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LOX/Hydrocarbon Rocket Engine Analytical Design Methodology Development and Validation

Karen E. Niiya and Richard E. Walker
Aerojet Propulsion Division
Sacramento, California

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LOX/HYDROCARBON ROCKET ENGINE ANALYTICAL DESIGN METHODOLOGY DEVELOPMENT AND VALIDATION

(Contract NAS 3-25556)

Final Report

VOLUME II
APPENDICES

Prepared
For

NASA/Lewis Research Center
21000 Brookpark Road
Cleveland, Ohio 44135

Prepared By:

J.L. Pieper
Project Engineer

Approved By:

Bryce L. Reimer
Program Manager

Thong V. Nguyen
Project Engineer

Aerojet Propulsion Division
P.O. Box 13222
Sacramento, California 95813-6000

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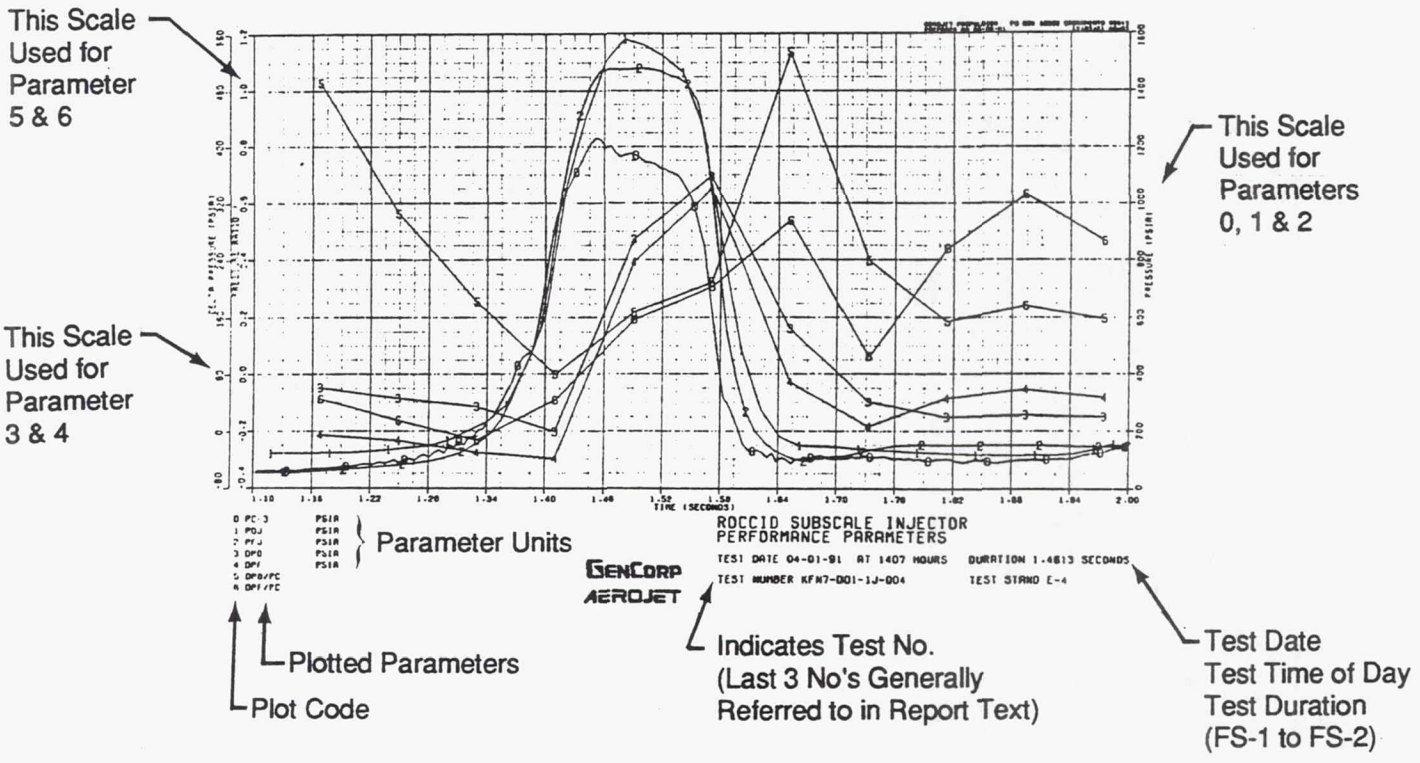
APPENDIX A

MEASURED MANIFOLD AND CHAMBER MEAN PRESSURES VERSUS TIME PLOT FOR ALL SUCCESSFUL TESTS

INDEX OF TEST DATA PLOTS

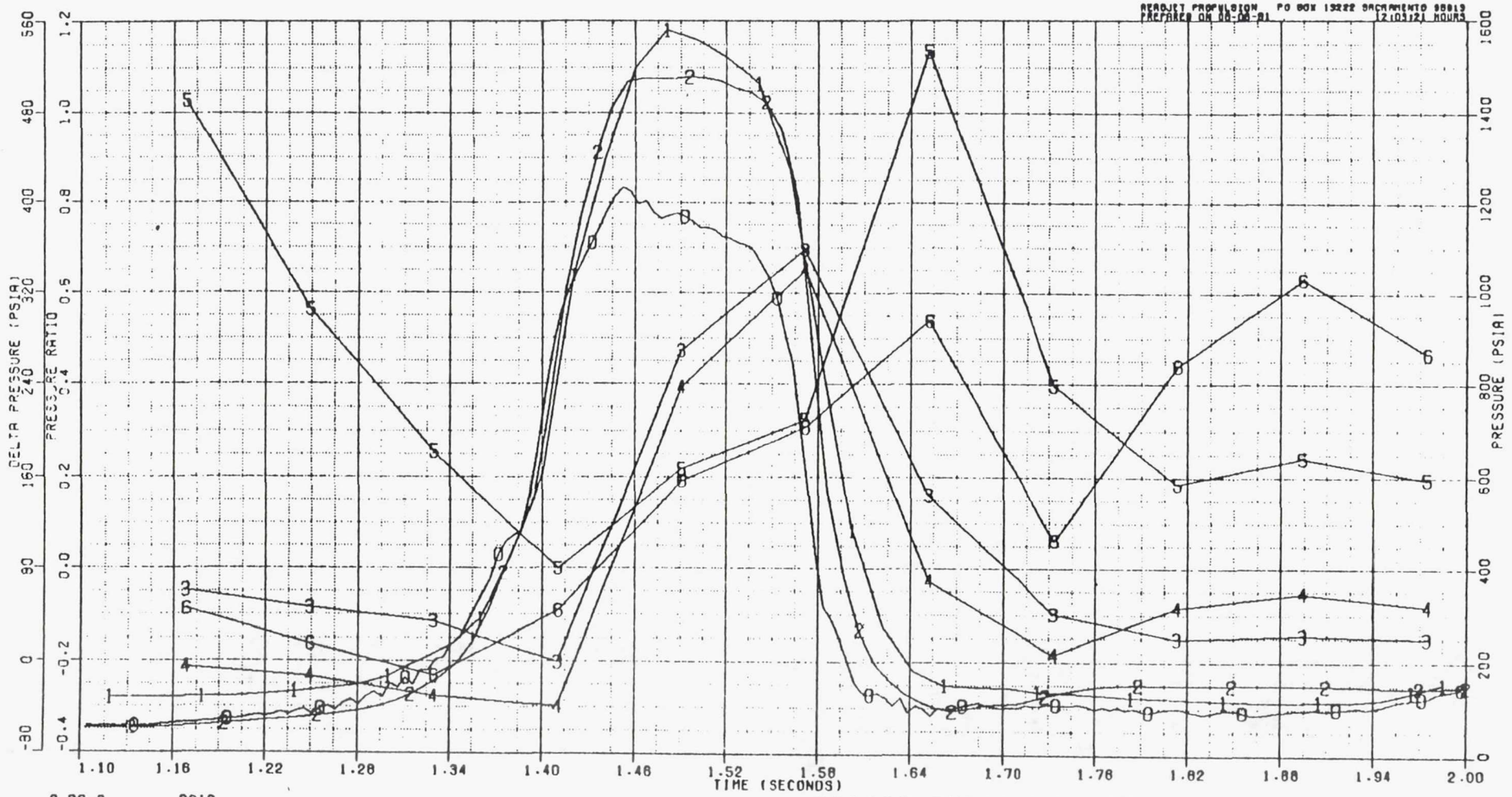
FOREWORD

This Appendix contains plots of selected pressure measurements as a function of time from the initial fireswitch (FS-1) activation. These plots were prepared from digital data obtained from the analog-to-digital converter for all 27 tests, where meaningful operation was achieved, in order to assess the combustion stability or instability characteristics of the combustor. The plots start at FS-1 + 1.10 seconds, which is the approximate time that the LOX/TEA + TEB ignition occurs. This hypergolic propellant combination is used as a combustion source to ignite the LOX/RP-1 propellants. Test data is plotted until well after the test shutdown switch (FS-2) in order to show pressure decays during the shutdown transient. Information contained in these plots are identified below:



PLOTTED PARAMETERS

PC-3	Chamber Pressure
POJ	LOX Injector Manifold Pressure
PFJ	RP-1 Injector Manifold Pressure
DPO	LOX Injector ΔP (POJ-Pc-3)
DPF	RP-1 Injector ΔP (PFJ-Pc-3)
DPO/Pc	DPO/Pc-3
DPF/Pc	DPF/Pc-3



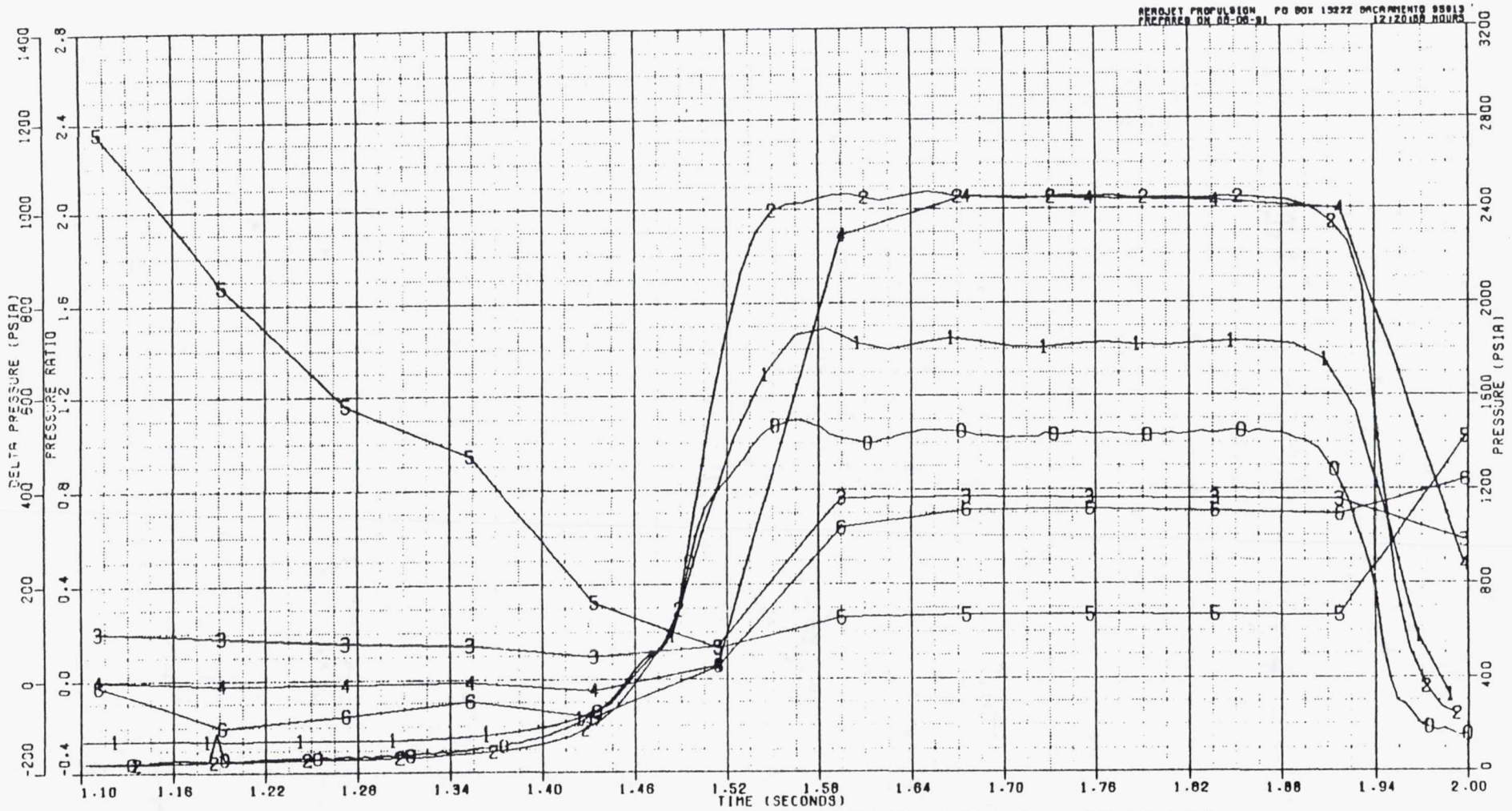
0 PC-3 PSIA
1 POJ PSIA
2 PFJ PSIA
3 OPO PSIA
4 OPF PSIA
5 OPO/PC
6 OPF/PC

ROCCID SUBSCALE INJECTOR PERFORMANCE PARAMETERS

TEST DATE 04-01-91 AT 1407 HOURS DURATION 1.4613 SECONDS

TEST NUMBER KFN7-D01-1J-004 TEST STAND E-4

GENCORP AEROJET



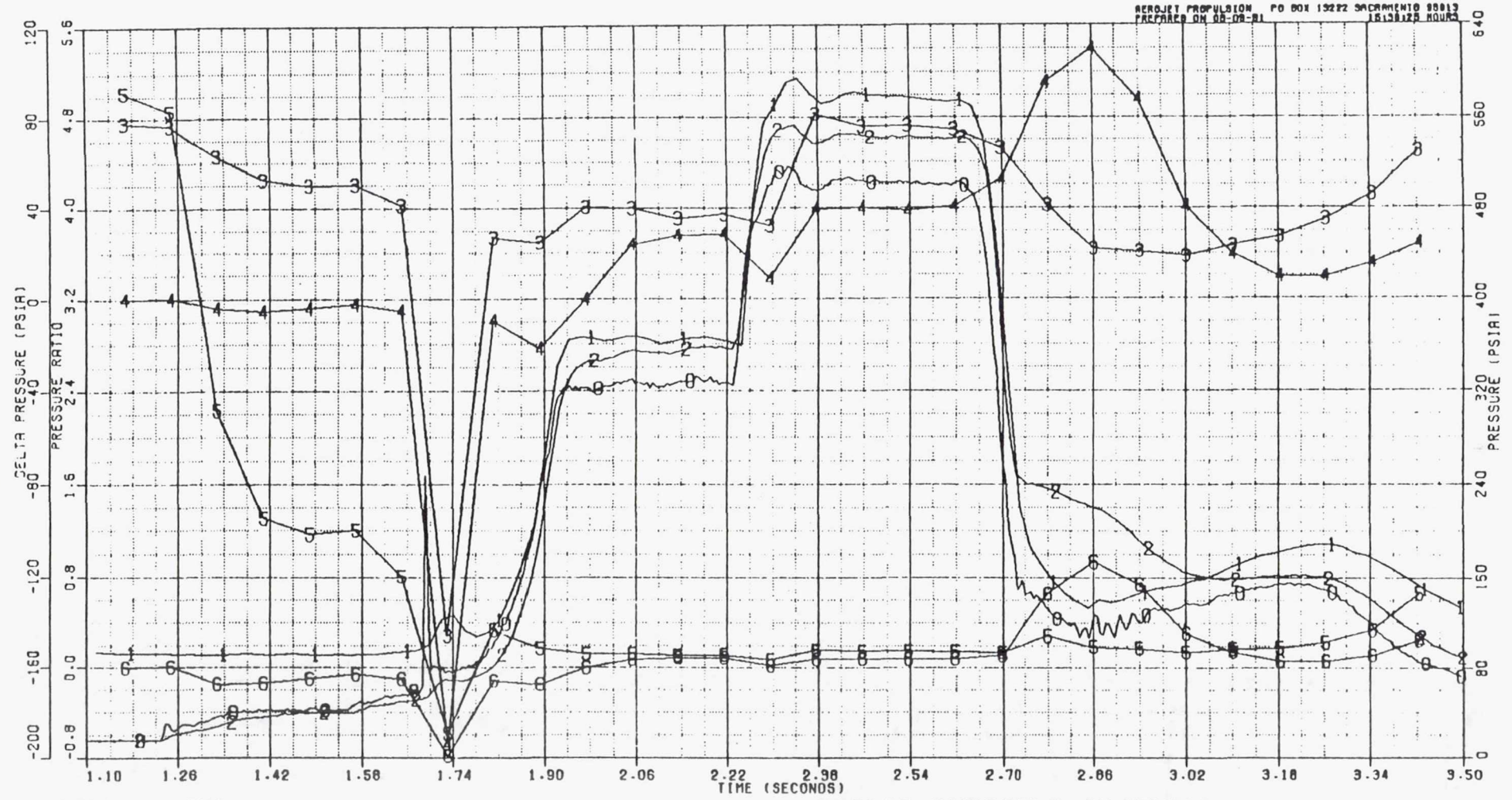
0 PC-3 PSIA
1 POJ PSIA
2 PFJ PSIA
3 DP0 PSIA
4 DPF PSIA
5 DP0/PC
6 DPF/PC

