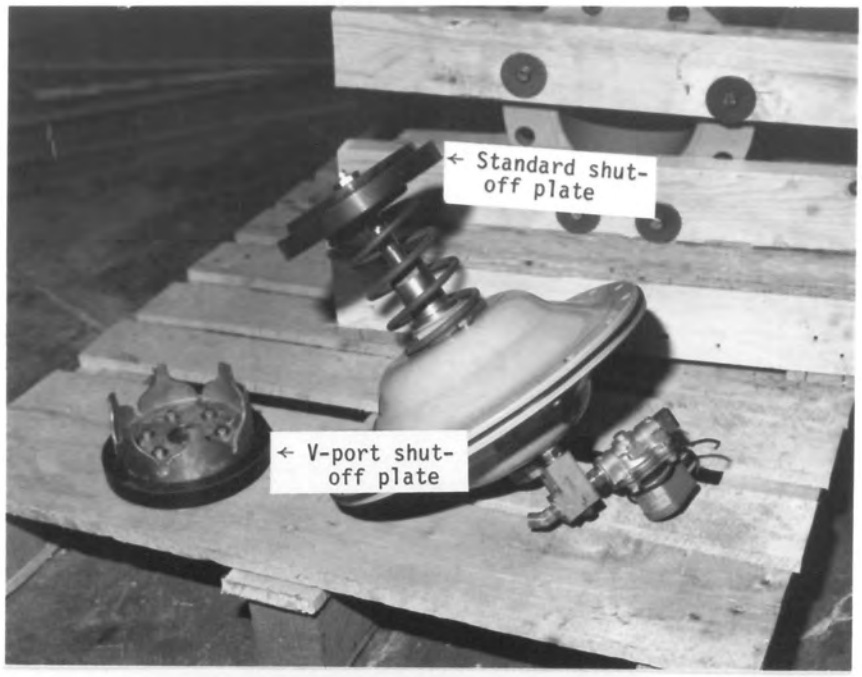

Figure 4

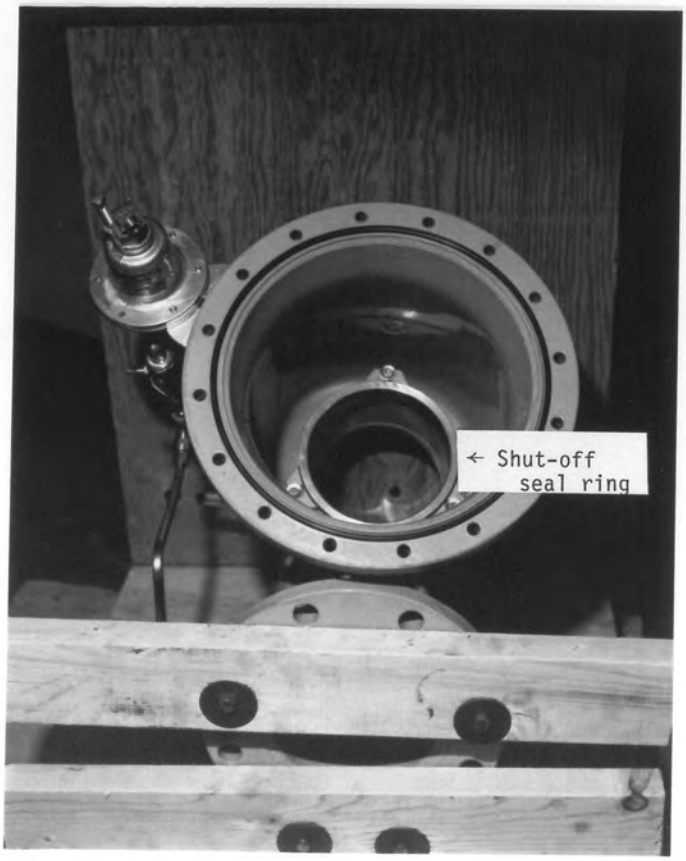

Figure 5

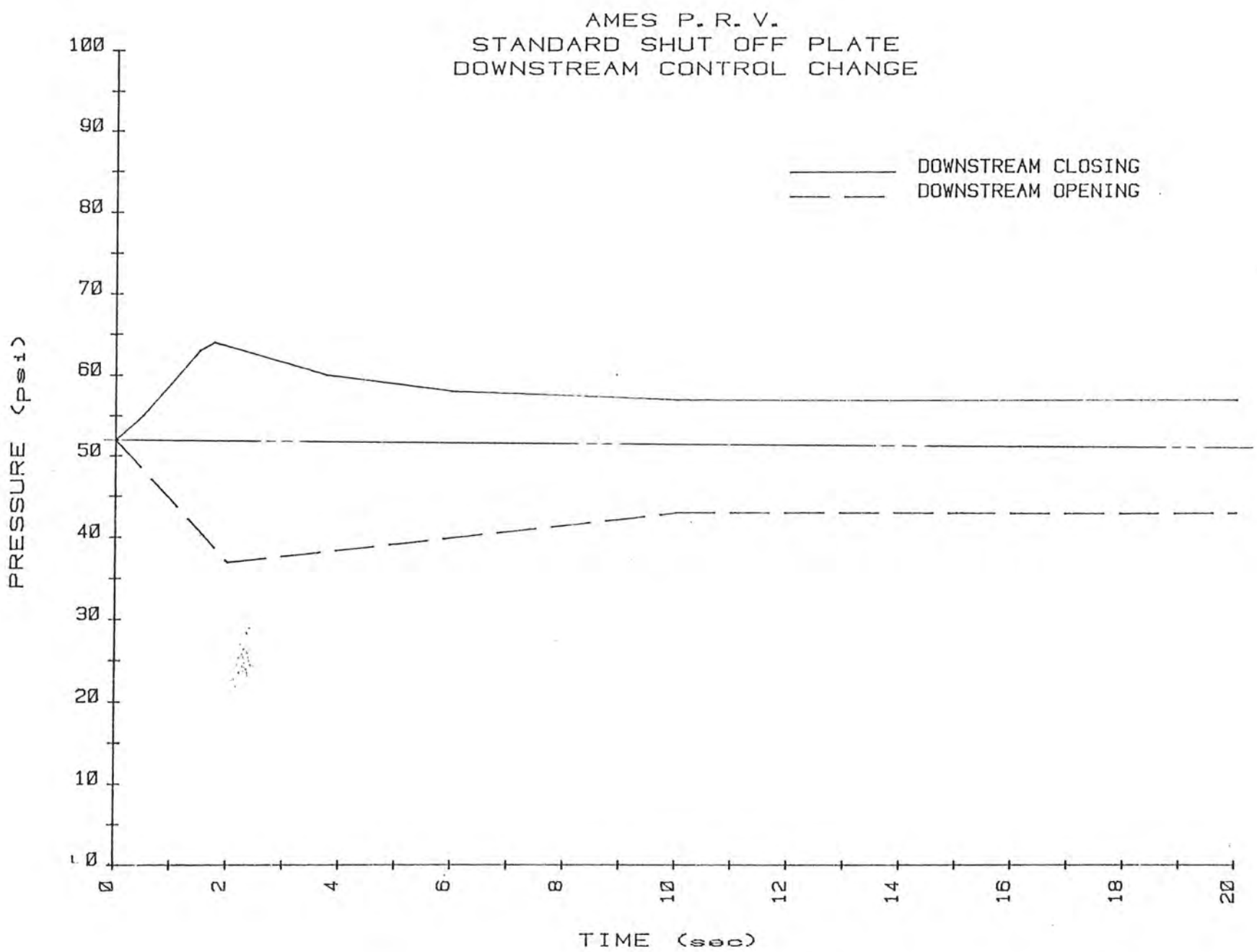
AMES P. R. V.
STANDARD SHUT OFF PLATE
DOWNSTREAM CONTROL CHANGE
DOWNSTREAM CLOSING
DOWNSTREAM OPENING
PRESSURE (psi)
100
90
80
70
60
50
40
30
20
10
0
0
2
4
6
8
10
12
14
16
18
20
TIME (sec)