GENCORP
AEROJET

ROCCID SUBSCALE INJECTOR PERFORMANCE PARAMETERS

TEST DATE 04-04-91 AT 1115 HOURS DURATION 1.853 SECONDS

TEST NUMBER KFN7-D01-1J-007 TEST STAND E-4



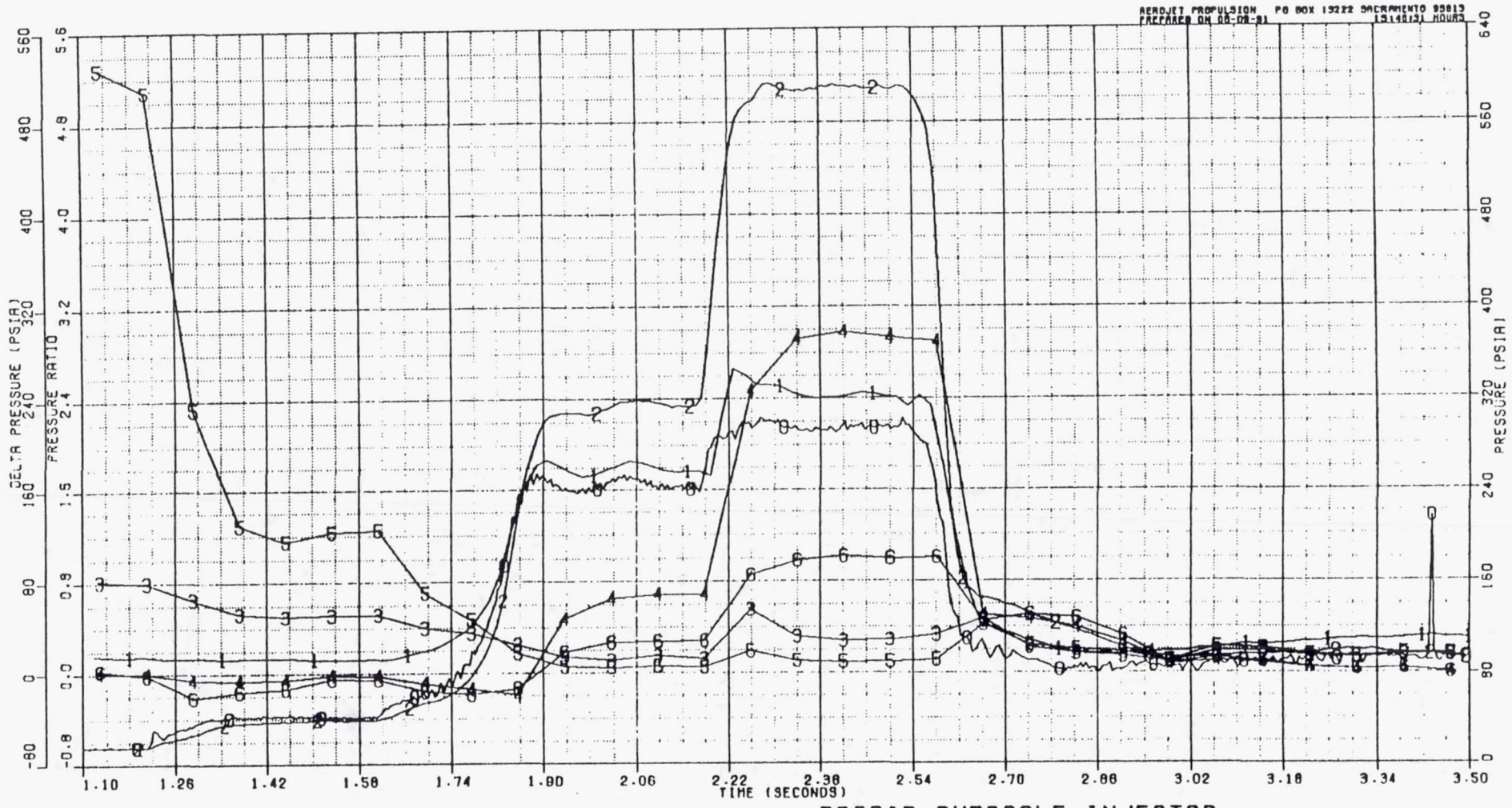
0 PC-3 PSIA
1 POJ PSIA
2 PFJ PSIA
3 OPO PSIA
4 OPF PSIA
5 OPO/PC
6 OPF/PC

ROCCID SUBSCALE INJECTOR PERFORMANCE PARAMETERS

TEST DATE 04-04-91 AT 1522 HOURS DURATION 2.569 SECONDS

TEST NUMBER KFN7-001-1J-009 TEST STAND E-4

GENCORP AEROJET



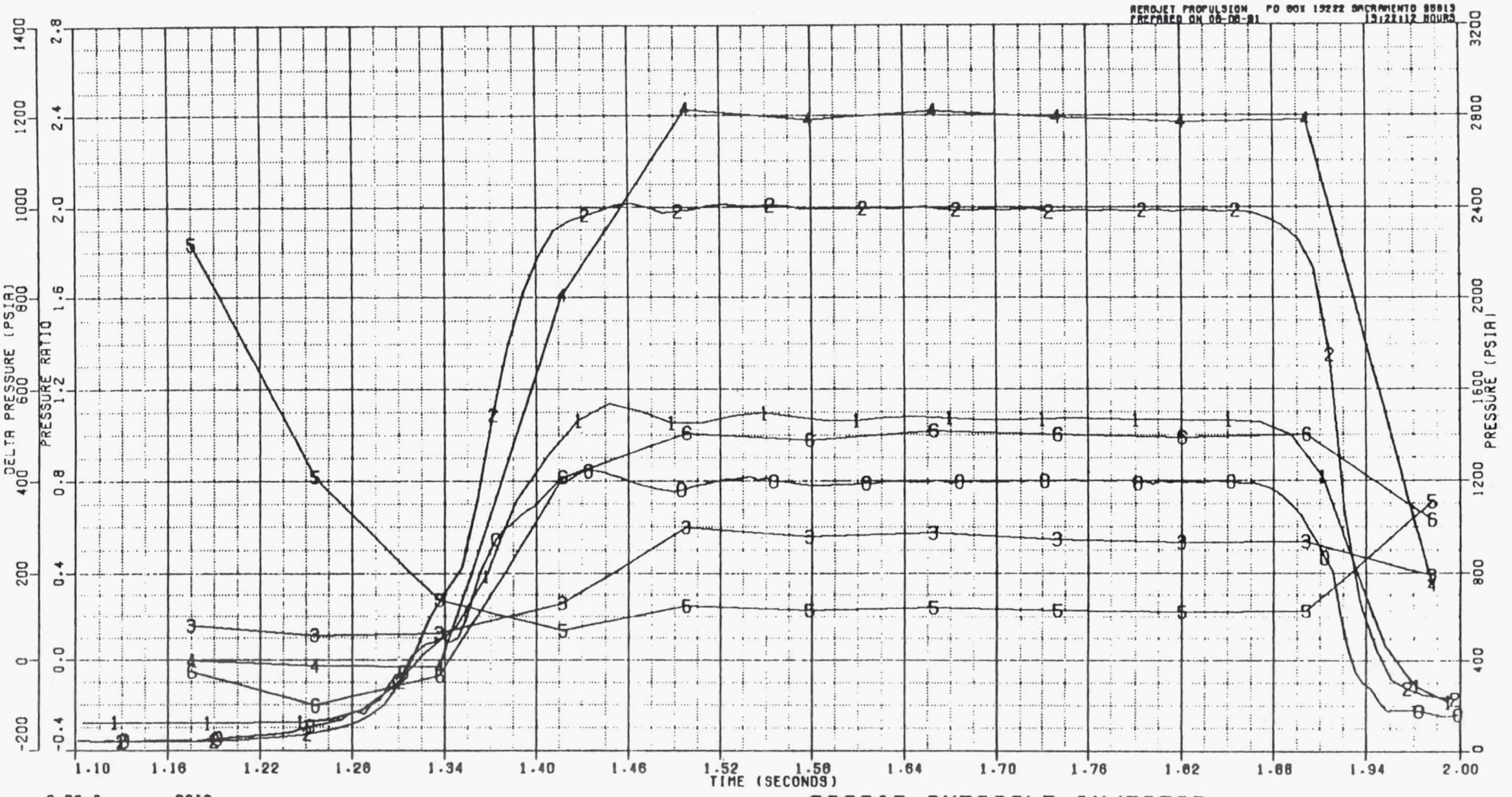
0 PC-3 PSIA
1 POJ PSIA
2 PFJ PSIA
3 OPO PSIA
4 OPF PSIA
5 OPO/PC
6 OPF/PC

ROCCID SUBSCALE INJECTOR PERFORMANCE PARAMETERS

TEST DATE 04-08-91 AT 1409 HOURS DURATION 2.494 SECONDS

TEST NUMBER KFN7-D01-1J-012 TEST STAND E-4

GENCORP AEROJET



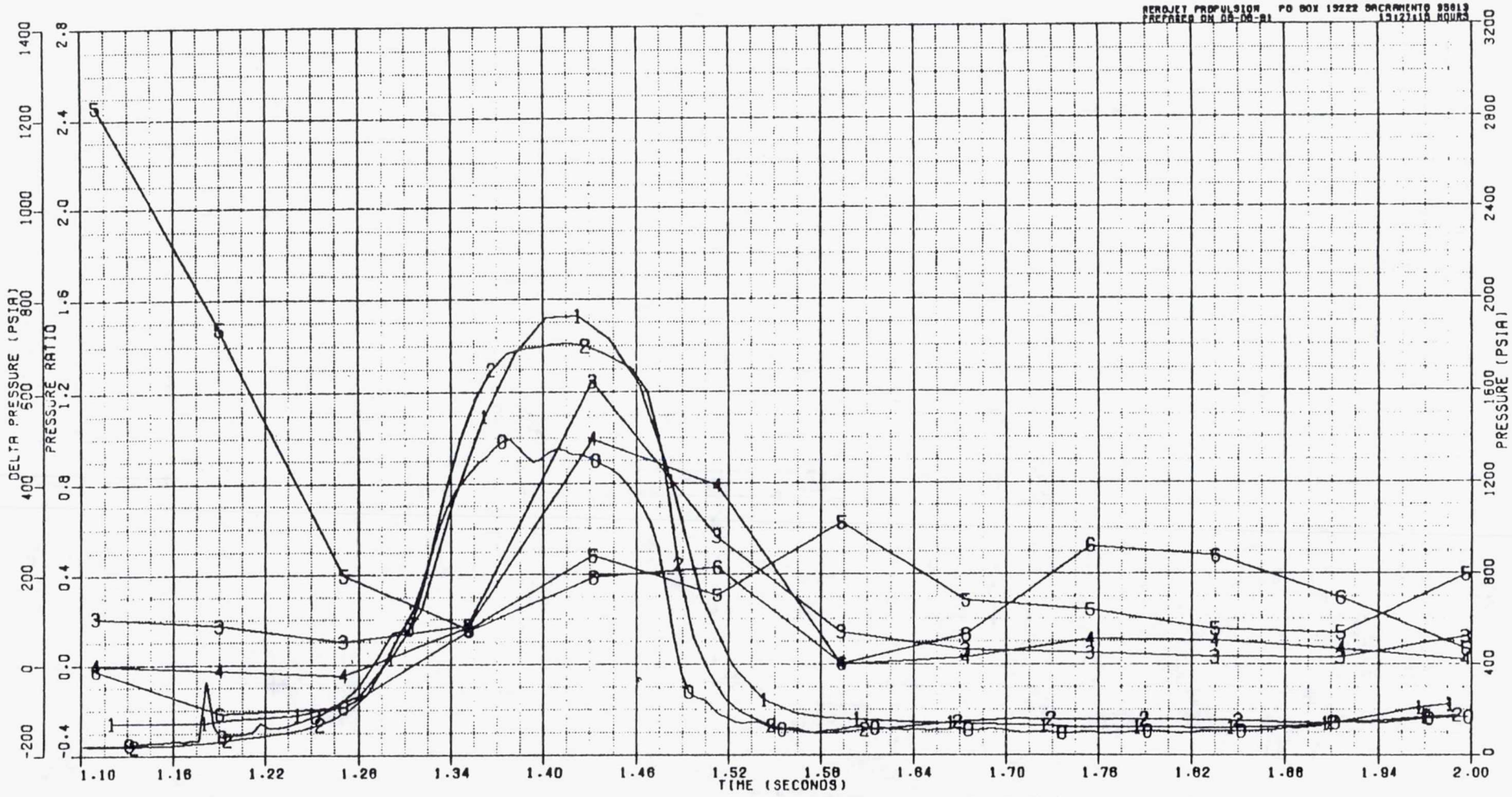
0 PC-3 PSIA
1 POJ PSIA
2 PFJ PSIA
3 DPO PSIA
4 DPF PSIA
5 DPO/PC
6 DPF/PC

ROCCID SUBSCALE INJECTOR PERFORMANCE PARAMETERS

TEST DATE 04-08-91 AT 1750 HOURS DURATION 1.823 SECONDS

TEST NUMBER KFN7-D01-1J-013 TEST STAND E-4

GENCORP AEROJET



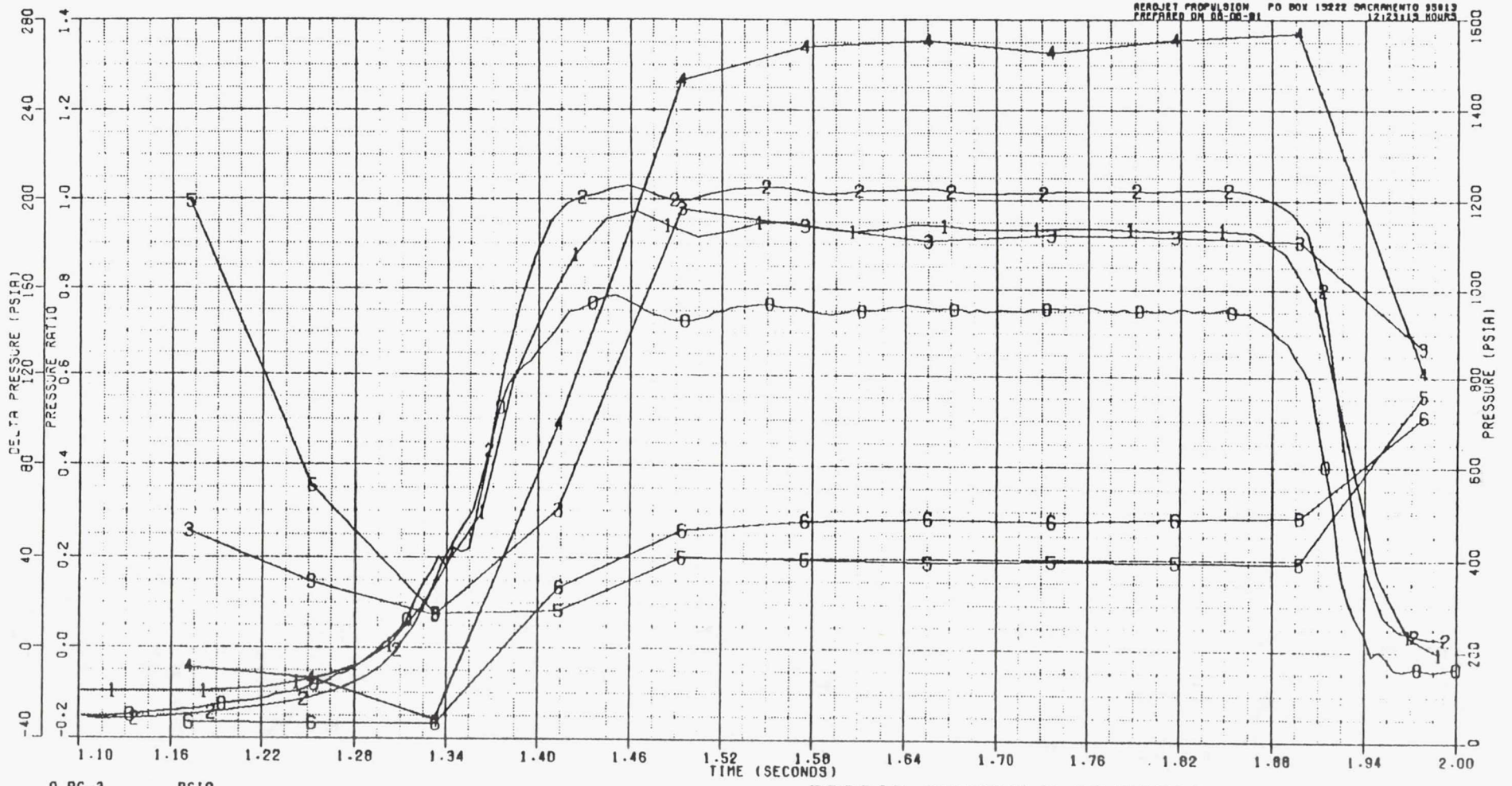
0 PC-3 PSIA
1 POJ PSIA
2 PFJ PSIA
3 DPO PSIA
4 DPF PSIA
5 DPO/PC
6 DPF/PC

GENCORP AEROJET

ROCCID SUBSCALE INJECTOR PERFORMANCE PARAMETERS

TEST DATE 04-09-91 AT 1110 HOURS DURATION 1.387 SECONDS

TEST NUMBER KFN7-D01-1J-014 TEST STAND E-4



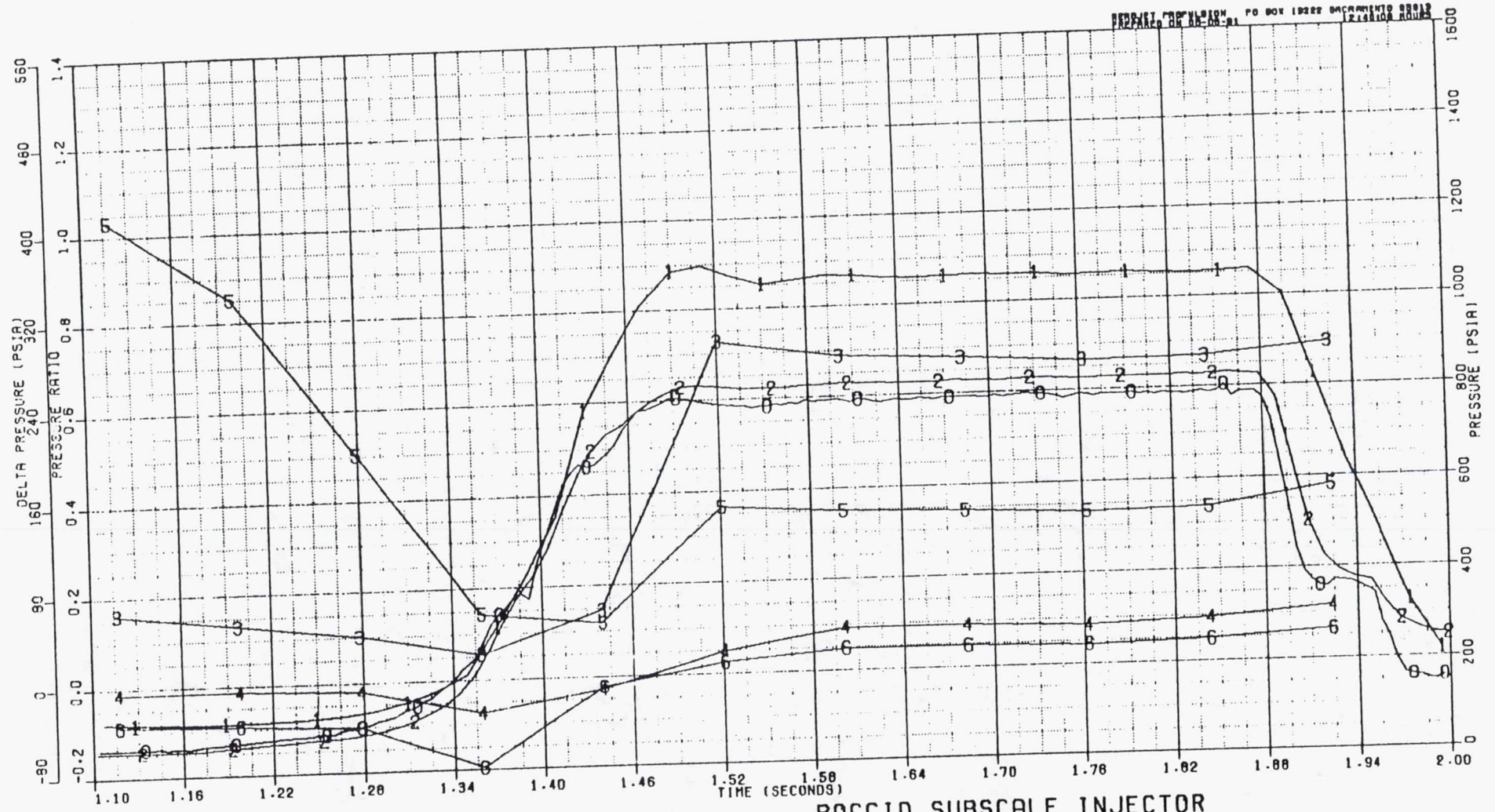
0 PC-3 PSIA
1 POJ PSIA
2 PFJ PSIA
3 DPO PSIA
4 DPF PSIA
5 DPO/PC
6 DPF/PC

GENCORP AEROJET

ROCCID SUBSCALE INJECTOR PERFORMANCE PARAMETERS

TEST DATE 04-09-91 AT 1347 HOURS DURATION 1.823 SECONDS

TEST NUMBER KFN7-D01-1J-015 TEST STAND E-4



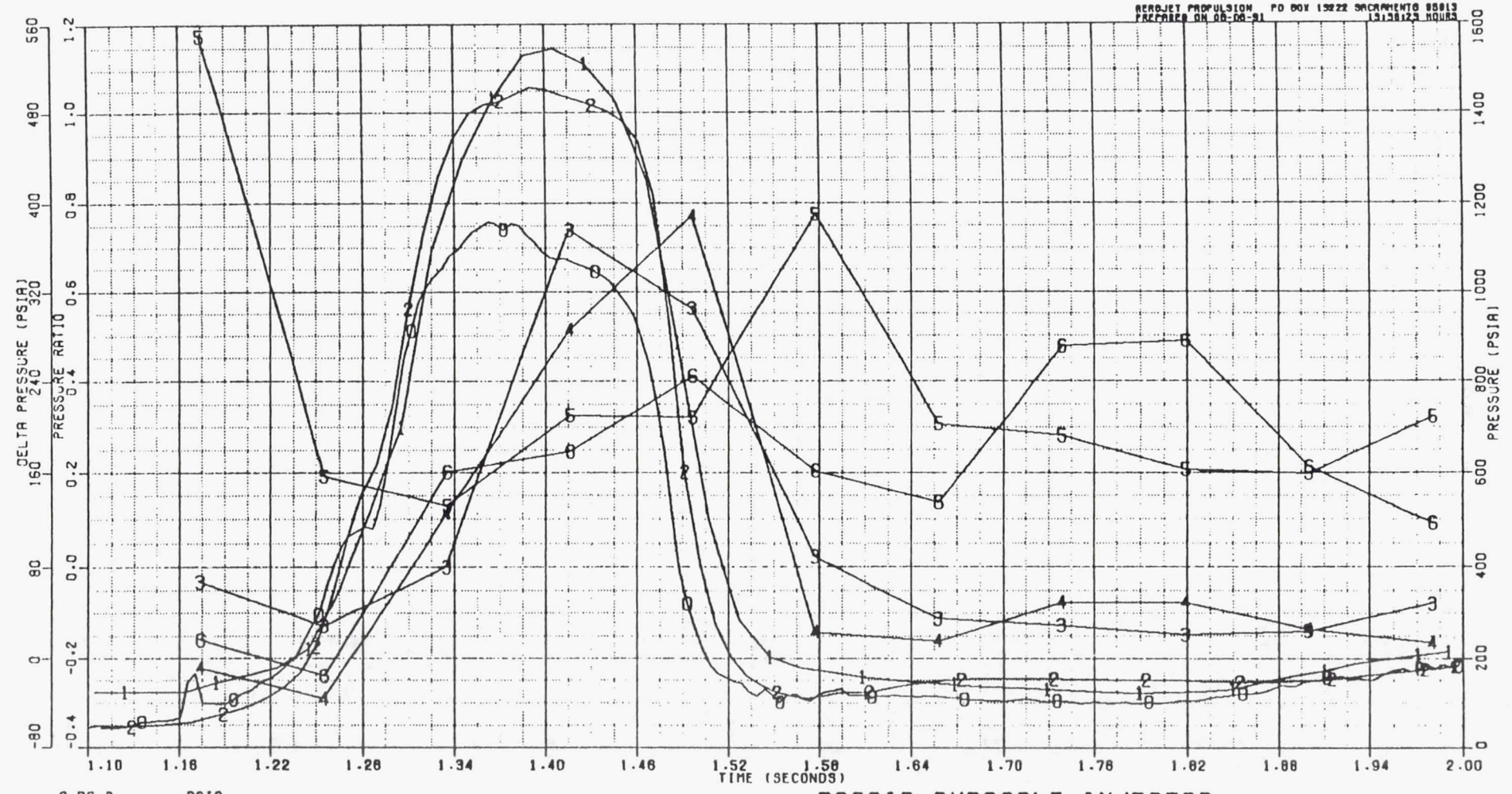
0 PC-3 PSIA
1 POJ PSIA
2 PFJ PSIA
3 OPO PSIA
4 OPF PSIA
5 OPO/PC
6 OPF/PC

GENCORP AEROJET

ROCCID SUBSCALE INJECTOR PERFORMANCE PARAMETERS

TEST DATE 04-09-91 AT 1553 HOURS DURATION 1.836 SECONDS

TEST NUMBER KFN7-D01-1J-017 TEST STAND E-4



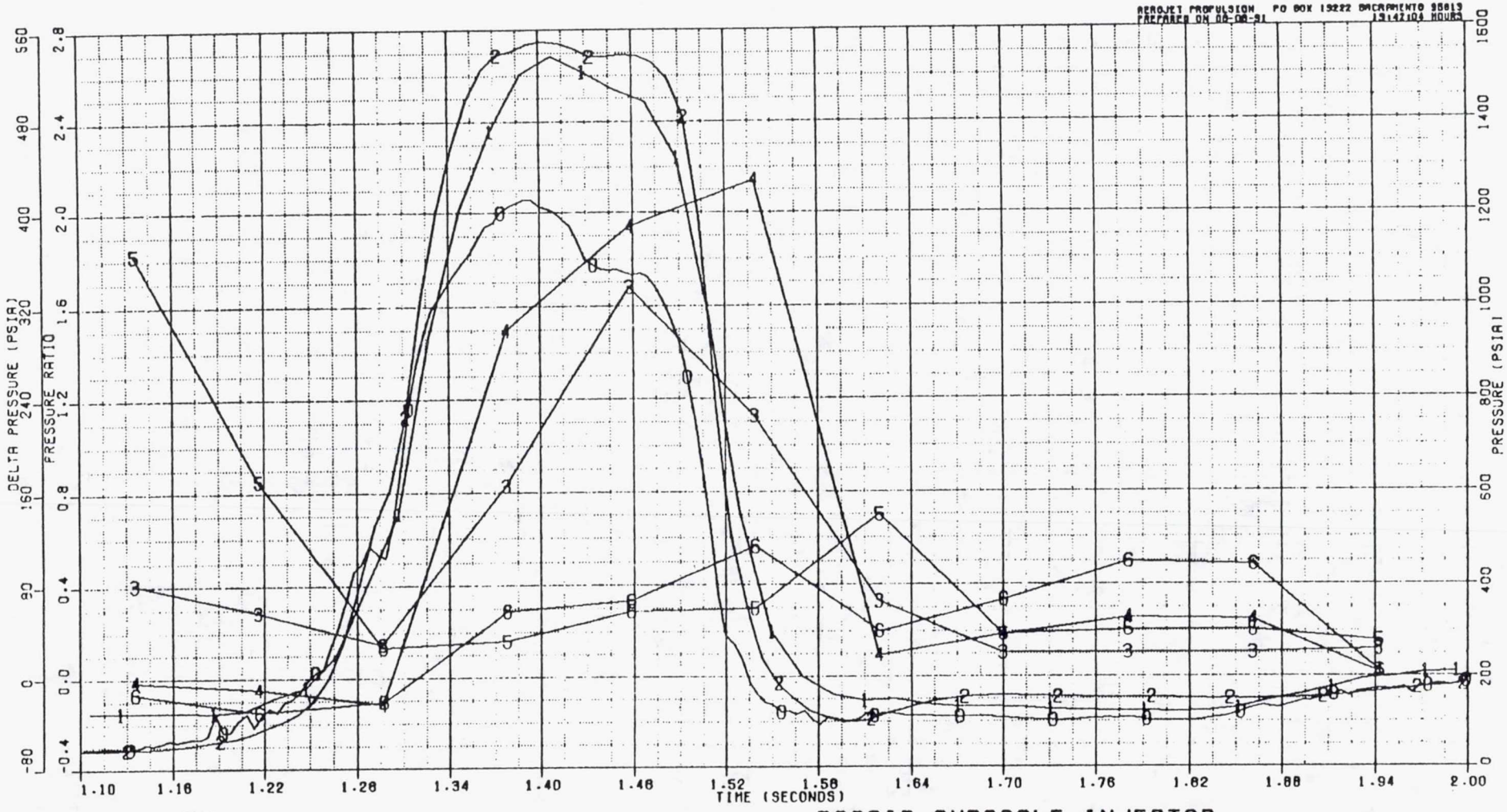
0 PC-3 PSIA
1 POJ PSIA
2 PFJ PSIA
3 DPO PSIA
4 DPF PSIA
5 DPO/PC
6 DPF/PC

GENCORP AEROJET

ROCCID SUBSCALE INJECTOR PERFORMANCE PARAMETERS

TEST DATE 04-10-91 AT 1105 HOURS DURATION 1.383 SECONDS

TEST NUMBER KFN7-001-1J-018 TEST STAND E-4



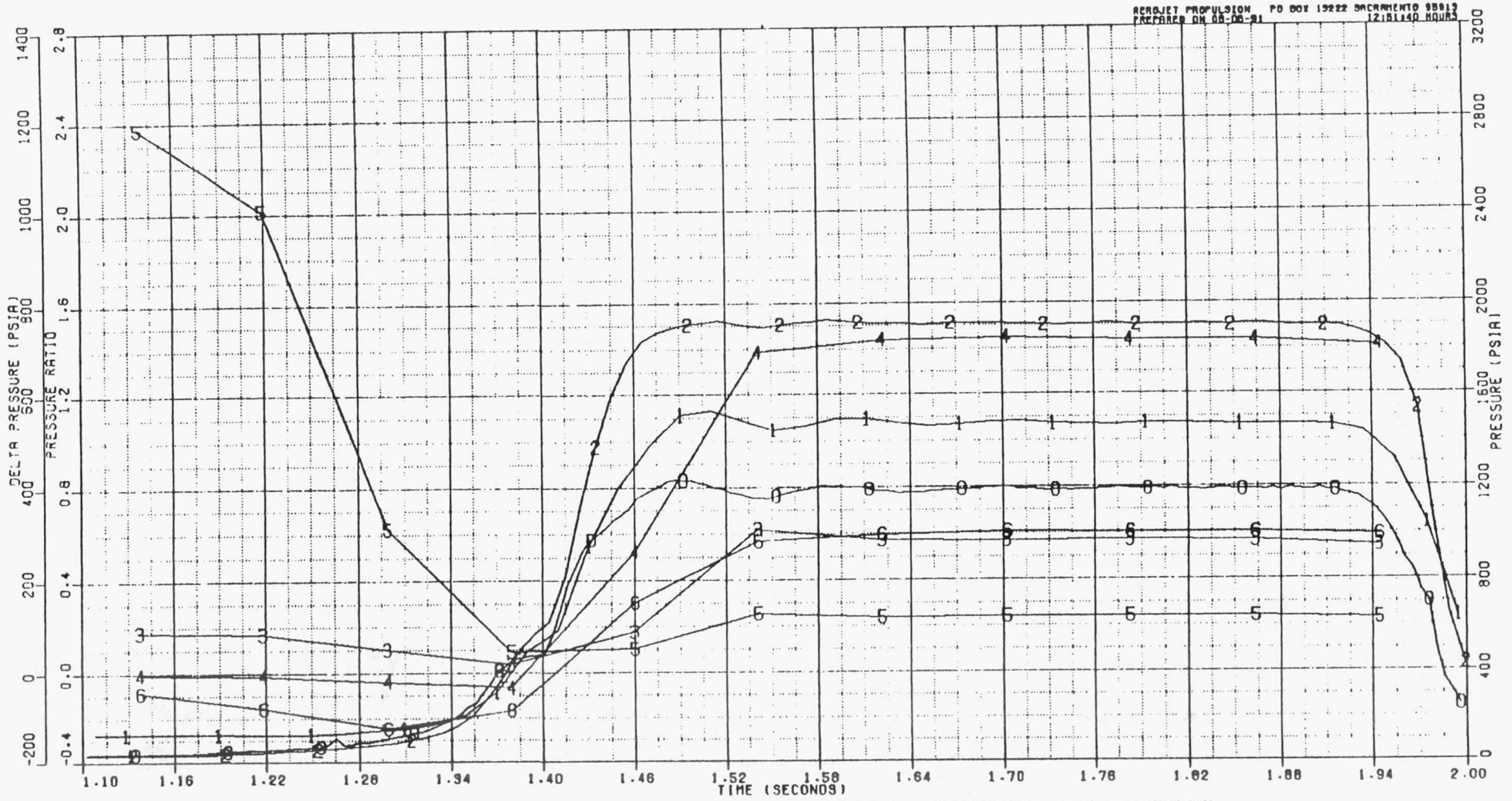
0 PC-3 PSIA
1 POJ PSIA
2 PFJ PSIA
3 DP0 PSIA
4 DPF PSIA
5 DP0/PC
6 DPF/PC

ROCCID SUBSCALE INJECTOR PERFORMANCE PARAMETERS

TEST DATE 04-10-91 AT 1341 HOURS DURATION 1.403 SECONDS

TEST NUMBER KFN7-D01-1J-019 TEST STAND E-4

GENCORP AEROJET



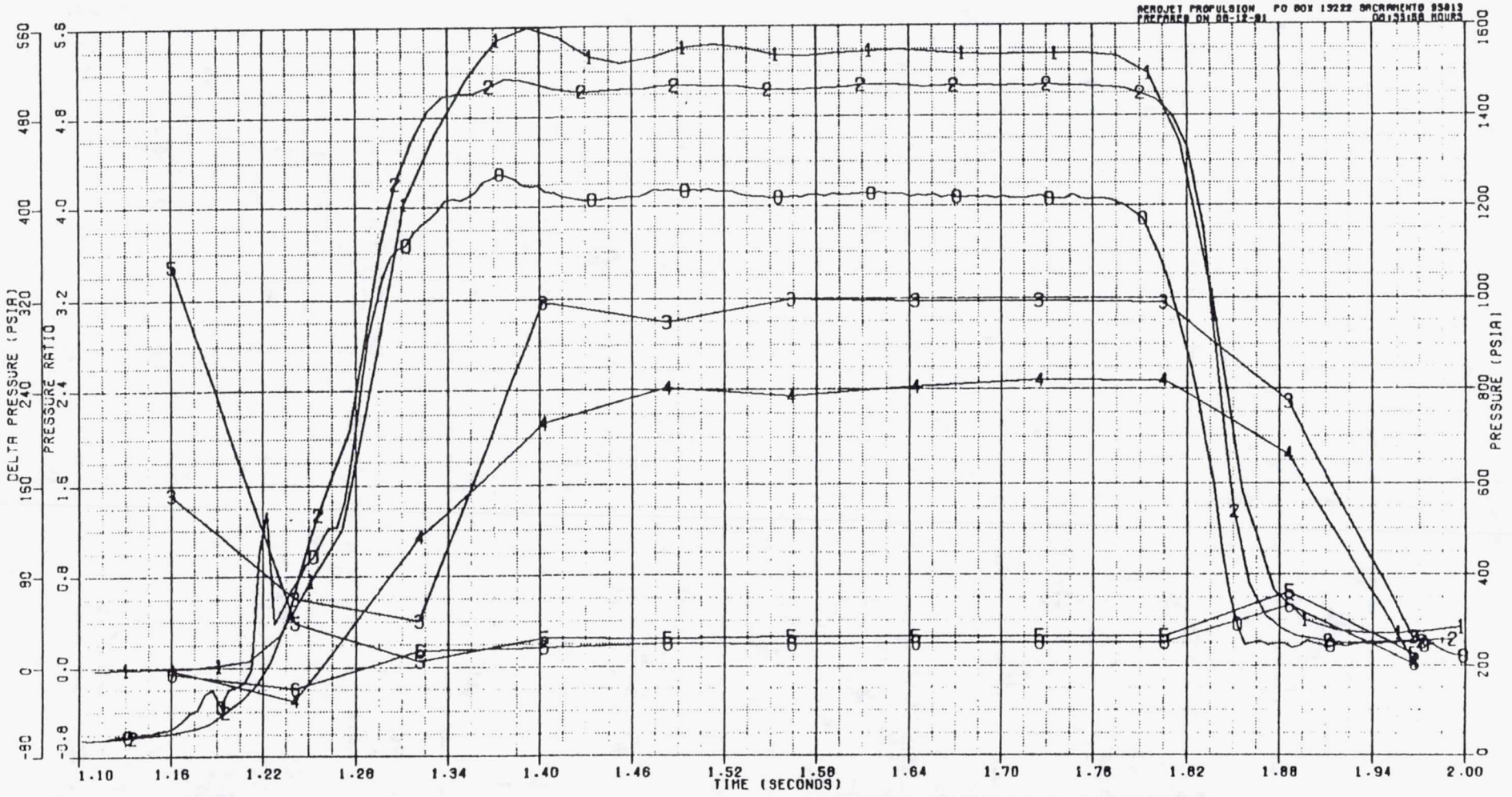
0 PC-3 PSIA
1 POJ PSIA
2 PFJ PSIA
3 DPO PSIA
4 DPF PSIA
5 DPO/PC
6 DPF/PC

GENCORP AEROJET

ROCCID SUBSCALE INJECTOR PERFORMANCE PARAMETERS

TEST DATE 04-10-91 AT 1455 HOURS DURATION 1.865 SECONDS

TEST NUMBER KFN7-001-1J-020 TEST STAND E-4



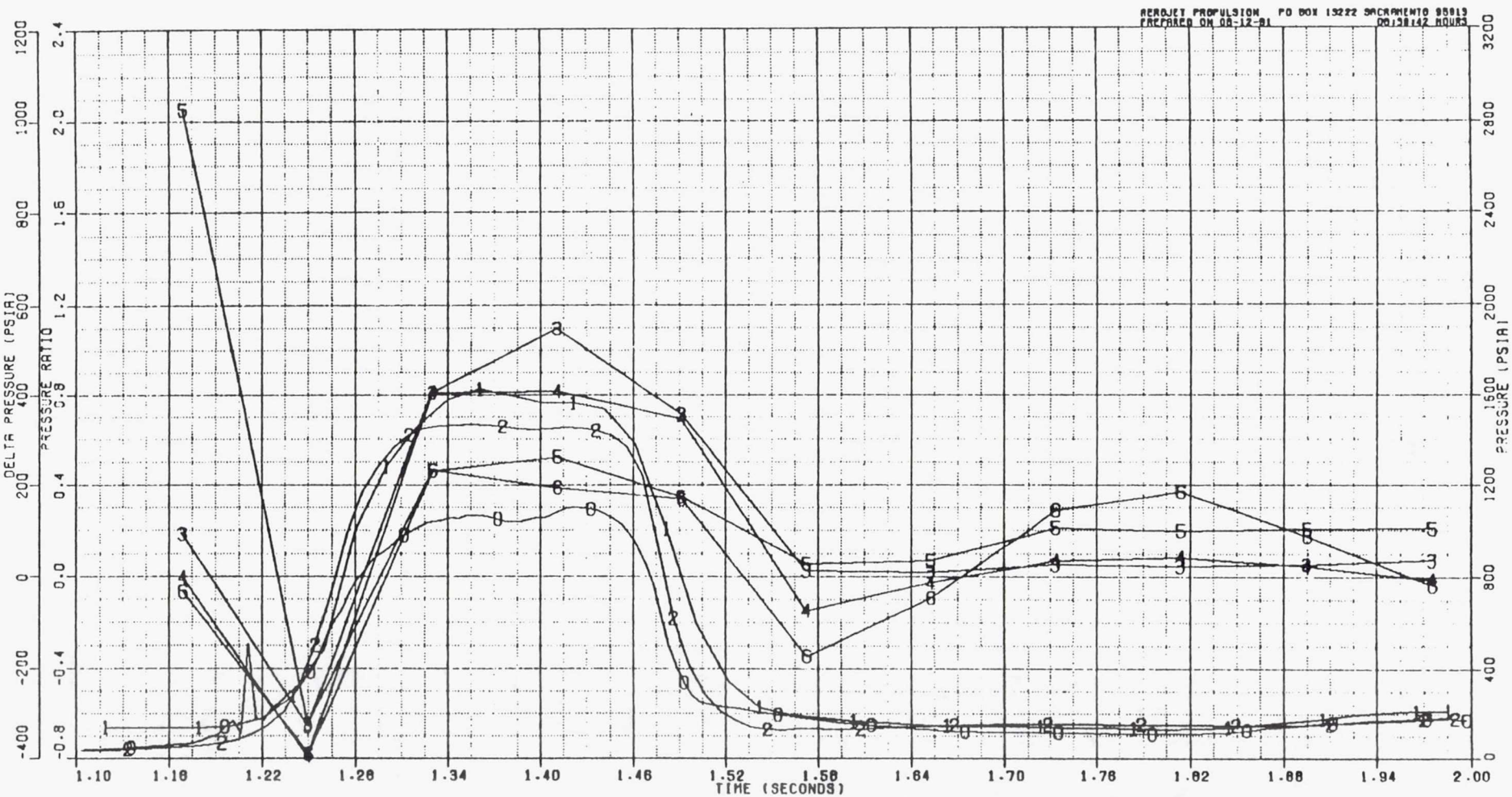
0 PC-3 PSIA
1 POJ PSIA
2 PFJ PSIA
3 OPO PSIA
4 OPF PSIA
5 OPO/PC
6 OPF/PC

GENCORP AEROJET

ROCCID SUBSCALE INJECTOR PERFORMANCE PARAMETERS

TEST DATE 04-15-91 AT 1342 HOURS DURATION 1.744 SECONDS

TEST NUMBER KFN7-D01-1J-021 TEST STAND E-4



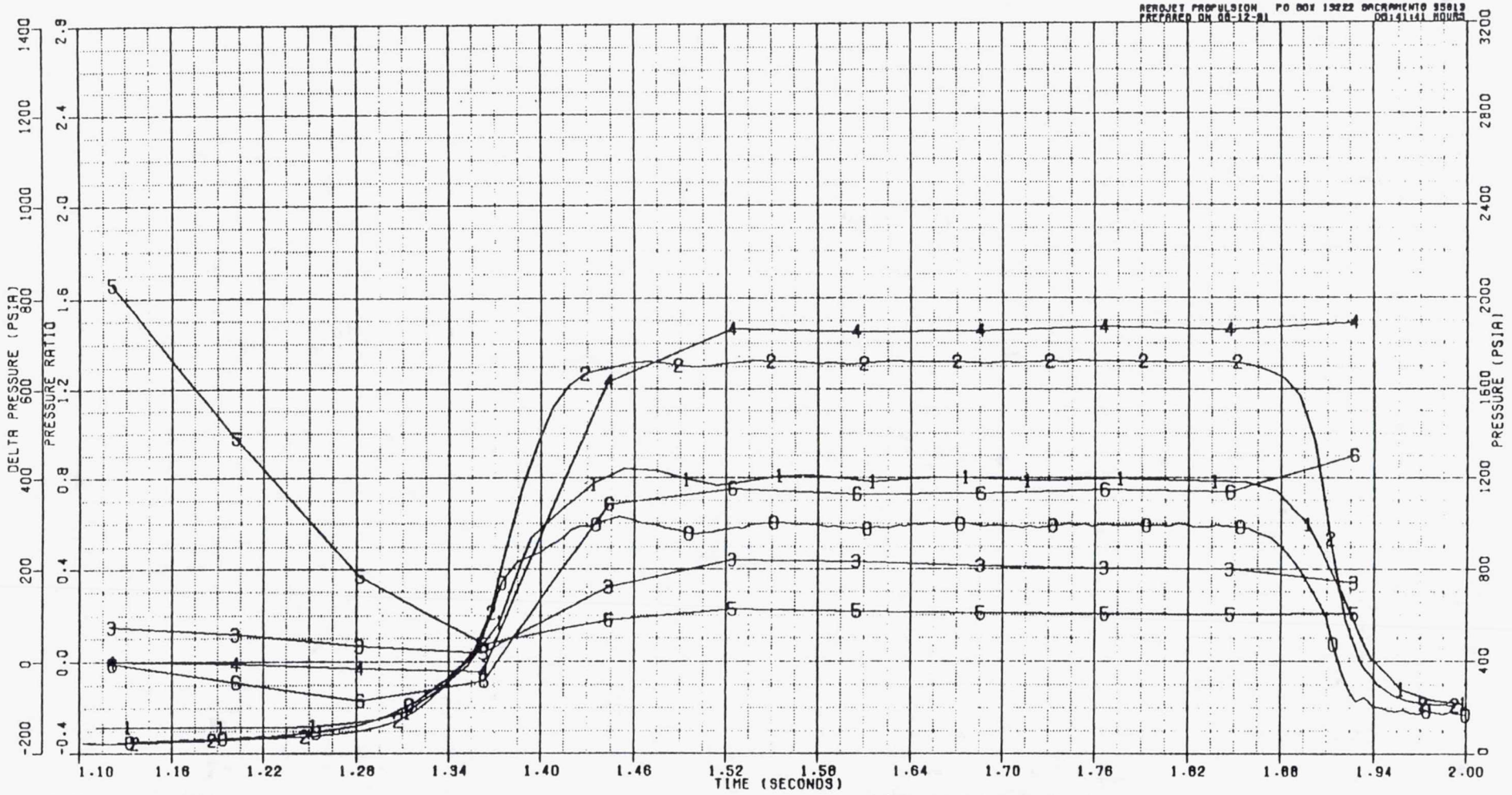
0 PC-3 PSIA
1 POJ PSIA
2 PFJ PSIA
3 OPO PSIA
4 OPF PSIA
5 OPO/PC
6 OPF/PC

ROCCID SUBSCALE INJECTOR PERFORMANCE PARAMETERS

TEST DATE 04-15-91 AT 1439 HOURS DURATION 1.366 SECONDS

TEST NUMBER KFN7-D01-1J-022 TEST STAND E-4

GENCORP AEROJET

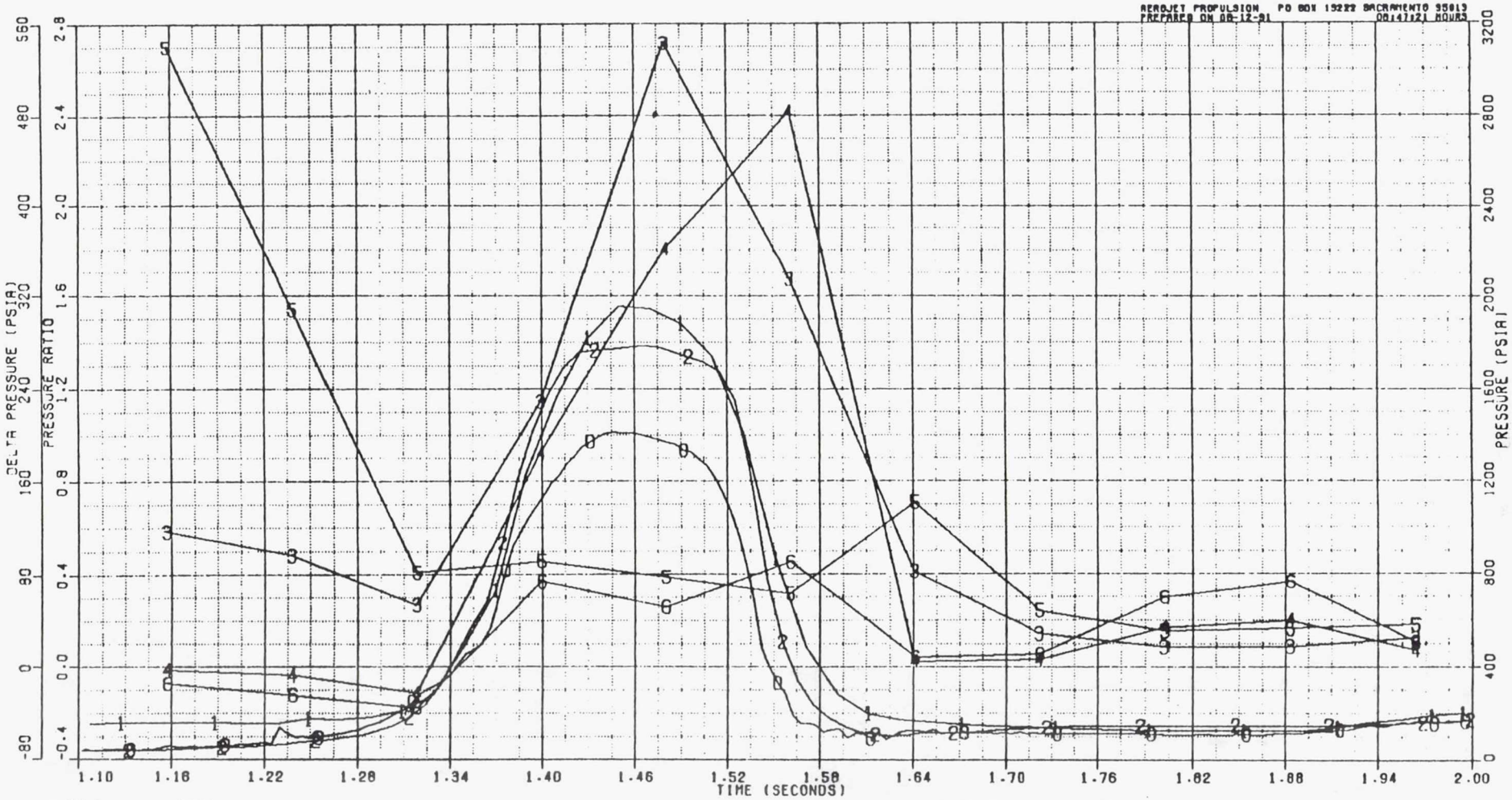


GENCORP AEROJET

ROCCID SUBSCALE INJECTOR PERFORMANCE PARAMETERS

TEST DATE 04-17-91 AT 1000 HOURS DURATION 1.825 SECONDS

TEST NUMBER KFN7-D01-1J-023 TEST STAND E-4



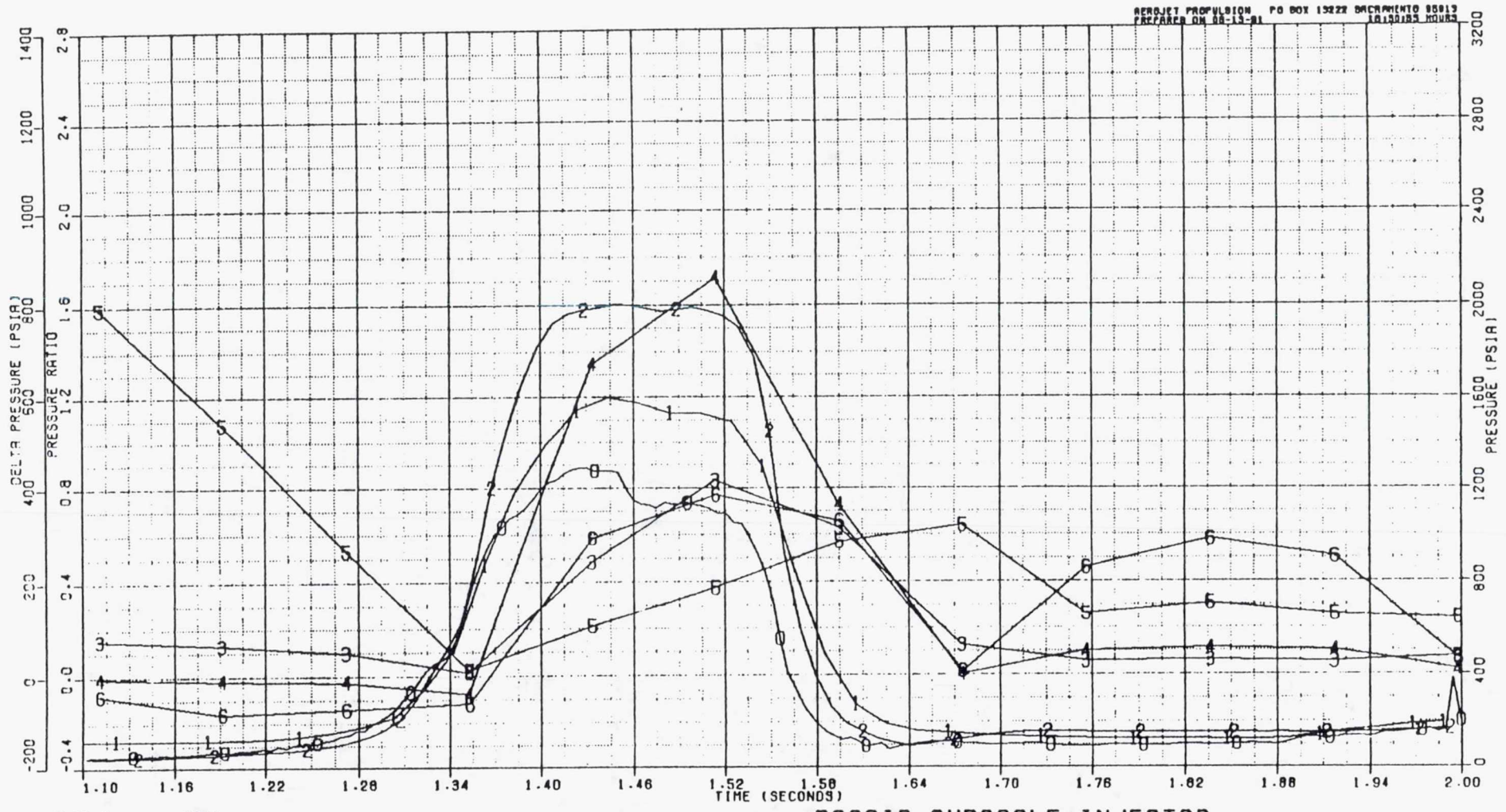
0 PC-3 PSIA
1 POJ PSIA
2 PFJ PSIA
3 OPO PSIA
4 OPF PSIA
5 OPO/PC
6 OPF/PC

GENCORP AEROJET

ROCCID SUBSCALE INJECTOR PERFORMANCE PARAMETERS

TEST DATE 04-17-91 AT 1330 HOURS DURATION 1.425 SECONDS

TEST NUMBER KFN7-D01-1J-025 TEST STAND E-4



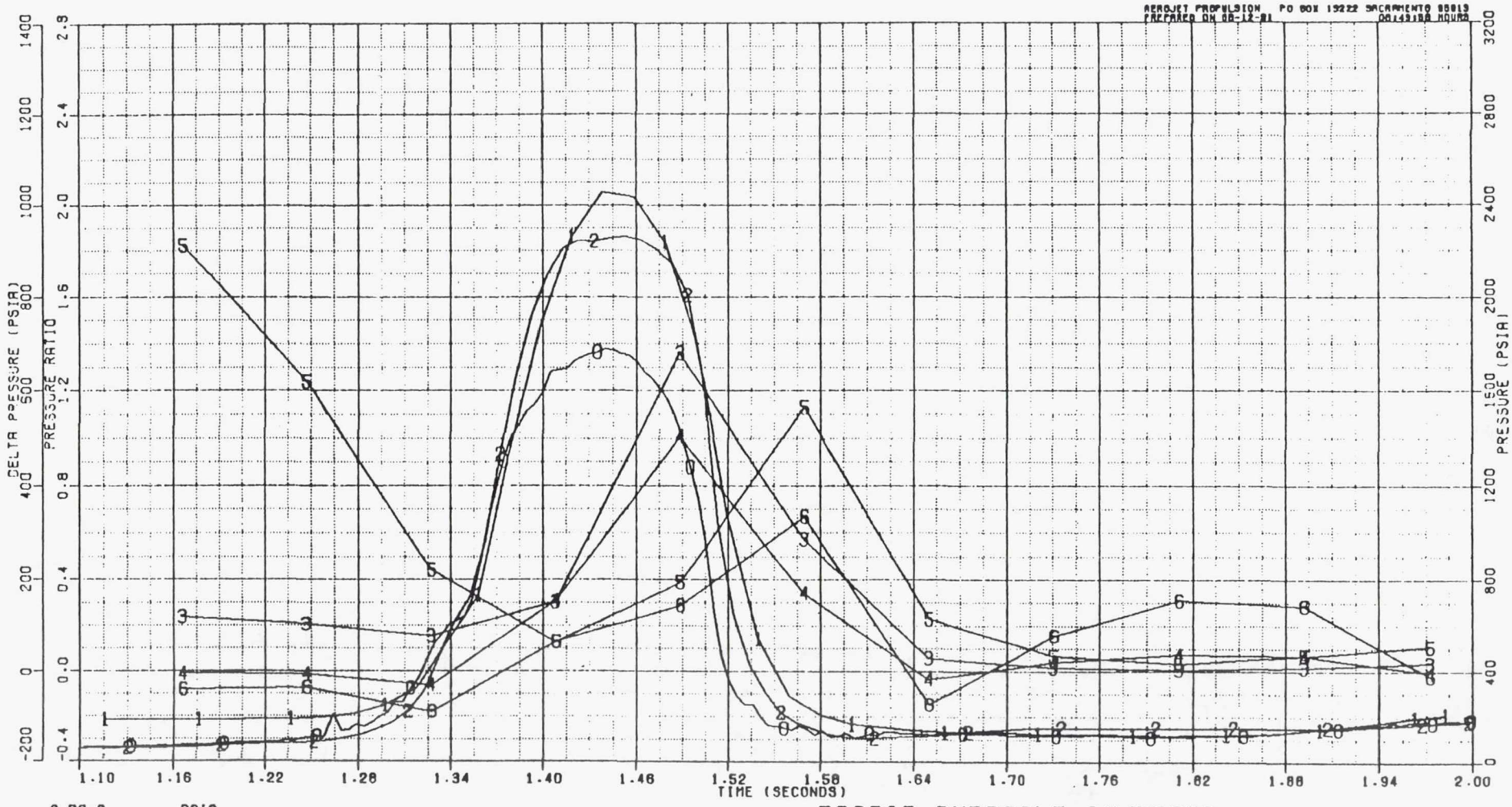
0 PC-3 PSIA
1 POJ PSIA
2 PFJ PSIA
3 OPO PSIA
4 OPF PSIA
5 OPO/PC
6 OPF/PC

GENCORP
AEROJET

ROCCID SUBSCALE INJECTOR PERFORMANCE PARAMETERS

TEST DATE 04-22-91 AT 1315 HOURS DURATION 1.464 SECONDS

TEST NUMBER KFN7-D01-1J-026 TEST STAND E-4



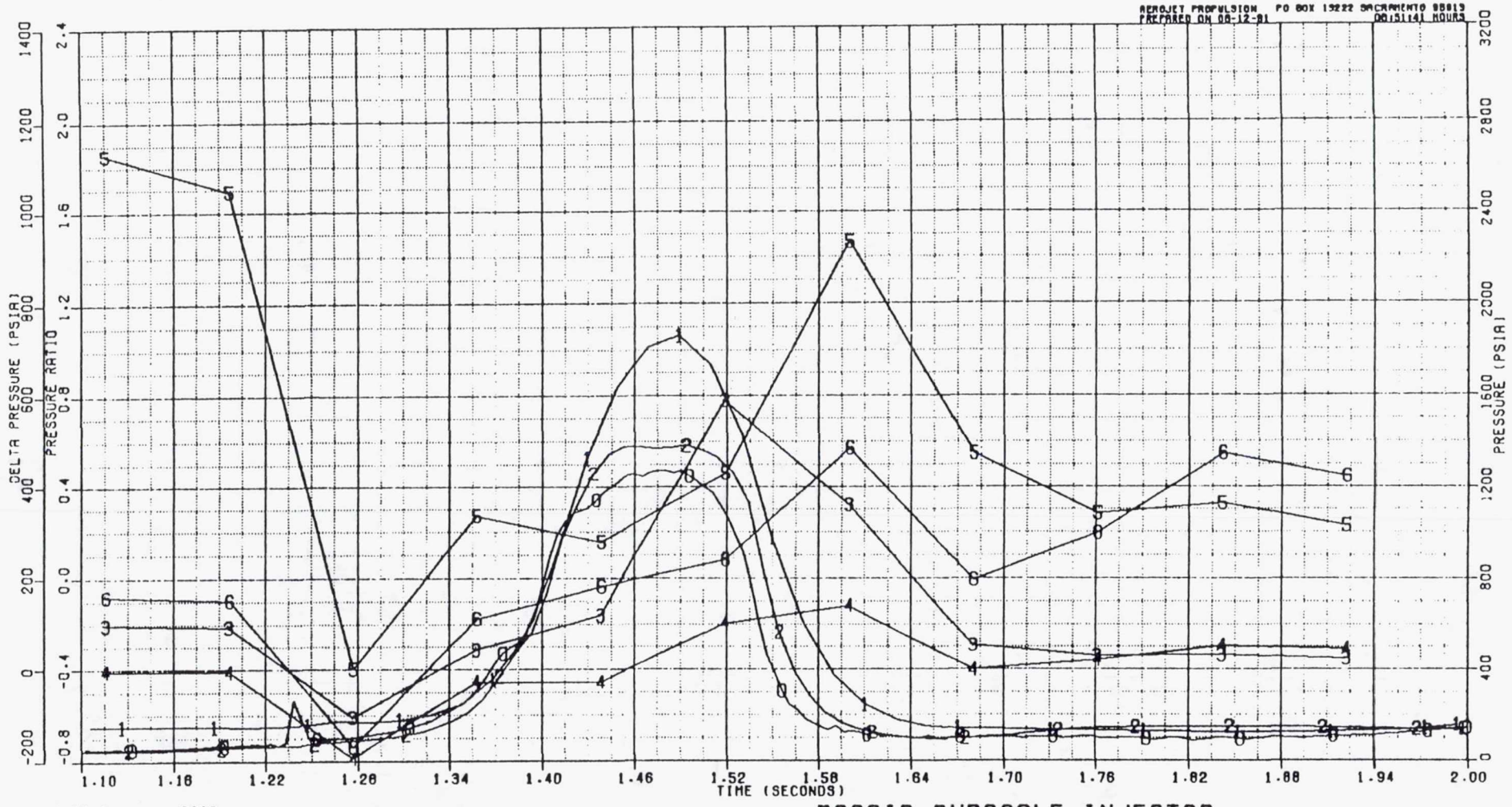
0 PC-3 PSIA
1 POJ PSIA
2 PFJ PSIA
3 DPO PSIA
4 DPF PSIA
5 DPO/PC
6 DPF/PC

GENCORP AEROJET

ROCCID SUBSCALE INJECTOR PERFORMANCE PARAMETERS

TEST DATE 04-23-91 AT 1056 HOURS DURATION 1.410 SECONDS

TEST NUMBER KFN7-D01-1J-027 TEST STAND E-4



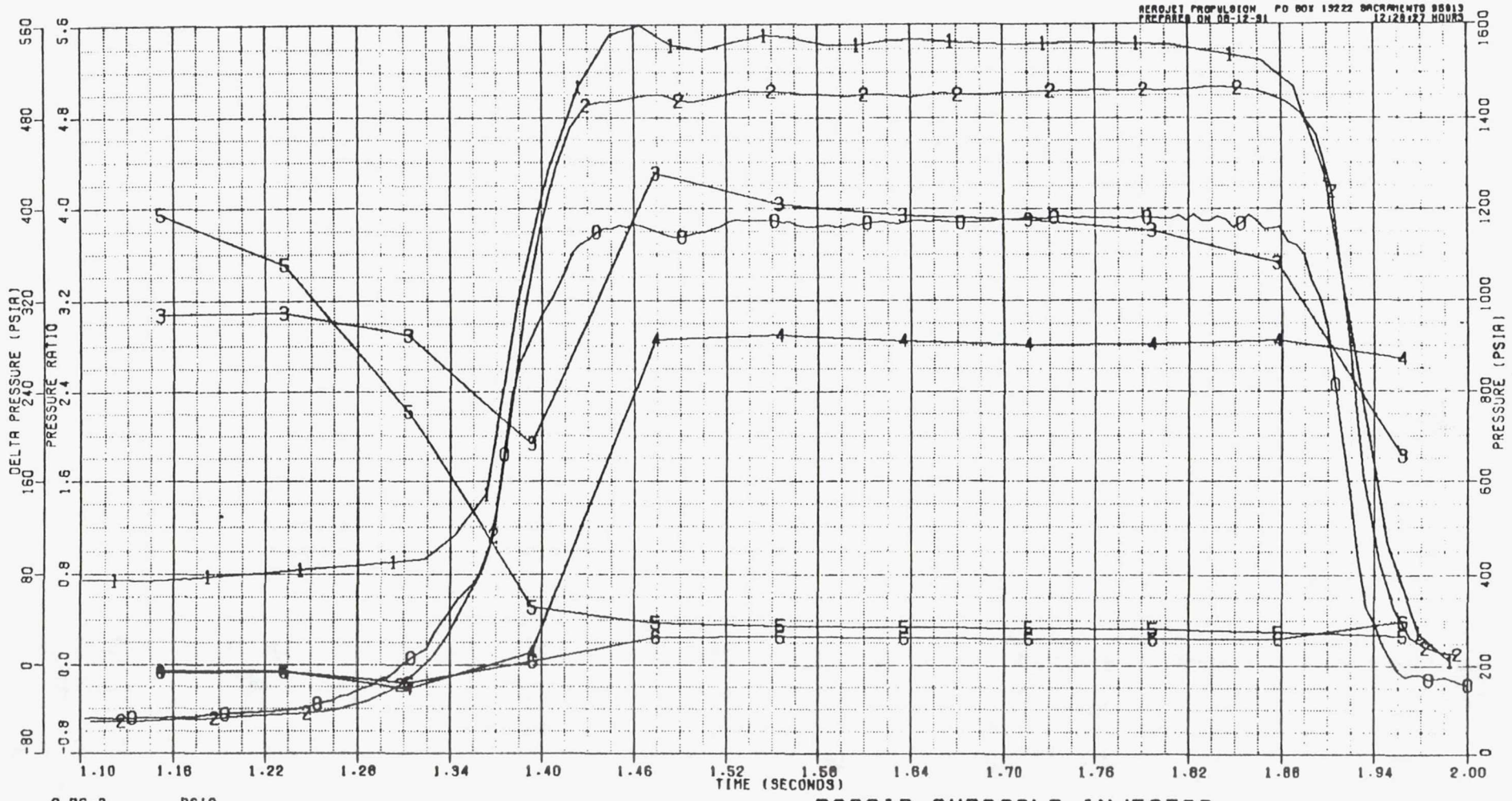
0 PC-3 PSIA
1 POJ PSIA
2 PFJ PSIA
3 OPO PSIA
4 OPF PSIA
5 OPO/PC
6 OPF/PC

GENCORP
AEROJET

ROCCID SUBSCALE INJECTOR PERFORMANCE PARAMETERS

TEST DATE 04-23-91 AT 1305 HOURS DURATION 1.436 SECONDS

TEST NUMBER KFN7-001-1J-028 TEST STAND E-4



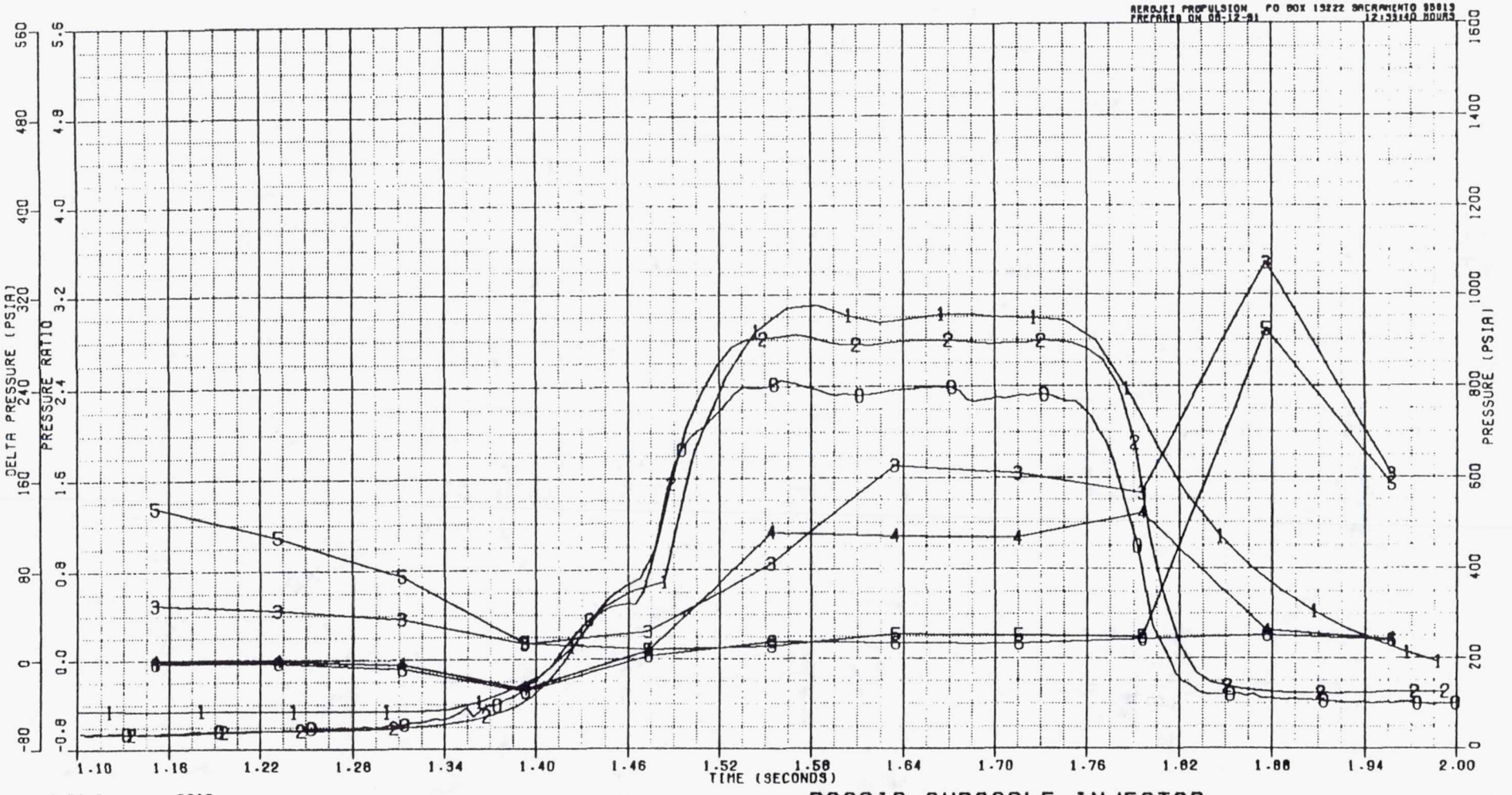
0 PC-3 PSIA
1 POJ PSIA
2 PFJ PSIA
3 OPO PSIA
4 OPF PSIA
5 OPO/PC
6 OPF/PC

ROCCID SUBSCALE INJECTOR PERFORMANCE PARAMETERS

TEST DATE 04-30-91 AT 1300 HOURS DURATION 1.835 SECONDS

TEST NUMBER KFN7-D01-1J-029 TEST STAND E-4

GENCORP AEROJET

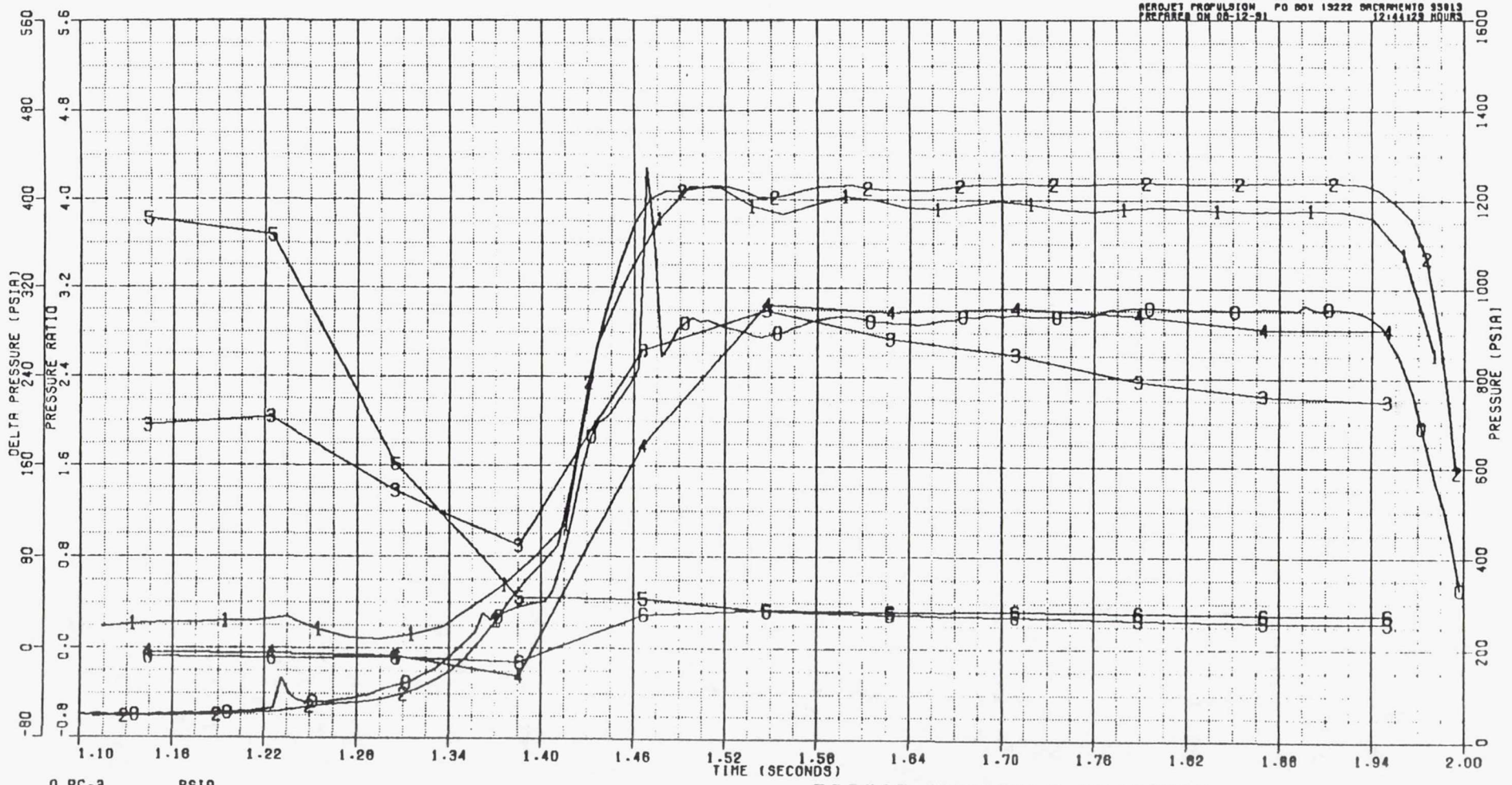


ROCCID SUBSCALE INJECTOR
PERFORMANCE PARAMETERS

TEST DATE 04-30-91 AT 1441 HOURS DURATION 1.693 SECONDS

TEST NUMBER KFN7-D01-1J-030 TEST STAND E-4

GENCORP
AEROJET



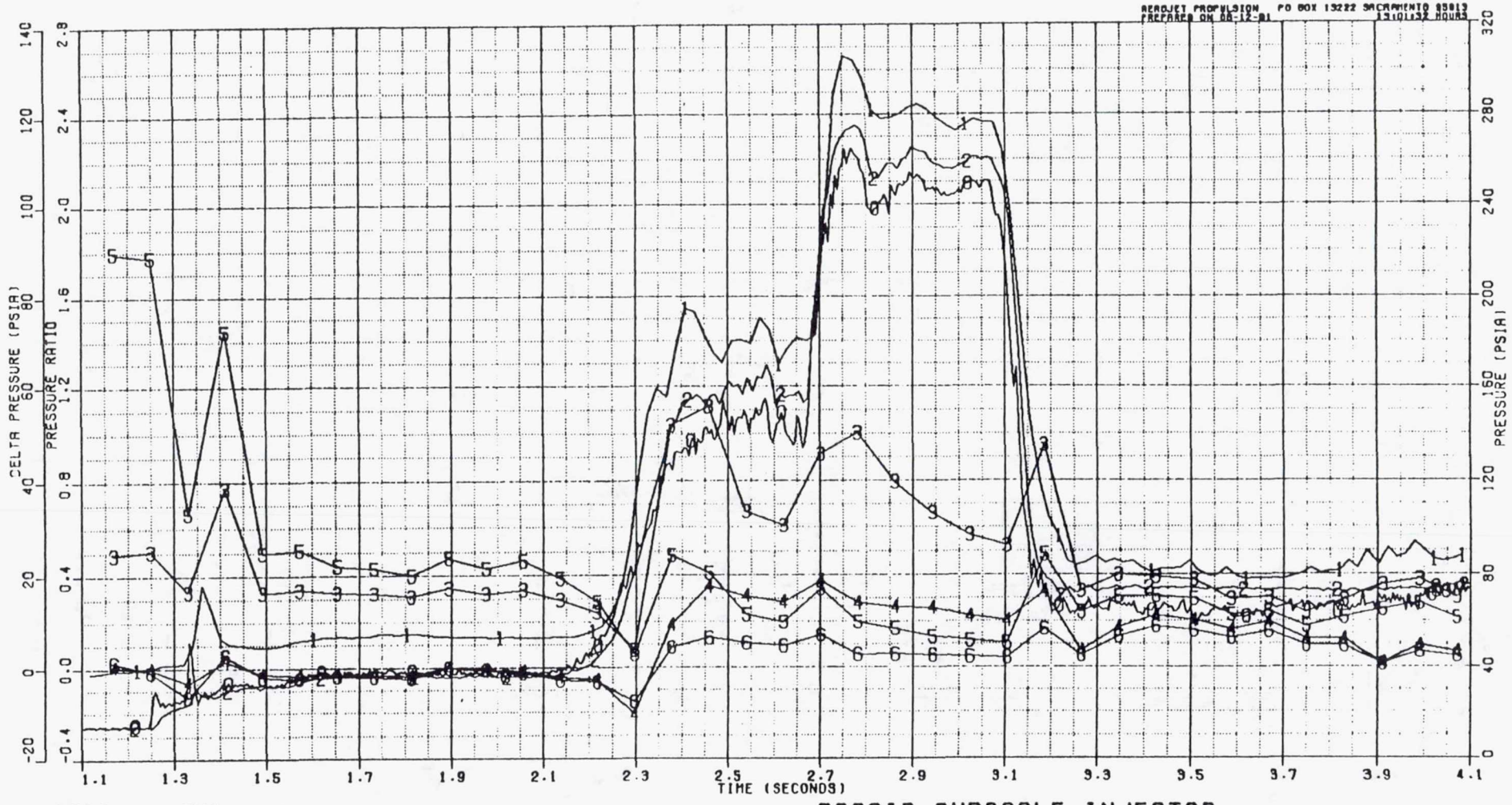
0 PC-3 PSIA
1 POJ PSIA
2 PFJ PSIA
3 OPO PSIA
4 OPF PSIA
5 OPO/PC
6 OPF/PC

GENCORP AEROJET

ROCCID SUBSCALE INJECTOR PERFORMANCE PARAMETERS

TEST DATE 05-01-91 AT 1102 HOURS DURATION 1.904 SECONDS

TEST NUMBER KFN7-001-1J-031 TEST STAND E-4

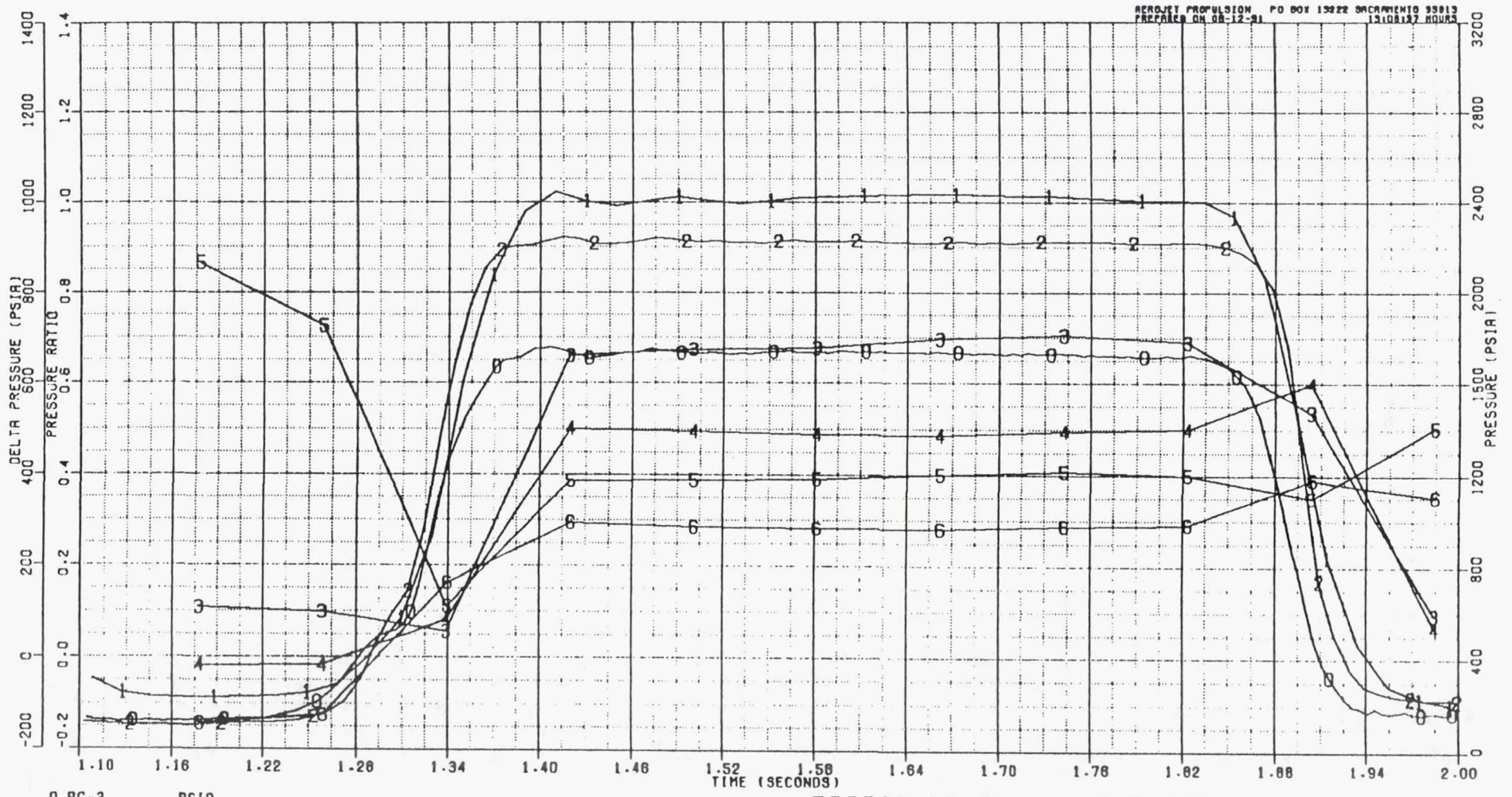


ROCCID SUBSCALE INJECTOR
PERFORMANCE PARAMETERS

TEST DATE 05-01-91 AT 1618 HOURS DURATION 3.016 SECONDS

TEST NUMBER KFN7-D01-1J-036 TEST STAND E-4

GENCORP
AEROJET



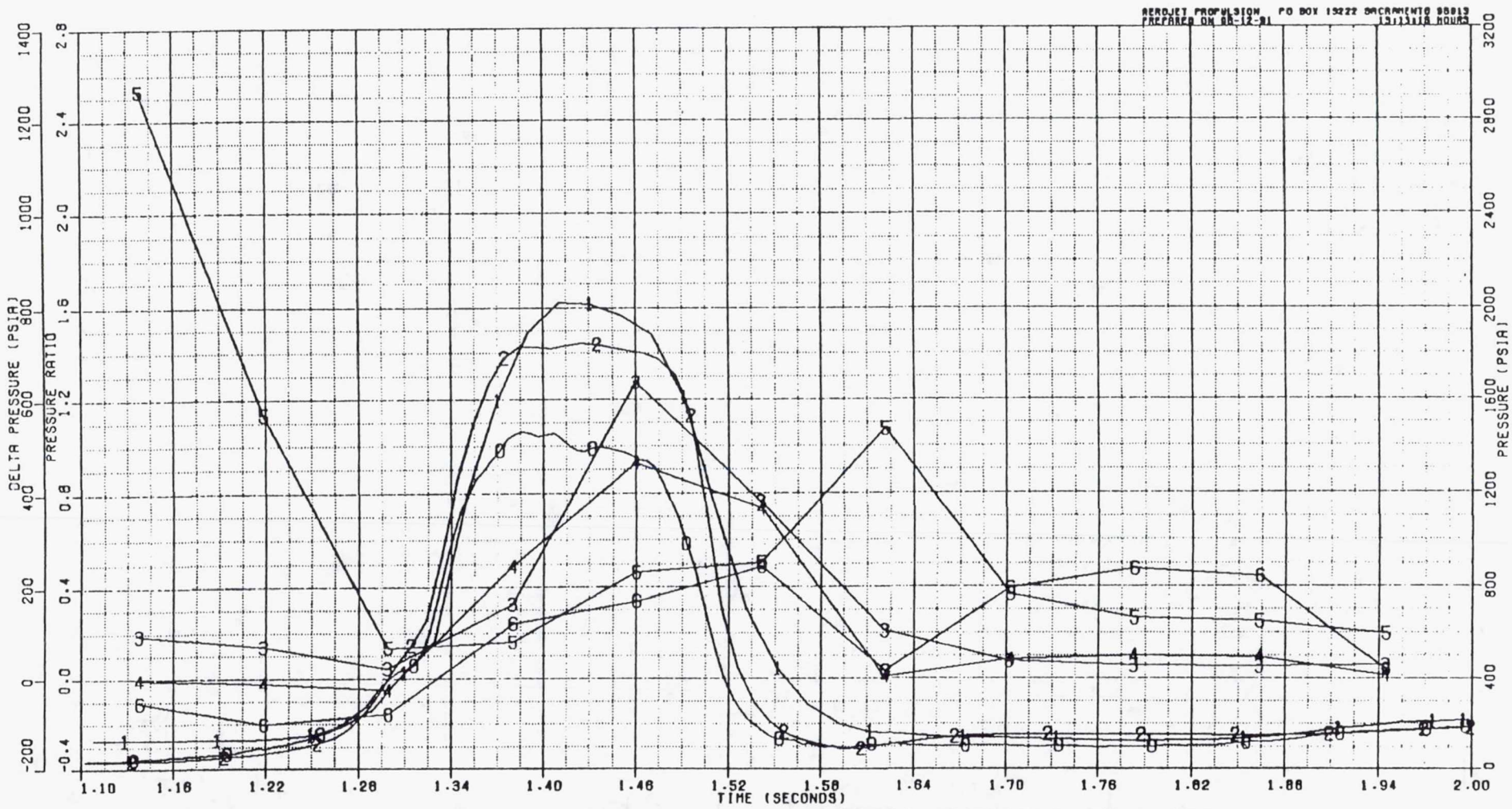
0 PC-3 PSIA
1 POJ PSIA
2 PFJ PSIA
3 DPO PSIA
4 DPF PSIA
5 DPO/PC
6 DPF/PC

GENCORP AEROJET

ROCCID SUBSCALE INJECTOR PERFORMANCE PARAMETERS

TEST DATE 05-02-91 AT 1336 HOURS DURATION 1.805 SECONDS

TEST NUMBER KFN7-D01-1J-037 TEST STAND E-4



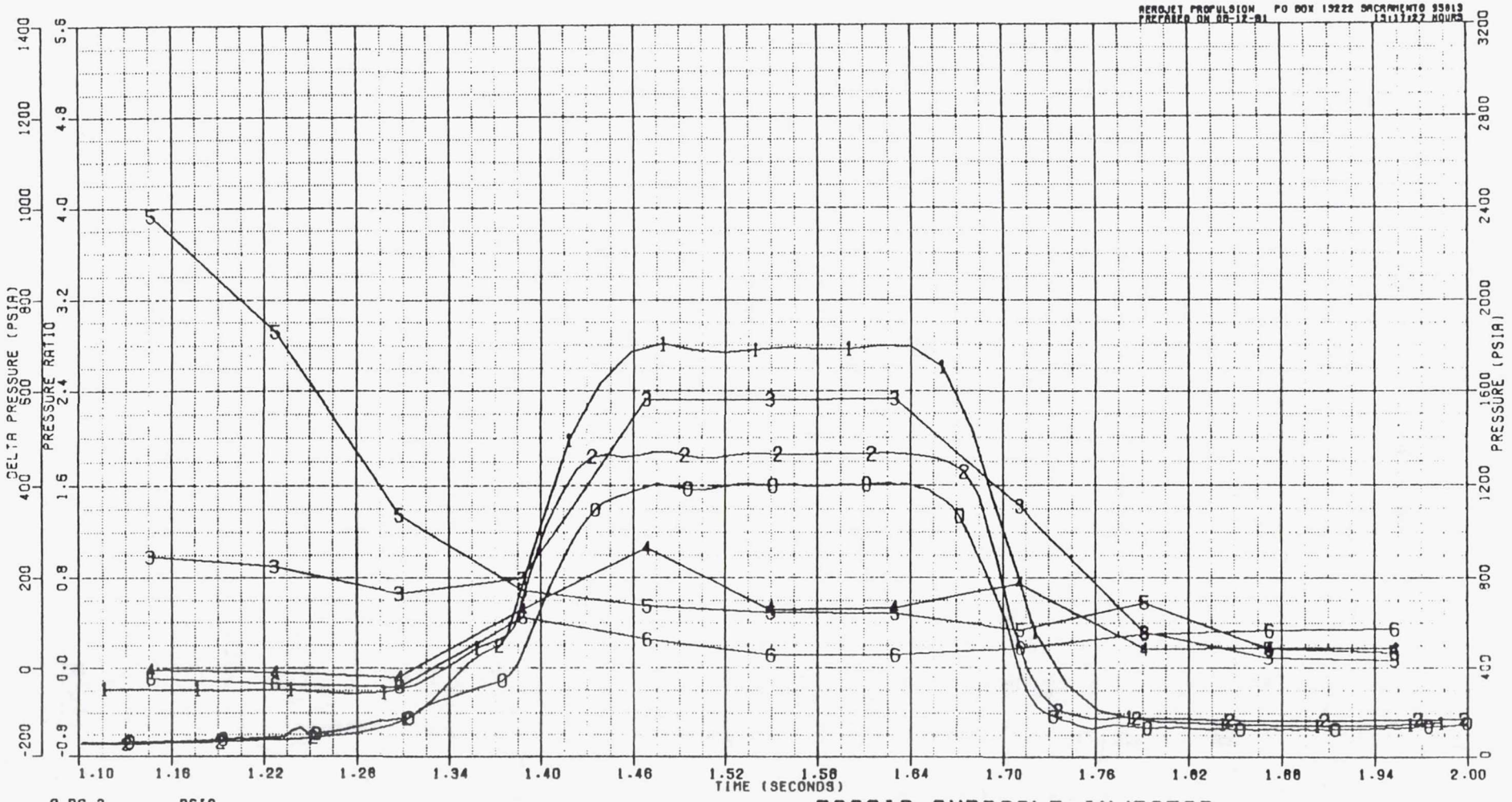
0 PC-3 PSIA
1 POJ PSIA
2 PFJ PSIA
3 DPO PSIA
4 DPF PSIA
5 DPO/PC
6 DPF/PC

GENCORP AEROJET

ROCCID SUBSCALE INJECTOR PERFORMANCE PARAMETERS

TEST DATE 05-02-91 AT 1452 HOURS DURATION 1.402 SECONDS

TEST NUMBER KFN7-D01-1J-038 TEST STAND E-4



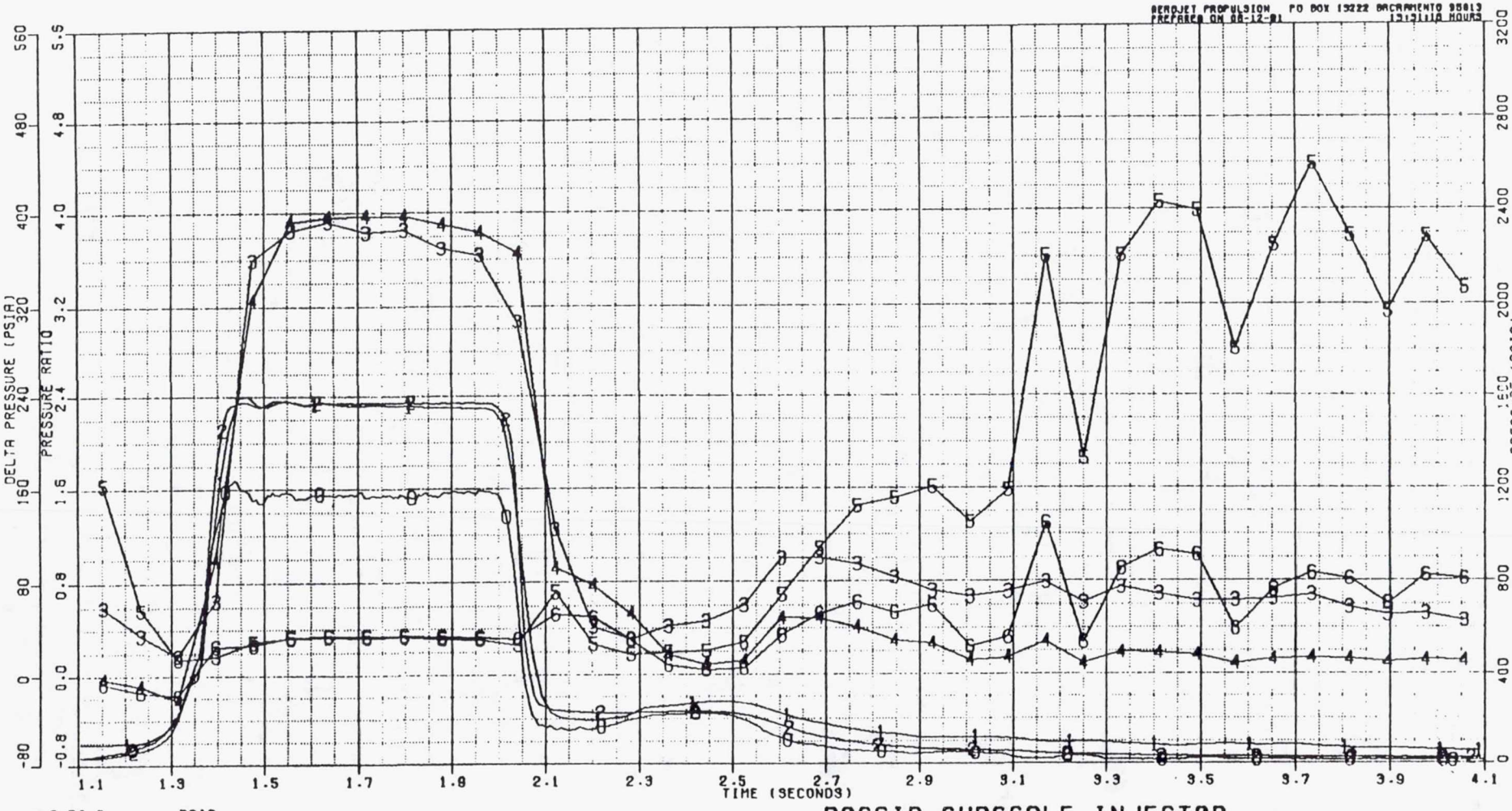
0 PC-3 PSIA
1 POJ PSIA
2 PFJ PSIA
3 DPO PSIA
4 DPF PSIA
5 DPO/PC
6 DPF/PC

ROCCID SUBSCALE INJECTOR PERFORMANCE PARAMETERS

TEST DATE 05-03-91 AT 1120 HOURS DURATION 1.594 SECONDS

TEST NUMBER KFN7-D01-1J-039 TEST STAND E-4

GENCORP AEROJET



ROCCID SUBSCALE INJECTOR
PERFORMANCE PARAMETERS

TEST DATE 05-03-91 AT 1314 HOURS DURATION 1.943 SECONDS

TEST NUMBER KFN7-001-1J-040 TEST STAND E-4

GENCORP
AEROJET

APPENDIX B

TIME SERIES, AMPLITUDE AND FREQUENCY EVOLUTION, AND POWER SPECTRAL ANALYSIS OF CHAMBER PRESSURE FOR ALL UNSTABLE-COMBUSTION TESTS

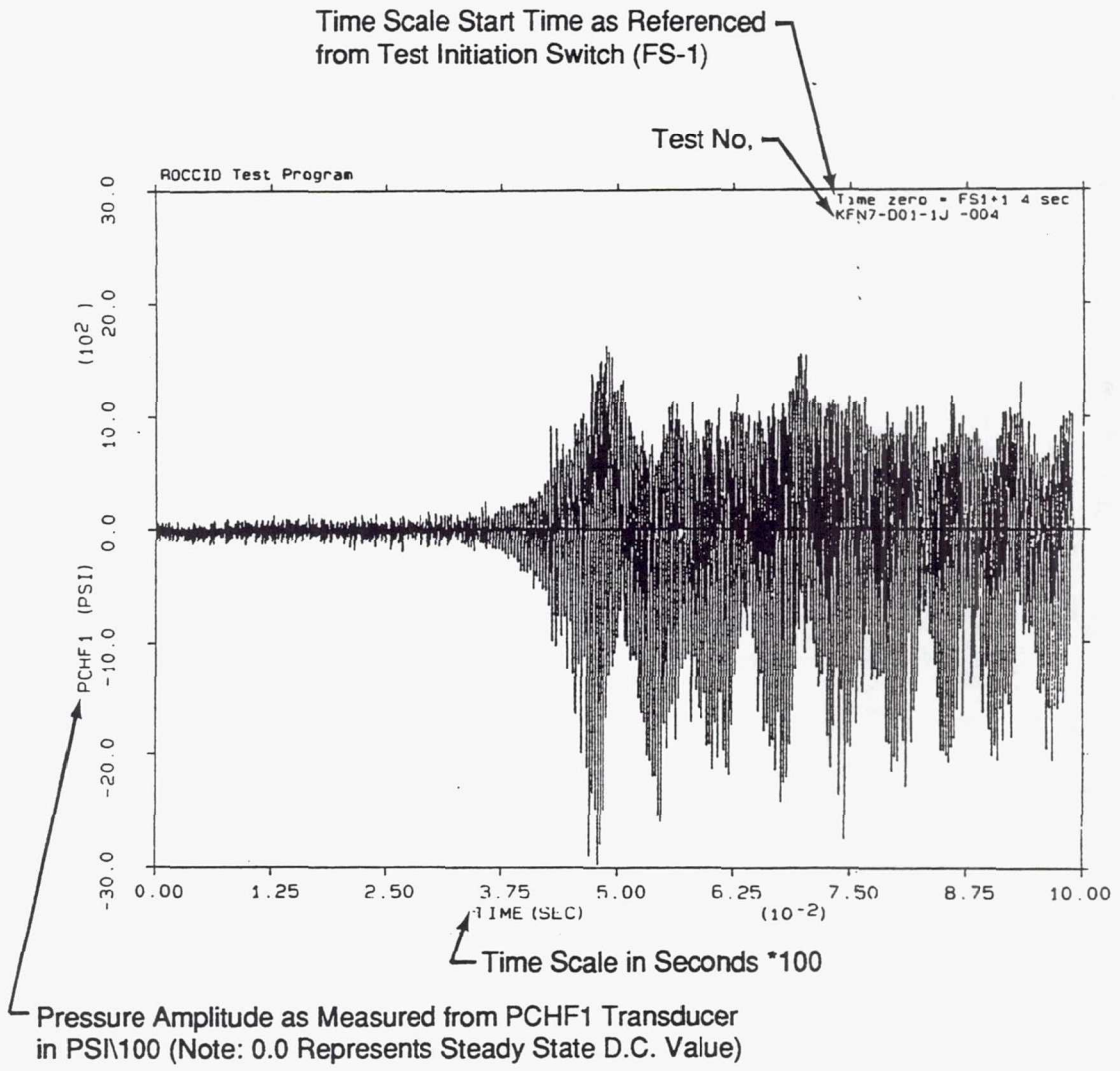
INDEX OF TEST DATA PLOTS

Note: See Foreword (next page) for explanation of information contained in the 3 plot set for each test.

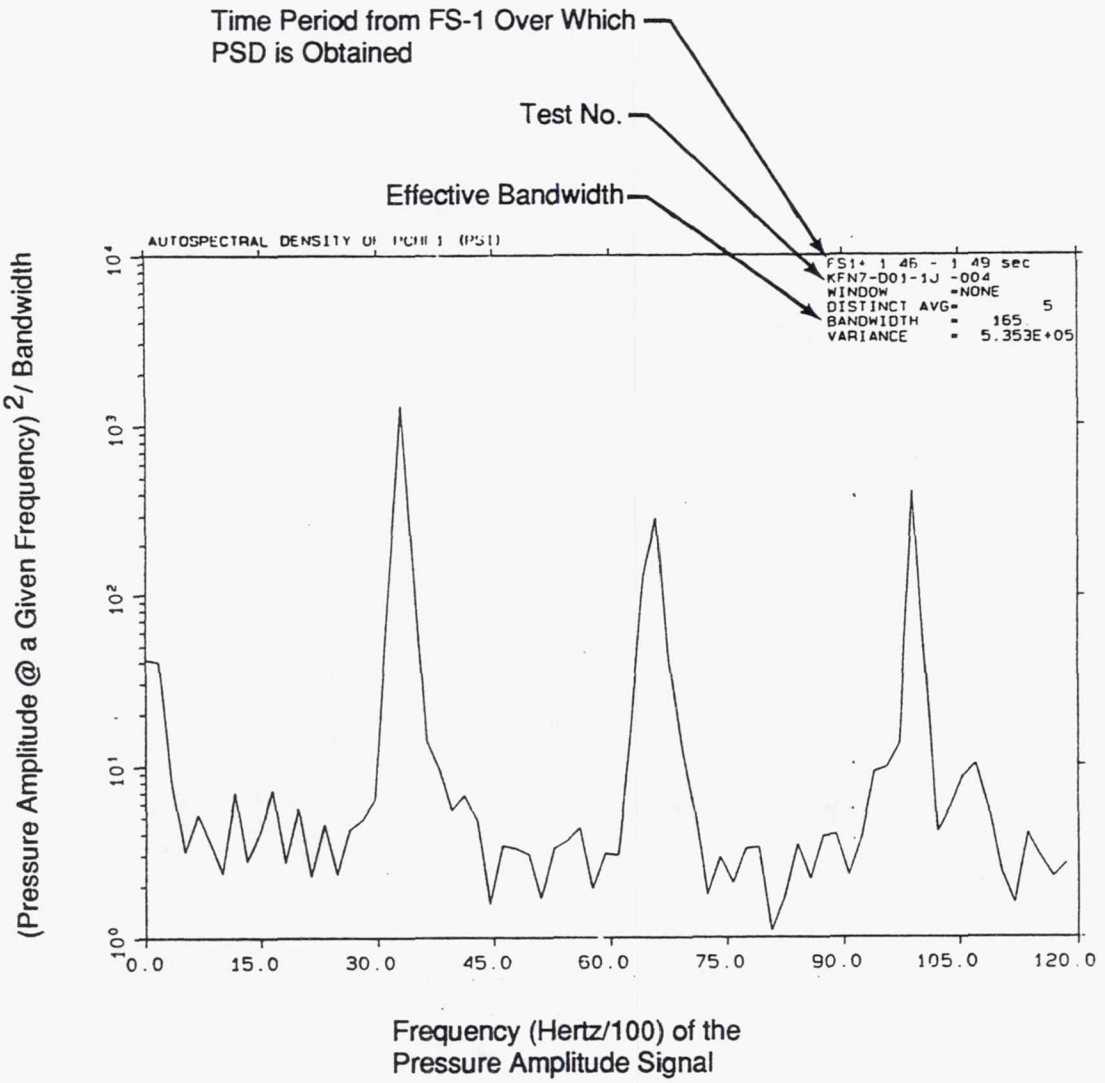
FOREWORD

Unstable operation was observed during 16 of the 27 valid tests conducted during the ROCCID validation test program. For each of these unstable tests, the following information is contained in this appendix:

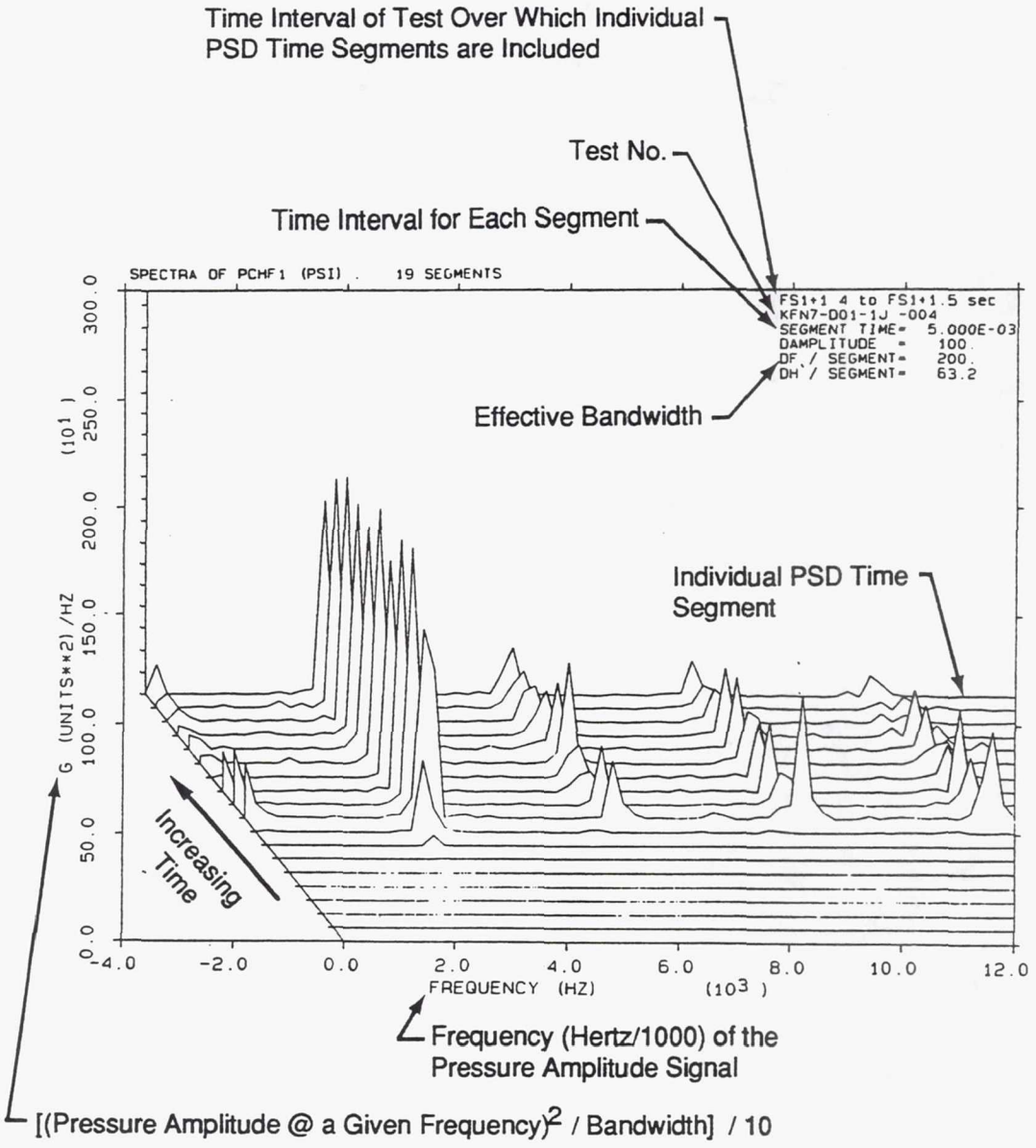
(1) High Frequency Chamber Pressure Transducer playback of the pressure amplitude versus time prior to and during the observed unstable combustion event. Sample format for this plot is as follows:



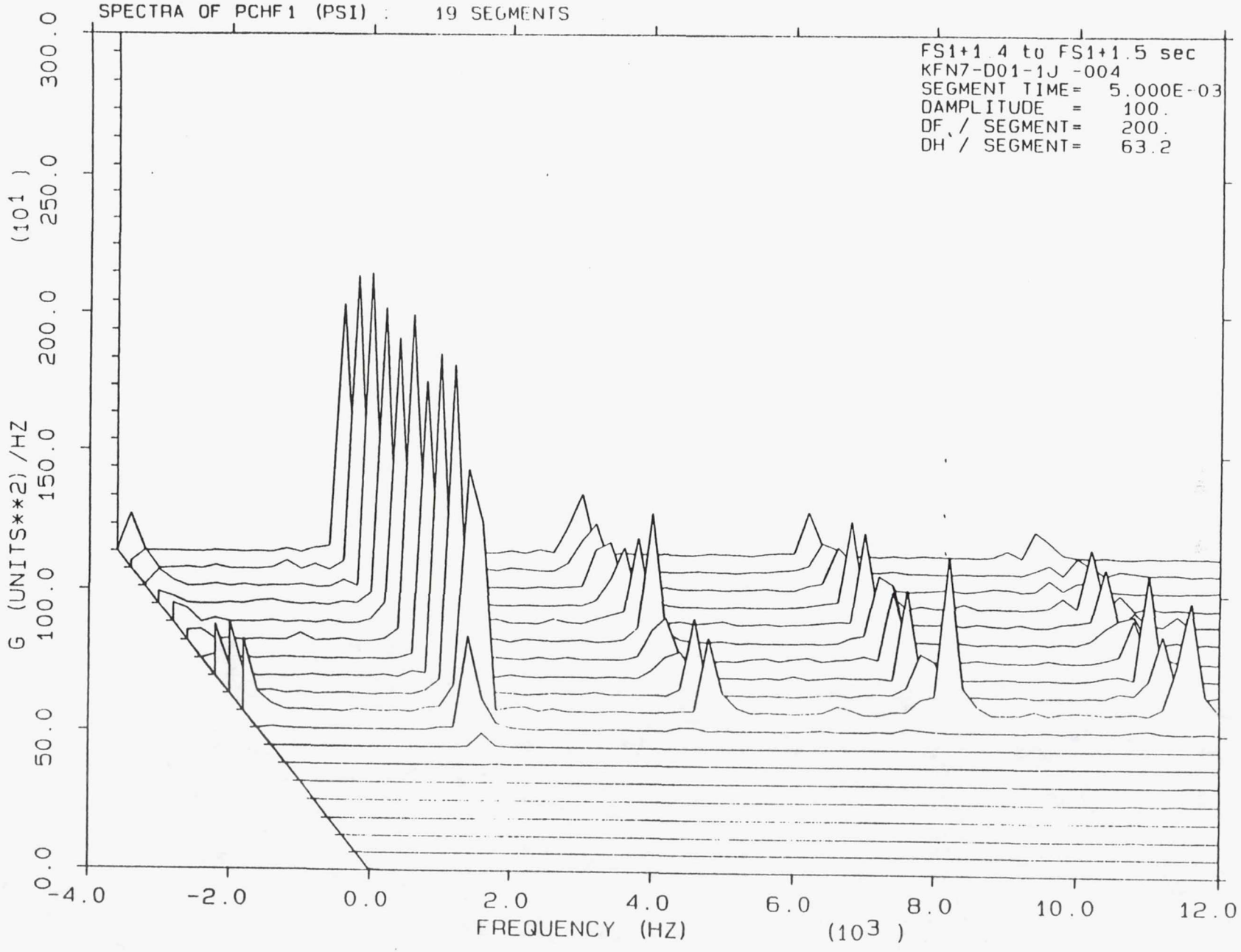
(2) Power Spectral Density (PSD) analysis of the high frequency pressure amplitude recorded signal. Sample format for this plot is as follows:

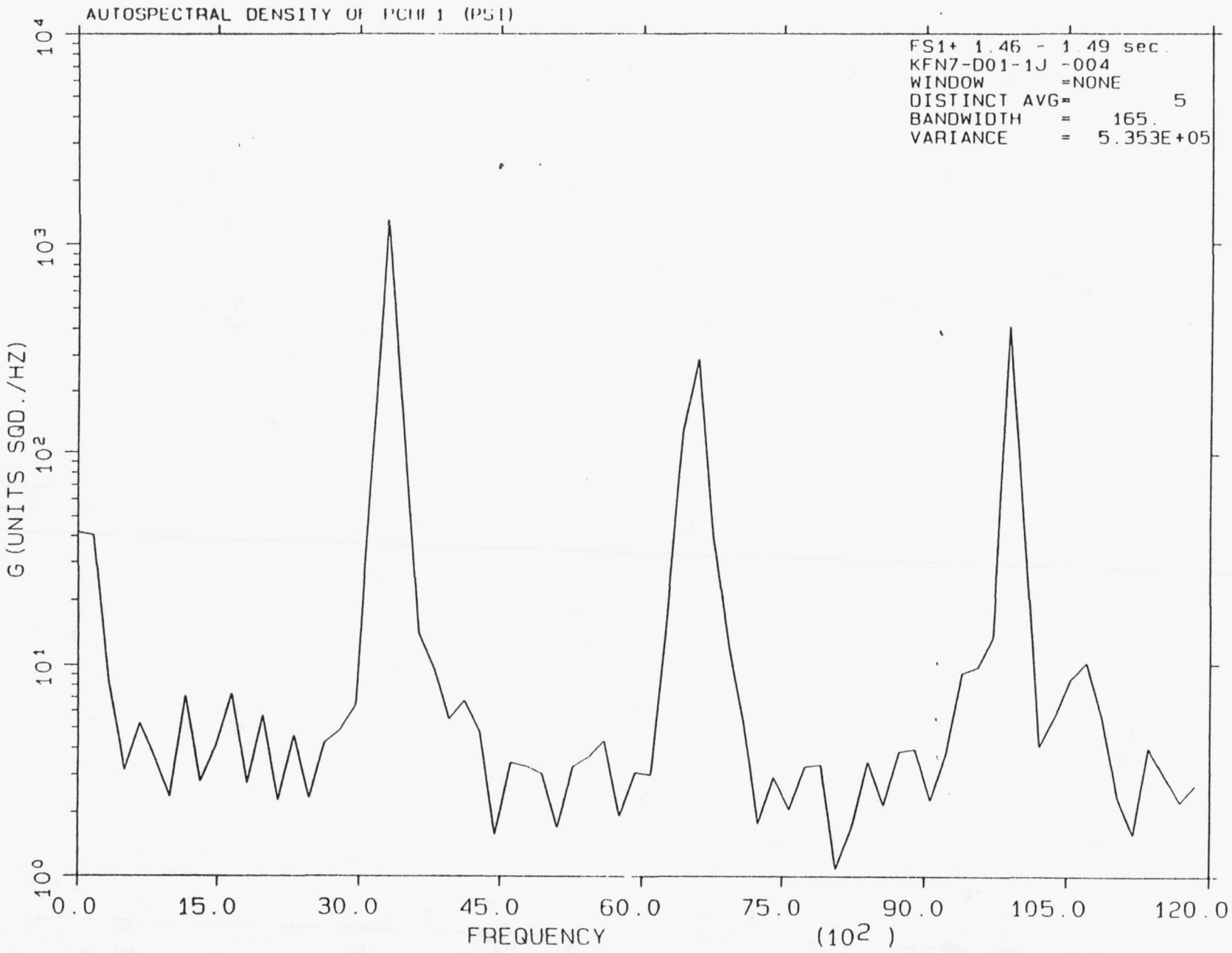


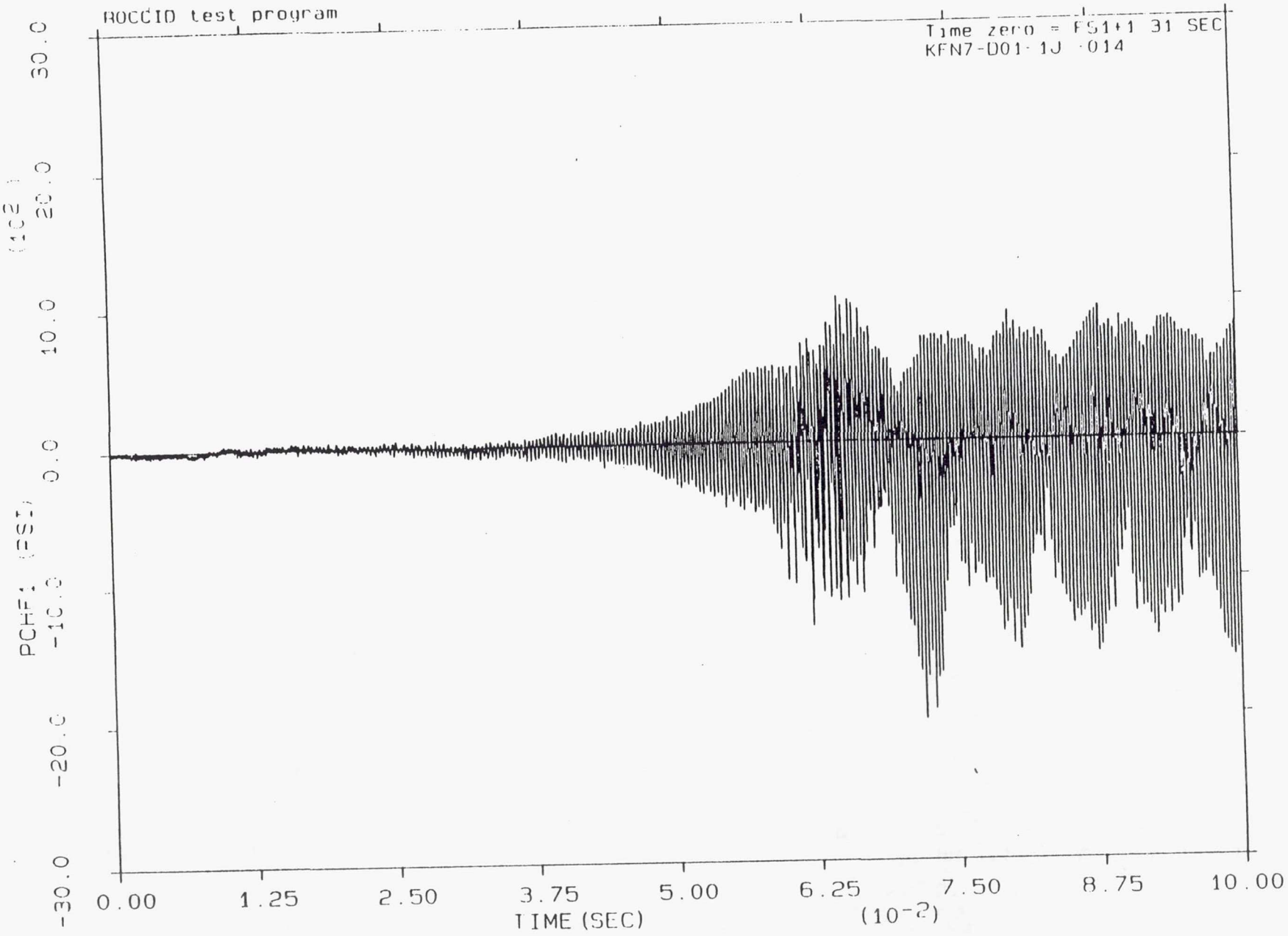
(3) Power Spectral Analysis of the high frequency pressure amplitude signal. Sample format for this pot is as follows:

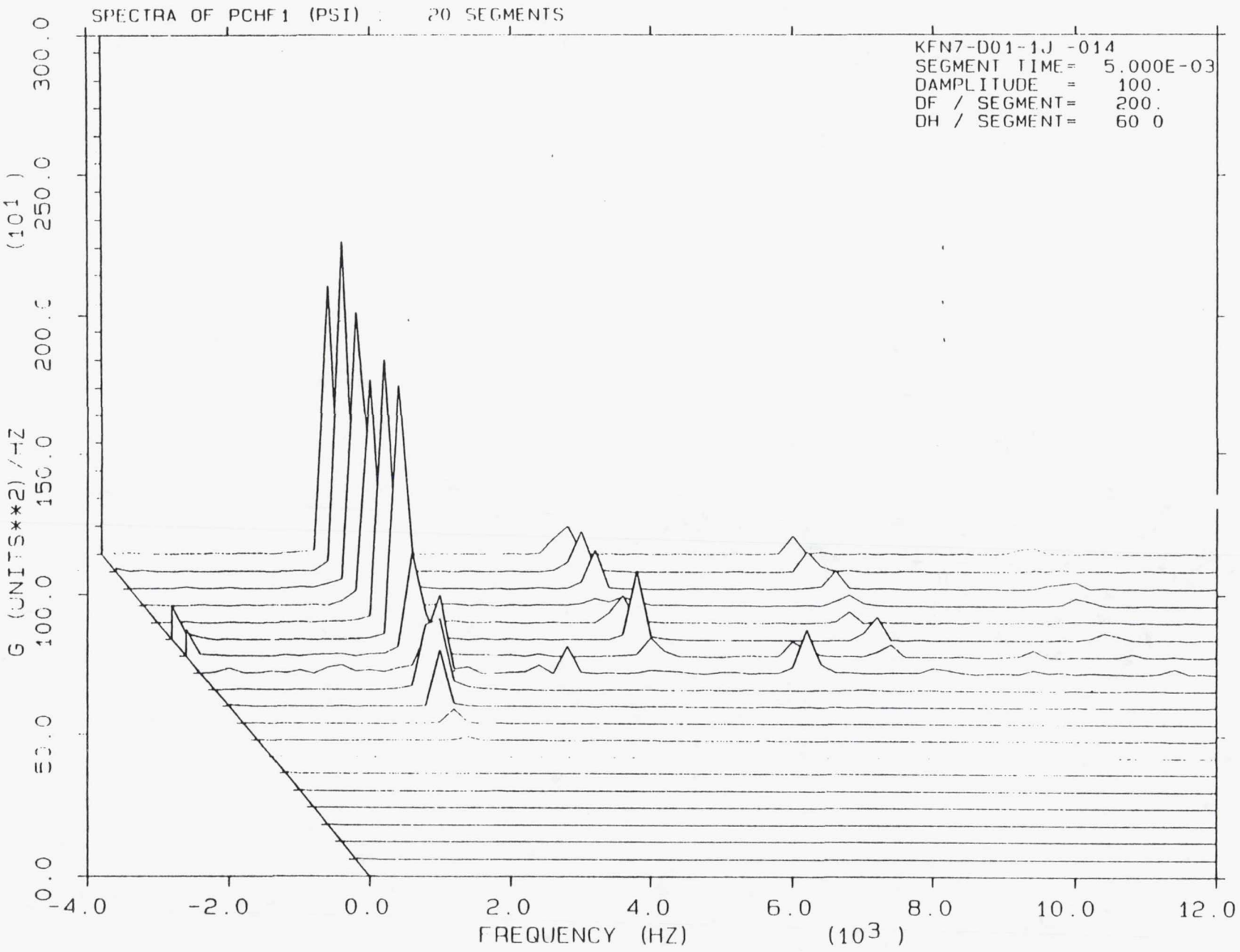


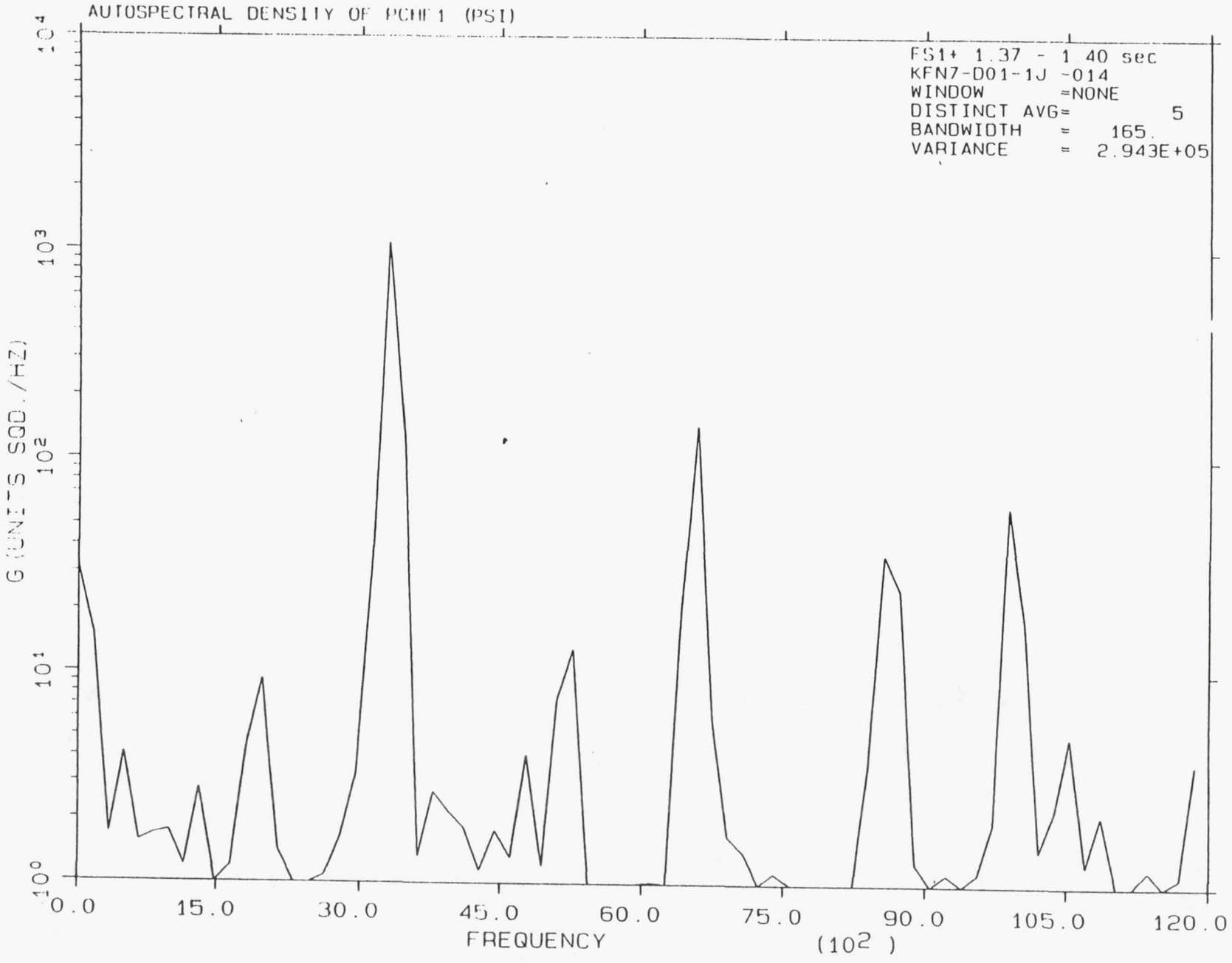
ROCCID Test Program
Time zero = FS1+1 4 sec
KFN7-001-1J -004
PCHF1 (PSI)
30.0
20.0
10.0
0.0
-10.0
-20.0
-30.0
(10^2)
0.00
1.25
2.50
3.75
5.00
6.25
7.50
8.75
10.00
TIME (SEC)
(10^-2)

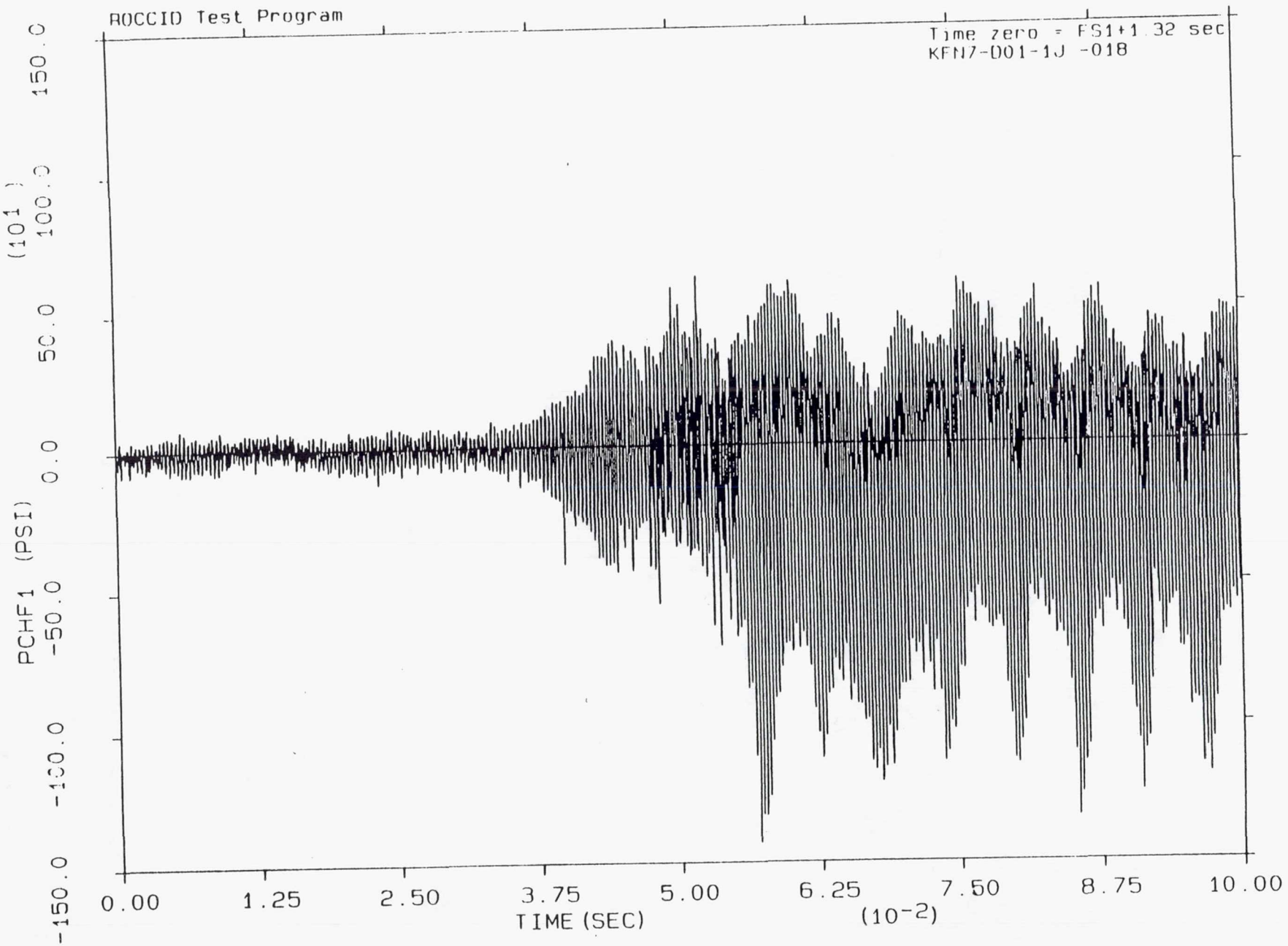

SPECTRA OF PCHF1 (PSI) : 19 SEGMENTS
FS1+1.4 to FS1+1.5 sec
KFN7-D01-1J -004
SEGMENT TIME= 5.000E-03
DAMPLITUDE = 100.
DF / SEGMENT= 200.
DH / SEGMENT= 63.2
G (UNITS**2)/HZ
(10^1)
0.0
50.0
100.0
150.0
200.0
250.0
300.0
-4.0
-2.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
FREQUENCY (HZ)
(10^3)

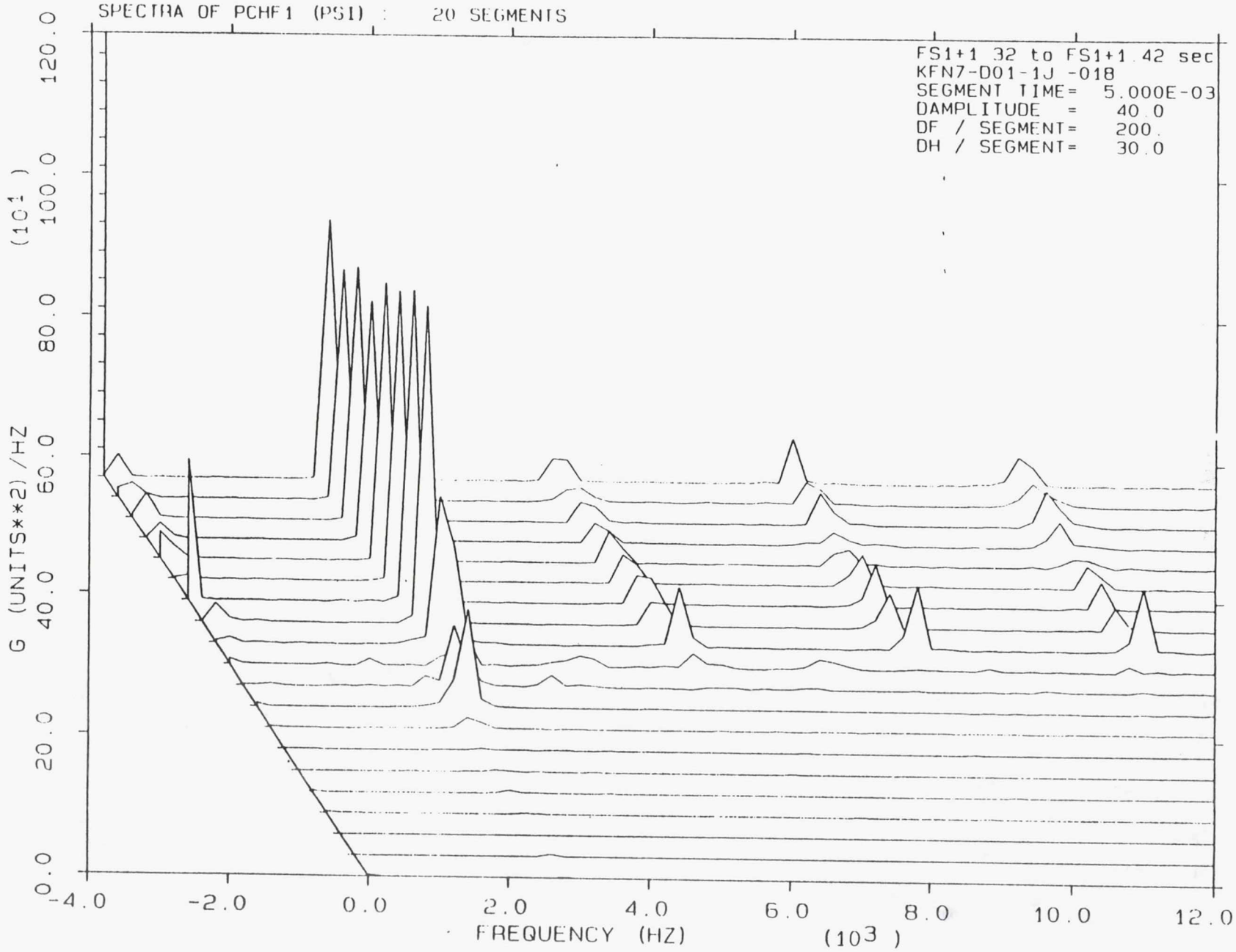

AUTOSPECTRAL DENSITY OF PCM 1 (PSI)
FS1+ 1.46 - 1.49 sec.
KFN7-D01-1J -004
WINDOW =NONE
DISTINCT AVG= 5
BANDWIDTH = 165.
VARIANCE = 5.353E+05
G (UNITS SQD./HZ)
10⁴
10³
10²
10¹
10⁰
0.0
15.0
30.0
45.0
60.0
75.0
90.0
105.0
120.0
FREQUENCY
(10²)