Figure 6

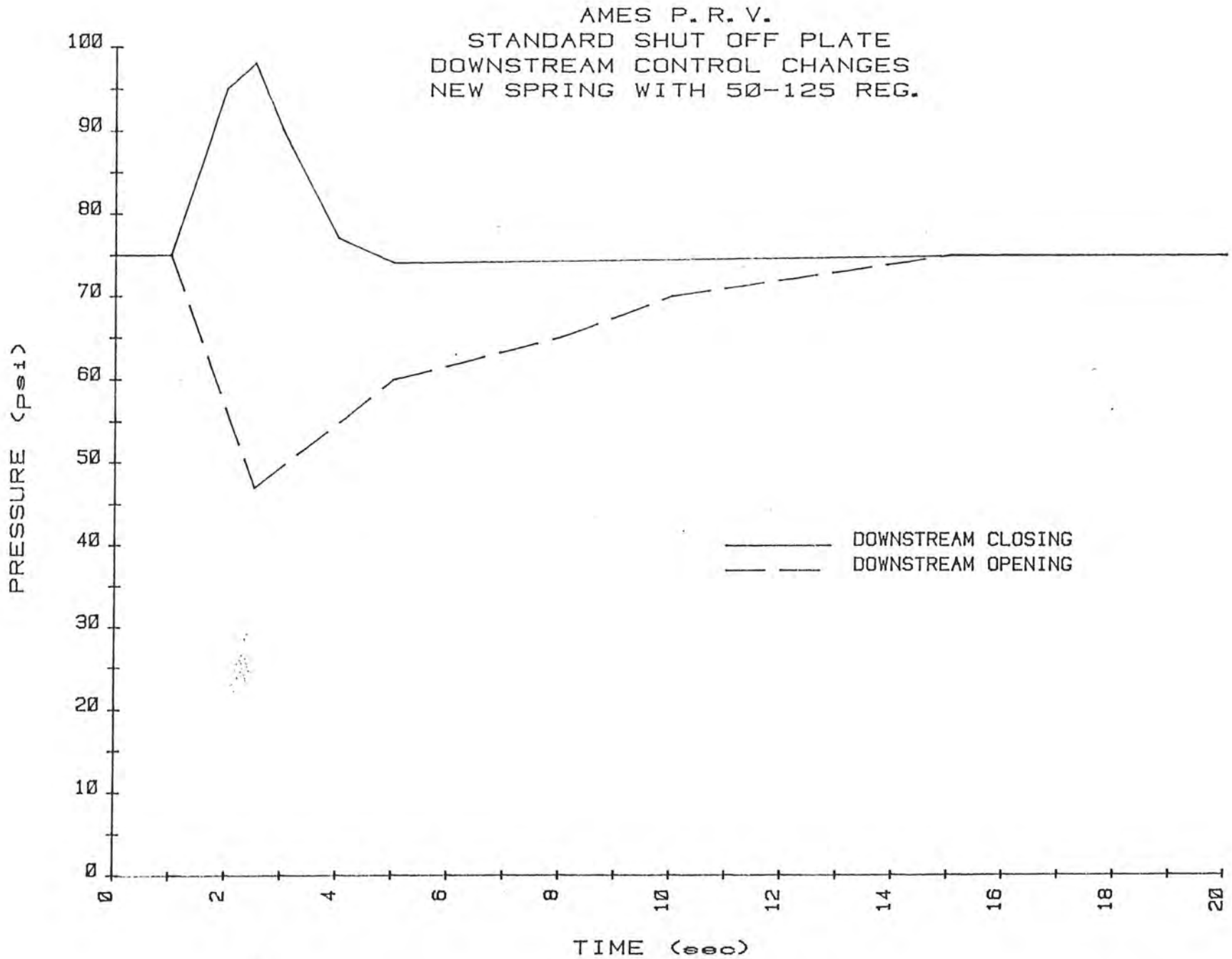
AMES P. R. V.
STANDARD SHUT OFF PLATE
DOWNSTREAM CONTROL CHANGES
NEW SPRING WITH 50-125 REG.
PRESSURE (psi)
100
90
80
70
60
50
40
30
20
10
0
0
2
4
6
8
10
12
14
16
18
20
TIME (sec)
DOWNSTREAM CLOSING
DOWNSTREAM OPENING