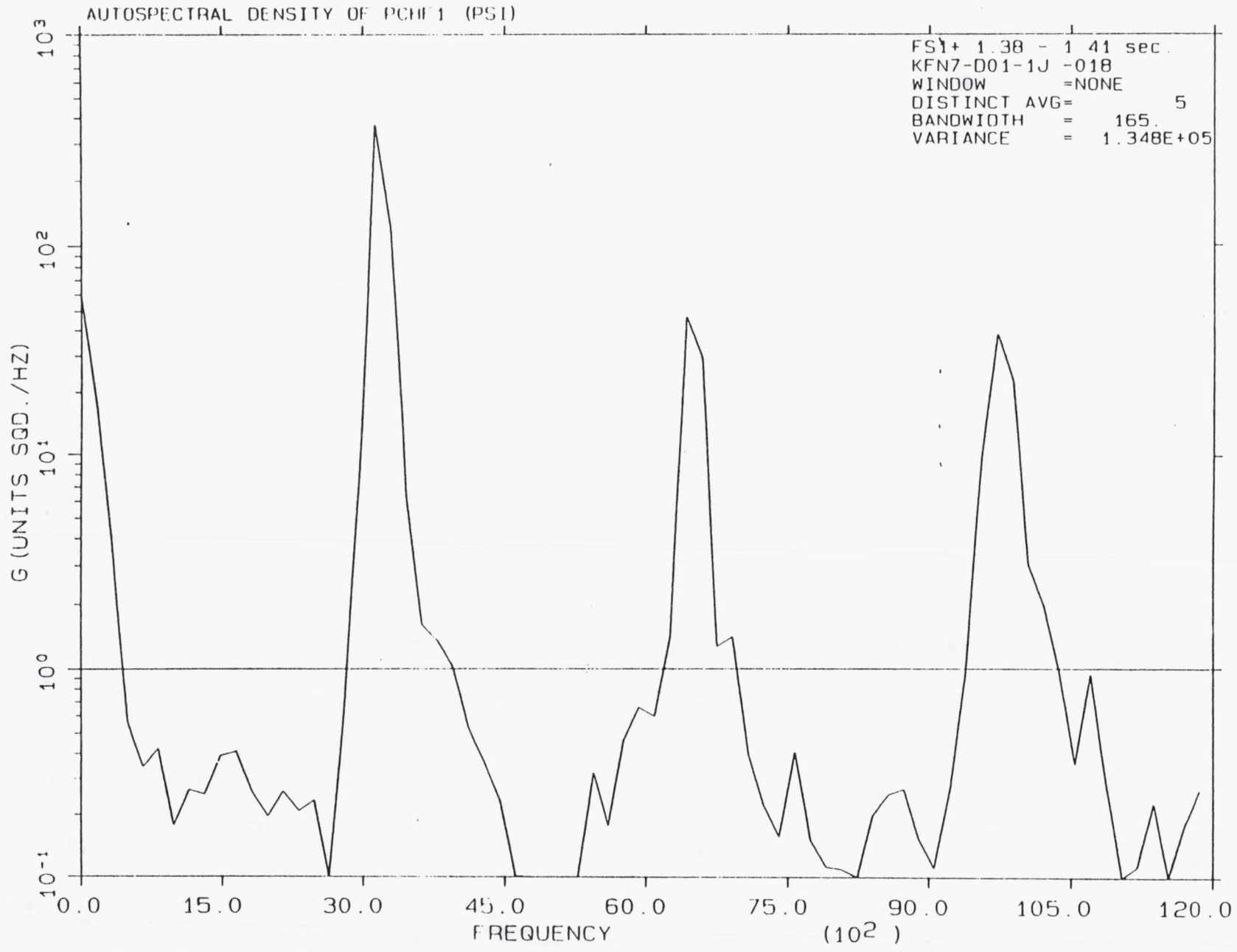

ROCCID test program
Time zero = FS1+1 31 SEC
KFN7-D01-1J -014
PCHF1 (PSI)
30.0
20.0
10.0
0.0
-10.0
-20.0
-30.0
0.00
1.25
2.50
3.75
5.00
6.25
7.50
8.75
10.00
TIME (SEC)
(10-2)

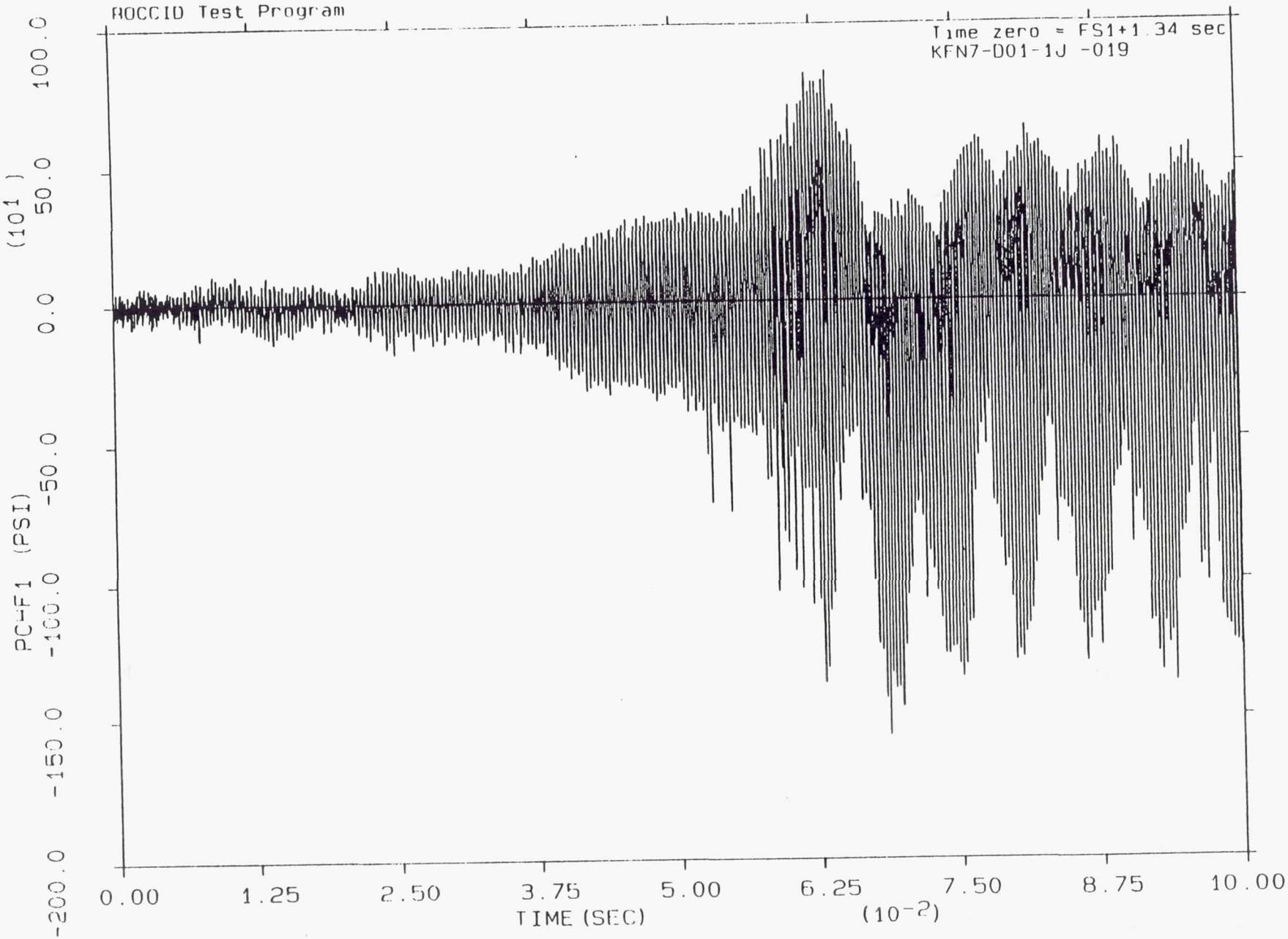

SPECTRA OF PCHF1 (PSI) 20 SEGMENTS
KFN7-D01-1J -014
SEGMENT TIME= 5.000E-03
DAMPLITUDE = 100.
DF / SEGMENT= 200.
DH / SEGMENT= 60 0
G (UNITS**2)/HZ
(10^1)
0.0
50.0
100.0
150.0
200.0
250.0
300.0
-4.0
-2.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
FREQUENCY (HZ)
(10^3)

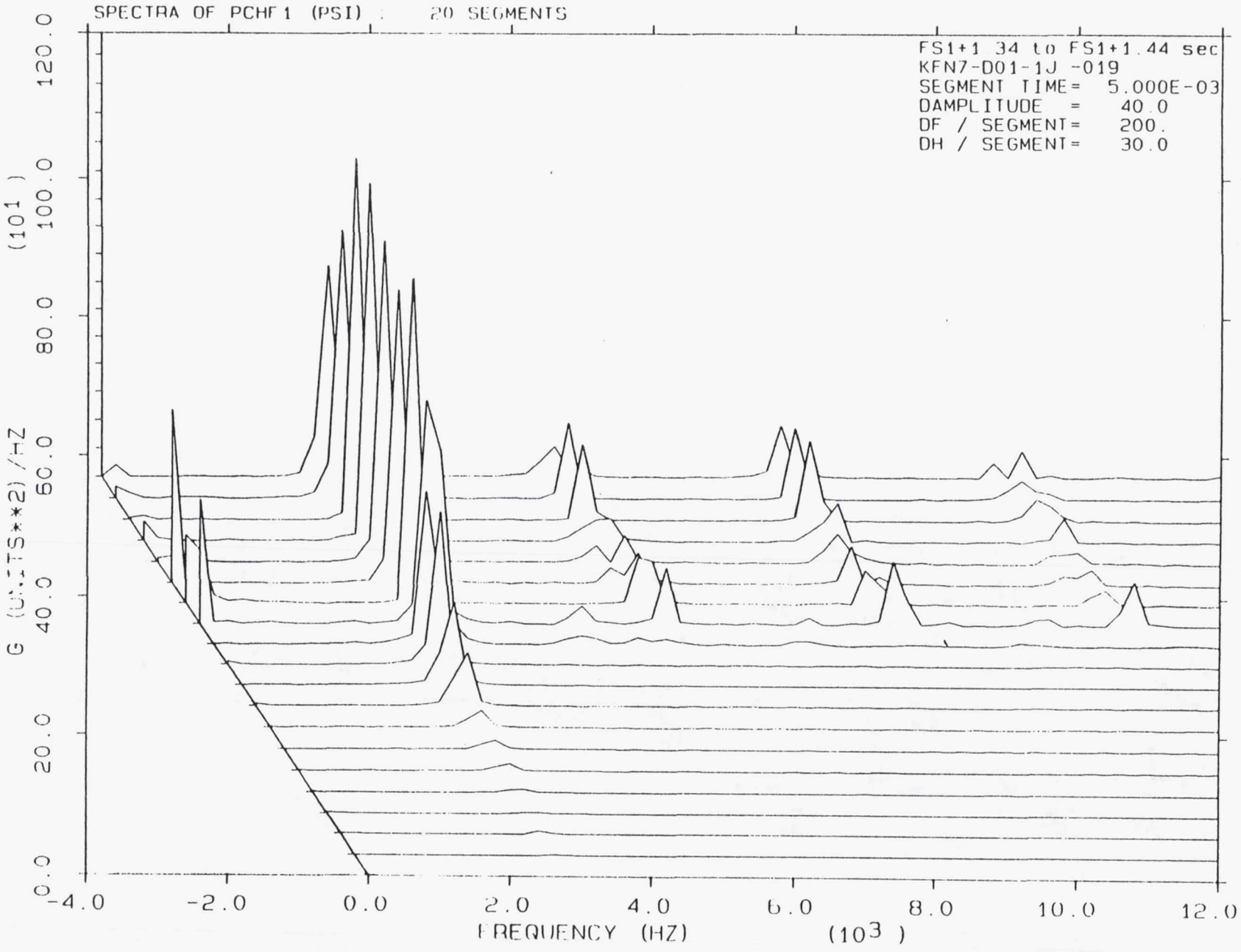

AUTOSPECTRAL DENSITY OF PCHF1 (PSI)
PS1+ 1.37 - 1.40 sec
KFN7-D01-1J -014
WINDOW =NONE
DISTINCT AVG= 5
BANDWIDTH = 165.
VARIANCE = 2.943E+05
G (UNITS SQD./HZ)
10⁴
10³
10²
10¹
10⁰
0.0
15.0
30.0
45.0
60.0
75.0
90.0
105.0
120.0
FREQUENCY
(10²)

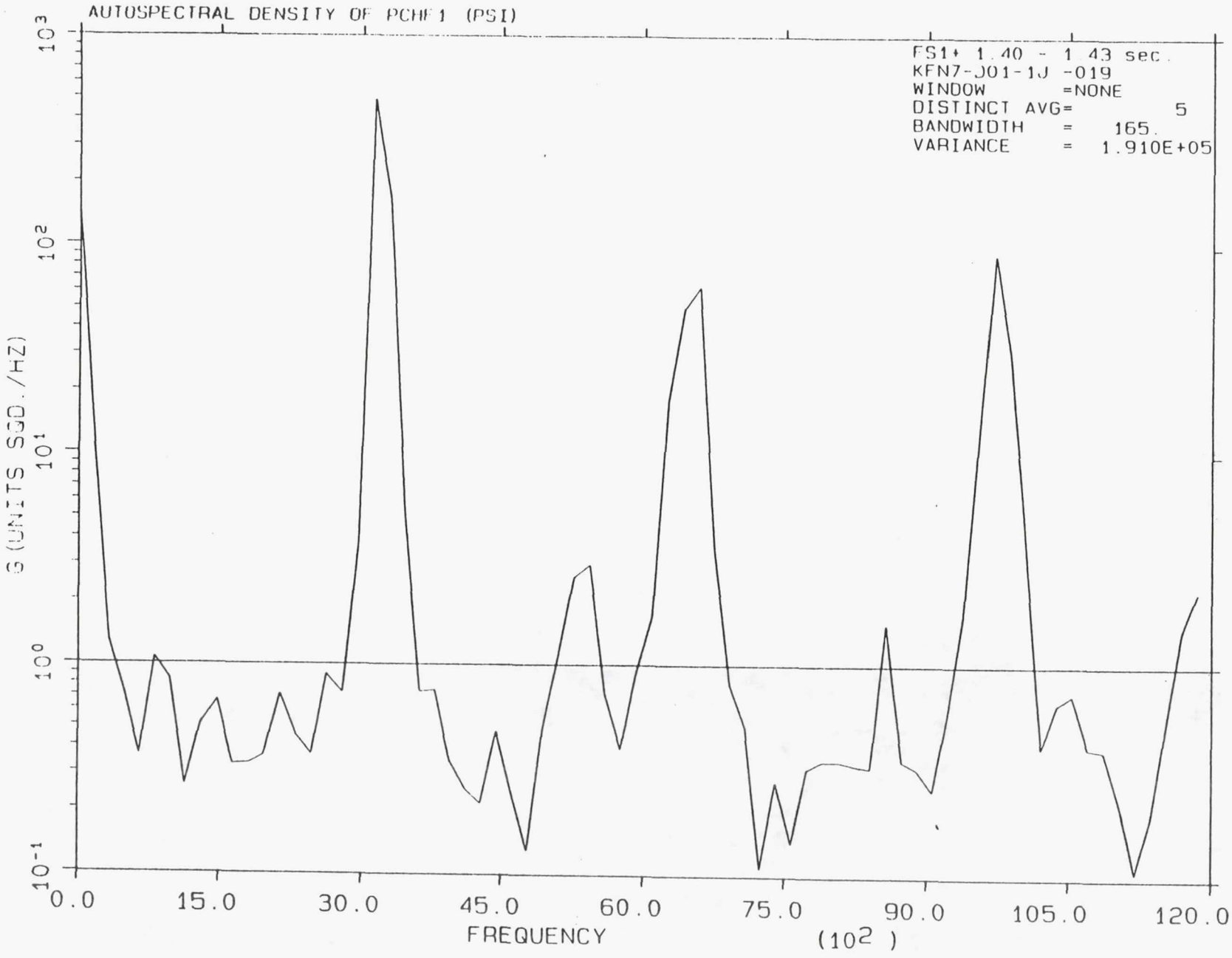

ROCCID Test Program
Time zero = FS1+1.32 sec
KFN7-001-1J -018
PCHF1 (PSI)
150.0
100.0
50.0
0.0
-50.0
-100.0
-150.0
(10¹)
0.00
1.25
2.50
3.75
5.00
6.25
7.50
8.75
10.00
TIME (SEC)
(10⁻²)

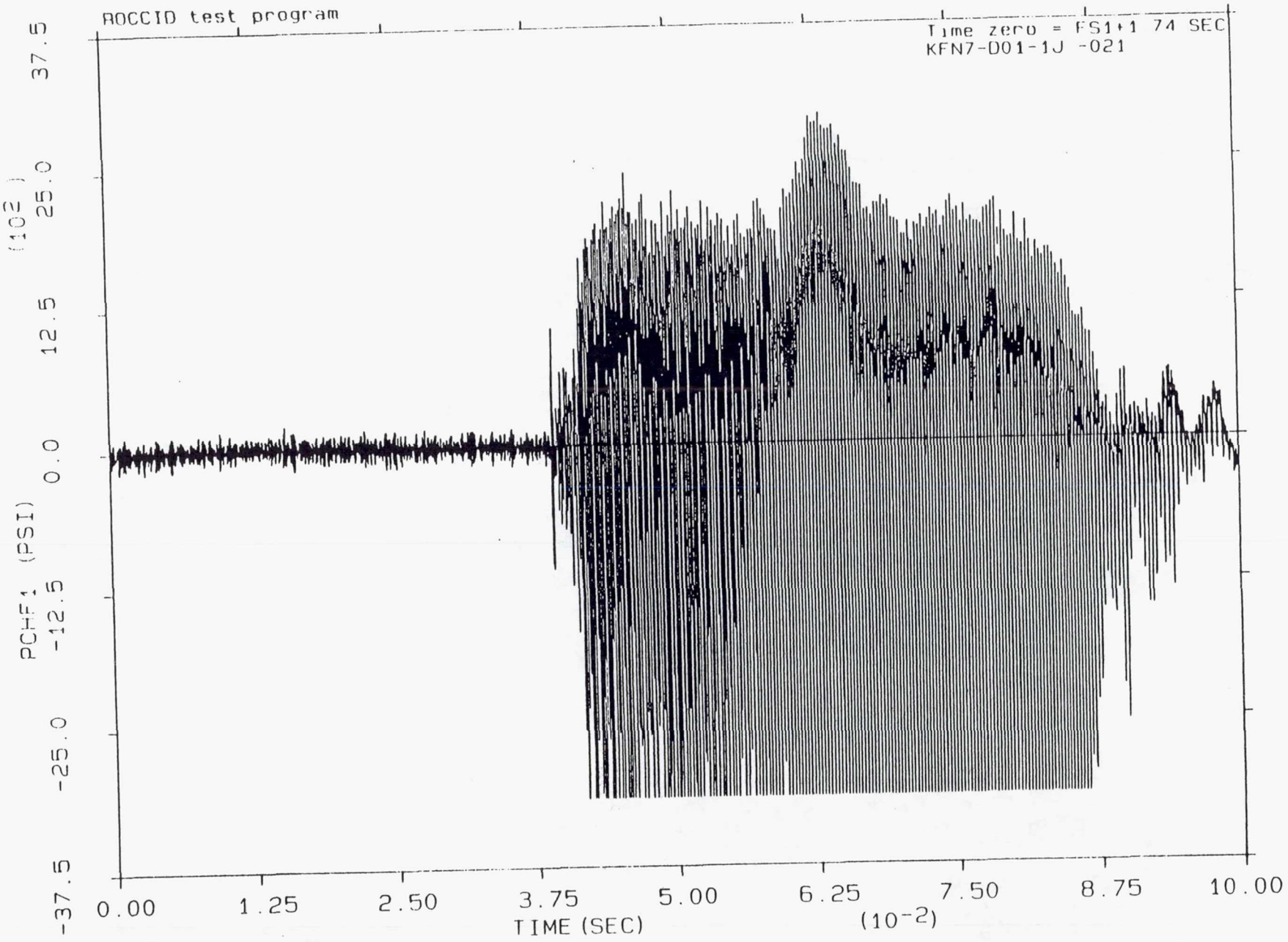

SPECTRA OF PCHF1 (PSI) : 20 SEGMENTS
FS1+1.32 to FS1+1.42 sec
KFN7-D01-1J -018
SEGMENT TIME= 5.000E-03
DAMPLITUDE = 40.0
DF / SEGMENT= 200.
DH / SEGMENT= 30.0
G (UNITS**2)/HZ
(10^1)
120.0
100.0
80.0
60.0
40.0
20.0
0.0
-4.0
-2.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
FREQUENCY (HZ)
(10^3)

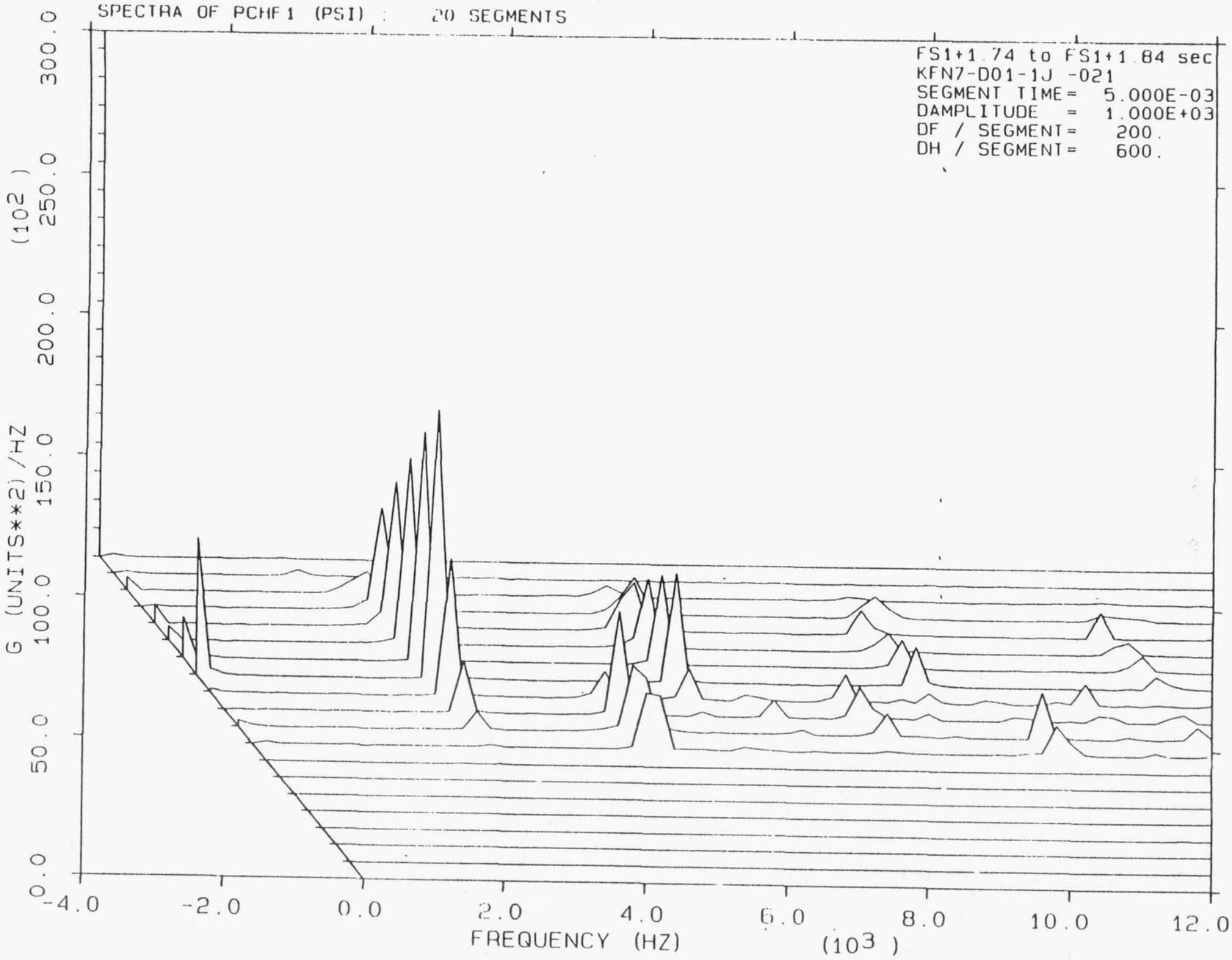

AUTOSPECTRAL DENSITY OF PCHF 1 (PSI)
FS1+ 1.38 - 1 41 sec.
KFN7-D01-1J -018
WINDOW =NONE
DISTINCT AVG= 5
BANDWIDTH = 165.
VARIANCE = 1.348E+05
G (UNITS SQD./HZ)
10³
10²
10¹
10⁰
10⁻¹
0.0
15.0
30.0
45.0
60.0
75.0
90.0
105.0
120.0
FREQUENCY (10²)

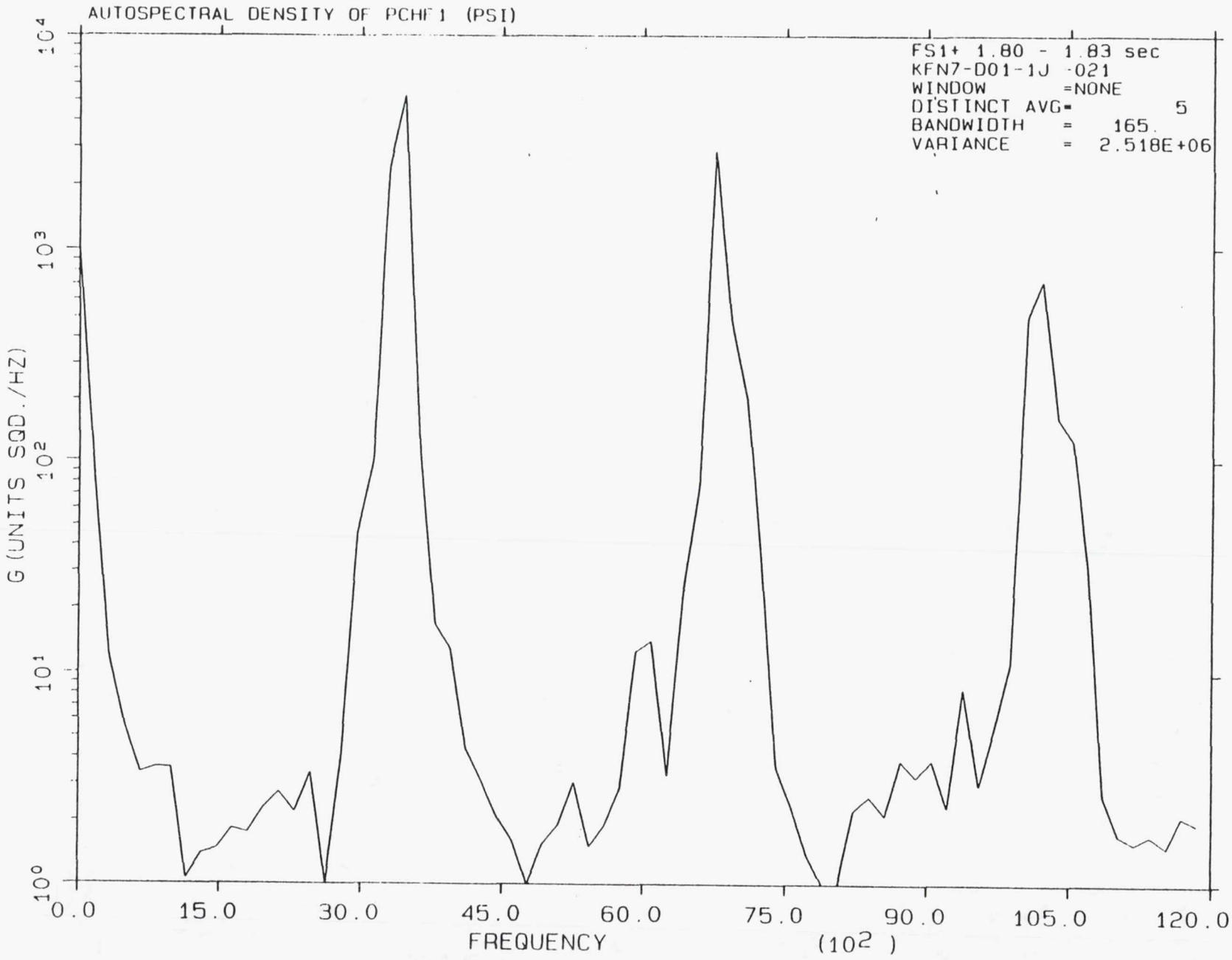

ROCCID Test Program
Time zero = FS1+1.34 sec
KFN7-D01-1J -019
PC-F1 (PSI)
(10^1)
100.0
50.0
0.0
-50.0
-100.0
-150.0
-200.0
0.00
1.25
2.50
3.75
5.00
6.25
7.50
8.75
10.00
TIME (SEC)
(10^-2)

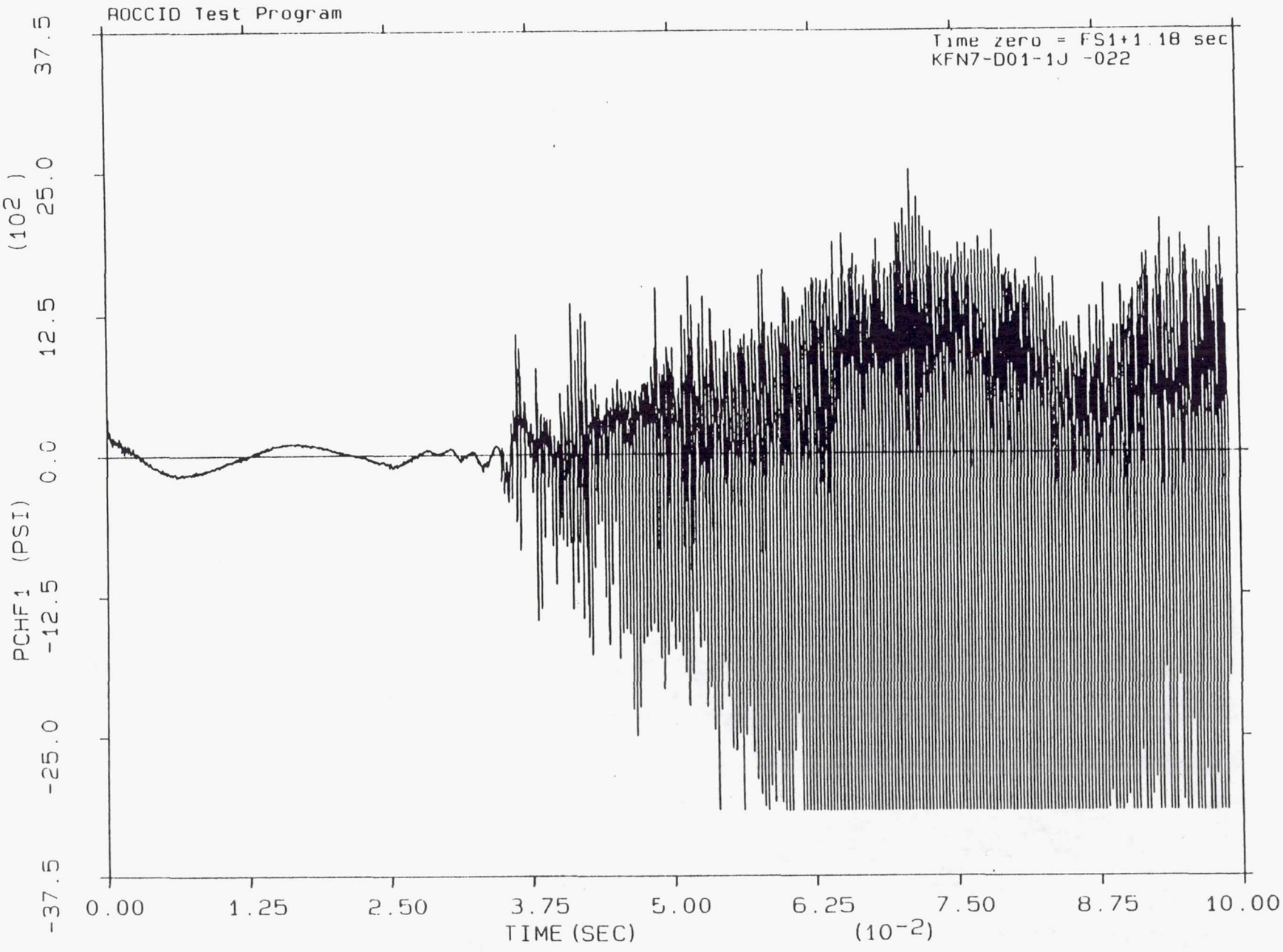

SPECTRA OF PCHF1 (PSI) . 20 SEGMENTS
FS1+1.34 to FS1+1.44 sec
KFN7-D01-1J -019
SEGMENT TIME= 5.000E-03
DAMPLITUDE = 40.0
DF / SEGMENT= 200.
DH / SEGMENT= 30.0
G (UNITS**2)/HZ
(10^1)
120.0
100.0
80.0
60.0
40.0
20.0
0.0
-4.0
-2.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
FREQUENCY (HZ)
(10^3)

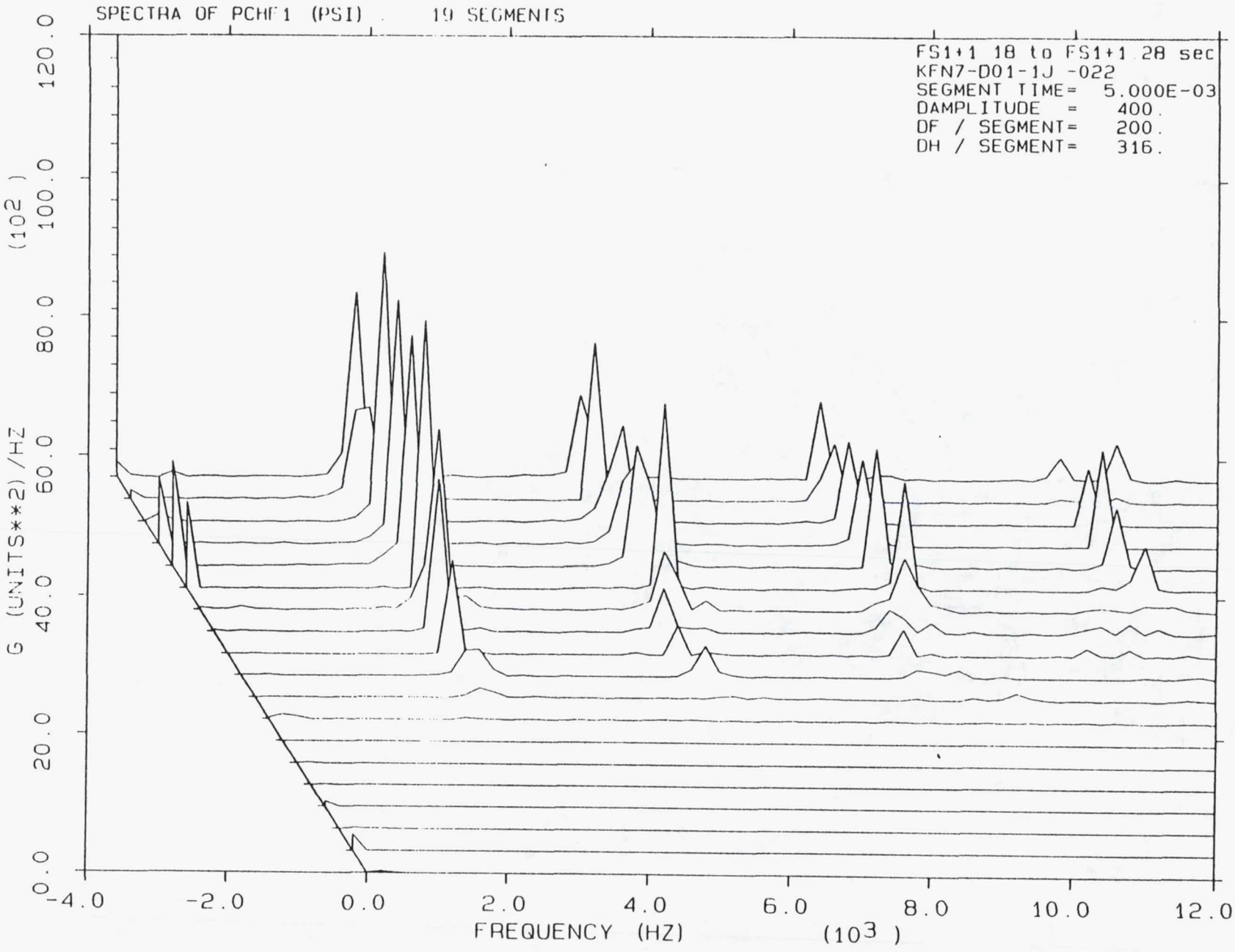

AUTOSPECTRAL DENSITY OF PCHF1 (PSI)
FS1+ 1.40 - 1.43 sec.
KFN7-J01-1J -019
WINDOW =NONE
DISTINCT AVG= 5
BANDWIDTH = 165.
VARIANCE = 1.910E+05
G (UNITS SQD./HZ)
10³
10²
10¹
10⁰
10⁻¹
0.0
15.0
30.0
45.0
60.0
75.0
90.0
105.0
120.0
FREQUENCY
(10²)

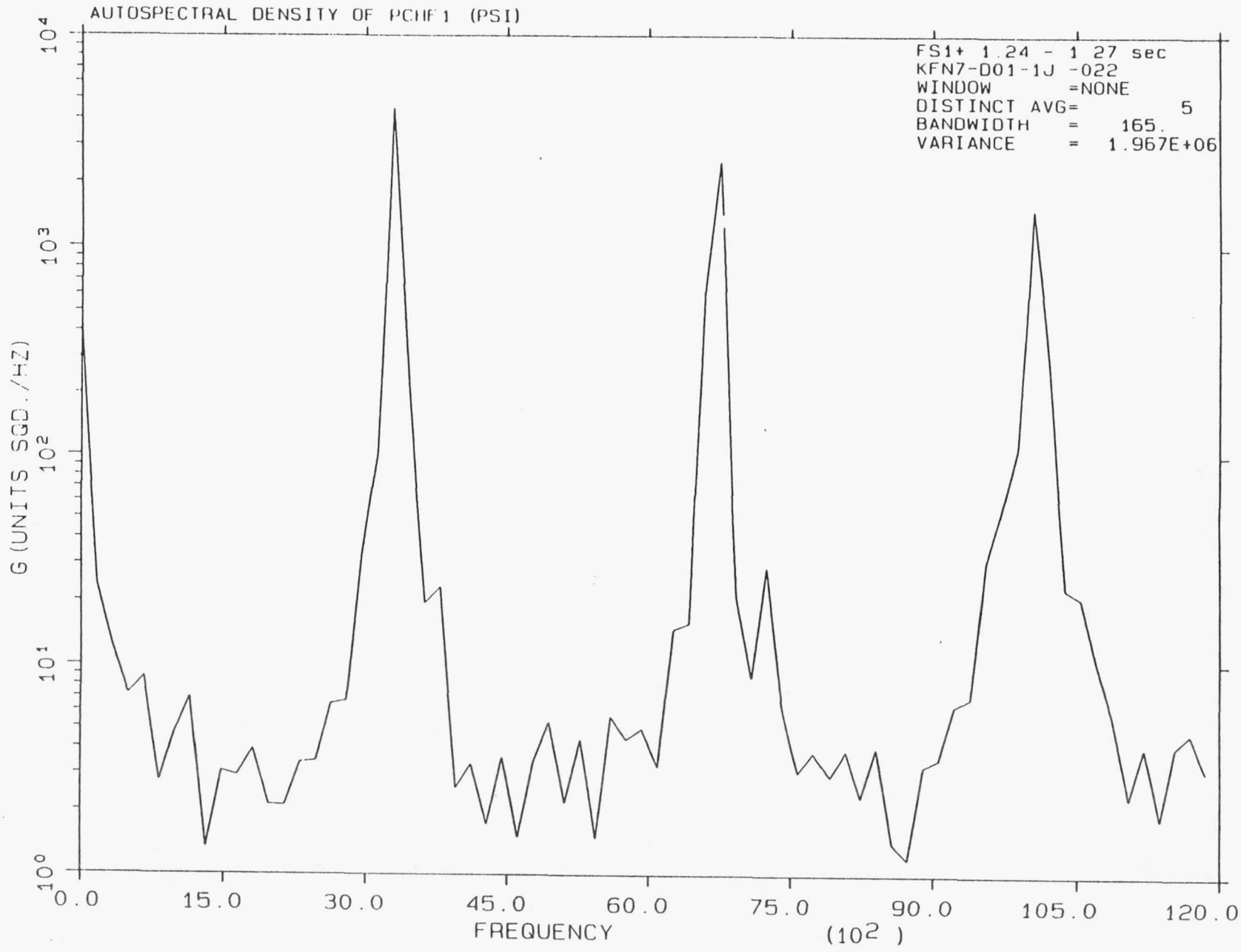

ROCCID test program
Time zero = FS1+1 74 SEC
KFN7-D01-1J -021
PCHF1 (PSI)
(10^2)
37.5
25.0
12.5
0.0
-12.5
-25.0
-37.5
0.00
1.25
2.50
3.75
5.00
6.25
7.50
8.75
10.00
TIME (SEC)
(10^-2)

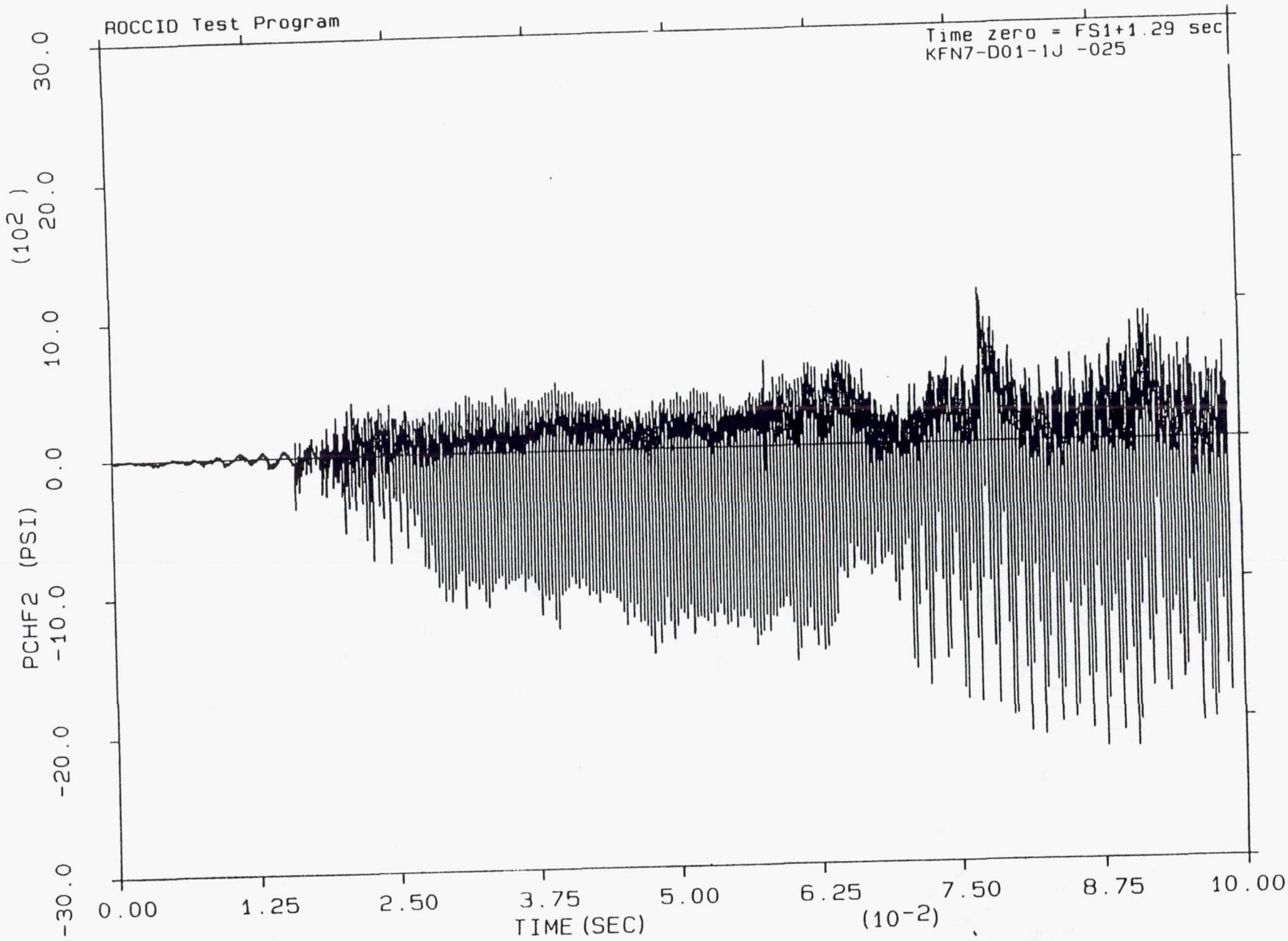

SPECTRA OF PCHF1 (PSI) : 20 SEGMENTS
FS1+1.74 to FS1+1.84 sec
KFN7-D01-1J -021
SEGMENT TIME= 5.000E-03
DAMPLITUDE = 1.000E+03
DF / SEGMENT= 200.
DH / SEGMENT= 600.
G (UNITS**2)/HZ
(10^2)
0.0
50.0
100.0
150.0
200.0
250.0
300.0
-4.0
-2.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
FREQUENCY (HZ)
(10^3)

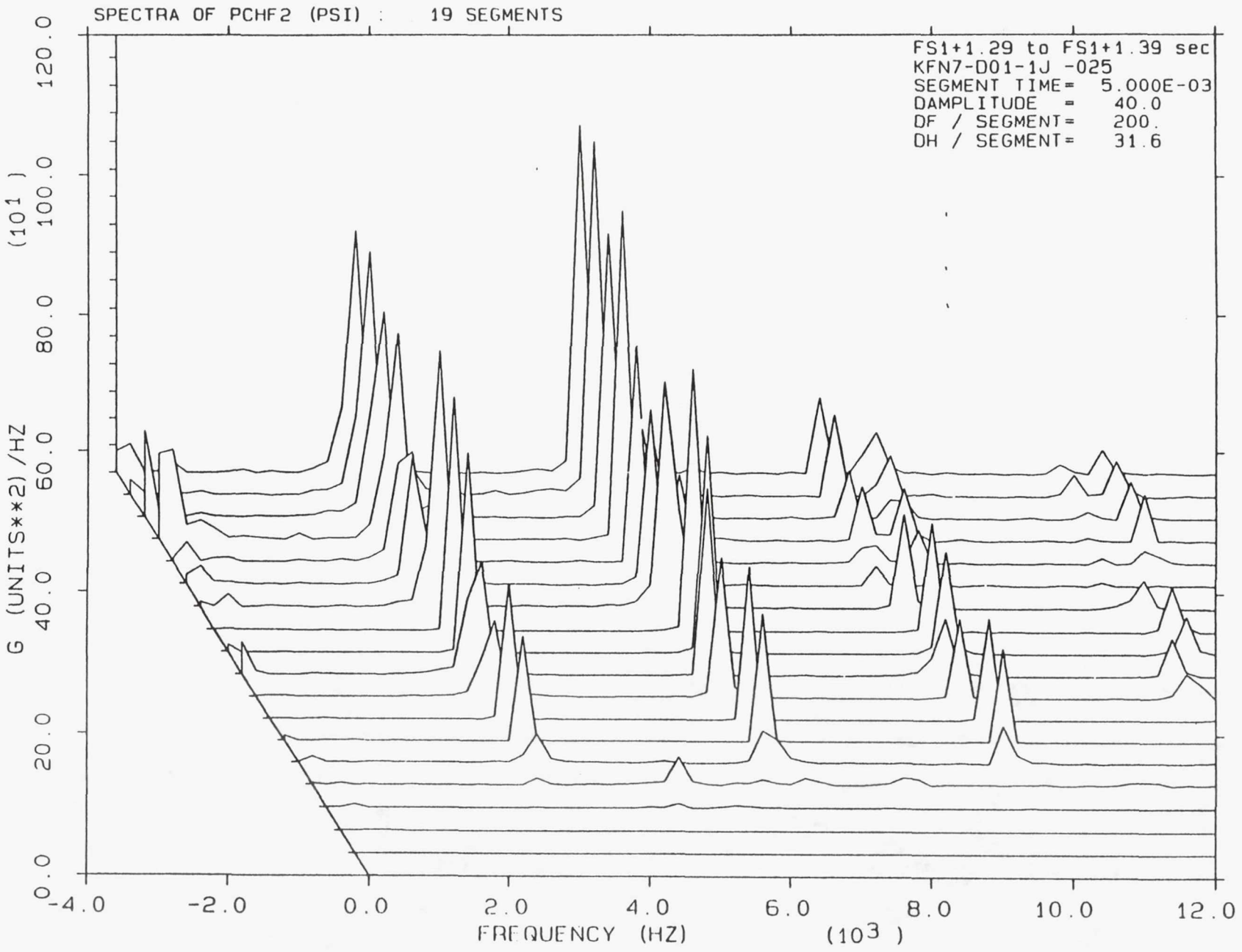

AUTOSPECTRAL DENSITY OF PCHF 1 (PSI)
FS1+ 1.80 - 1.83 sec
KFN7-D01-1J -021
WINDOW =NONE
DISTINCT AVG= 5
BANDWIDTH = 165.
VARIANCE = 2.518E+06
G (UNITS SQD./HZ)
10⁴
10³
10²
10¹
10⁰
0.0
15.0
30.0
45.0
60.0
75.0
90.0
105.0
120.0
FREQUENCY
(10²)

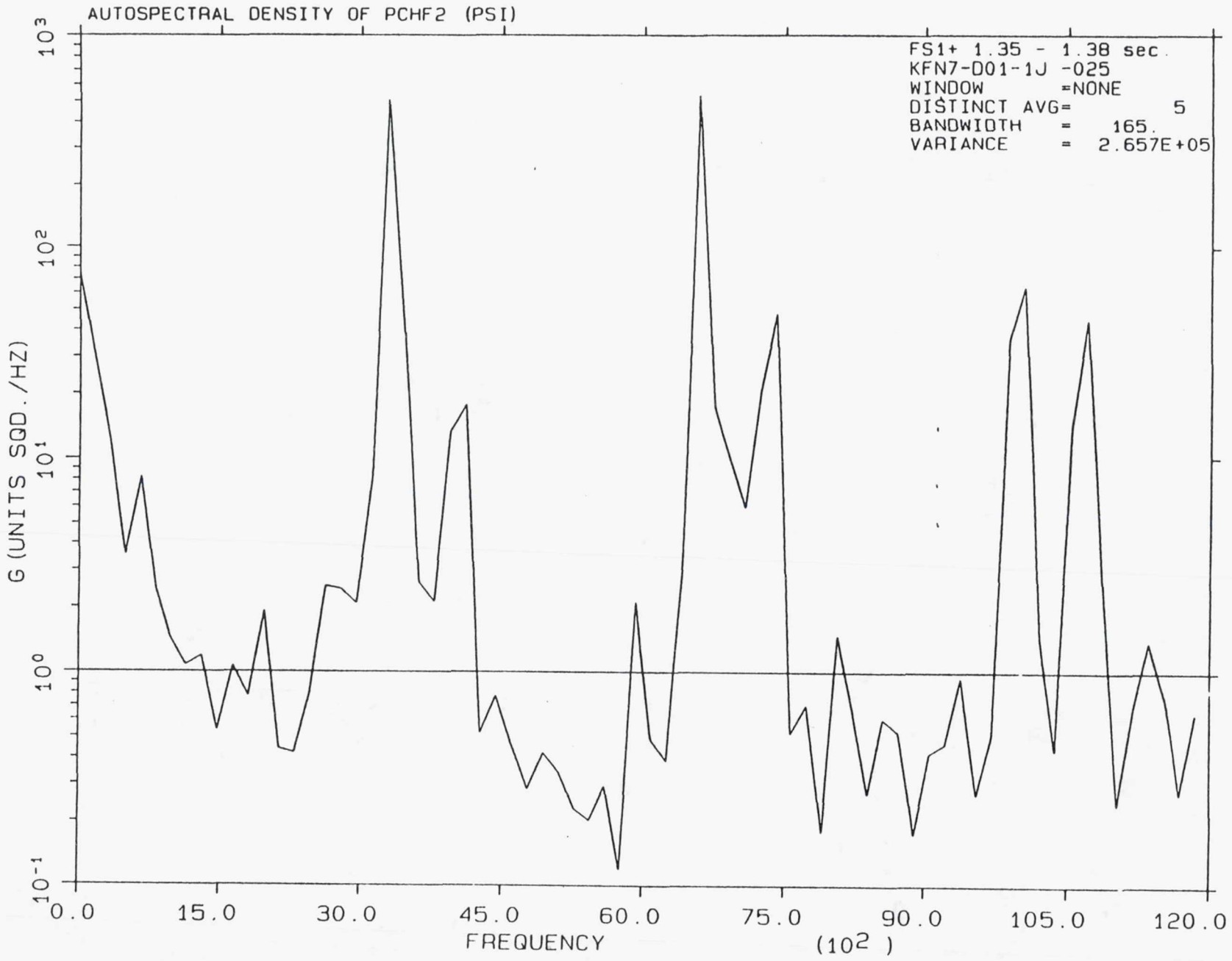

ROCCID Test Program
Time zero = FS1+1.18 sec
KFN7-D01-1J -022
PCHF1 (PSI)
(10^2)
37.5
25.0
12.5
0.0
-12.5
-25.0
-37.5
0.00
1.25
2.50
3.75
5.00
6.25
7.50
8.75
10.00
TIME (SEC)
(10^-2)