Figure 7

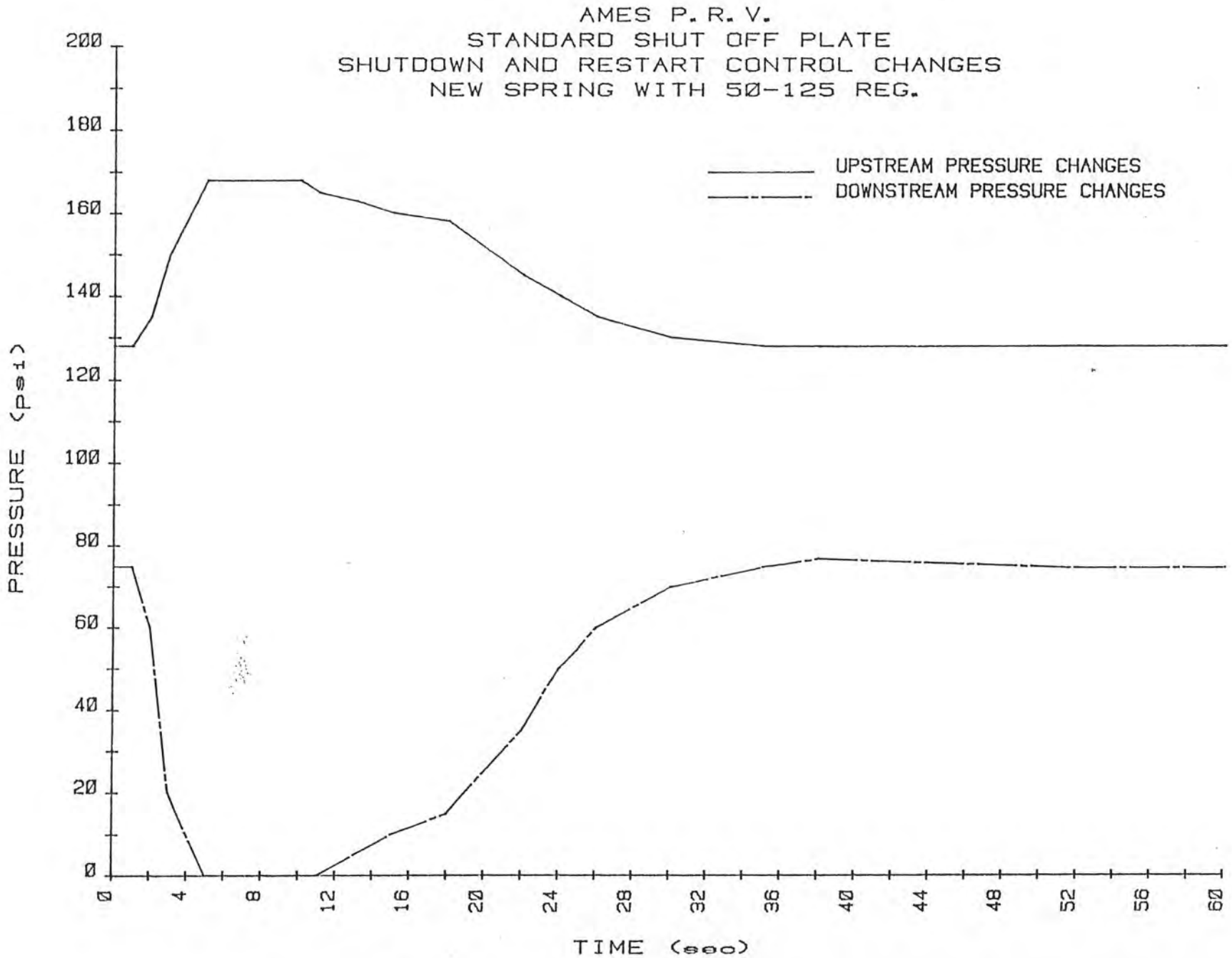
AMES P. R. V.
STANDARD SHUT OFF PLATE
SHUTDOWN AND RESTART CONTROL CHANGES
NEW SPRING WITH 50-125 REG.
UPSTREAM PRESSURE CHANGES
DOWNSTREAM PRESSURE CHANGES
PRESSURE (psi)
200
180
160
140
120
100
80
60
40
20
0
0
4
8
12
16
20
24
28
32
36
40
44
48
52
56
60
TIME (sec)