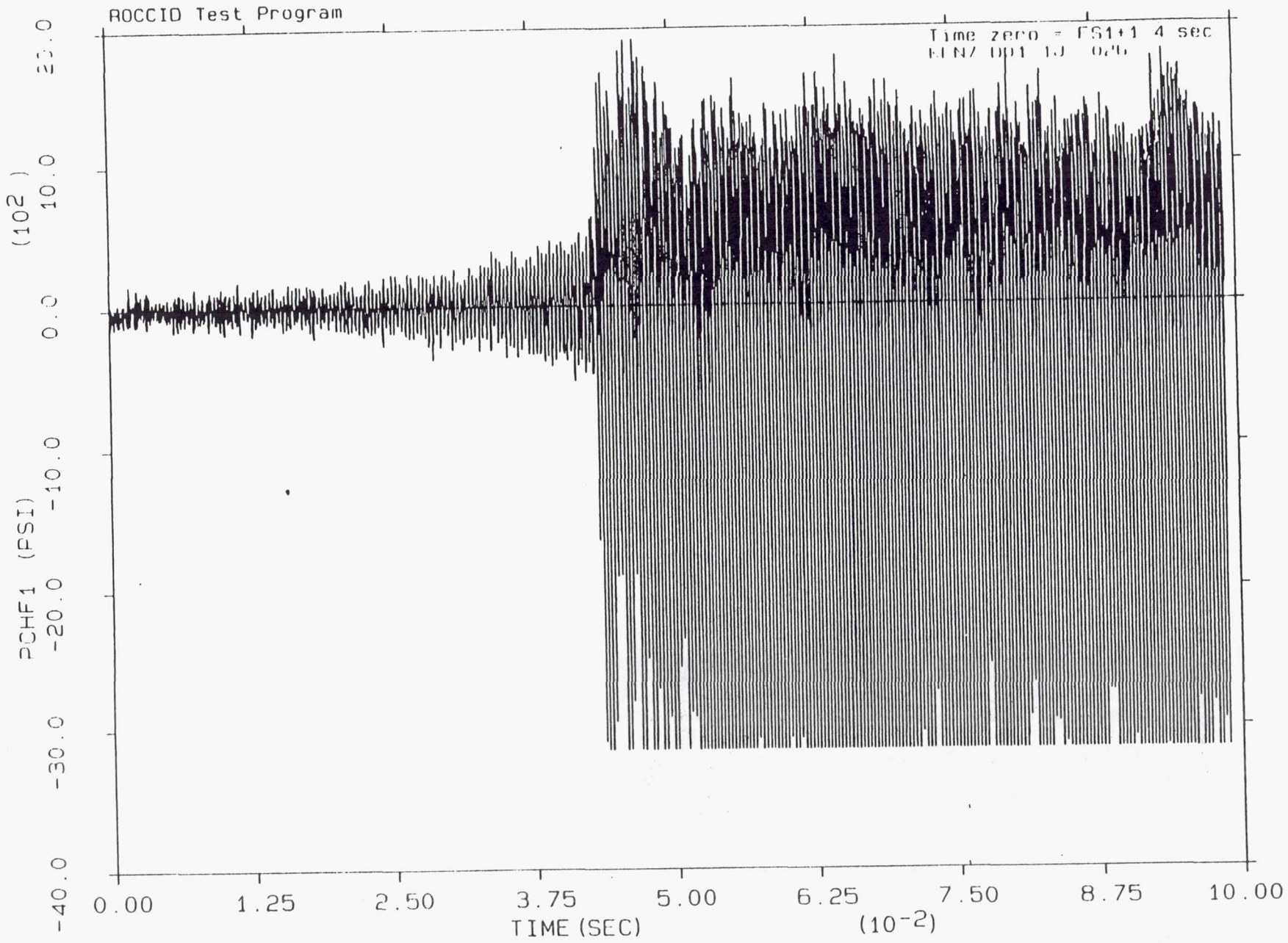

SPECTRA OF PCHF1 (PSI) 19 SEGMENTS
FS1+1 18 to FS1+1 28 sec
KFN7-D01-1J -022
SEGMENT TIME= 5.000E-03
DAMPLITUDE = 400.
DF / SEGMENT= 200.
DH / SEGMENT= 316.
G (UNITS**2)/HZ
(10^2)
120.0
100.0
80.0
60.0
40.0
20.0
0.0
-4.0
-2.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
FREQUENCY (HZ)
(10^3)

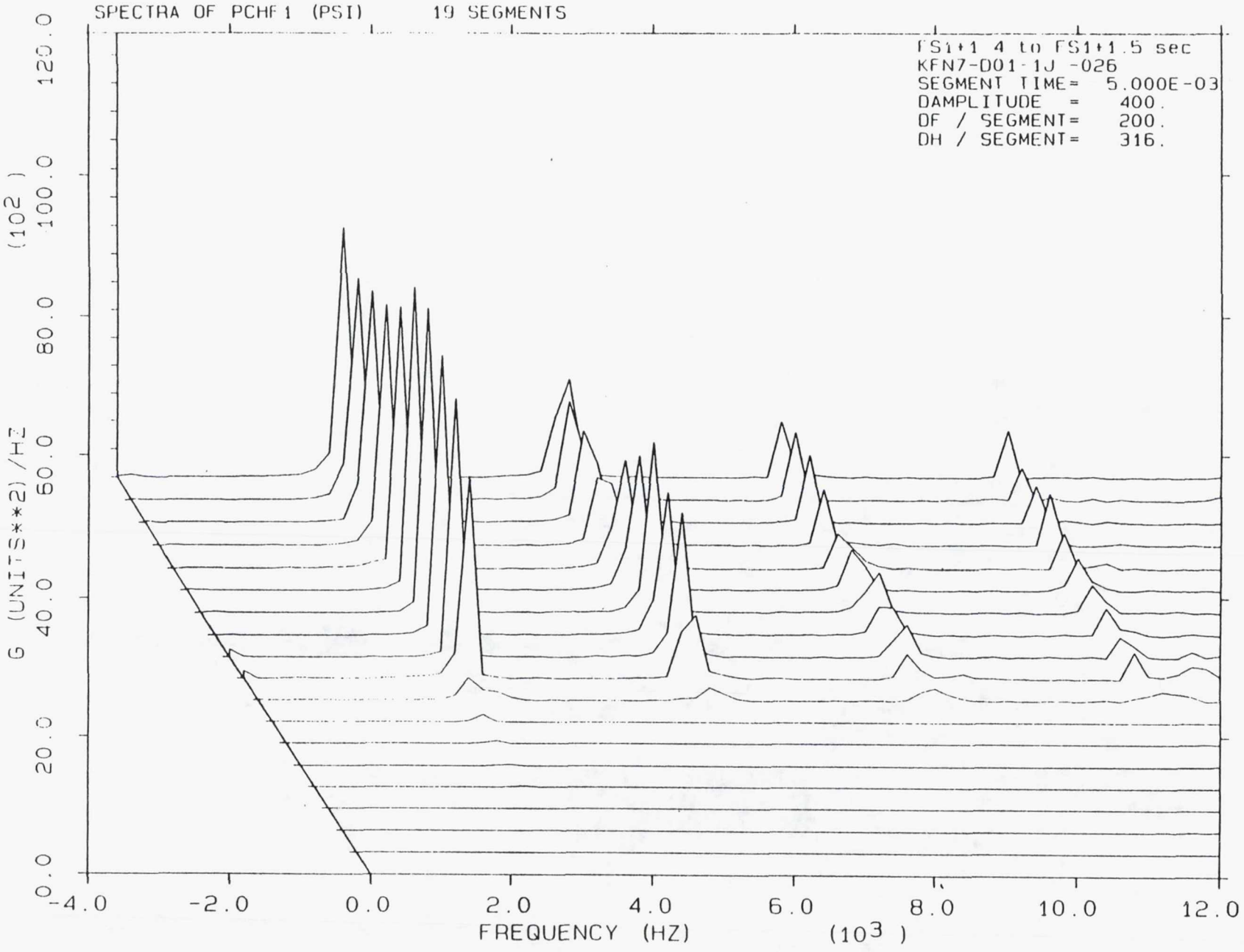

AUTOSPECTRAL DENSITY OF PCHF1 (PSI)
FS1+ 1.24 - 1.27 sec
KFN7-D01-1J -022
WINDOW =NONE
DISTINCT AVG= 5
BANDWIDTH = 165.
VARIANCE = 1.967E+06
G (UNITS SQD./HZ)
10^4
10^3
10^2
10^1
10^0
0.0
15.0
30.0
45.0
60.0
75.0
90.0
105.0
120.0
FREQUENCY
(10^2)

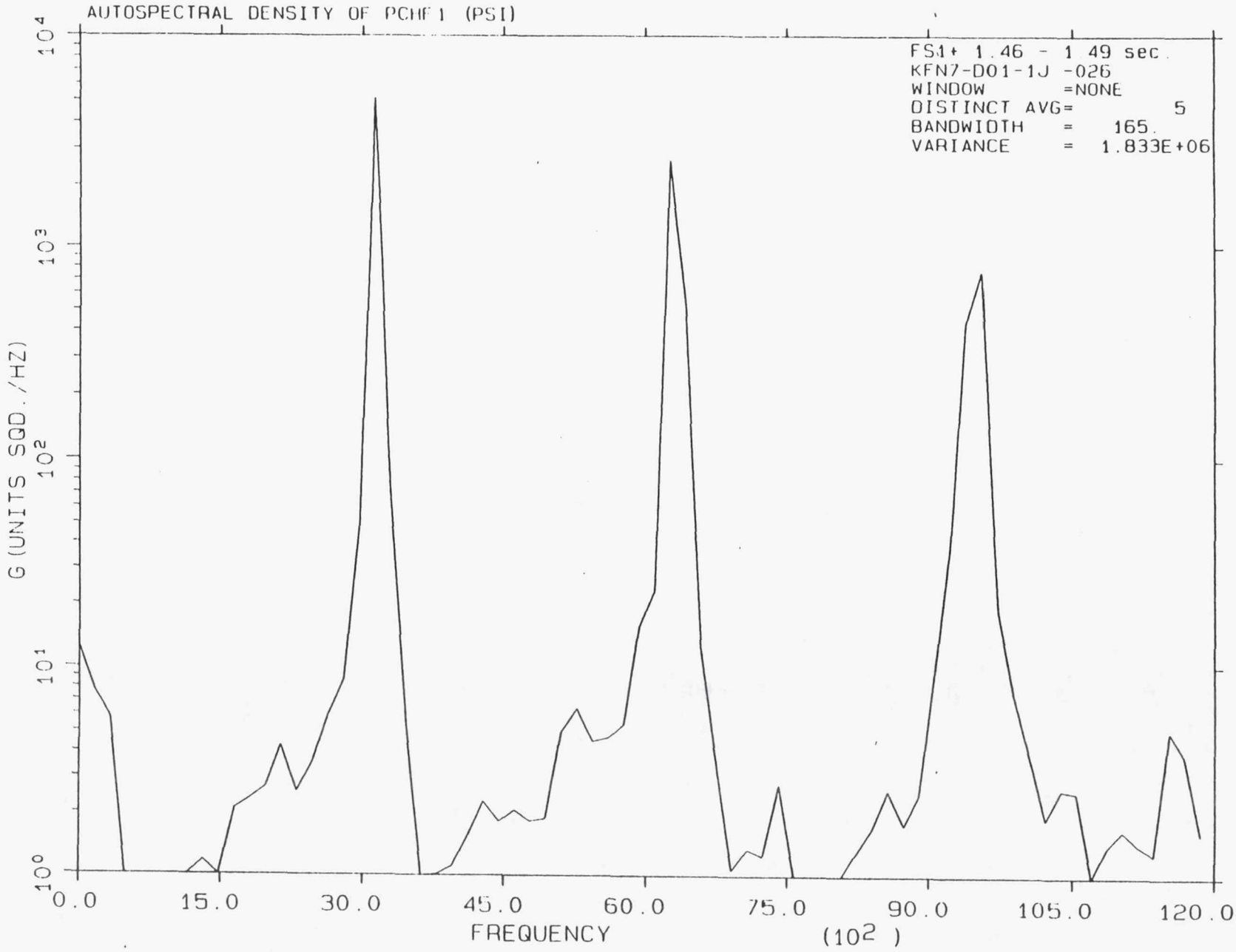

ROCCID Test Program
Time zero = FS1+1.29 sec
KFN7-D01-1J -025
PCHF2 (PSI) (10^2)
30.0
20.0
10.0
0.0
-10.0
-20.0
-30.0
0.00
1.25
2.50
3.75
5.00
6.25
7.50
8.75
10.00
TIME (SEC)
(10^-2)

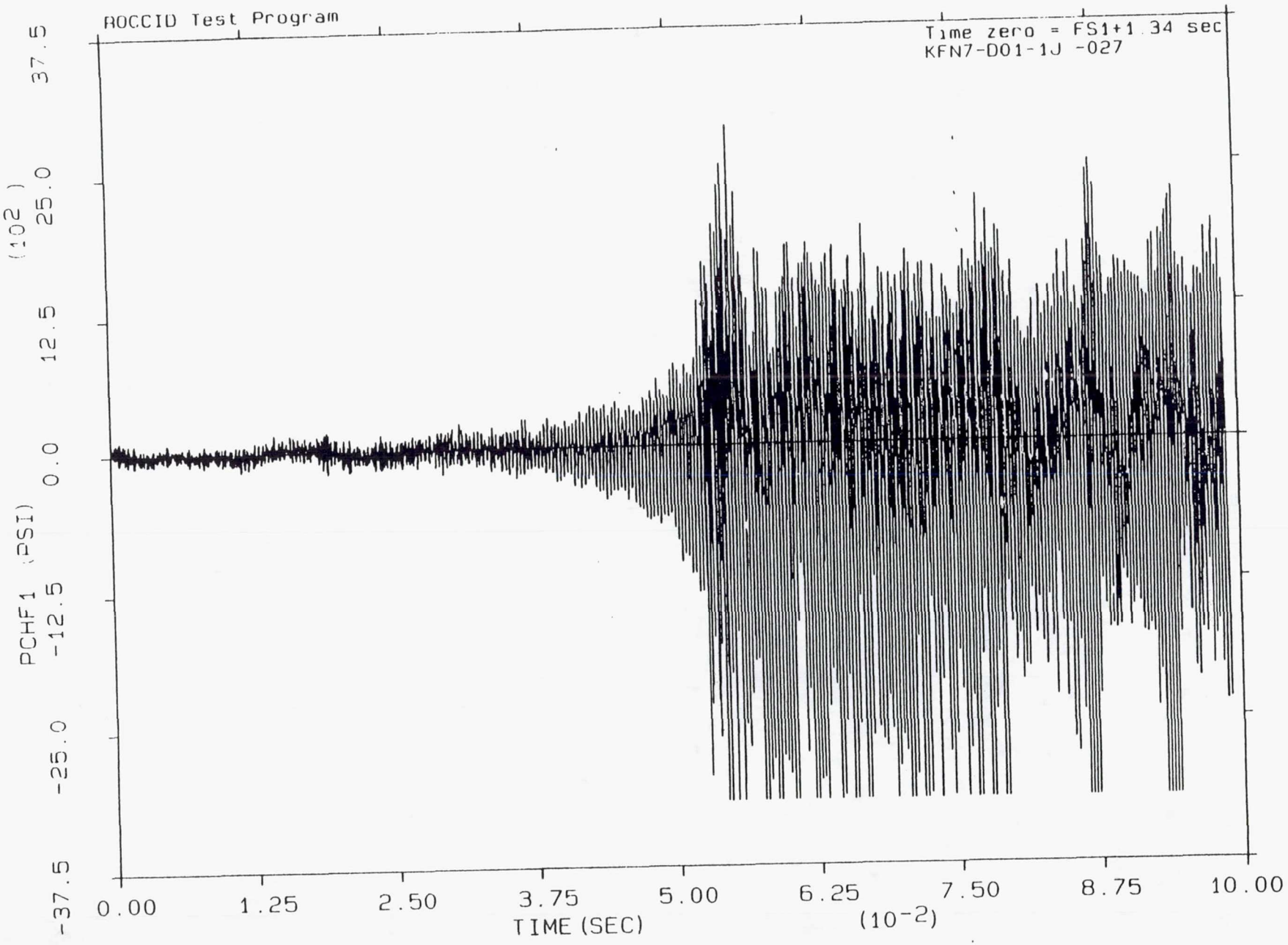

SPECTRA OF PCHF2 (PSI) : 19 SEGMENTS
FS1+1.29 to FS1+1.39 sec
KFN7-D01-1J -025
SEGMENT TIME= 5.000E-03
DAMPLITUDE = 40.0
DF / SEGMENT= 200.
DH / SEGMENT= 31.6
G (UNITS**2)/HZ
(10^1)
0.0
20.0
40.0
60.0
80.0
100.0
120.0
-4.0
-2.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
FREQUENCY (HZ)
(10^3)

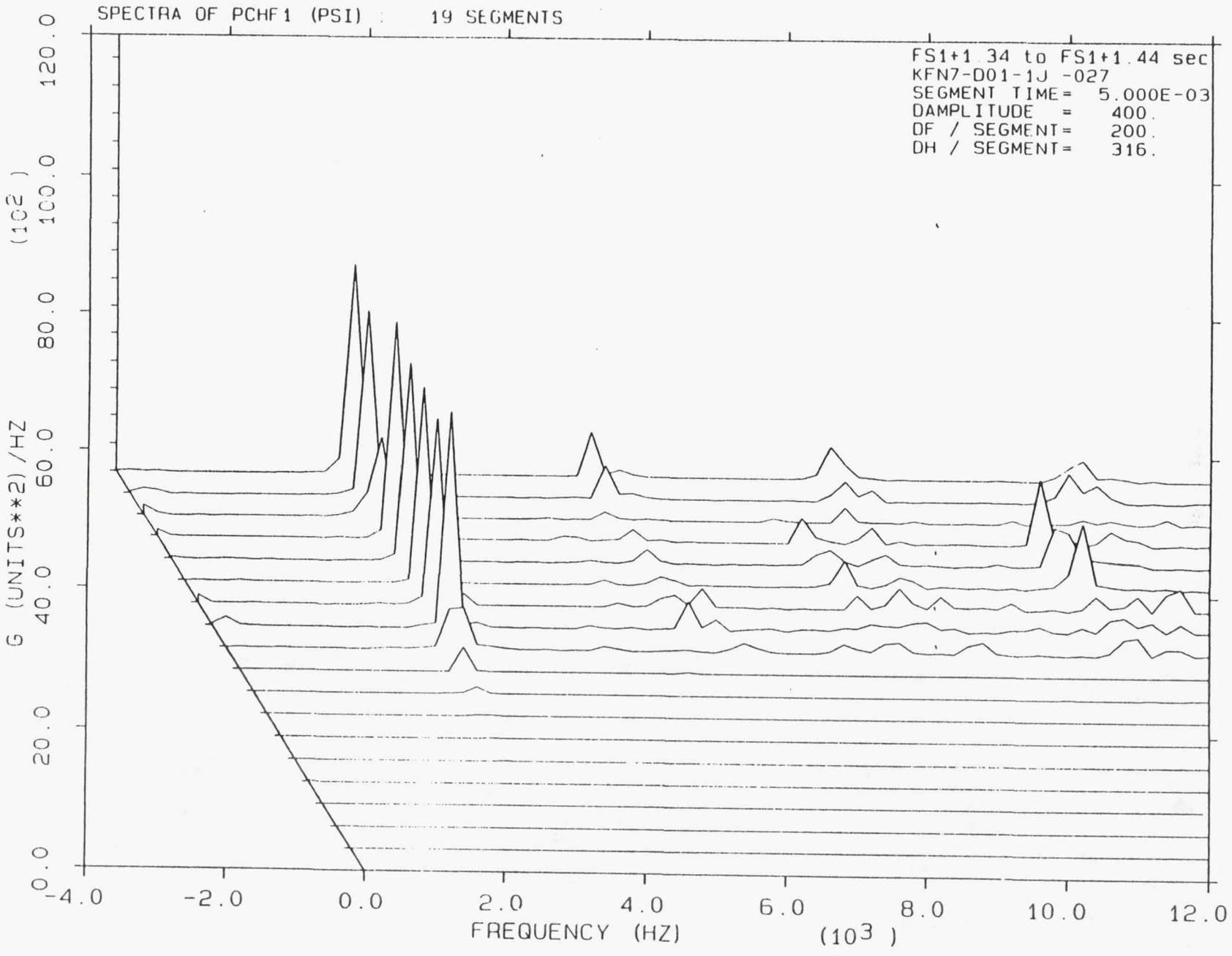

AUTOSPECTRAL DENSITY OF PCHF2 (PSI)
FS1+ 1.35 - 1.38 sec.
KFN7-D01-1J -025
WINDOW =NONE
DISTINCT AVG= 5
BANDWIDTH = 165.
VARIANCE = 2.657E+05
G (UNITS SQD./HZ)
10³
10²
10¹
10⁰
10⁻¹
0.0
15.0
30.0
45.0
60.0
75.0
90.0
105.0
120.0
FREQUENCY
(10²)

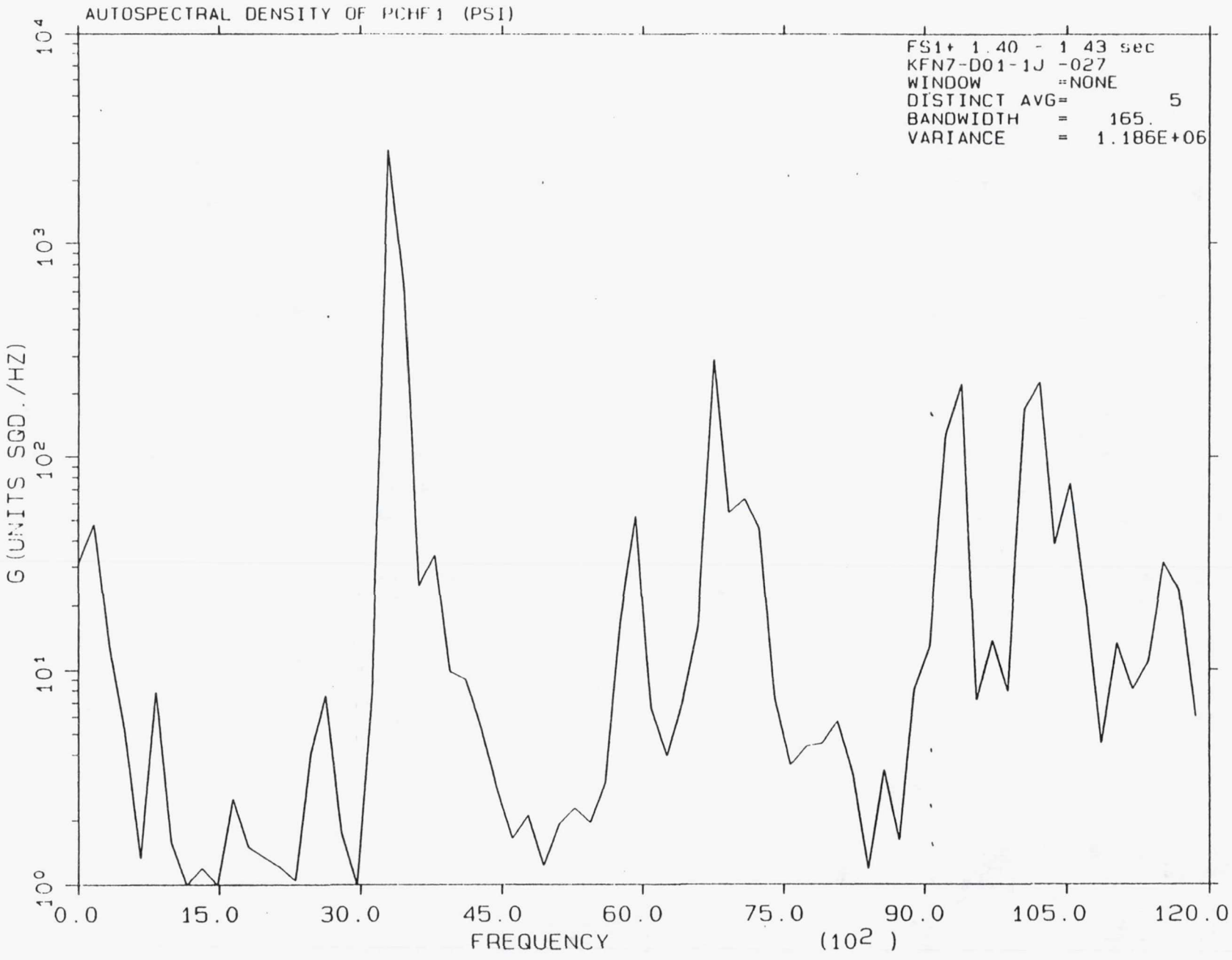

ROCCID Test Program
Time zero = FS1+1.4 sec
PCHF1 (PSI)
(10^2)
30.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
0.00
1.25
2.50
3.75
5.00
6.25
7.50
8.75
10.00
TIME (SEC)
(10^-2)

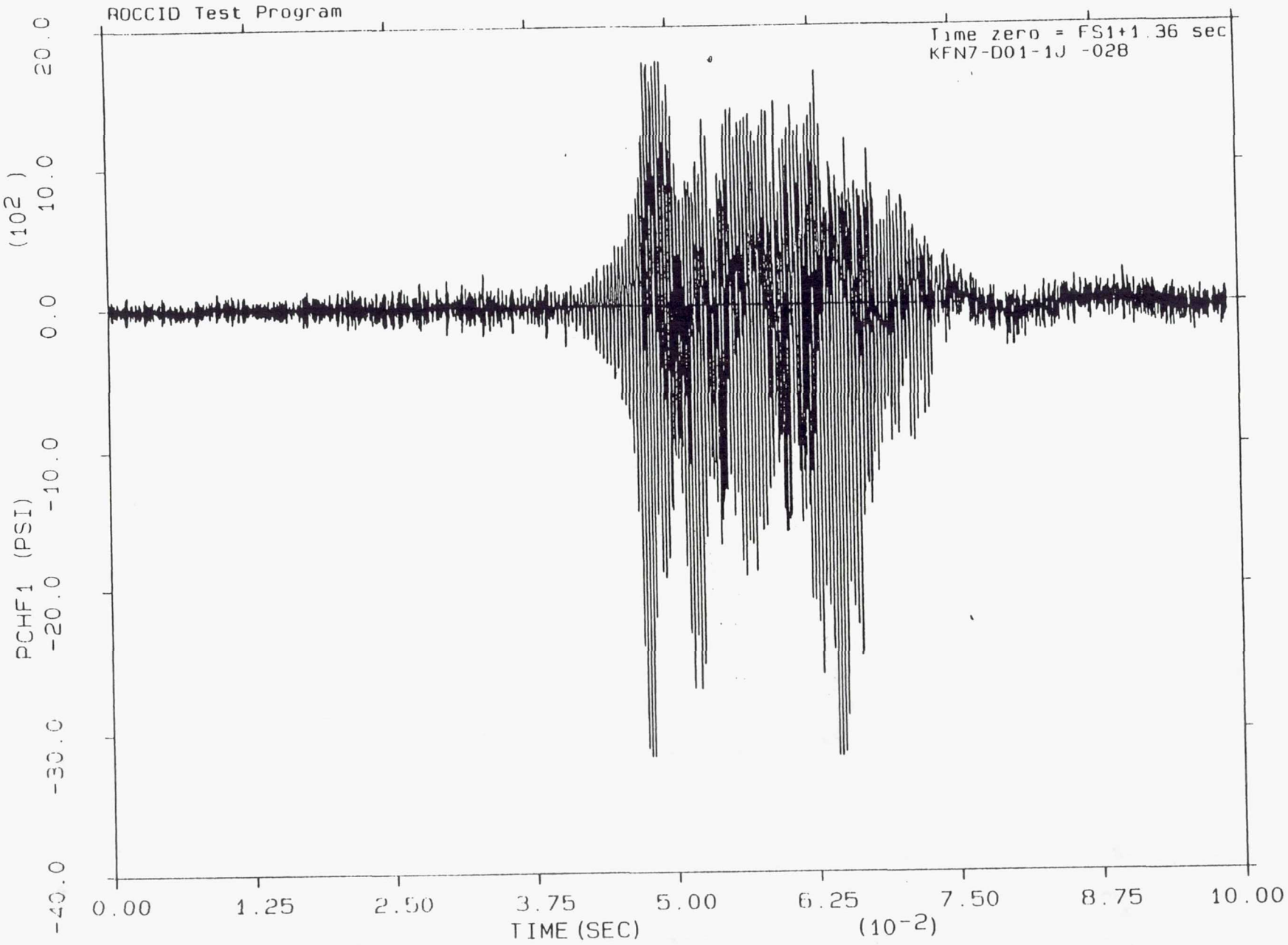

SPECTRA OF PCHF1 (PSI) 19 SEGMENTS
FS1+1.4 to FS1+1.5 sec
KFN7-D01-1J -026
SEGMENT TIME= 5.000E-03
DAMPLITUDE = 400.
DF / SEGMENT= 200.
DH / SEGMENT= 316.
G (UNITS**2)/HZ
(10^2)
0.0
20.0
40.0
60.0
80.0
100.0
120.0
-4.0
-2.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
FREQUENCY (HZ)
(10^3)

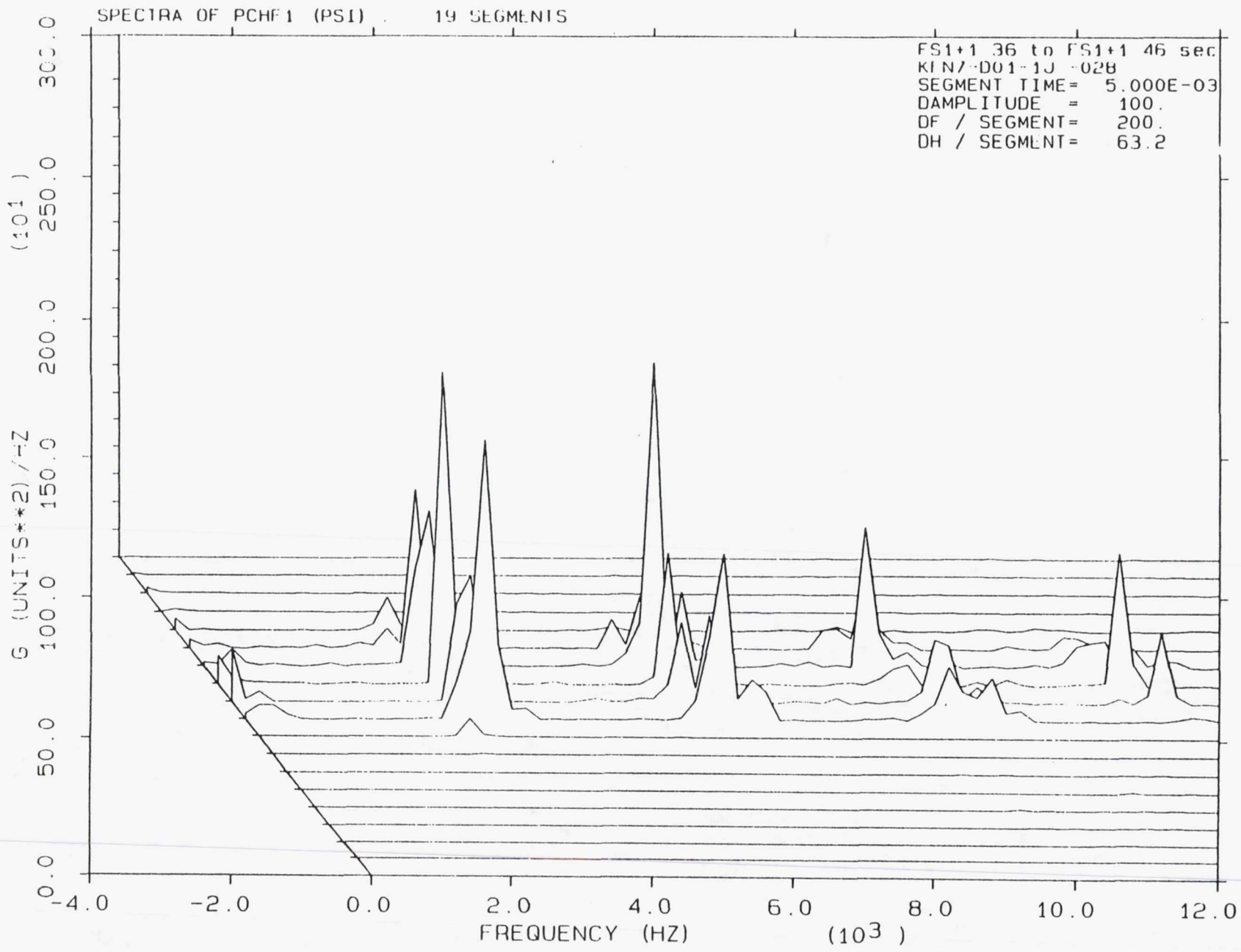

AUTOSPECTRAL DENSITY OF PCHF 1 (PSI)
FS1+ 1.46 - 1 49 sec.
KFN7-D01-1J -026
WINDOW =NONE
DISTINCT AVG= 5
BANDWIDTH = 165.
VARIANCE = 1.833E+06
G (UNITS SQD./HZ)
10⁴
10³
10²
10¹
10⁰
0.0
15.0
30.0
45.0
60.0
75.0
90.0
105.0
120.0
FREQUENCY
(10²)

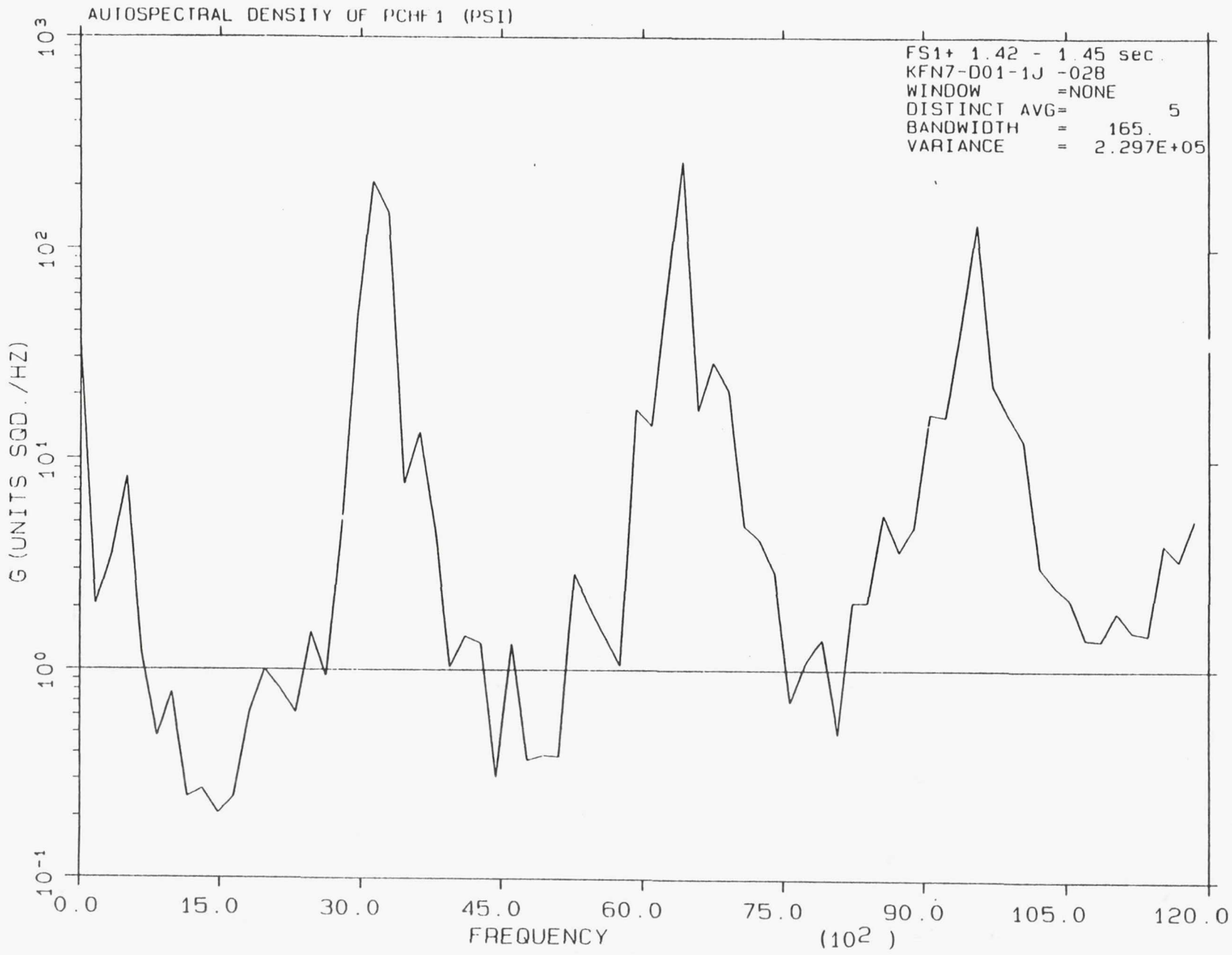

ROCCID Test Program
Time zero = FS1+1.34 sec
KFN7-D01-1J -027
PCHF1 (PSI)
(10^2)
37.5
25.0
12.5
0.0
-12.5
-25.0
-37.5
0.00
1.25
2.50
3.75
5.00
6.25
7.50
8.75
10.00
TIME (SEC)
(10^-2)

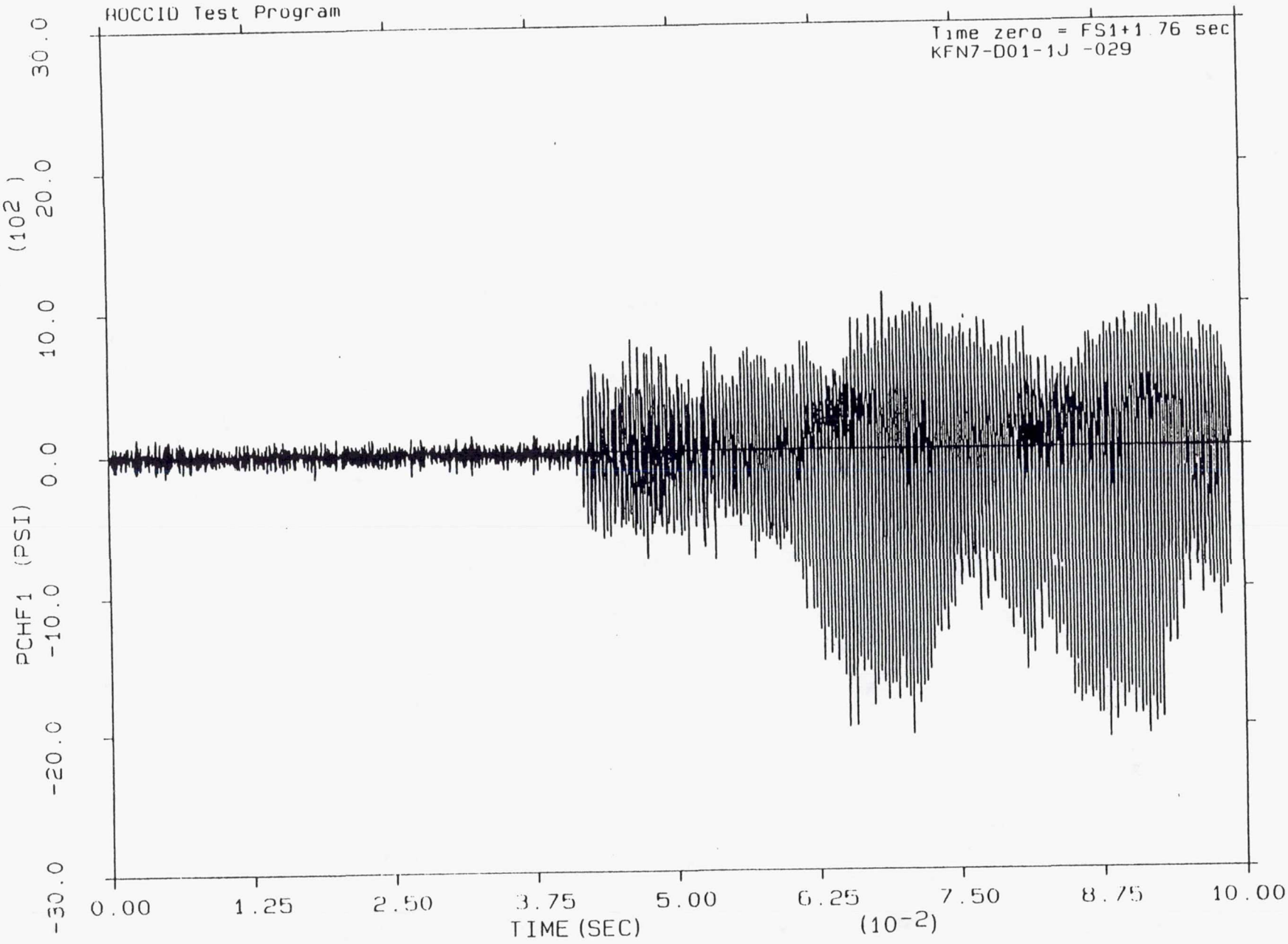

SPECTRA OF PCHF1 (PSI) : 19 SEGMENTS
FS1+1.34 to FS1+1.44 sec
KFN7-D01-1J -027
SEGMENT TIME= 5.000E-03
DAMPLITUDE = 400.
DF / SEGMENT= 200.
DH / SEGMENT= 316.
G (UNITS**2)/HZ
(10^2)
0.0
20.0
40.0
60.0
80.0
100.0
120.0
-4.0
-2.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
FREQUENCY (HZ)
(10^3)

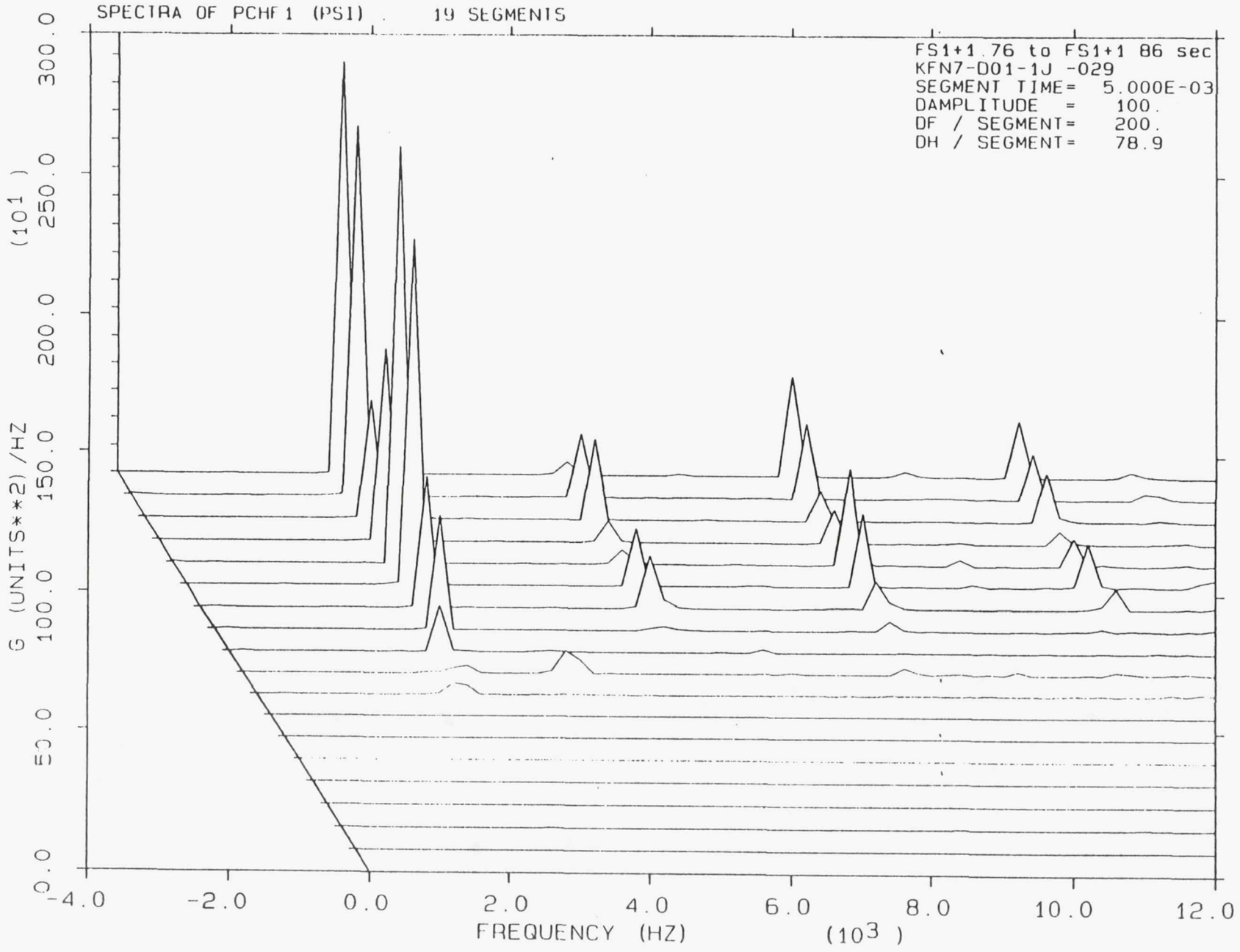

AUTOSPECTRAL DENSITY OF PCHF1 (PSI)
FS1+ 1.40 - 1.43 sec
KFN7-D01-1J -027
WINDOW =NONE
DISTINCT AVG= 5
BANDWIDTH = 165.
VARIANCE = 1.186E+06
G (UNITS SQD./HZ)
10⁴
10³
10²
10¹
10⁰
0.0
15.0
30.0
45.0
60.0
75.0
90.0
105.0
120.0
FREQUENCY
(10²)

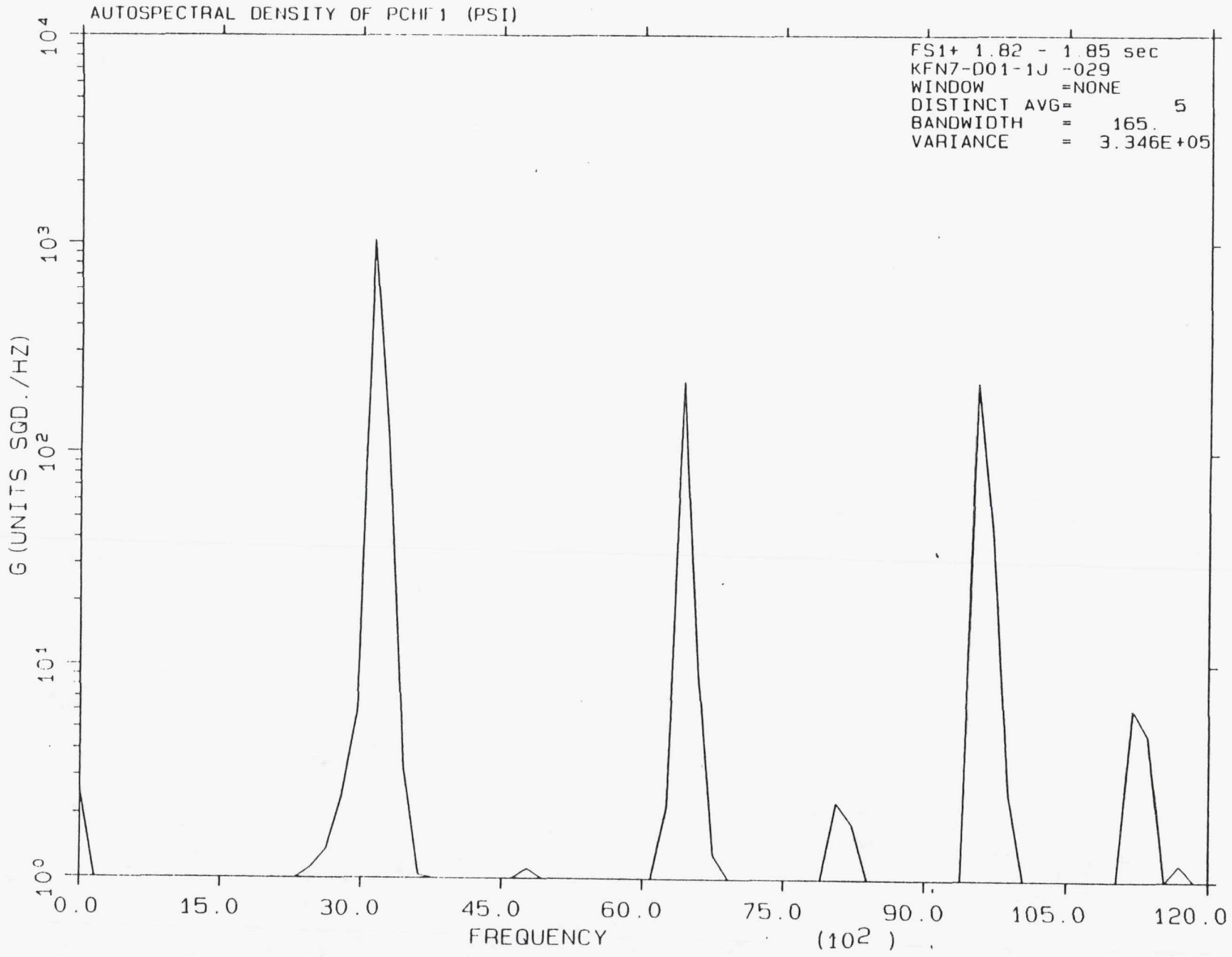

AOCCID Test Program
Time zero = FS1+1.36 sec
KFN7-D01-1J -028
PCHF1 (PSI) (10^2)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
0.00
1.25
2.50
3.75
5.00
6.25
7.50
8.75
10.00
TIME (SEC)
(10^-2)

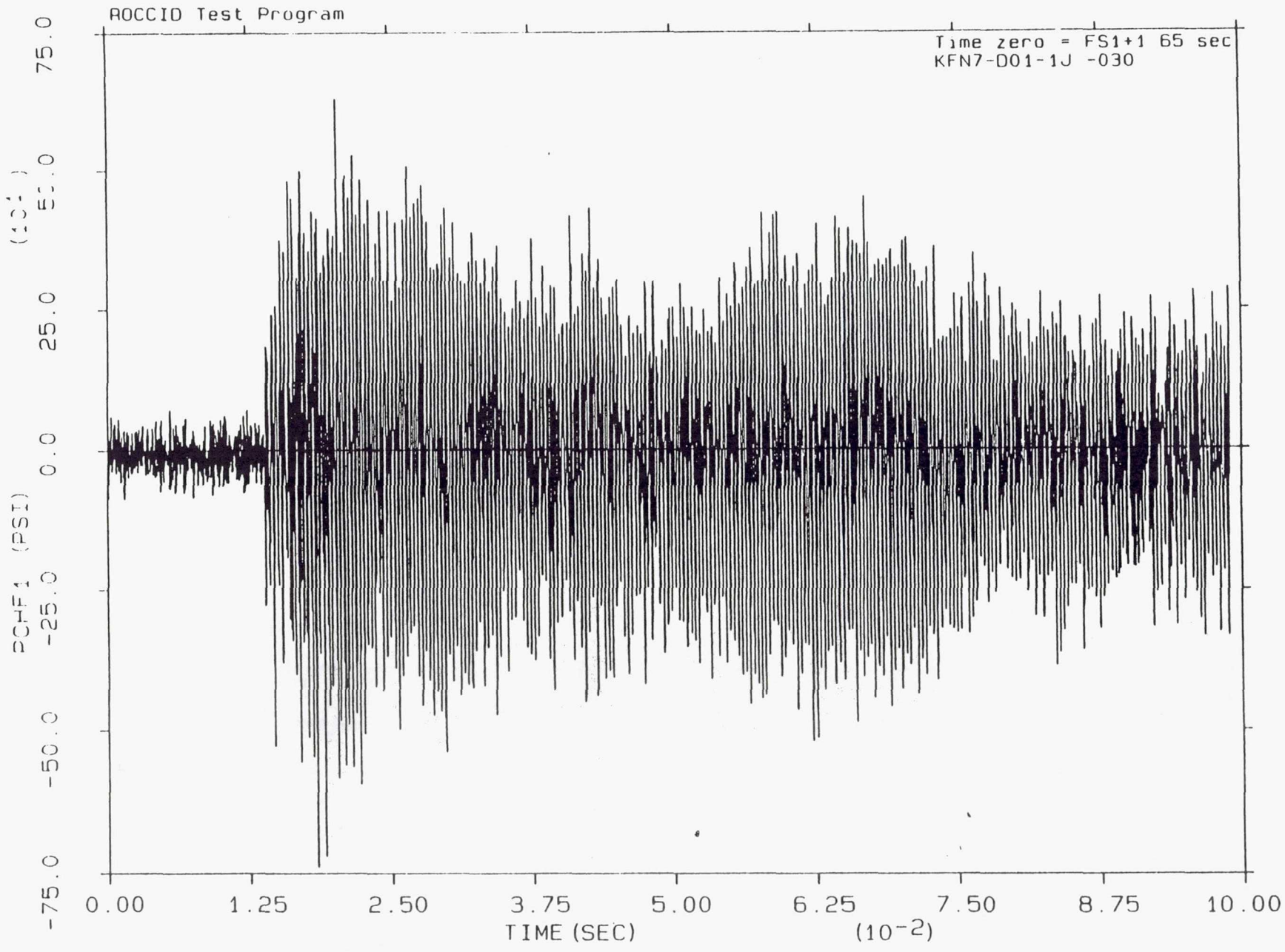

SPECTRA OF PCHF1 (PSI) . 19 SEGMENTS
FS1+1.36 to FS1+1.46 sec
KIN7-D01-1J -028
SEGMENT TIME= 5.000E-03
DAMPLITUDE = 100.
DF / SEGMENT= 200.
DH / SEGMENT= 63.2
G (UNITS**2)/HZ (10^1)
0.0
50.0
100.0
150.0
200.0
250.0
300.0
-4.0
-2.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
FREQUENCY (HZ)
(10^3)

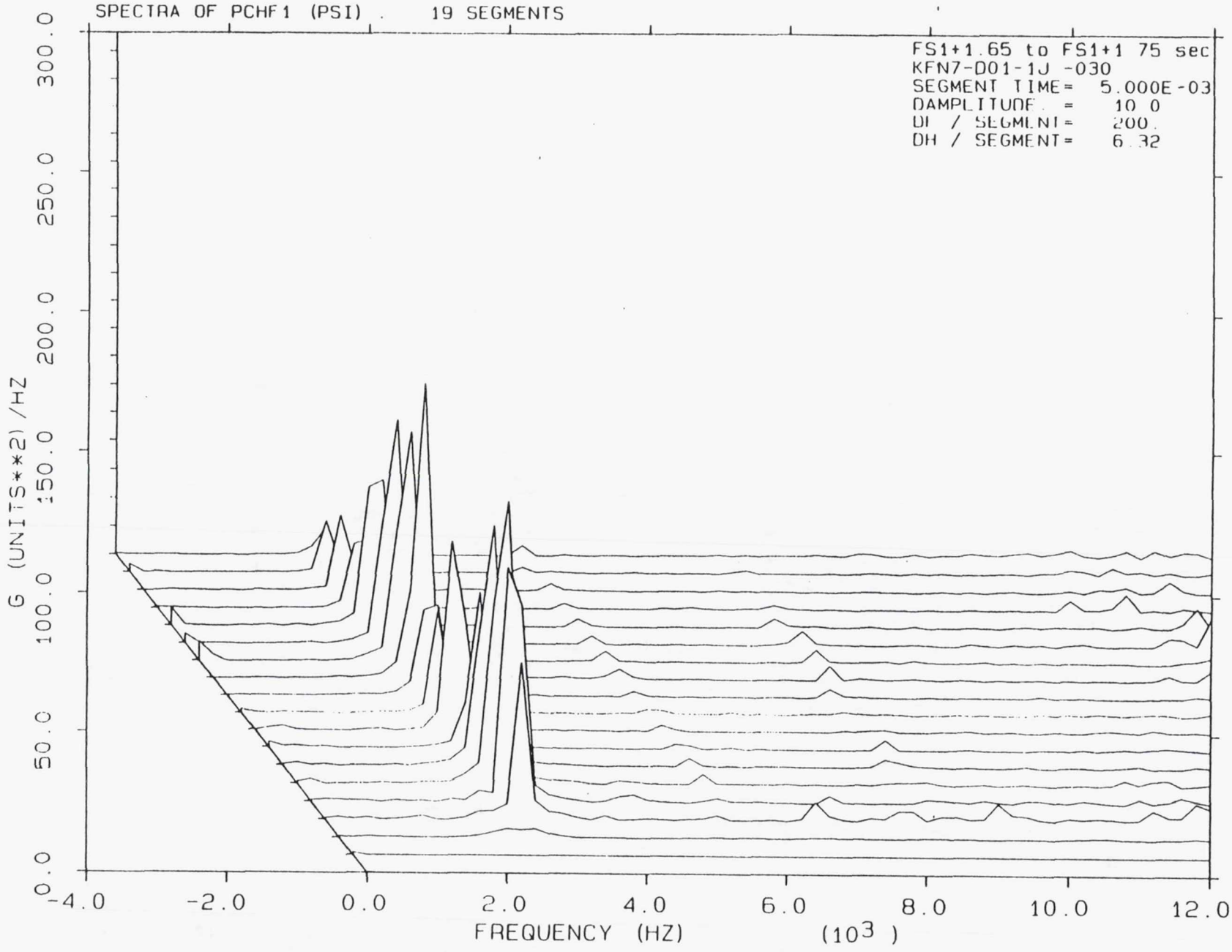

AUTOSPECTRAL DENSITY OF PCHF 1 (PSI)
FS1+ 1.42 - 1.45 sec.
KFN7-D01-1J -028
WINDOW =NONE
DISTINCT AVG= 5
BANDWIDTH = 165.
VARIANCE = 2.297E+05
G (UNITS SQD./HZ)
10^3
10^2
10^1
10^0
10^{-1}
0.0
15.0
30.0
45.0
60.0
75.0
90.0
105.0
120.0
FREQUENCY
(10^2)

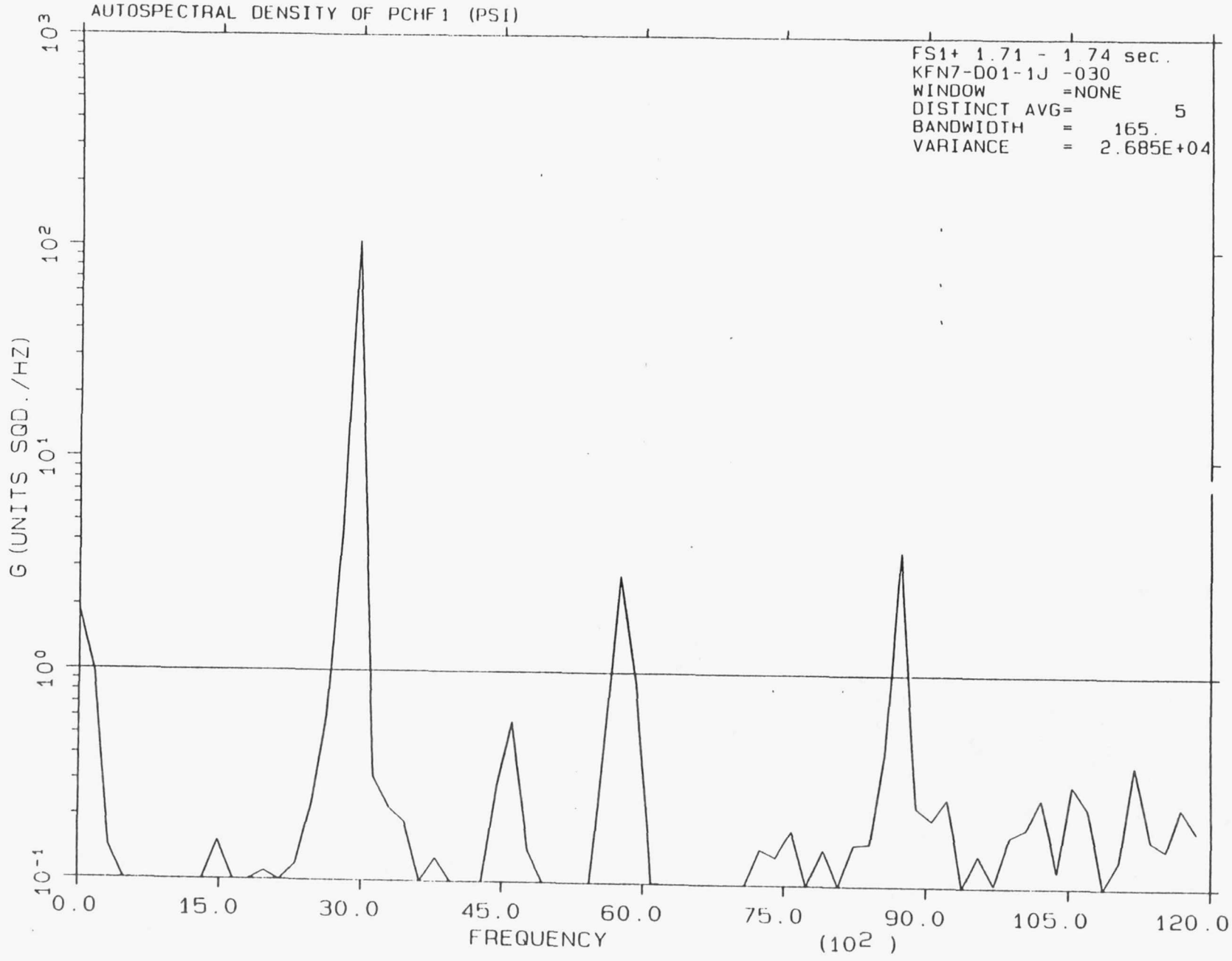

ROCCID Test Program
Time zero = FS1+1.76 sec
KFN7-D01-1J -029
PCHF1 (PSI)
(10^2)
30.0
20.0
10.0
0.0
-10.0
-20.0
-30.0
0.00
1.25
2.50
3.75
5.00
6.25
7.50
8.75
10.00
TIME (SEC)
(10^-2)

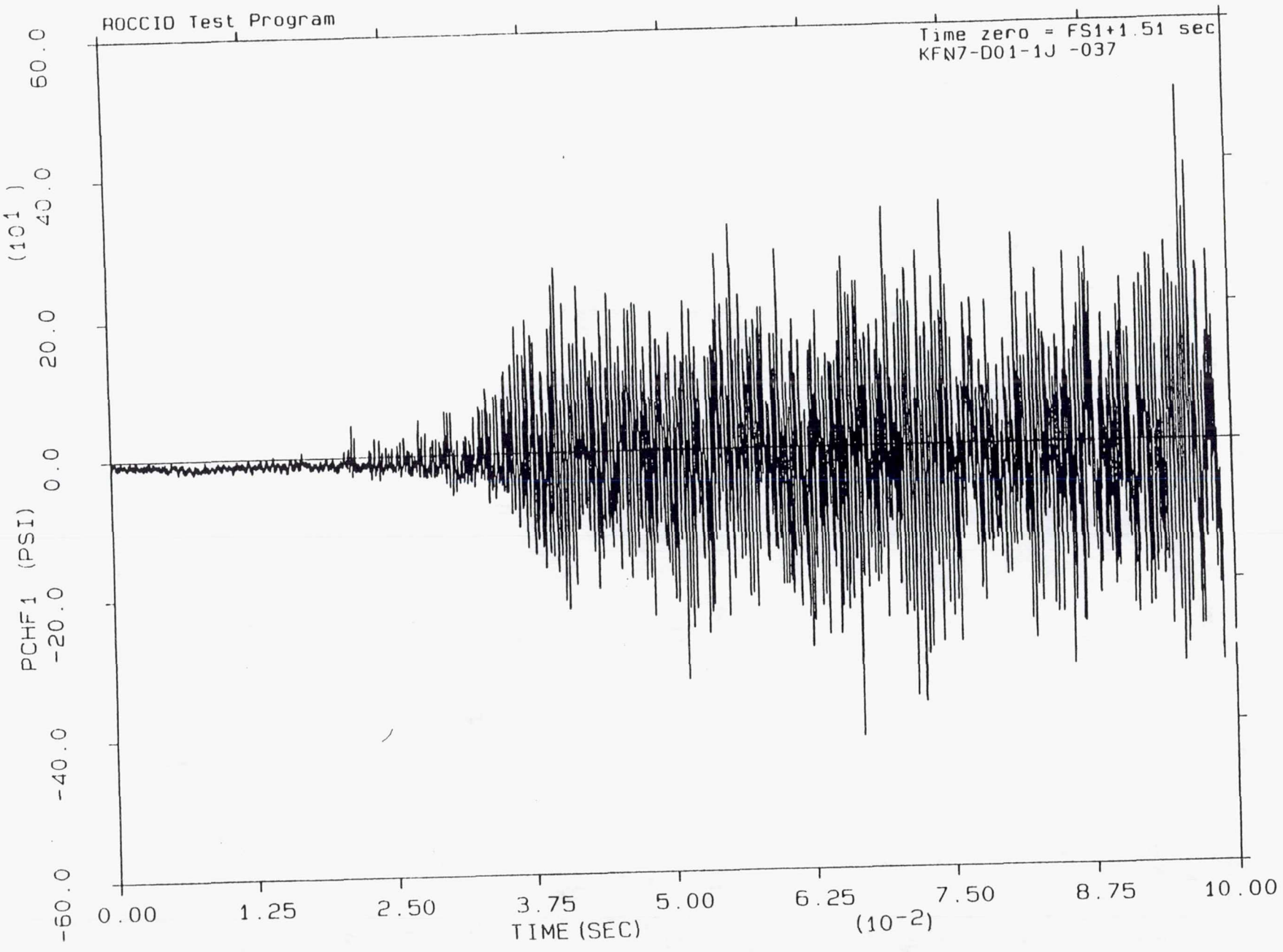

SPECTRA OF PCHF1 (PSI) 19 SEGMENTS
FS1+1.76 to FS1+1.86 sec
KFN7-D01-1J -029
SEGMENT TIME= 5.000E-03
DAMPLITUDE = 100.
DF / SEGMENT= 200.
DH / SEGMENT= 78.9
G (UNITS**2)/HZ
(10^1)
300.0
250.0
200.0
150.0
100.0
50.0
0.0
-4.0
-2.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
FREQUENCY (HZ)
(10^3)

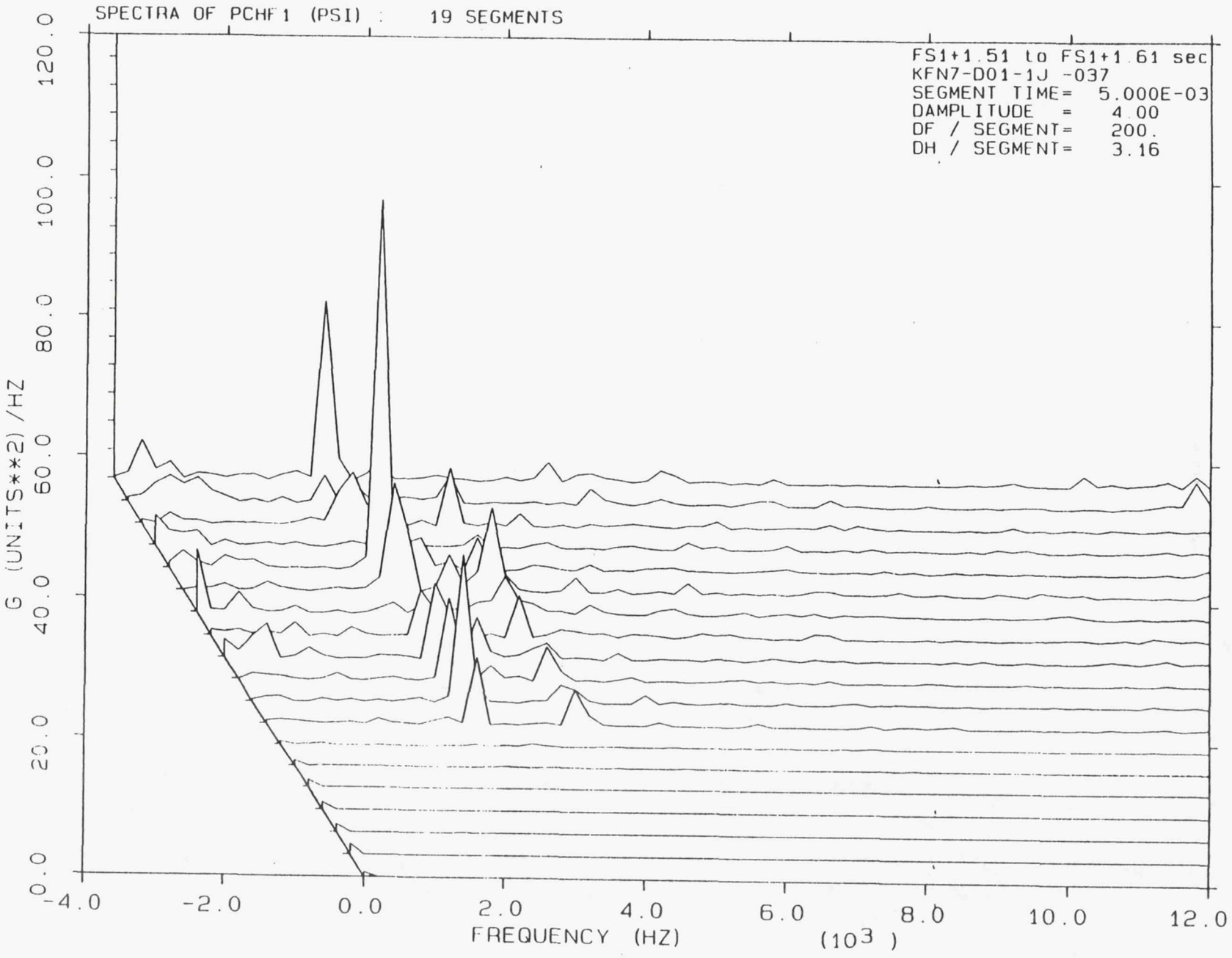

AUTOSPECTRAL DENSITY OF PCHF 1 (PSI)
FS1+ 1.82 - 1.85 sec
KFN7-D01-1J -029
WINDOW =NONE
DISTINCT AVG= 5
BANDWIDTH = 165.
VARIANCE = 3.346E+05
G(UNITS SQD./HZ)
10^4
10^3
10^2
10^1
10^0
0.0
15.0
30.0
45.0
60.0
75.0
90.0
105.0
120.0
FREQUENCY
(10^2)

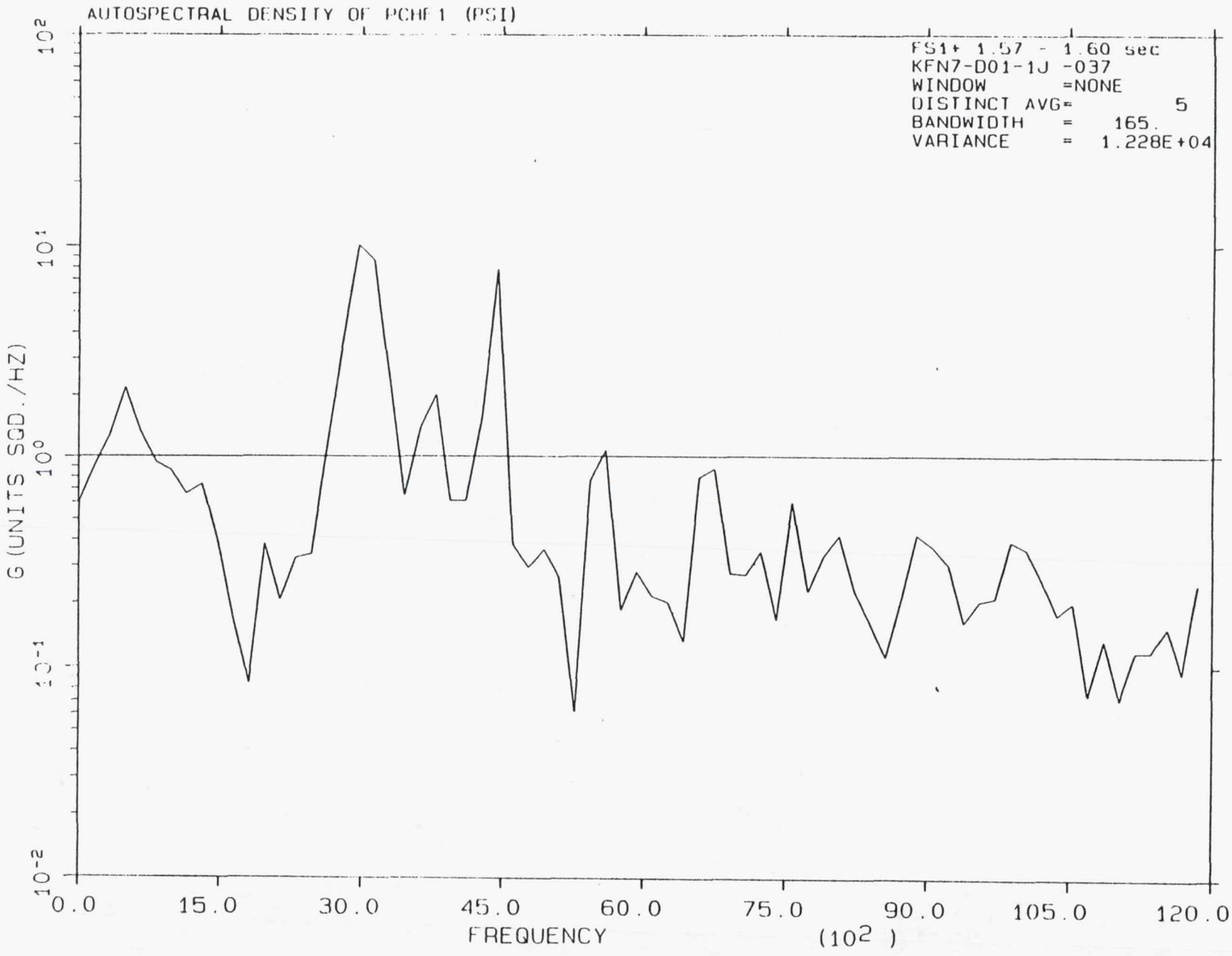

AOCCID Test Program
Time zero = FS1+1 65 sec
KFN7-D01-1J -030
75.0
25.0
0.0
-25.0
-50.0
-75.0
PCHF1 (PSI)
0.00
1.25
2.50
3.75
5.00
6.25
7.50
8.75
10.00
TIME (SEC)
(10-2)

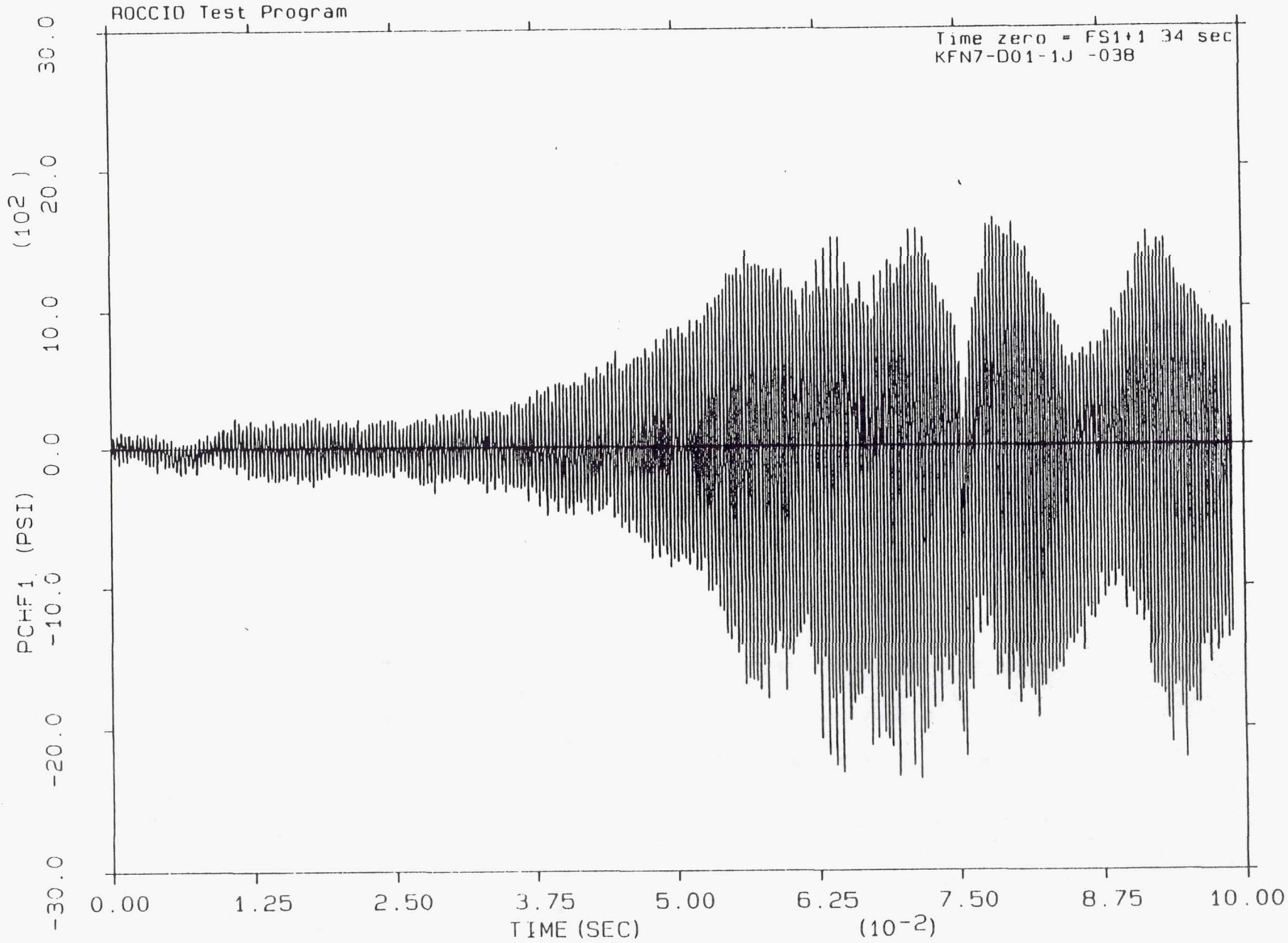

SPECTRA OF PCHF1 (PSI) . 19 SEGMENTS
FS1+1.65 to FS1+1 75 sec
KFN7-D01-1J -030
SEGMENT TIME= 5.000E-03
DAMPLITUDE = 10 0
DI / SEGMENT= 200.
DH / SEGMENT= 6.32
G (UNITS**2)/HZ
0.0
50.0
100.0
150.0
200.0
250.0
300.0
-4.0
-2.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
FREQUENCY (HZ)
(10^3)

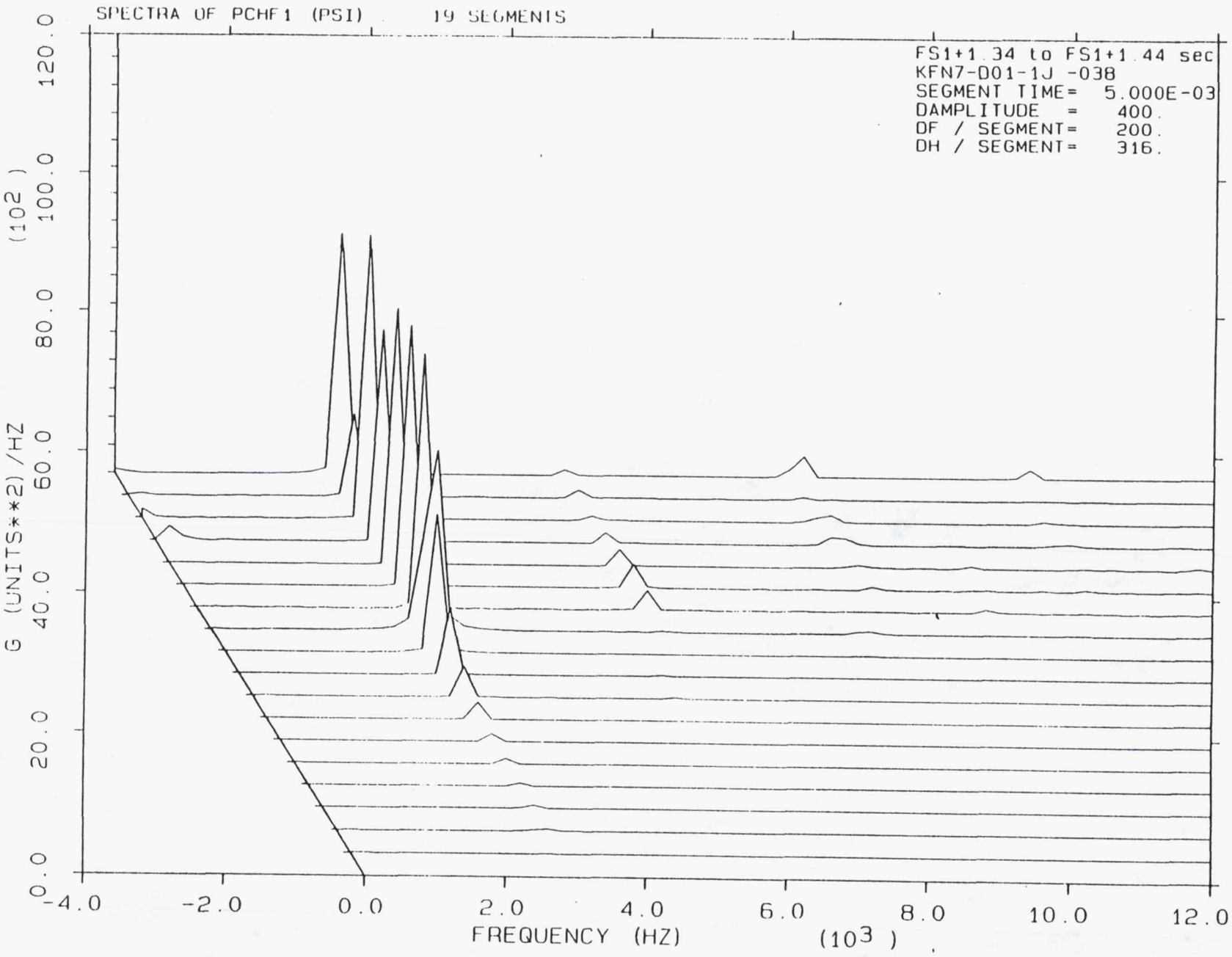

AUTOSPECTRAL DENSITY OF PCHF1 (PSI)
FS1+ 1.71 - 1 74 sec.
KFN7-D01-1J -030
WINDOW =NONE
DISTINCT AVG= 5
BANDWIDTH = 165.
VARIANCE = 2.685E+04
G (UNITS SQD./HZ)
10³
10²
10¹
10⁰
10⁻¹
0.0
15.0
30.0
45.0
60.0
75.0
90.0
105.0
120.0
FREQUENCY
(10²)

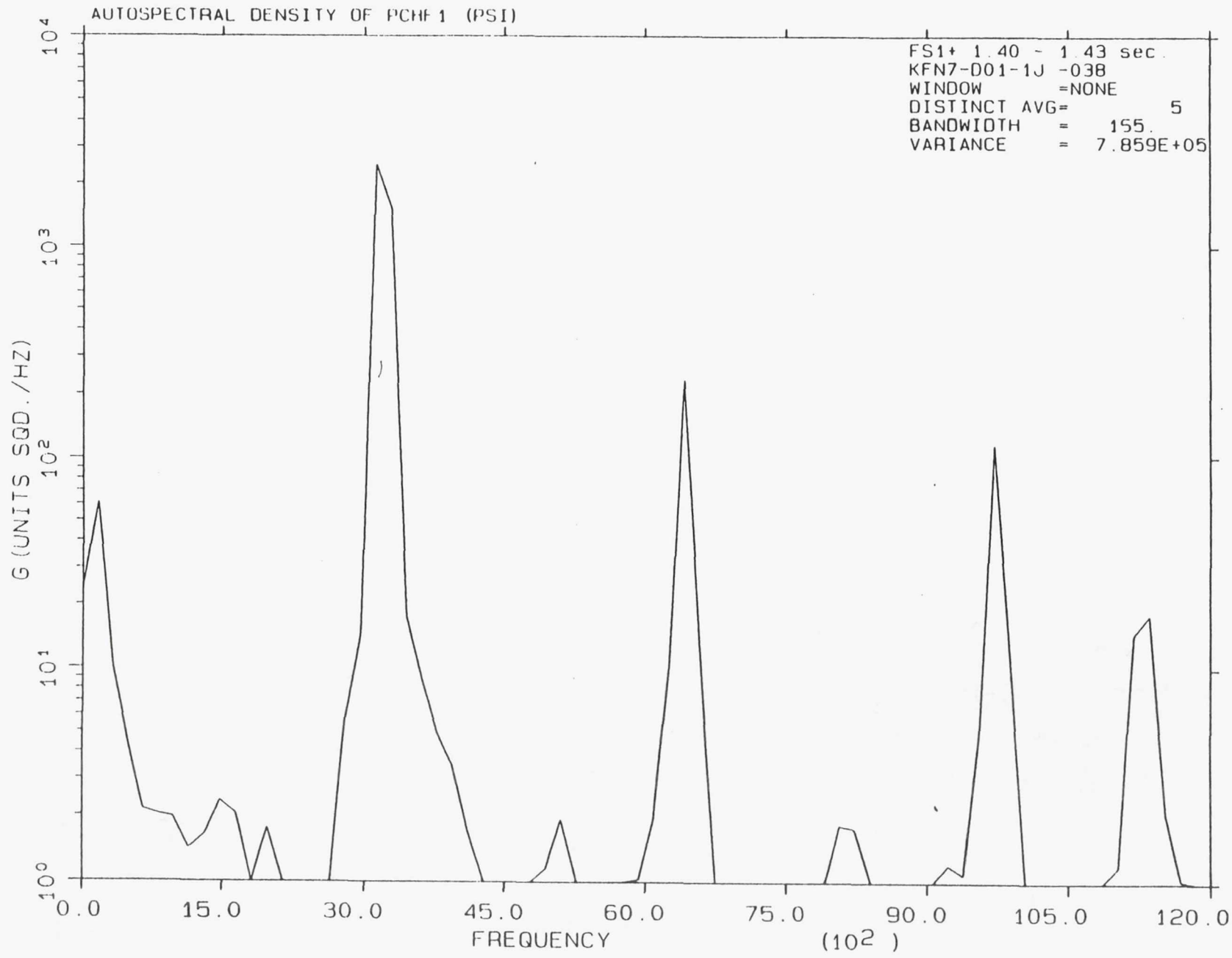

ROCCID Test Program
Time zero = FS1+1.51 sec
KFN7-D01-1J -037
PCHF1 (PSI)
(10^1)
60.0
40.0
20.0
0.0
-20.0
-40.0
-60.0
0.00
1.25
2.50
3.75
5.00
6.25
7.50
8.75
10.00
TIME (SEC)
(10^-2)

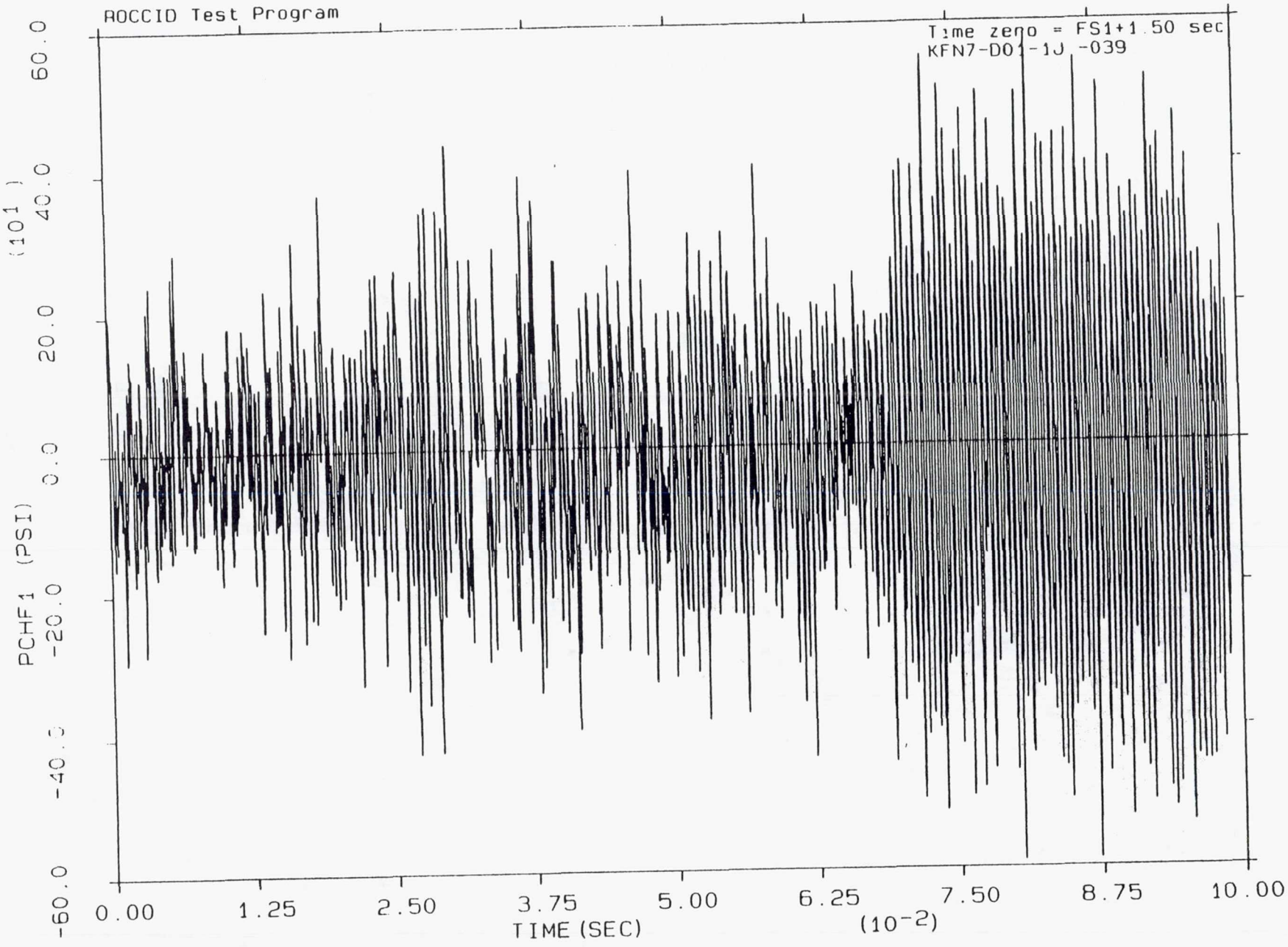

SPECTRA OF PCHF1 (PSI) : 19 SEGMENTS
FS1+1.51 to FS1+1.61 sec
KFN7-D01-1J -037
SEGMENT TIME= 5.000E-03
DAMPLITUDE = 4.00
DF / SEGMENT= 200.
DH / SEGMENT= 3.16
G (UNITS**2)/HZ
0.0
20.0
40.0
60.0
80.0
100.0
120.0
-4.0
-2.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
FREQUENCY (HZ)
(10^3)

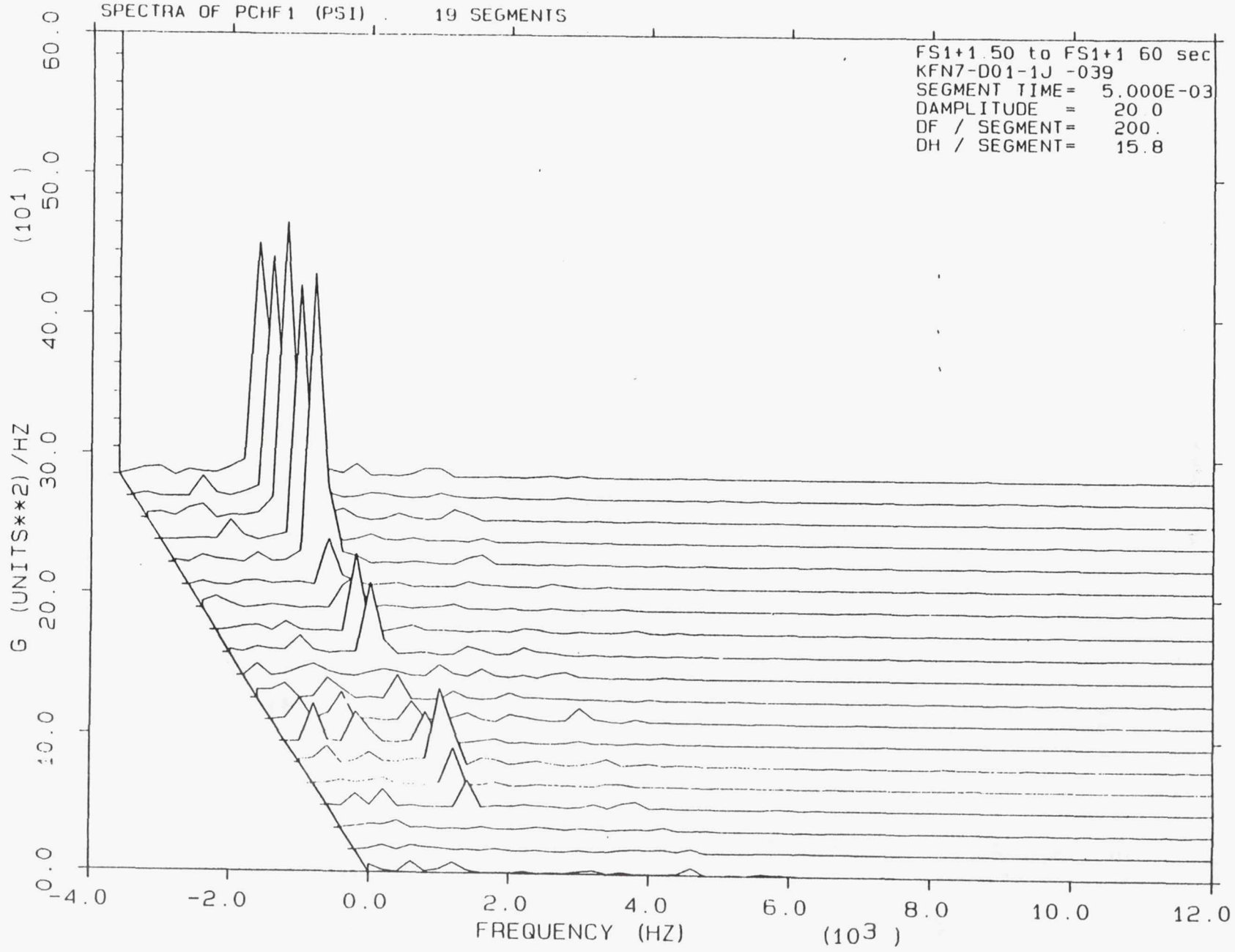

AUTOSPECTRAL DENSITY OF PCHF 1 (PSI)
FS1+ 1.57 - 1.60 sec
KFN7-D01-1J -037
WINDOW =NONE
DISTINCT AVG= 5
BANDWIDTH = 165.
VARIANCE = 1.228E+04
G (UNITS SQD./HZ)
10²
10¹
10⁰
10⁻¹
10⁻²
0.0
15.0
30.0
45.0
60.0
75.0
90.0
105.0
120.0
FREQUENCY
(10²)

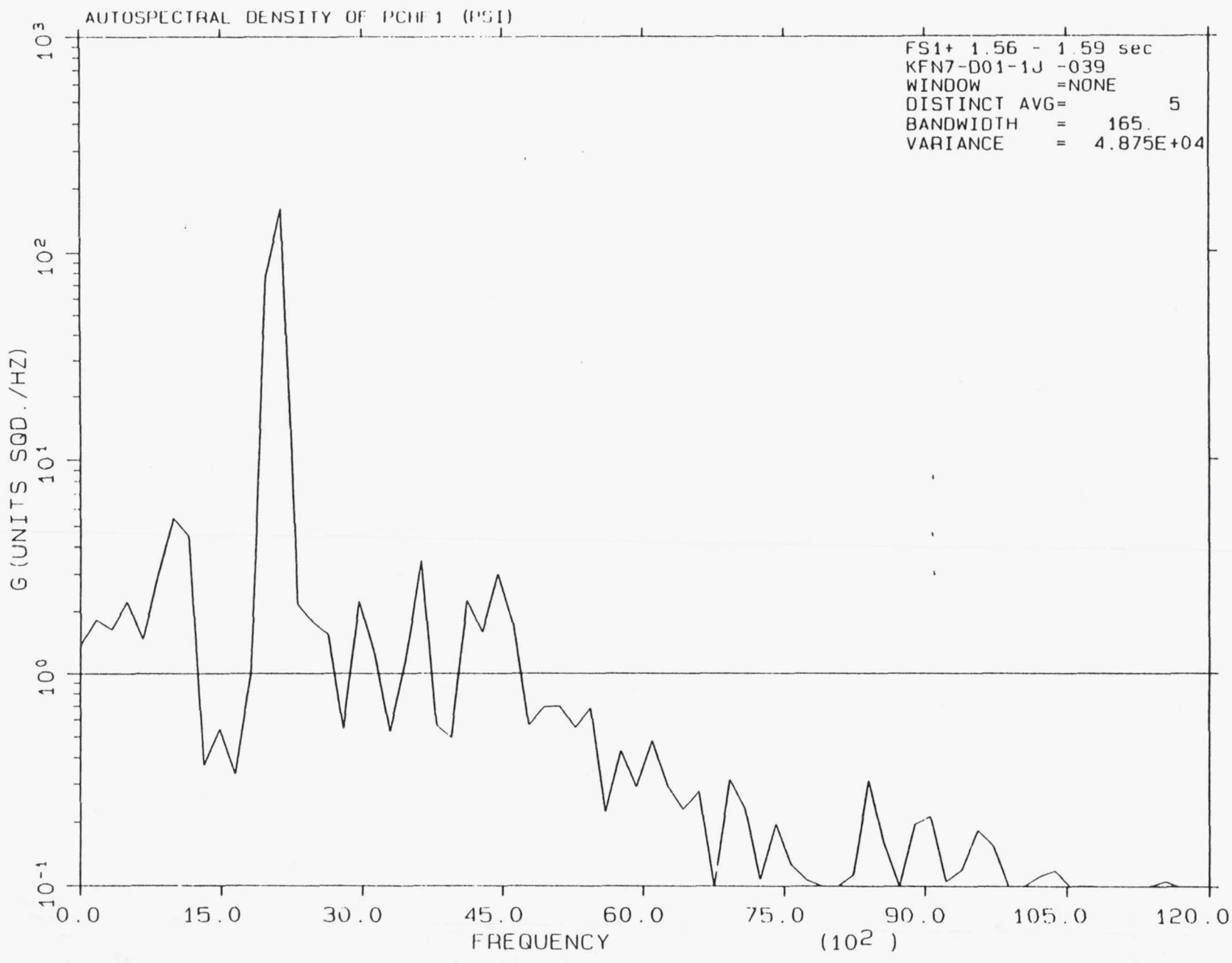

ROCCID Test Program
Time zero = FS1+1 34 sec
KFN7-D01-1J -038
PCHF1 (PSI)
(10^2)
30.0
20.0
10.0
0.0
-10.0
-20.0
-30.0
0.00
1.25
2.50
3.75
5.00
6.25
7.50
8.75
10.00
TIME (SEC)
(10^-2)

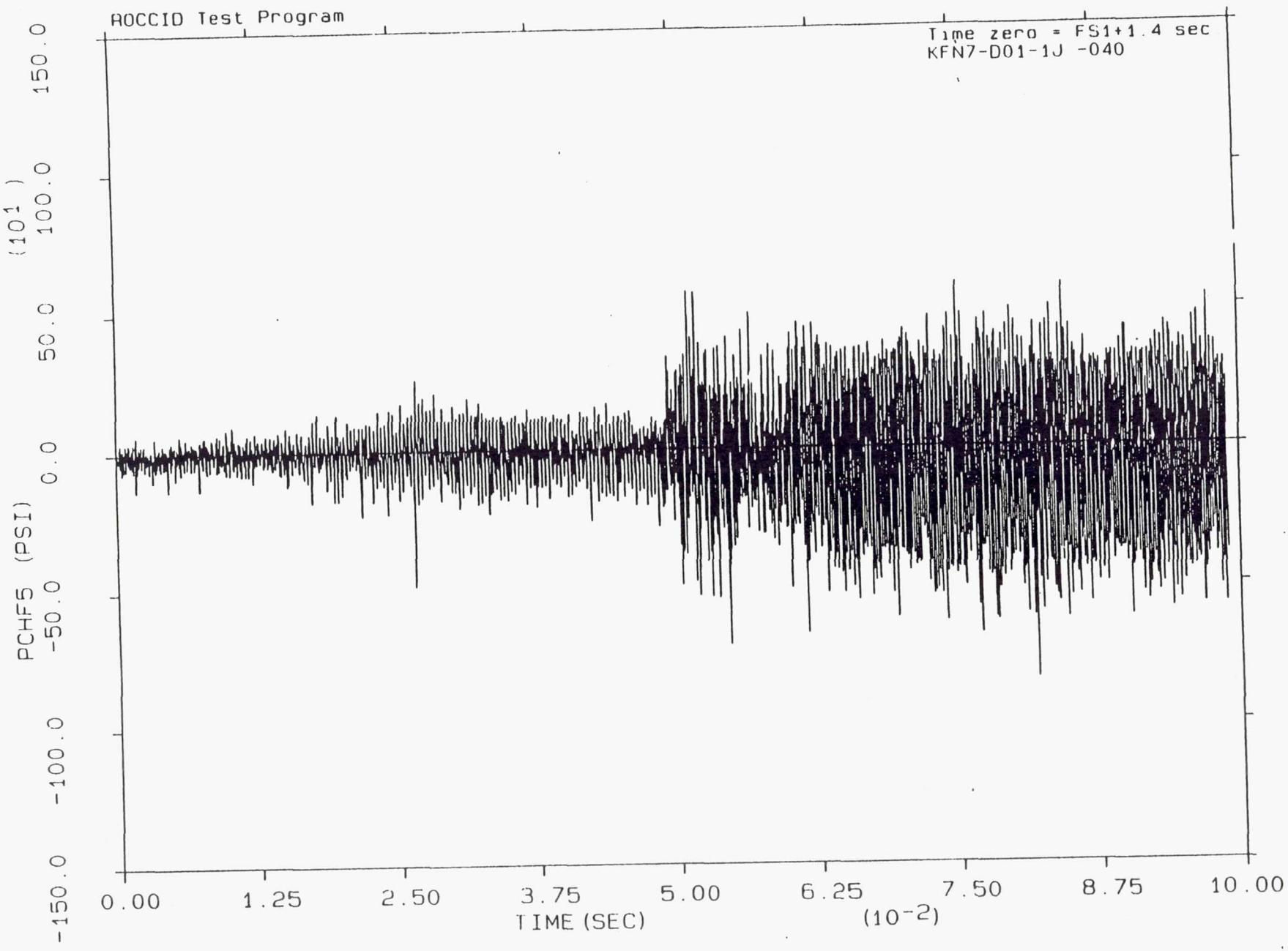

SPECTRA OF PCHF1 (PSI)
19 SEGMENTS
FS1+1.34 to FS1+1.44 sec
KFN7-D01-1J -038
SEGMENT TIME= 5.000E-03
DAMPLITUDE = 400.
DF / SEGMENT= 200.
DH / SEGMENT= 316.
G (UNITS**2)/HZ
(10^2)
0.0
20.0
40.0
60.0
80.0
100.0
120.0
-4.0
-2.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
FREQUENCY (HZ)
(10^3)