Figure 8

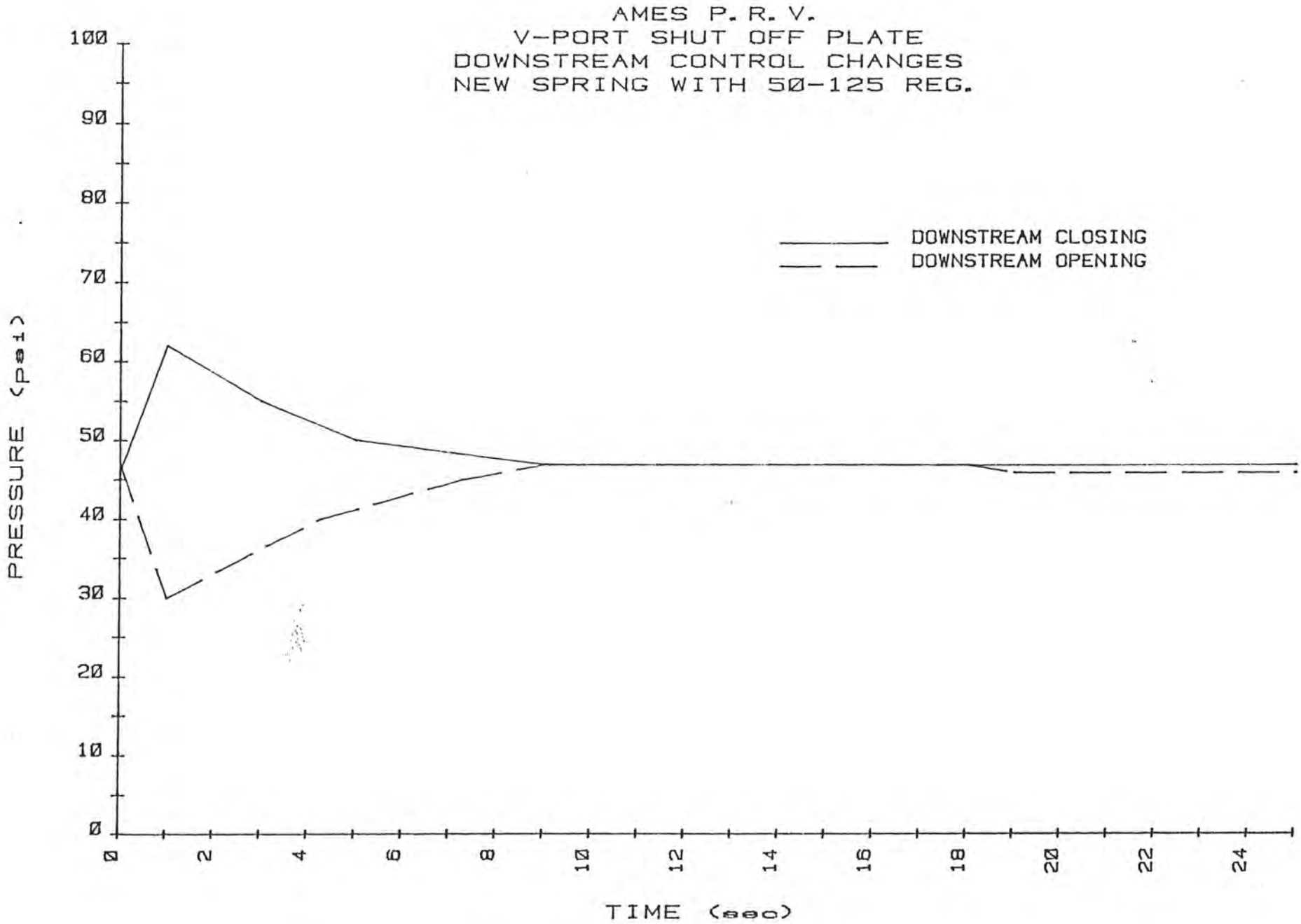
AMES P. R. V.
V-PORT SHUT OFF PLATE
DOWNSTREAM CONTROL CHANGES
NEW SPRING WITH 50-125 REG.
DOWNSTREAM CLOSING
DOWNSTREAM OPENING
PRESSURE (psi)
100
90
80
70
60
50
40
30
20
10
0
0
2
4
6
8
10
12
14
16
18
20
22
24
TIME (sec)

Figure 9

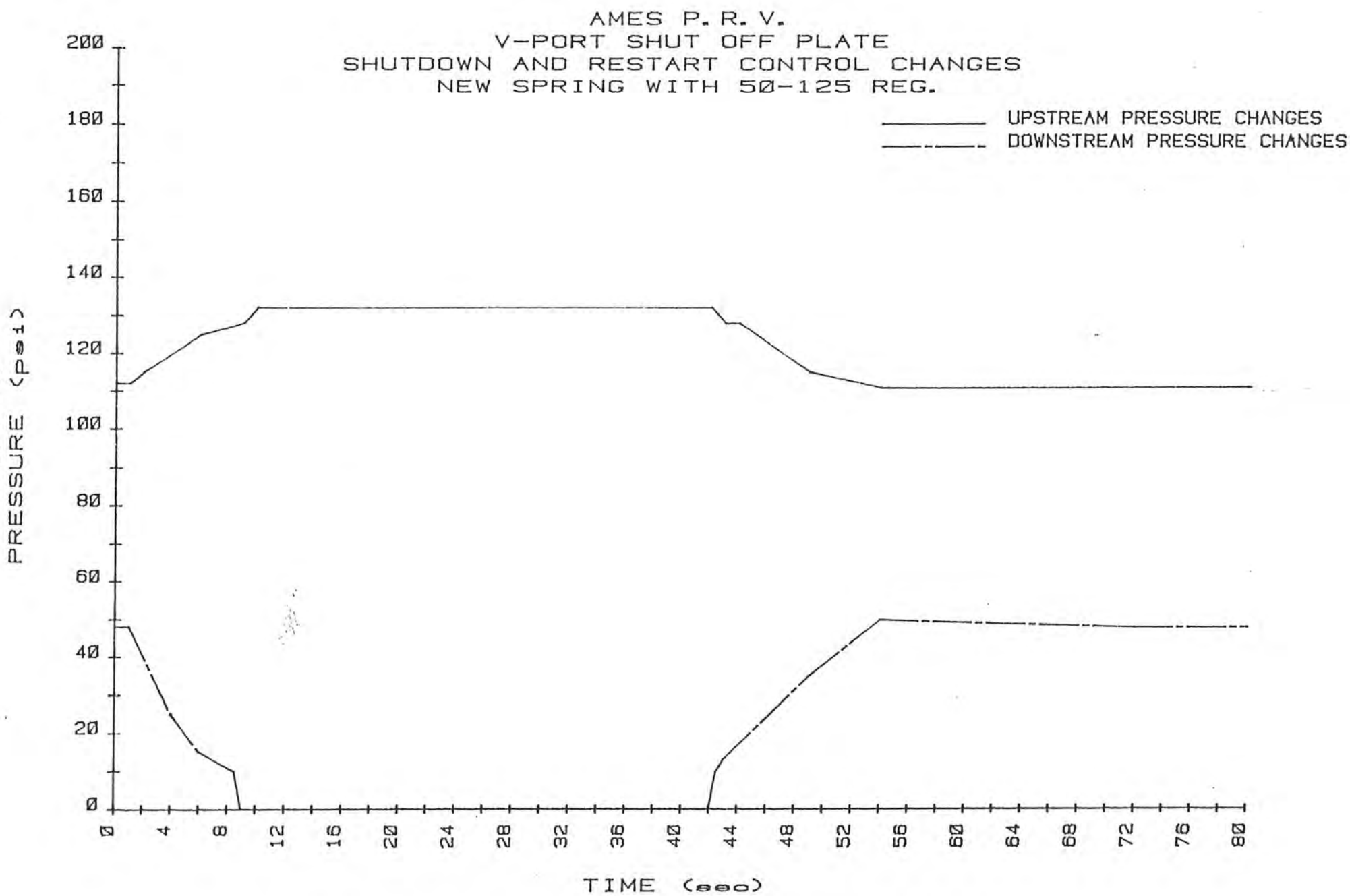
AMES P. R. V.
V-PORT SHUT OFF PLATE
SHUTDOWN AND RESTART CONTROL CHANGES
NEW SPRING WITH 50-125 REG.
UPSTREAM PRESSURE CHANGES
DOWNSTREAM PRESSURE CHANGES
PRESSURE (psi)
200
180
160
140
120
100
80
60
40
20
0
0
4
8
12
16
20
24
28
32
36
40
44
48
52
56
60
64
68
72
76
80
TIME (sec)