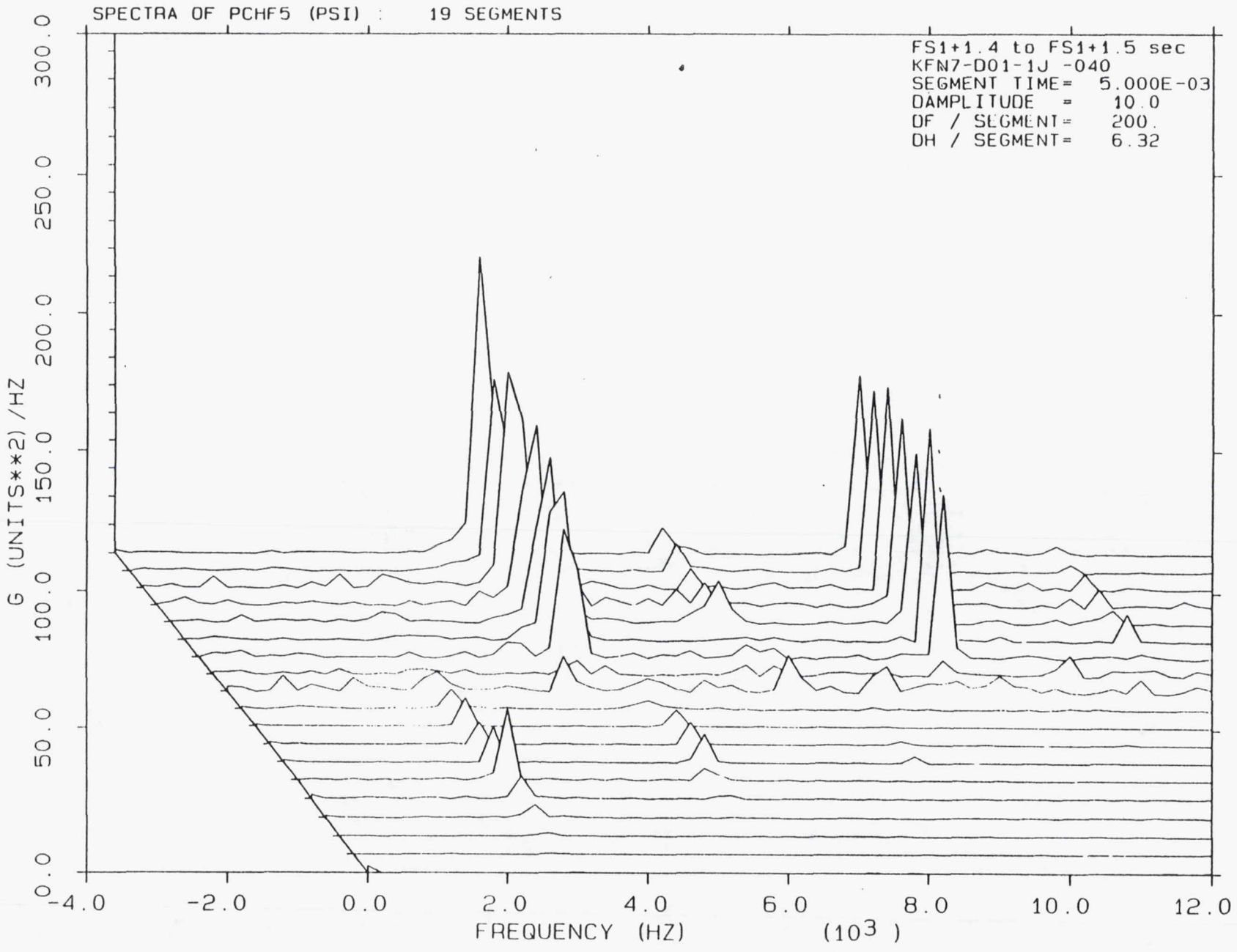

AUTOSPECTRAL DENSITY OF PCHF 1 (PSI)
FS1+ 1.40 - 1.43 sec.
KFN7-D01-1J -038
WINDOW =NONE
DISTINCT AVG= 5
BANDWIDTH = 155.
VARIANCE = 7.859E+05
G (UNITS SQD./HZ)
10⁴
10³
10²
10¹
10⁰
0.0
15.0
30.0
45.0
60.0
75.0
90.0
105.0
120.0
FREQUENCY
(10²)

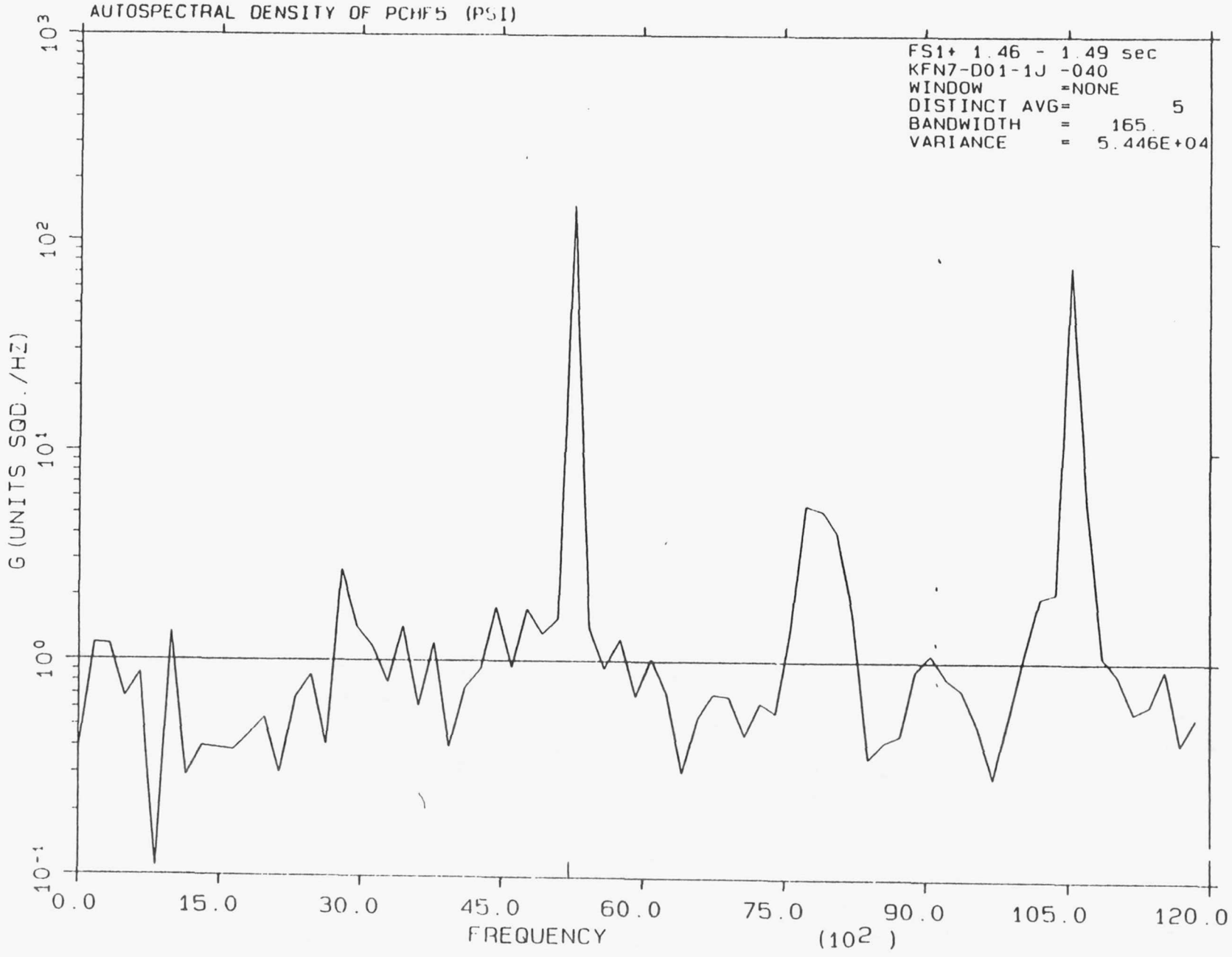

AOCCID Test Program
Time zero = FS1+1.50 sec
KFN7-D01-1J -039
PCHF1 (PSI) (10^1)
60.0
40.0
20.0
0.0
-20.0
-40.0
-60.0
0.00
1.25
2.50
3.75
5.00
6.25
7.50
8.75
10.00
TIME (SEC)
(10^-2)


SPECTRA OF PCHF1 (PSI) 19 SEGMENTS
FS1+1.50 to FS1+1.60 sec
KFN7-D01-1J -039
SEGMENT TIME= 5.000E-03
DAMPLITUDE = 20.0
DF / SEGMENT= 200.
DH / SEGMENT= 15.8
G (UNITS**2)/HZ
(10^1)
60.0
50.0
40.0
30.0
20.0
10.0
0.0
-4.0
-2.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
FREQUENCY (HZ)
(10^3)


AUTOSPECTRAL DENSITY OF PCHF 1 (PSI)
FS1+ 1.56 - 1.59 sec
KFN7-D01-1J -039
WINDOW =NONE
DISTINCT AVG= 5
BANDWIDTH = 165.
VARIANCE = 4.875E+04
G (UNITS SQD./HZ)
10³
10²
10¹
10⁰
10⁻¹
0.0
15.0
30.0
45.0
60.0
75.0
90.0
105.0
120.0
FREQUENCY
(10²)


AOCCID Test Program
Time zero = FS1+1.4 sec
KFN7-D01-1J -040
PCHF5 (PSI)
(10^1)
150.0
100.0
50.0
0.0
-50.0
-100.0
-150.0
0.00
1.25
2.50
3.75
5.00
6.25
7.50
8.75
10.00
TIME (SEC)
(10^-2)


SPECTRA OF PCHF5 (PSI) : 19 SEGMENTS
FS1+1.4 to FS1+1.5 sec
KFN7-D01-1J -040
SEGMENT TIME= 5.000E-03
DAMPLITUDE = 10.0
DF / SEGMENT= 200.
DH / SEGMENT= 6.32
G (UNITS**2) /HZ
0.0
50.0
100.0
150.0
200.0
250.0
300.0
-4.0
-2.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
FREQUENCY (HZ)
(10^3)


AUTOSPECTRAL DENSITY OF PCHF5 (PSI)
FS1+ 1.46 - 1.49 sec
KFN7-D01-1J -040
WINDOW =NONE
DISTINCT AVG= 5
BANDWIDTH = 165.
VARIANCE = 5.446E+04
G (UNITS SQD./HZ)
10³
10²
10¹
10⁰
10⁻¹
0.0
15.0
30.0
45.0
60.0
75.0
90.0
105.0
120.0
FREQUENCY
(10²)

APPENDIX C

TIME SERIES, AMPLITUDE AND FREQUENCY EVOLUTION, AND POWER SPECTRAL ANALYSIS OF MANIFOLD AND CHAMBER PRESSURES AND ACCELERATIONS FOR TEST 004

INDEX OF TEST DATA PLOTS

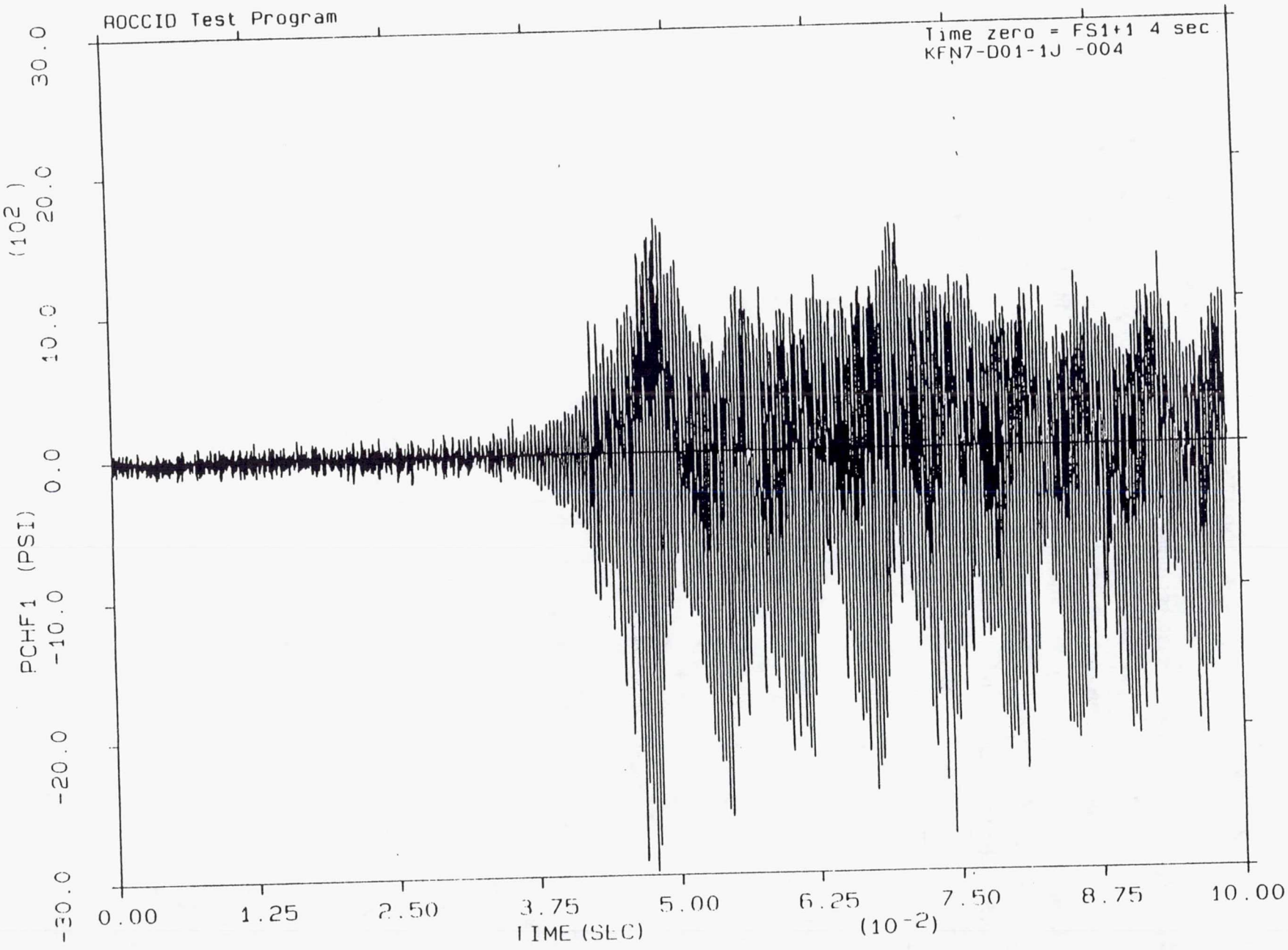
ALL DATA OBTAINED FROM TEST NO. KFN7-D01-1J-004

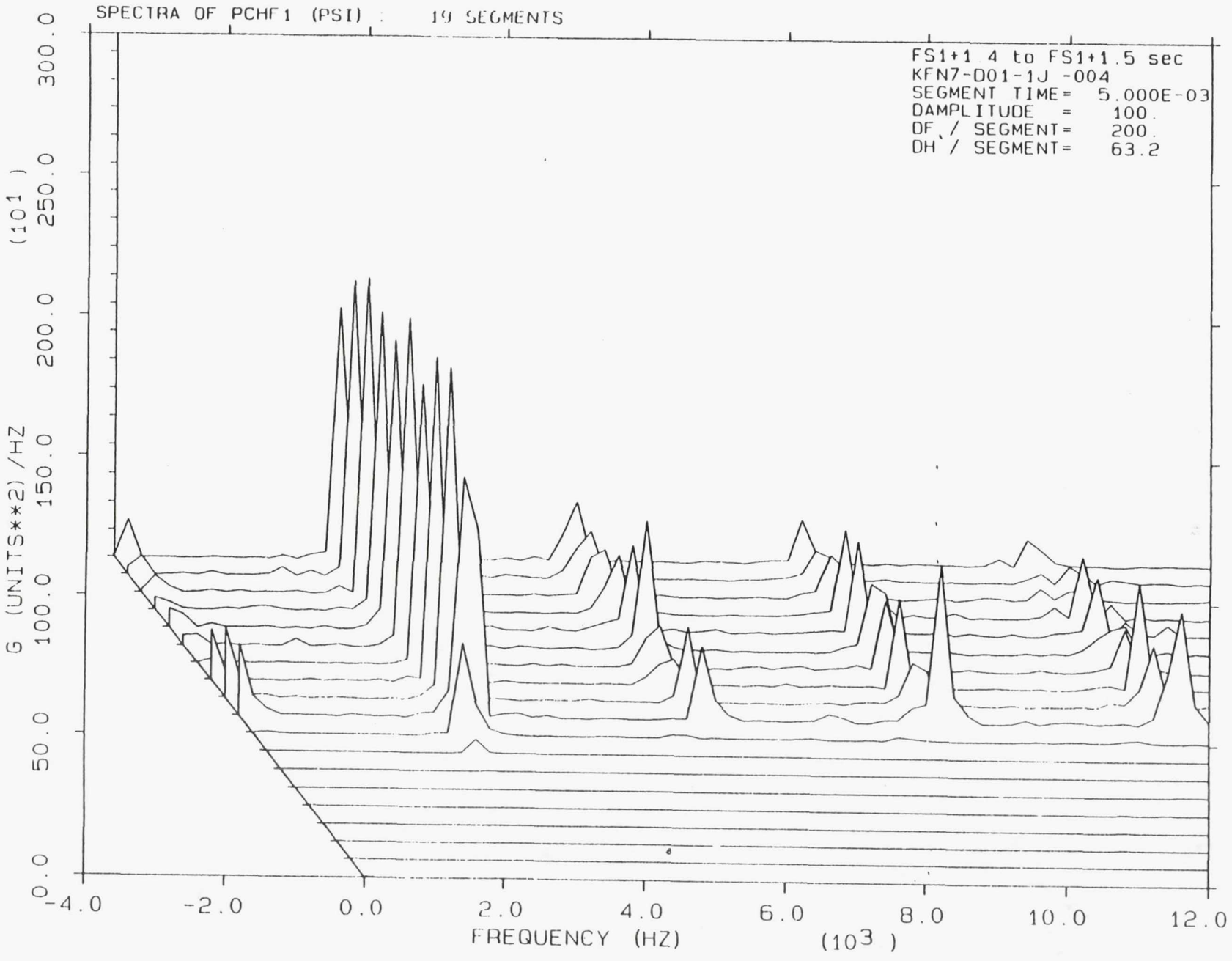
High Frequency Measurement Parameter	High Frequency Amplitude Versus Time Playback	Power Spectral Analysis	Power Spectral Density
	(Page Nos. for Specific Plot for Each Parameter)		
PCHF-1	C-2	C-3	C-4
PCHF-2	C-5	C-6	C-7
PCHF-3	C-8	C-9	C-10
PCHF-4	C-11	C-12	C-13
PCHF-5	C-14	C-15	C-16
POJHF	C-17	C-18	C-19
PFJHF	C-20	C-21	C-22
AX	C-23	C-24	C-25
AY	C-26	C-27	C-28
AZ	C-29	C-30	C-31

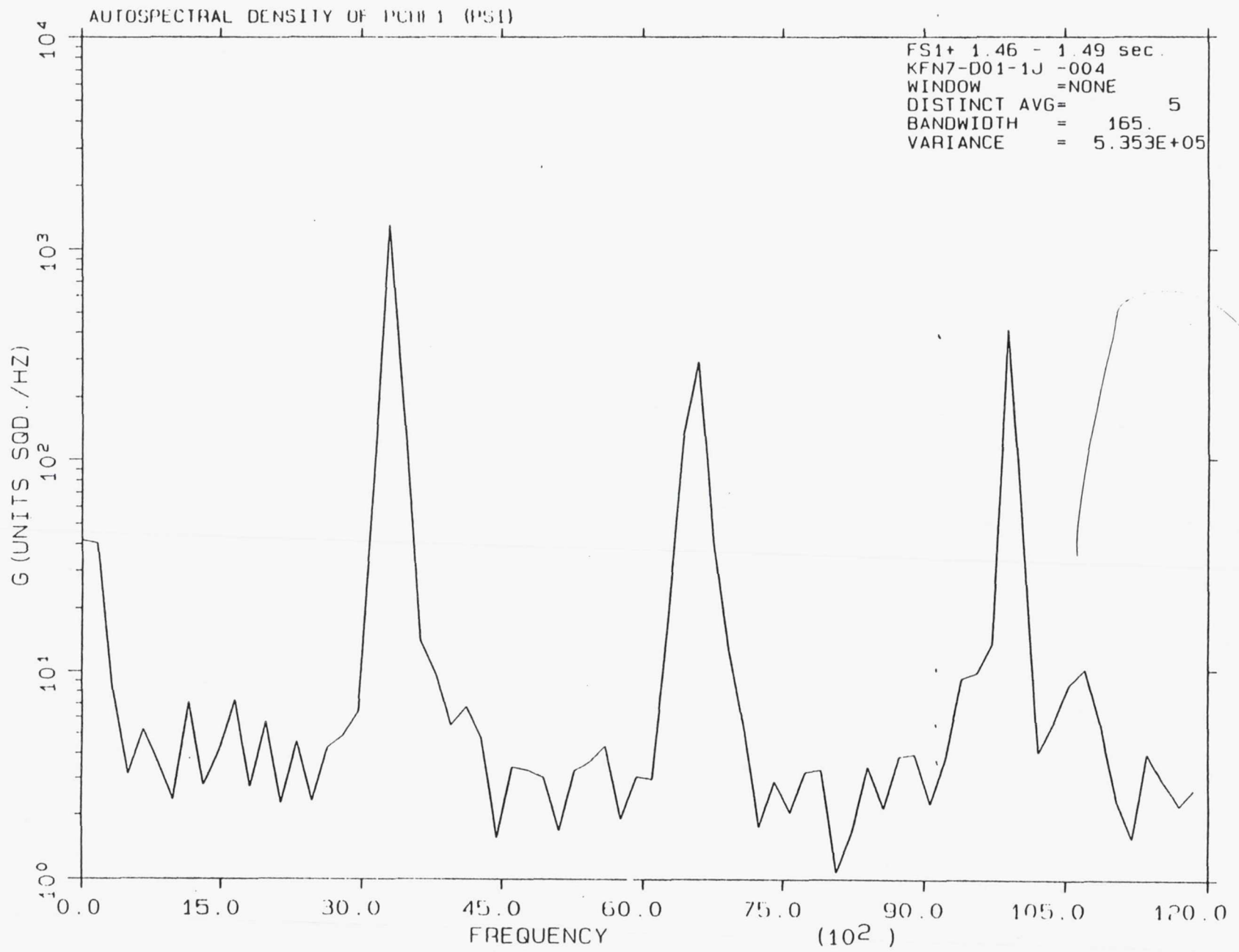
Symbol	Parameter Definition
PCHF	High Frequency Chamber Pressure (PSI)
POJHF	High Frequency LOX Injector Manifold Pressure (PSI)
PFJHF	High Frequency RP-1 Injector Manifold Pressure (PSI)
AX	Accelerometer X Axis (g's)
AY	Accelerometer Y Axis (g's)
AZ	Accelerometer Z Axis (g's)

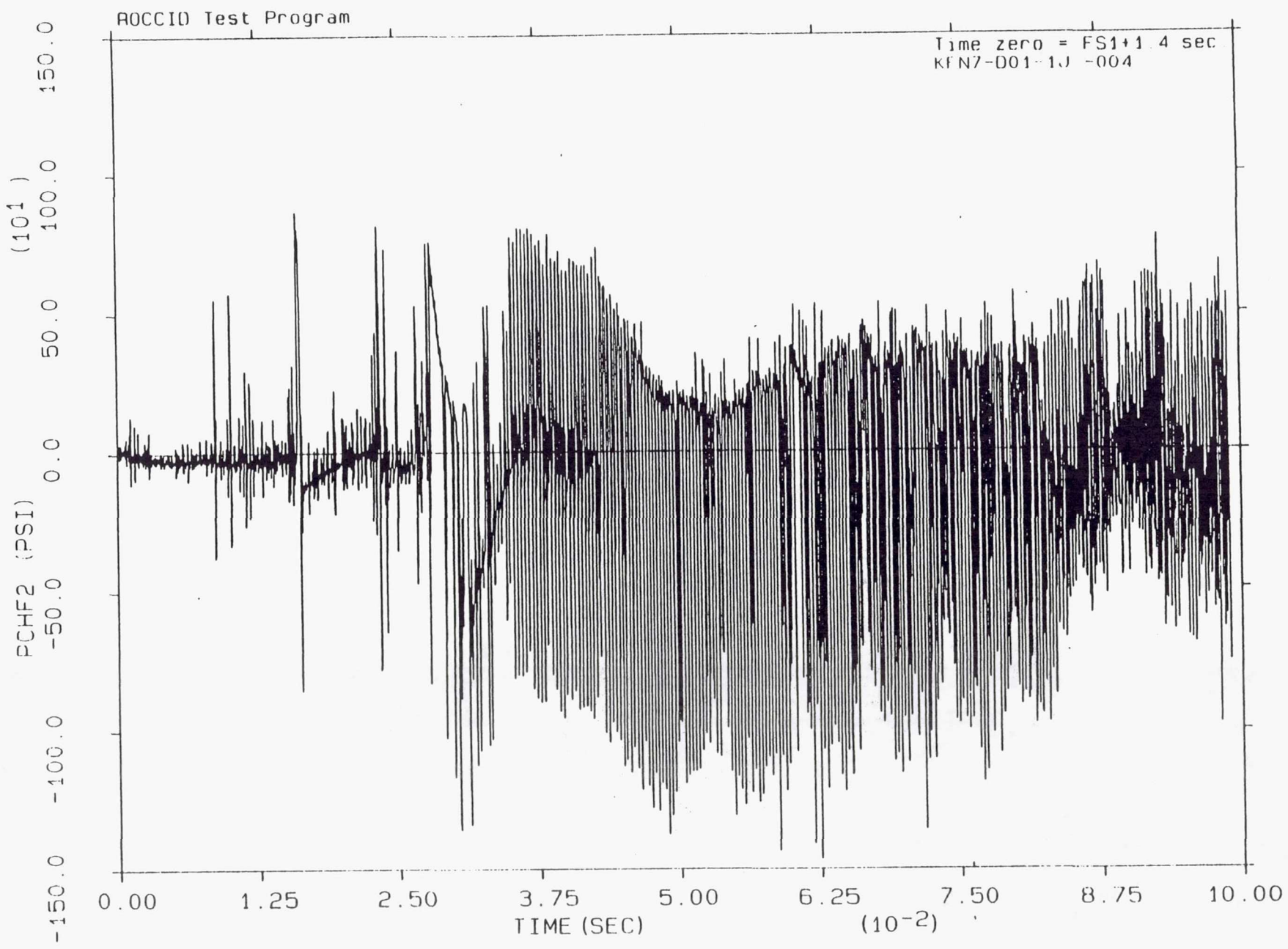
FOREWORD

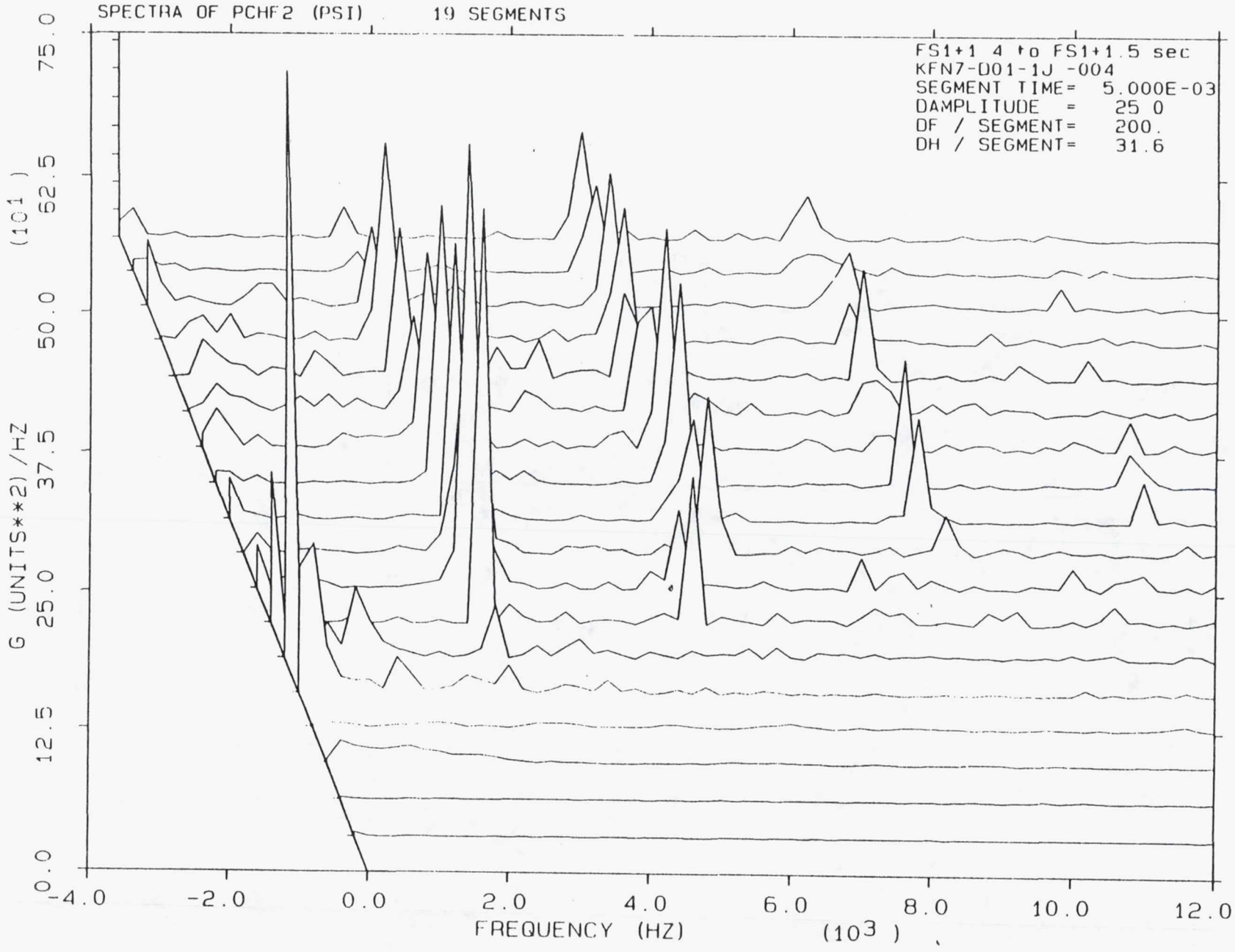
Included in this appendix is a complete display of high frequency measurements obtained during test KFN7-D01-1J-004. A total of 10 parameters are displayed including five high frequency chamber pressure measurements (see Figure 51 of Volume I for measurement locations), one each high frequency pressure measurements located in the injector manifold inlet pipes of the fuel and oxidizer circuits, and three accelerometer recordings obtained from a tri-axial accelerometer mounted on the injector assembly. High frequency amplitude versus time, power spectral analysis and power spectral density plots for each of the 10 parameters are included. The plot formats are the same as those described in Appendix B.

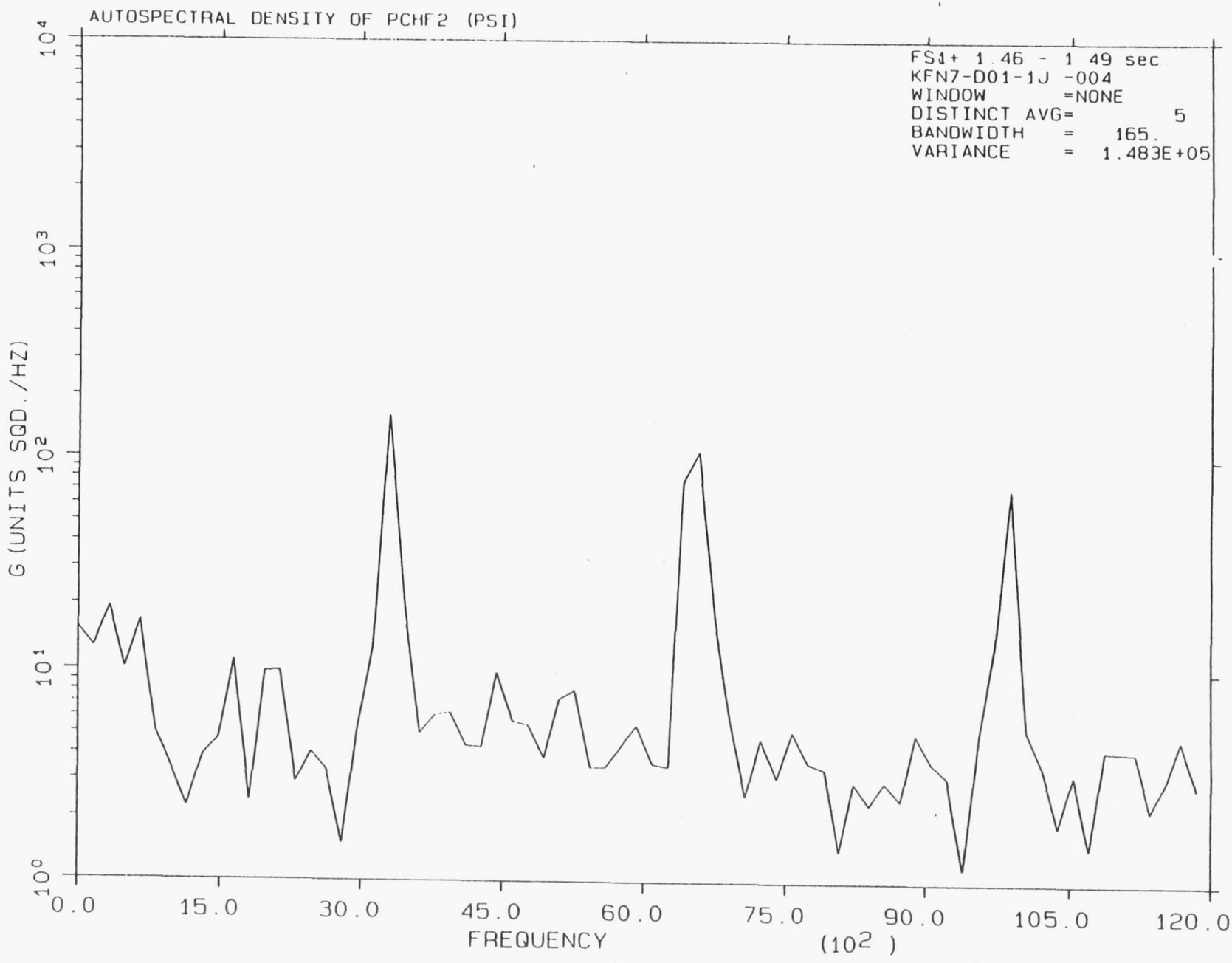

AOCCID Test Program
Time zero = FS1+1 4 sec
KFN7-D01-1J -004
PCHF1 (PSI) (10^2)
30.0
20.0
10.0
0.0
-10.0
-20.0
-30.0
0.00
1.25
2.50
3.75
5.00
6.25
7.50
8.75
10.00
TIME (SEC)
(10^-2)

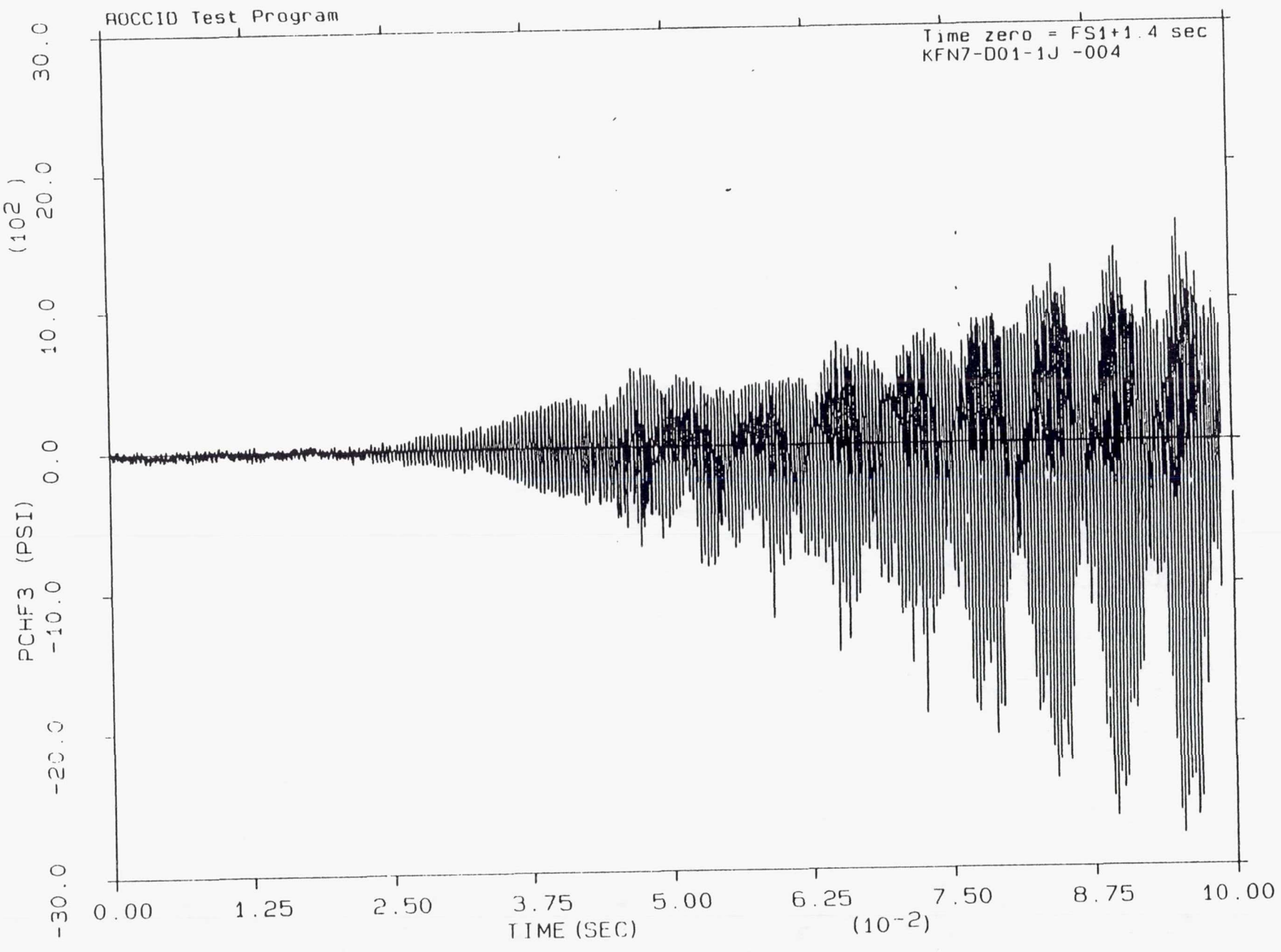

SPECTRA OF PCHF1 (PSI) : 19 SEGMENTS
FS1+1.4 to FS1+1.5 sec
KFN7-D01-1J -004
SEGMENT TIME= 5.000E-03
DAMPLITUDE = 100.
DF / SEGMENT= 200.
DH / SEGMENT= 63.2
G (UNITS**2)/HZ (10^1)
0.0
50.0
100.0
150.0
200.0
250.0
300.0
-4.0
-2.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
FREQUENCY (HZ) (10^3)

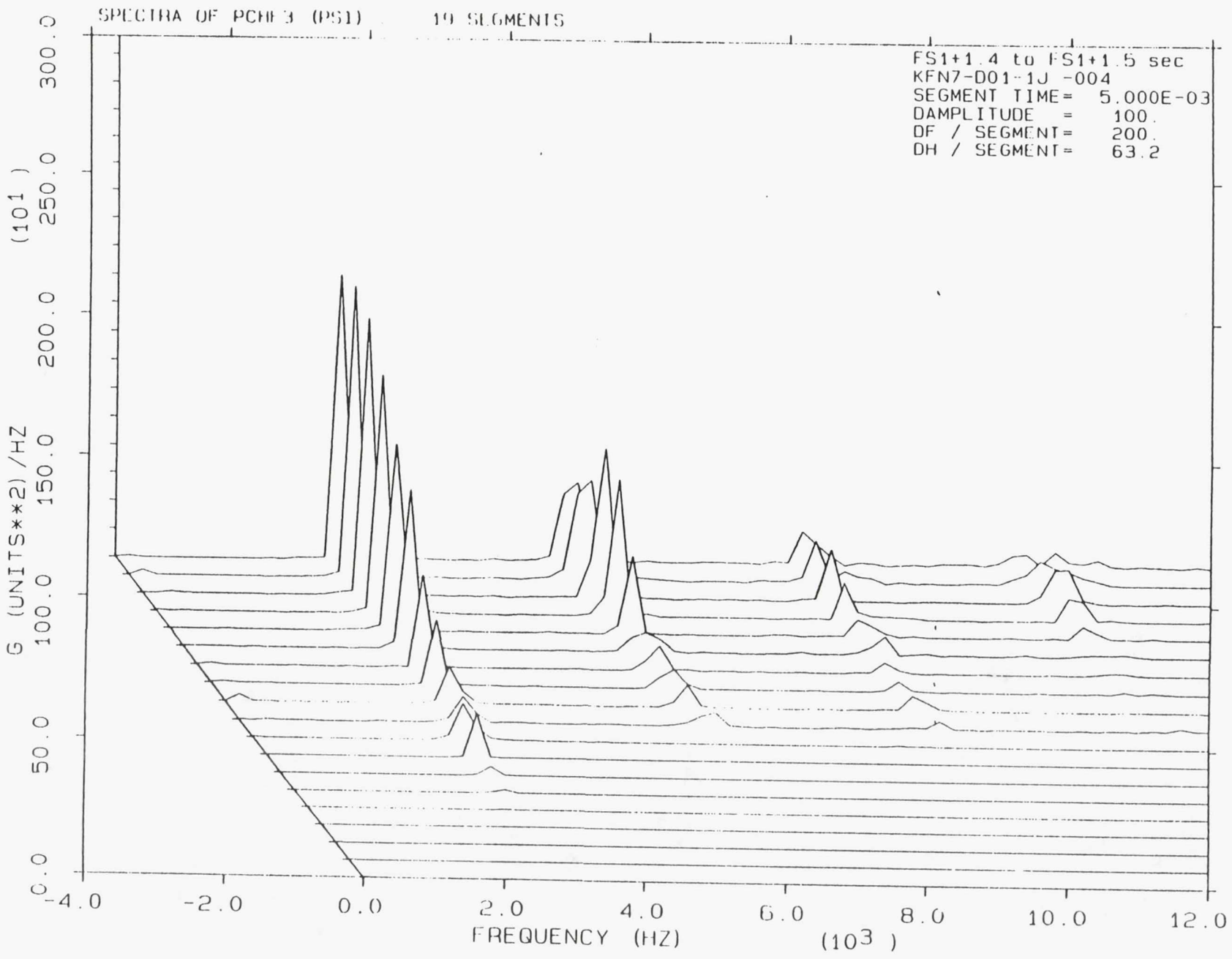

AUTOSPECTRAL DENSITY OF PCH# 1 (PSI)
FS1+ 1.46 - 1.49 sec.
KFN7-D01-1J -004
WINDOW =NONE
DISTINCT AVG= 5
BANDWIDTH = 165.
VARIANCE = 5.353E+05
G (UNITS SQD./HZ)
10⁴
10³
10²
10¹
10⁰
0.0
15.0
30.0
45.0
60.0
75.0
90.0
105.0
120.0
FREQUENCY
(10²)

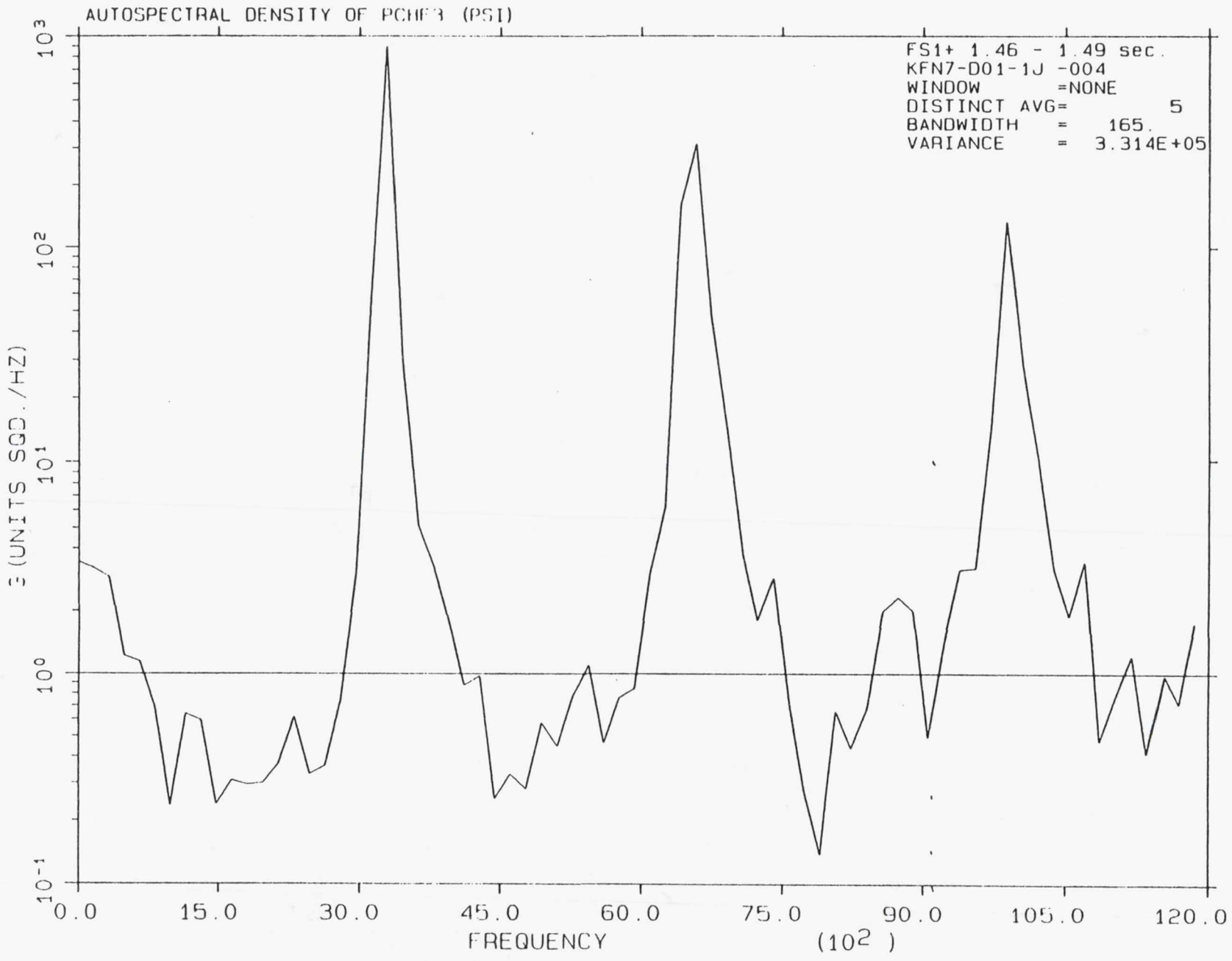

AOCCID Test Program
Time zero = FS1+1.4 sec
KFN7-D01-1J -004
PCHF2 (PSI)
(10^1)
150.0
100.0
50.0
0.0
-50.0
-100.0
-150.0
0.00
1.25
2.50
3.75
5.00
6.25
7.50
8.75
10.00
TIME (SEC)
(10^-2)

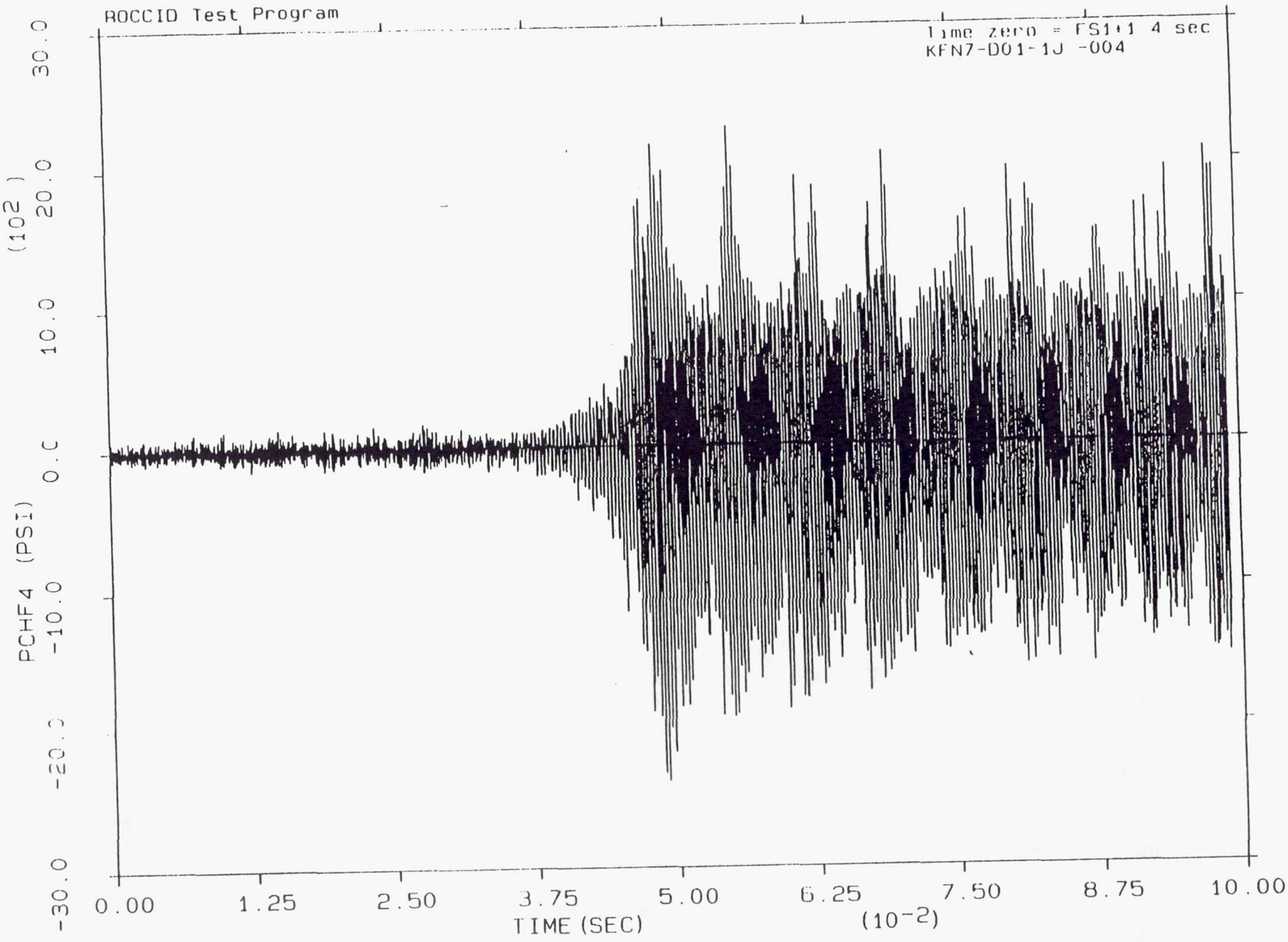

SPECTRA OF PCHF2 (PSI) 19 SEGMENTS
FS1+1.4 to FS1+1.5 sec
KFN7-D01-1J -004
SEGMENT TIME= 5.000E-03
DAMPLITUDE = 25.0
DF / SEGMENT= 200.
DH / SEGMENT= 31.6
G (UNITS**2)/HZ (10^1)
0.0
12.5
25.0
37.5
50.0
62.5
75.0
-4.0
-2.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
FREQUENCY (HZ) (10^3)