Figure 10

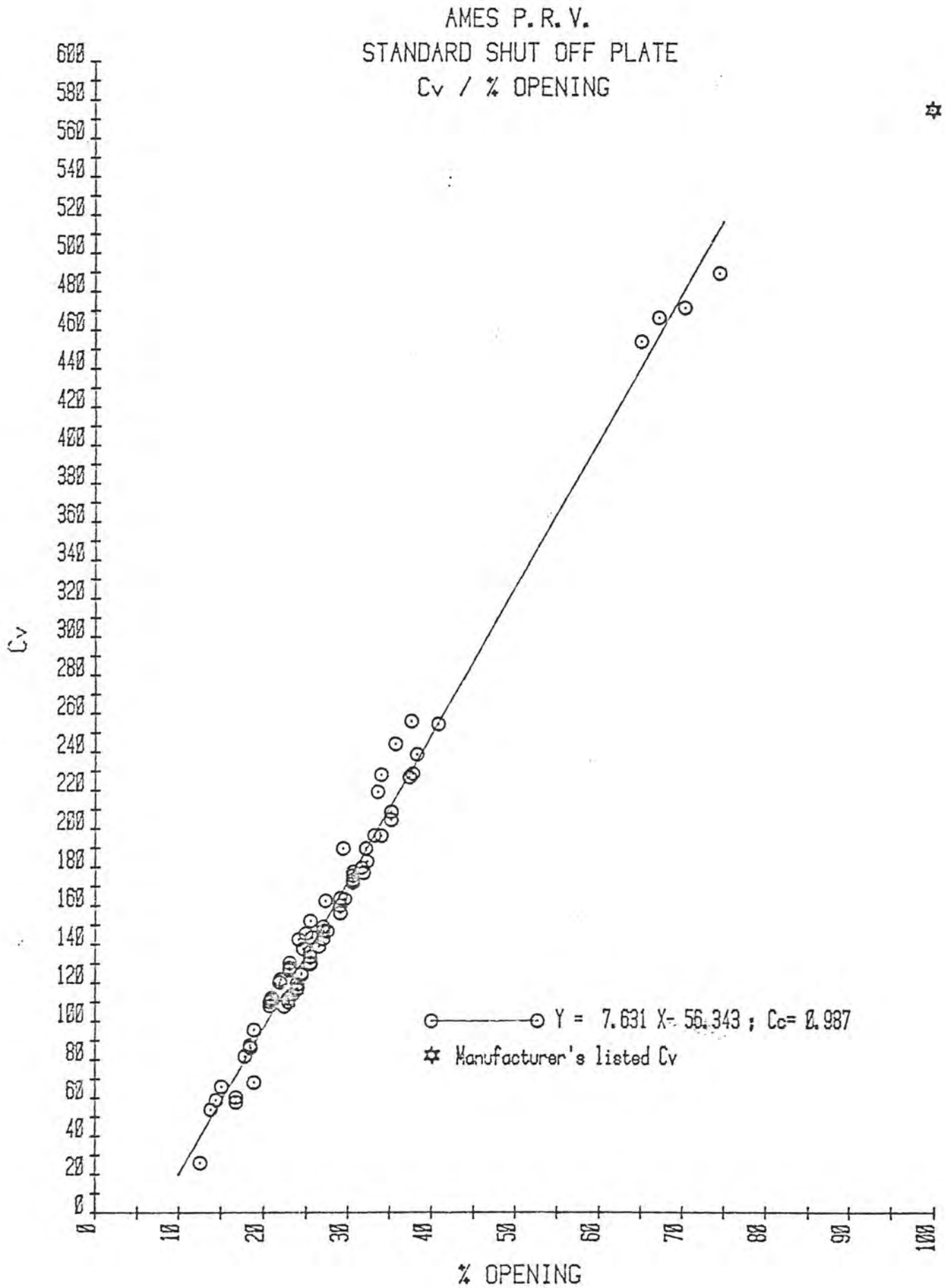
AMES P.R.V.
STANDARD SHUT OFF PLATE
Cv / % OPENING
Cv
% OPENING
Y = 7.631 X- 56.343 ; Cc= 0.987
Manufacturer's listed Cv

Figure 11

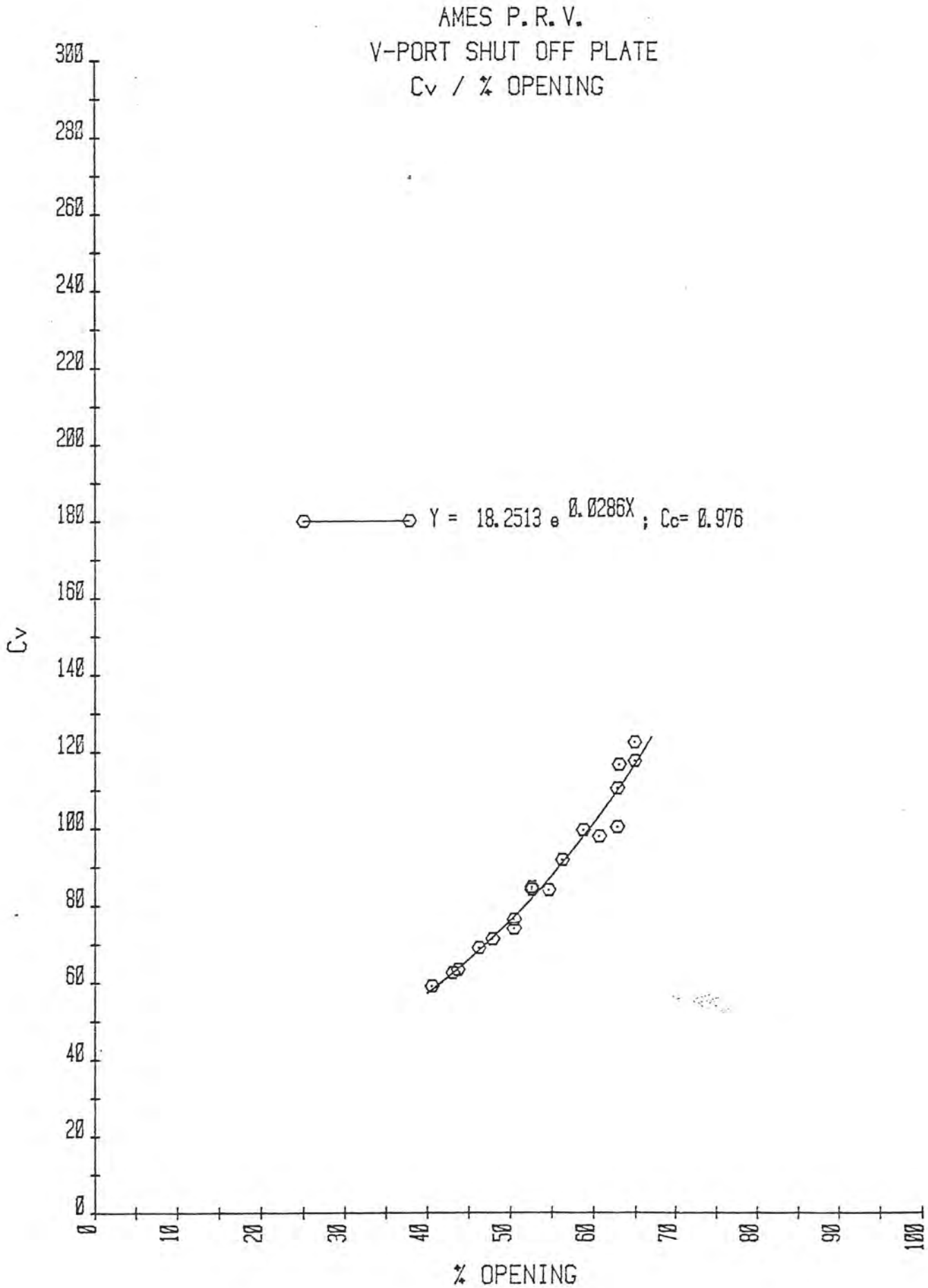
AMES P.R.V.
V-PORT SHUT OFF PLATE
Cv / % OPENING
Y = 18.2513 e 0.0286X ; Cc= 0.976
Cv
% OPENING
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
0
10
20
30
40
50
60
70
80
90
100

Figure 12