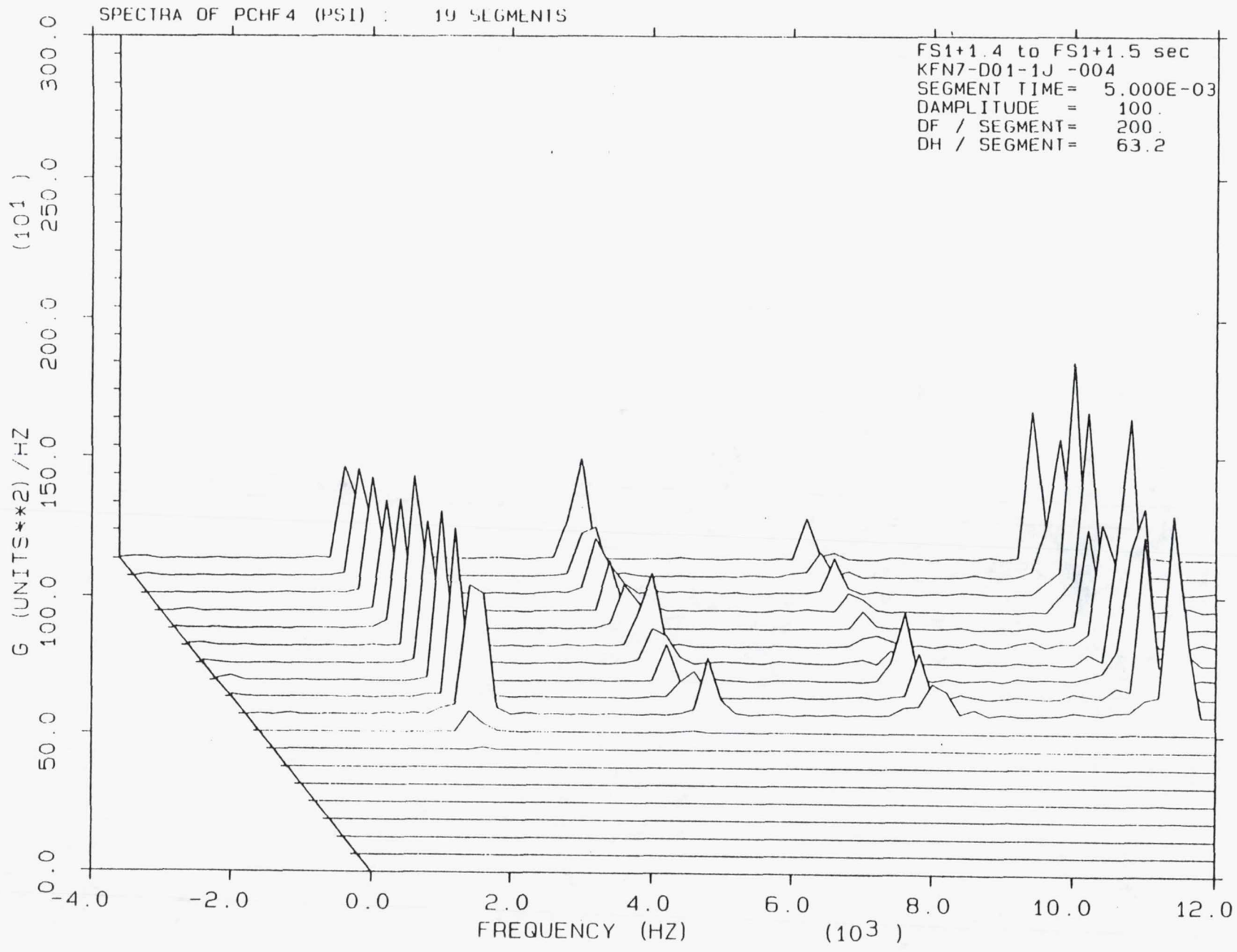

AUTOSPECTRAL DENSITY OF PCHF2 (PSI)
FS1+ 1.46 - 1.49 sec
KFN7-D01-1J -004
WINDOW =NONE
DISTINCT AVG= 5
BANDWIDTH = 165.
VARIANCE = 1.483E+05
G (UNITS SQD./HZ)
10⁴
10³
10²
10¹
10⁰
0.0
15.0
30.0
45.0
60.0
75.0
90.0
105.0
120.0
FREQUENCY
(10²)

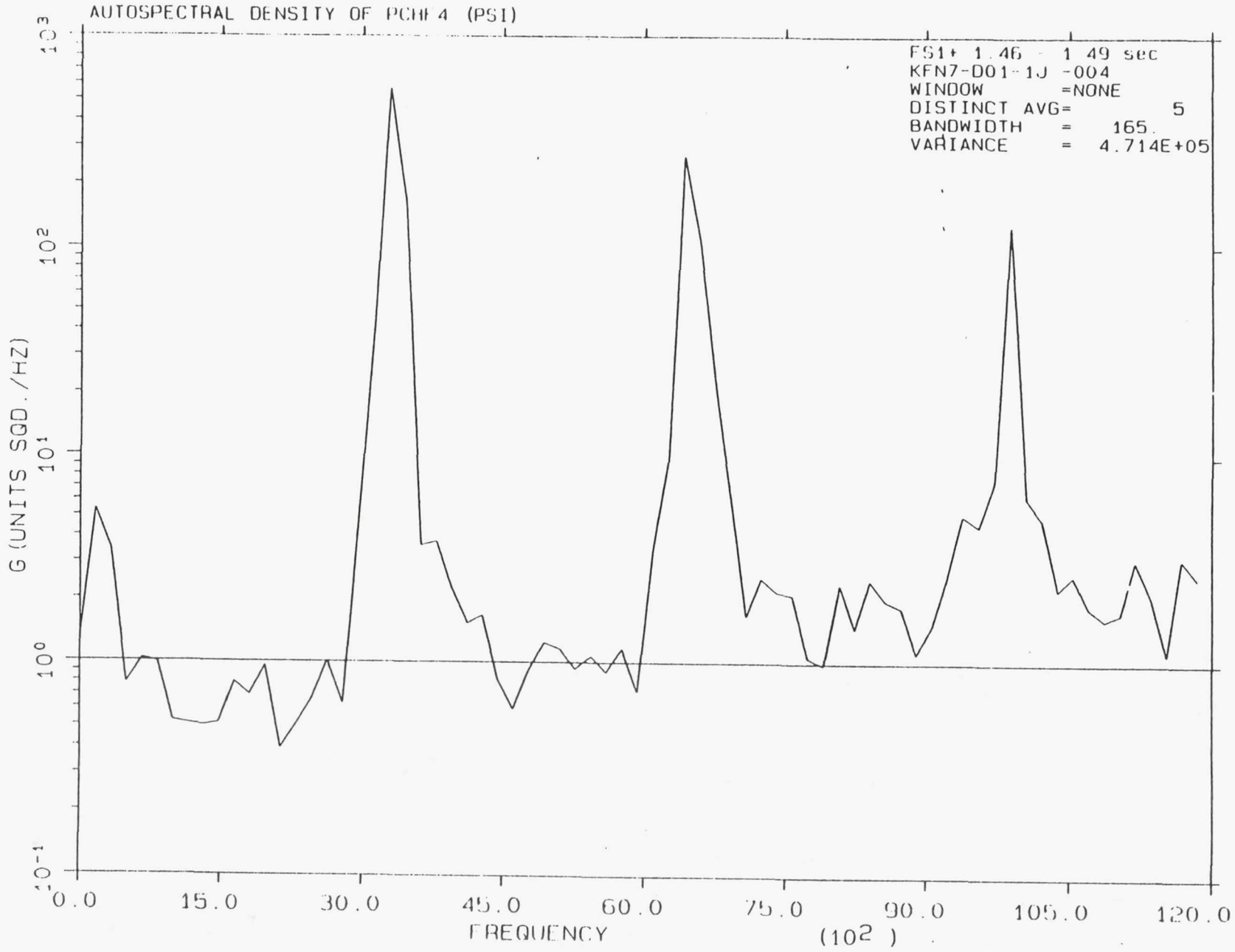

AOCCID Test Program
Time zero = FS1+1.4 sec
KFN7-D01-1J -004
PCHF3 (PSI)
(10^2)
30.0
20.0
10.0
0.0
-10.0
-20.0
-30.0
0.00
1.25
2.50
3.75
5.00
6.25
7.50
8.75
10.00
TIME (SEC)
(10^-2)

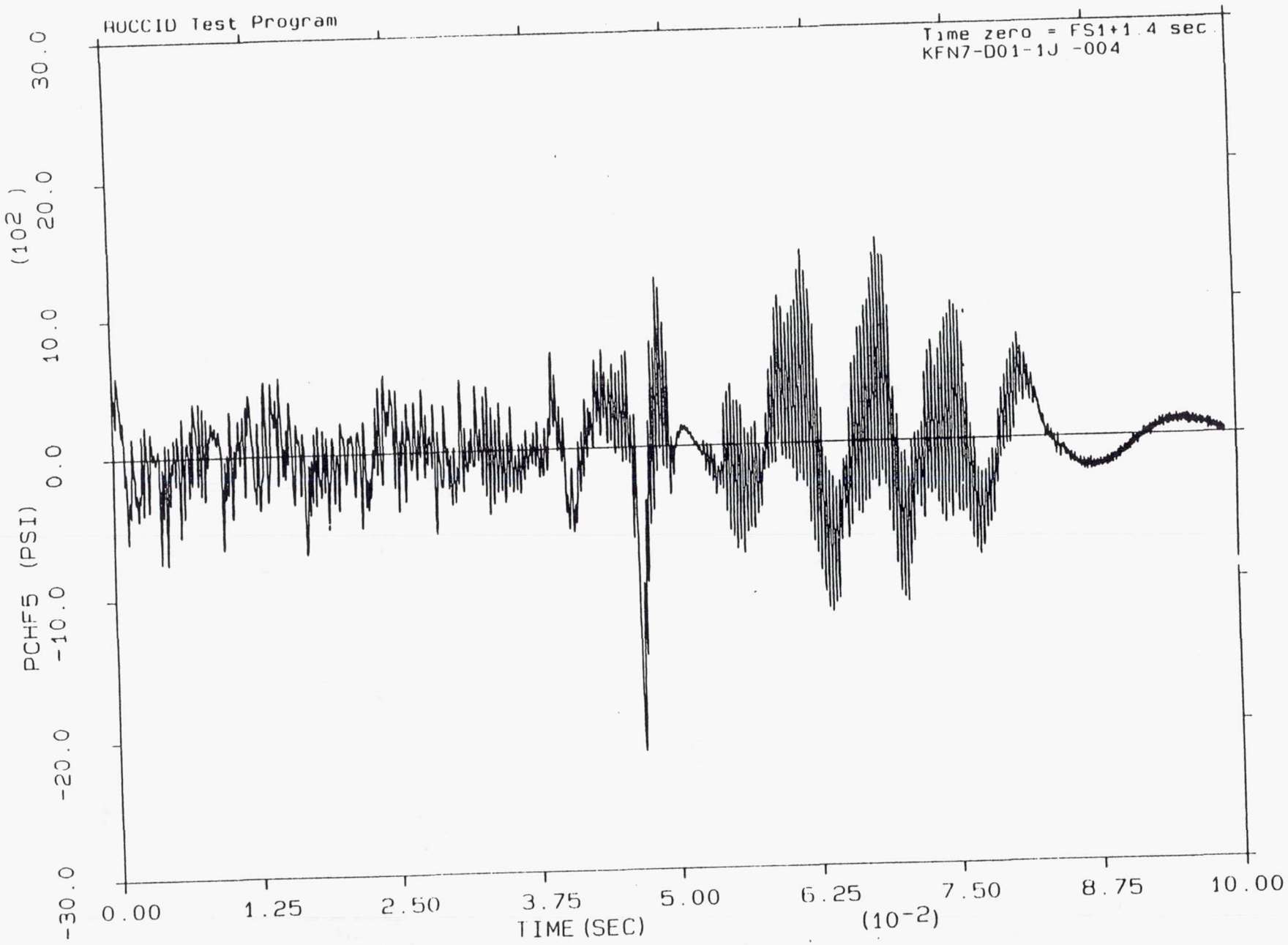

SPECTRA OF PCH# 3 (PS1)
19 SEGMENTS
FS1+1.4 to FS1+1.5 sec
KFN7-D01-1J -004
SEGMENT TIME= 5.000E-03
DAMPLITUDE = 100.
DF / SEGMENT= 200.
DH / SEGMENT= 63.2
G (UNITS**2)/HZ
(10^1)
0.0
50.0
100.0
150.0
200.0
250.0
300.0
-4.0
-2.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
FREQUENCY (HZ)
(10^3)

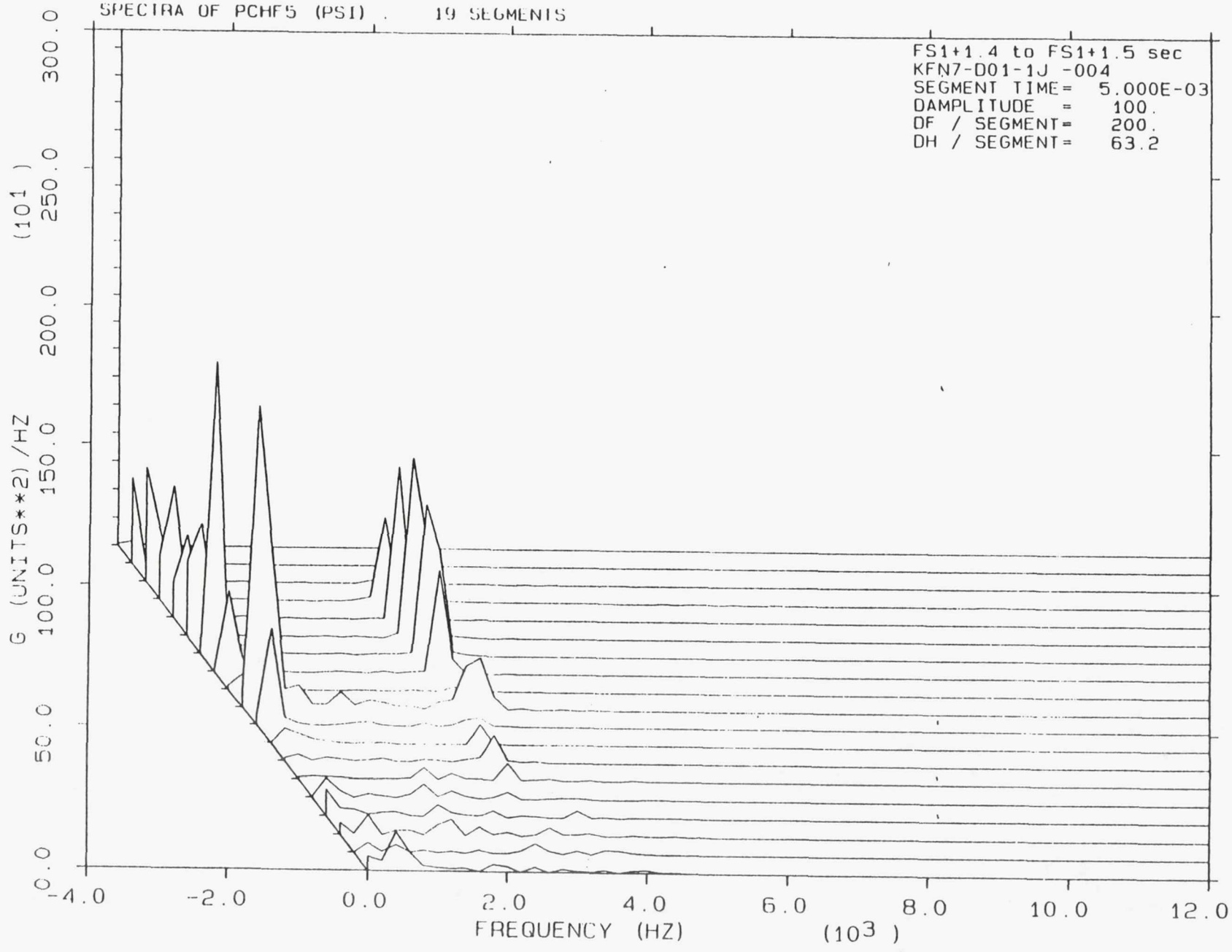

AUTOSPECTRAL DENSITY OF PCHF3 (PSI)
FS1+ 1.46 - 1.49 sec.
KFN7-D01-1J -004
WINDOW =NONE
DISTINCT AVG= 5
BANDWIDTH = 165.
VARIANCE = 3.314E+05
Ξ (UNITS SQD./HZ)
10³
10²
10¹
10⁰
10⁻¹
0.0
15.0
30.0
45.0
60.0
75.0
90.0
105.0
120.0
FREQUENCY (10²)

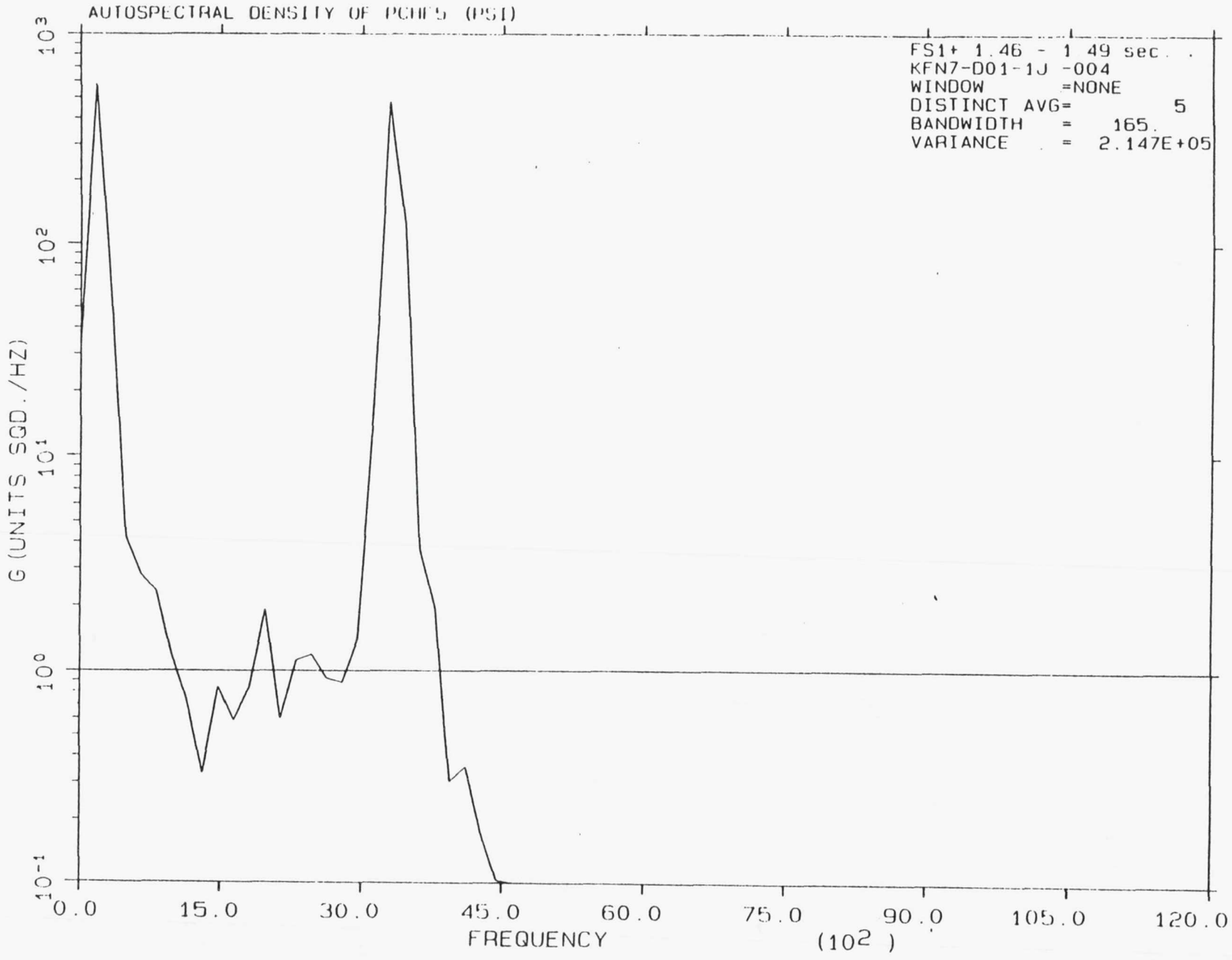

ROCCID Test Program
Time zero = FS1+1 4 sec
KFN7-D01-1J -004
PCHF4 (PSI)
(10^2)
30.0
20.0
10.0
0.0
-10.0
-20.0
-30.0
0.00
1.25
2.50
3.75
5.00
6.25
7.50
8.75
10.00
TIME (SEC)
(10^-2)

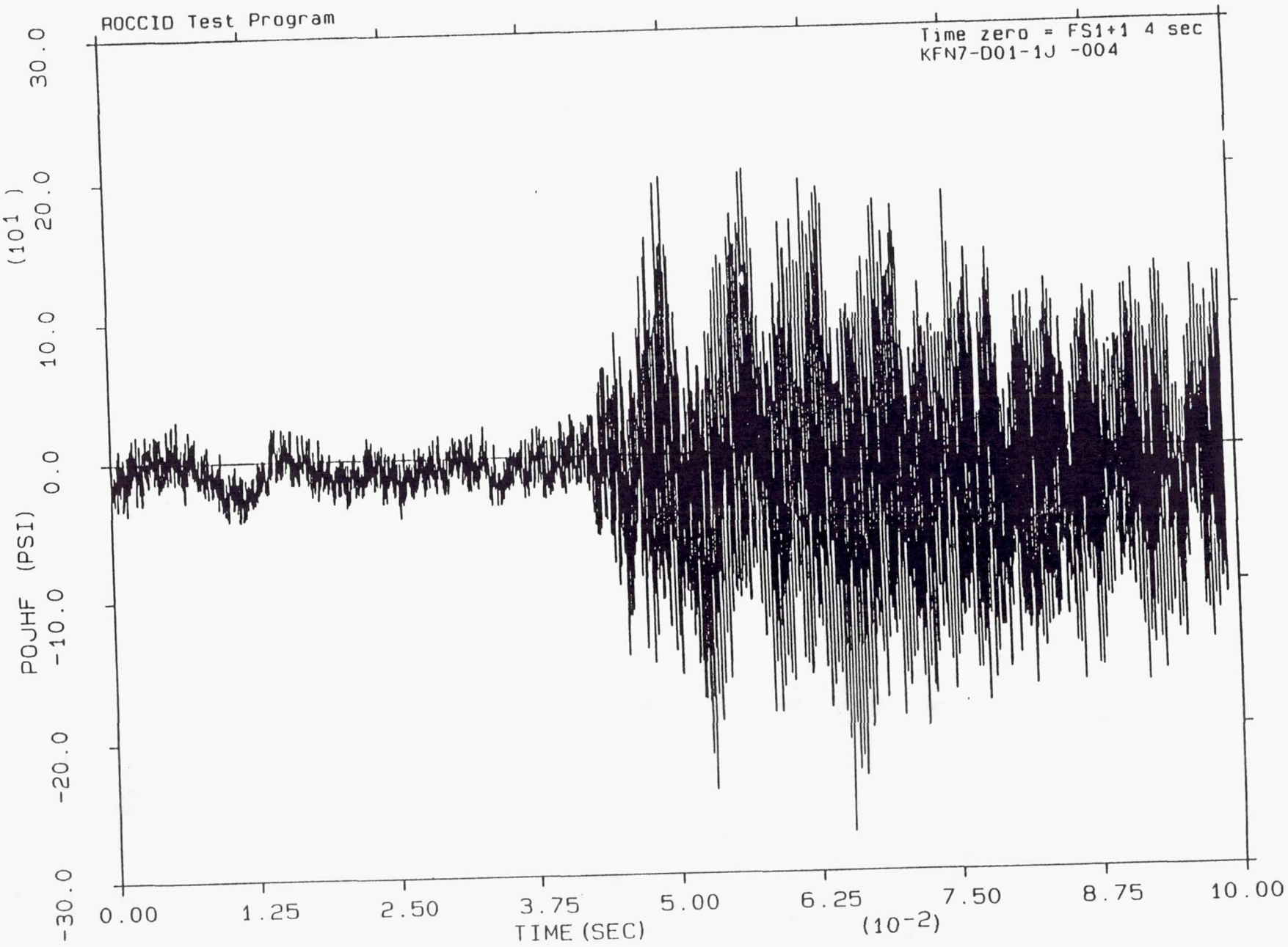

SPECTRA OF PCHF4 (PSI) : 19 SEGMENTS
FS1+1.4 to FS1+1.5 sec
KFN7-D01-1J -004
SEGMENT TIME= 5.000E-03
DAMPLITUDE = 100.
DF / SEGMENT= 200.
DH / SEGMENT= 63.2
G (UNITS**2)/HZ
(10^1)
0.0
50.0
100.0
150.0
200.0
250.0
300.0
-4.0
-2.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
FREQUENCY (HZ)
(10^3)

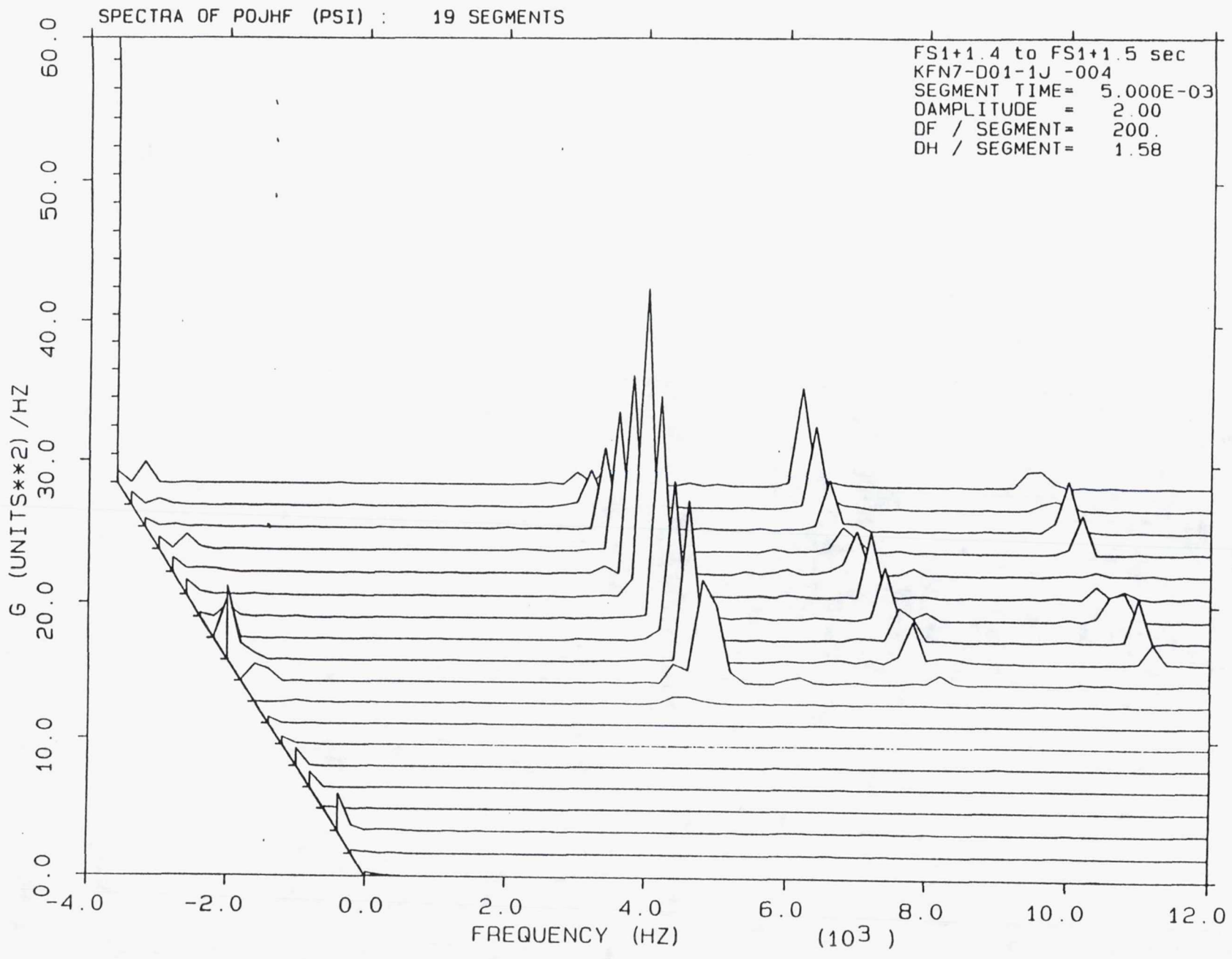

AUTOSPECTRAL DENSITY OF PCHF 4 (PSI)
FS1= 1.46 - 1.49 sec
KFN7-D01-1J -004
WINDOW =NONE
DISTINCT AVG= 5
BANDWIDTH = 165.
VARIANCE = 4.714E+05
G (UNITS SQD./HZ)
10³
10²
10¹
10⁰
10⁻¹
0.0
15.0
30.0
45.0
60.0
75.0
90.0
105.0
120.0
FREQUENCY
(10²)

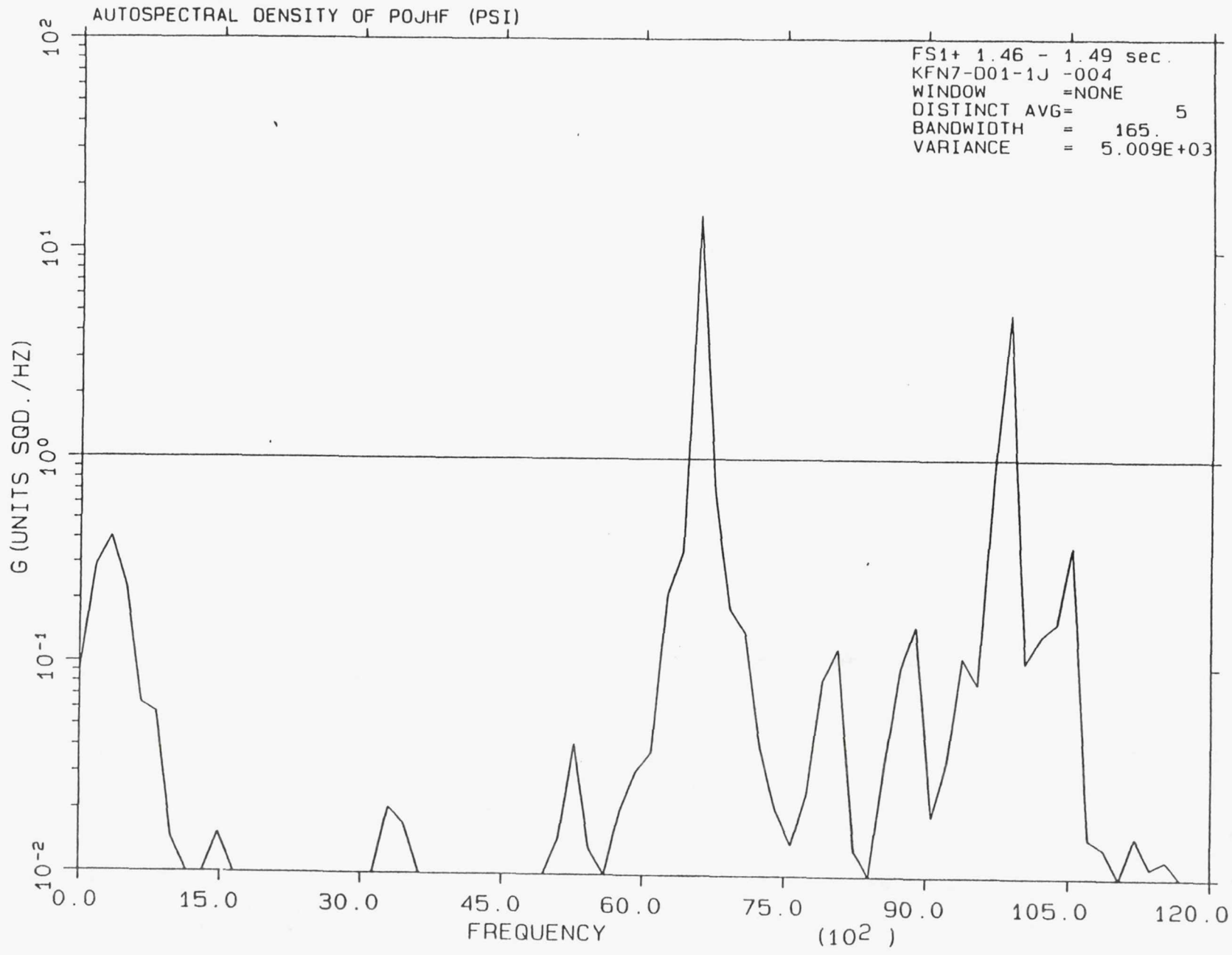

AUCCID Test Program
Time zero = FS1+1.4 sec
KFN7-D01-1J -004
PCHF5 (PSI)
(10^2)
30.0
20.0
10.0
0.0
-10.0
-20.0
-30.0
0.00
1.25
2.50
3.75
5.00
6.25
7.50
8.75
10.00
TIME (SEC)
(10^-2)

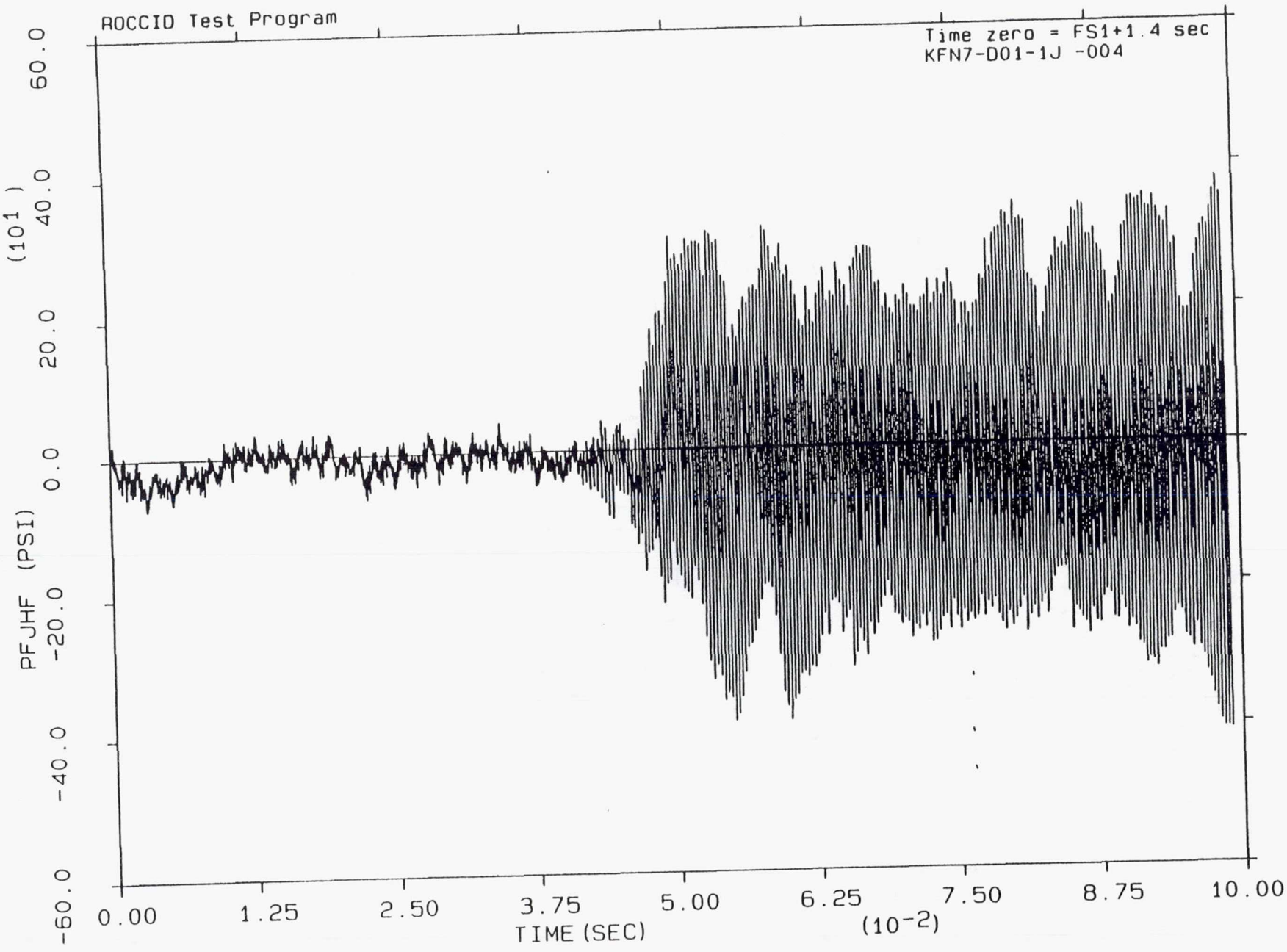

SPECTRA OF PCHF5 (PSI) . 19 SEGMENTS
FS1+1.4 to FS1+1.5 sec
KFN7-D01-1J -004
SEGMENT TIME= 5.000E-03
DAMPLITUDE = 100.
DF / SEGMENT= 200.
DH / SEGMENT= 63.2
G (UNITS**2)/HZ (10^1)
0.0
50.0
100.0
150.0
200.0
250.0
300.0
-4.0
-2.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
FREQUENCY (HZ) (10^3)


AUTOSPECTRAL DENSITY OF PCHFS (PSI)
FS1+ 1.46 - 1 49 sec. .
KFN7-D01-1J -004
WINDOW =NONE
DISTINCT AVG= 5
BANDWIDTH = 165.
VARIANCE = 2.147E+05
G (UNITS SQD./HZ)
10³
10²
10¹
10⁰
10⁻¹
0.0
15.0
30.0
45.0
60.0
75.0
90.0
105.0
120.0
FREQUENCY
(10²)

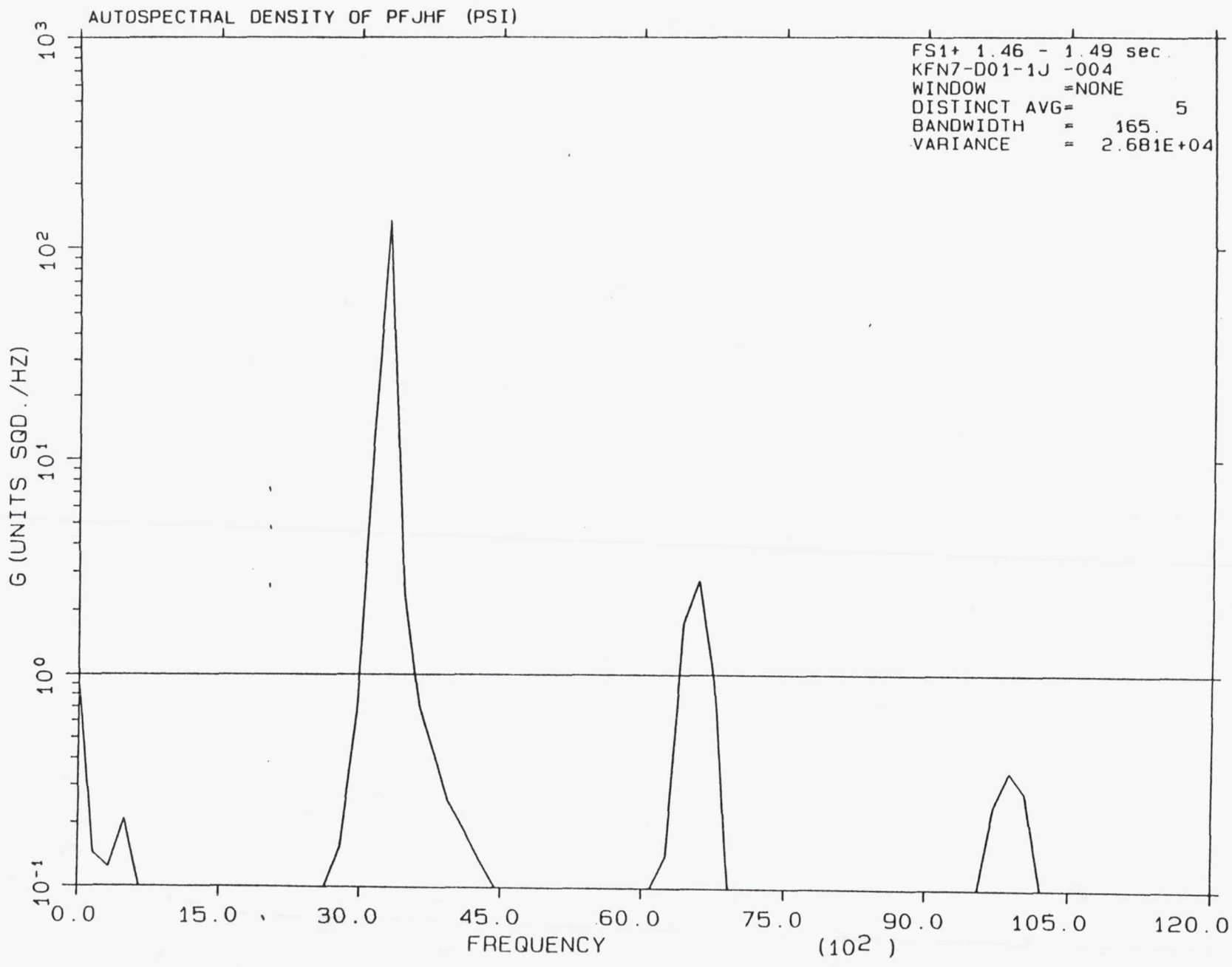

ROCCID Test Program
Time zero = FS1+1 4 sec
KFN7-D01-1J -004
POJHF (PSI)
(10^1)
30.0
20.0
10.0
0.0
-10.0
-20.0
-30.0
0.00
1.25
2.50
3.75
5.00
6.25
7.50
8.75
10.00
TIME (SEC)
(10^-2)

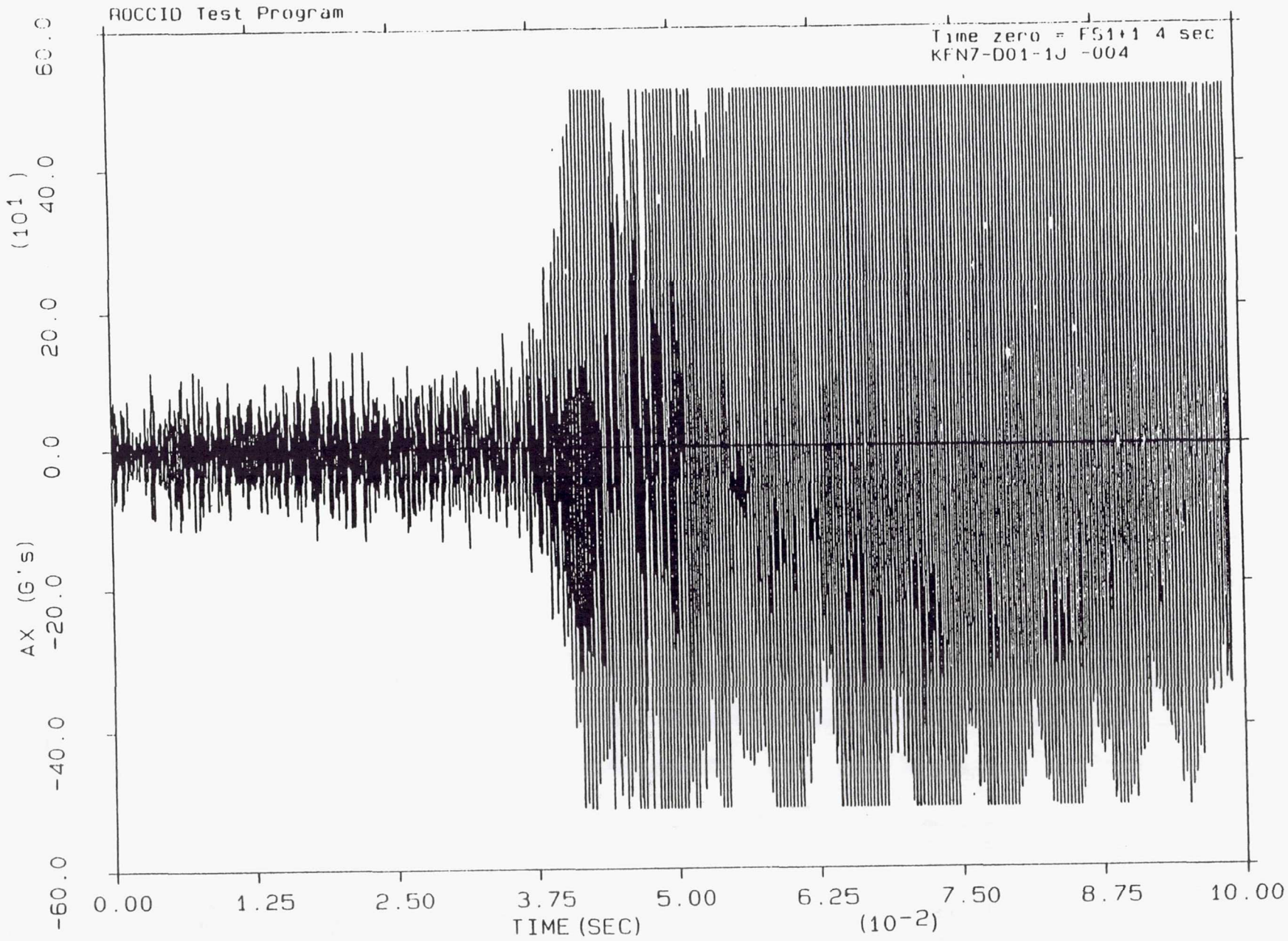

SPECTRA OF POJHF (PSI) : 19 SEGMENTS
FS1+1.4 to FS1+1.5 sec
KFN7-D01-1J -004
SEGMENT TIME= 5.000E-03
DAMPLITUDE = 2.00
DF / SEGMENT= 200.
DH / SEGMENT= 1.58
G (UNITS**2) /HZ
0.0
10.0
20.0
30.0
40.0
50.0
60.0
-4.0
-2.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
FREQUENCY (HZ)
(10^3)

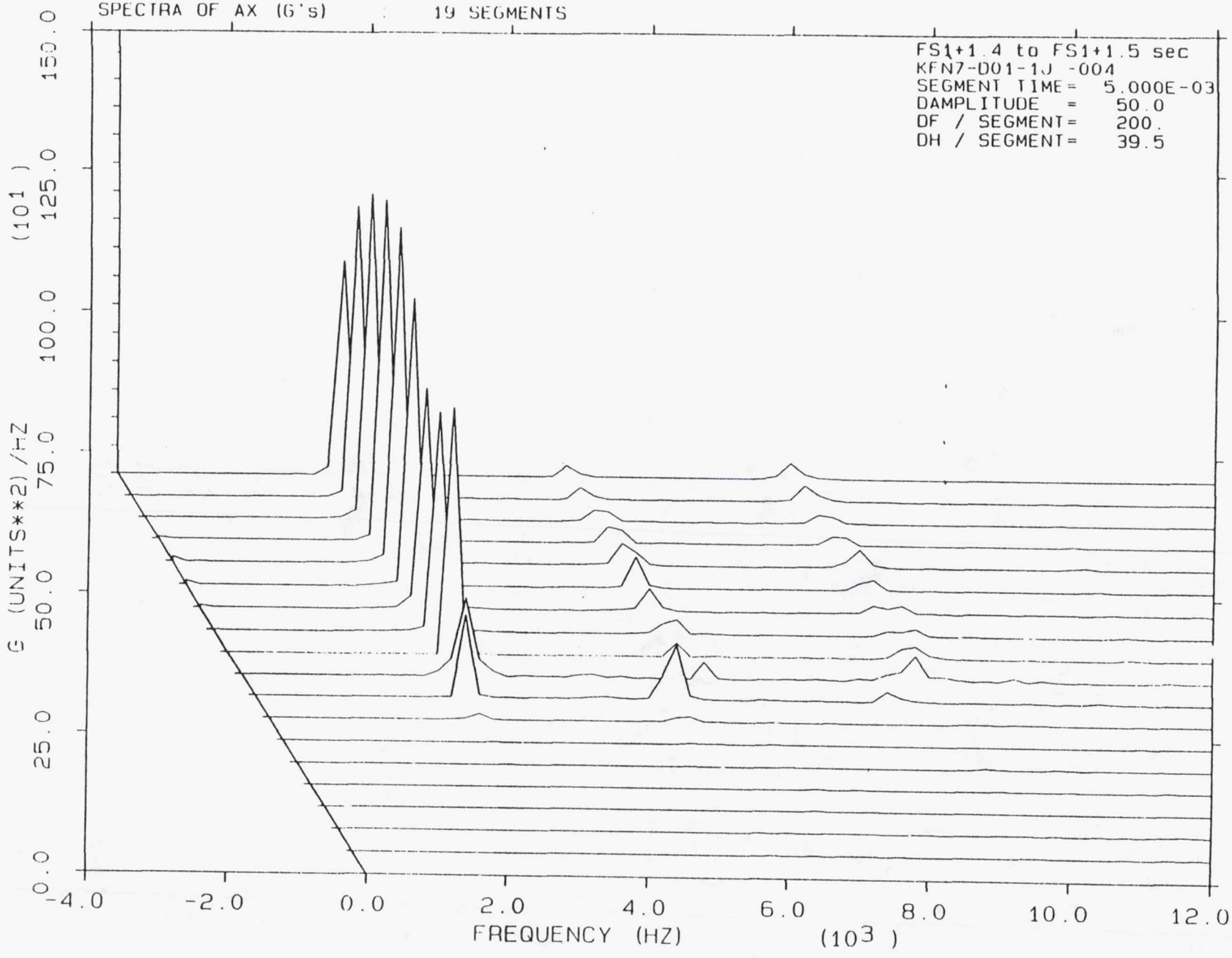

AUTOSPECTRAL DENSITY OF POJHF (PSI)
FS1+ 1.46 - 1.49 sec.
KFN7-D01-1J -004
WINDOW =NONE
DISTINCT AVG= 5
BANDWIDTH = 165.
VARIANCE = 5.009E+03
G (UNITS SQD./HZ)
10²
10¹
10⁰
10⁻¹
10⁻²
0.0
15.0
30.0
45.0
60.0
75.0
90.0
105.0
120.0
FREQUENCY
(10²)

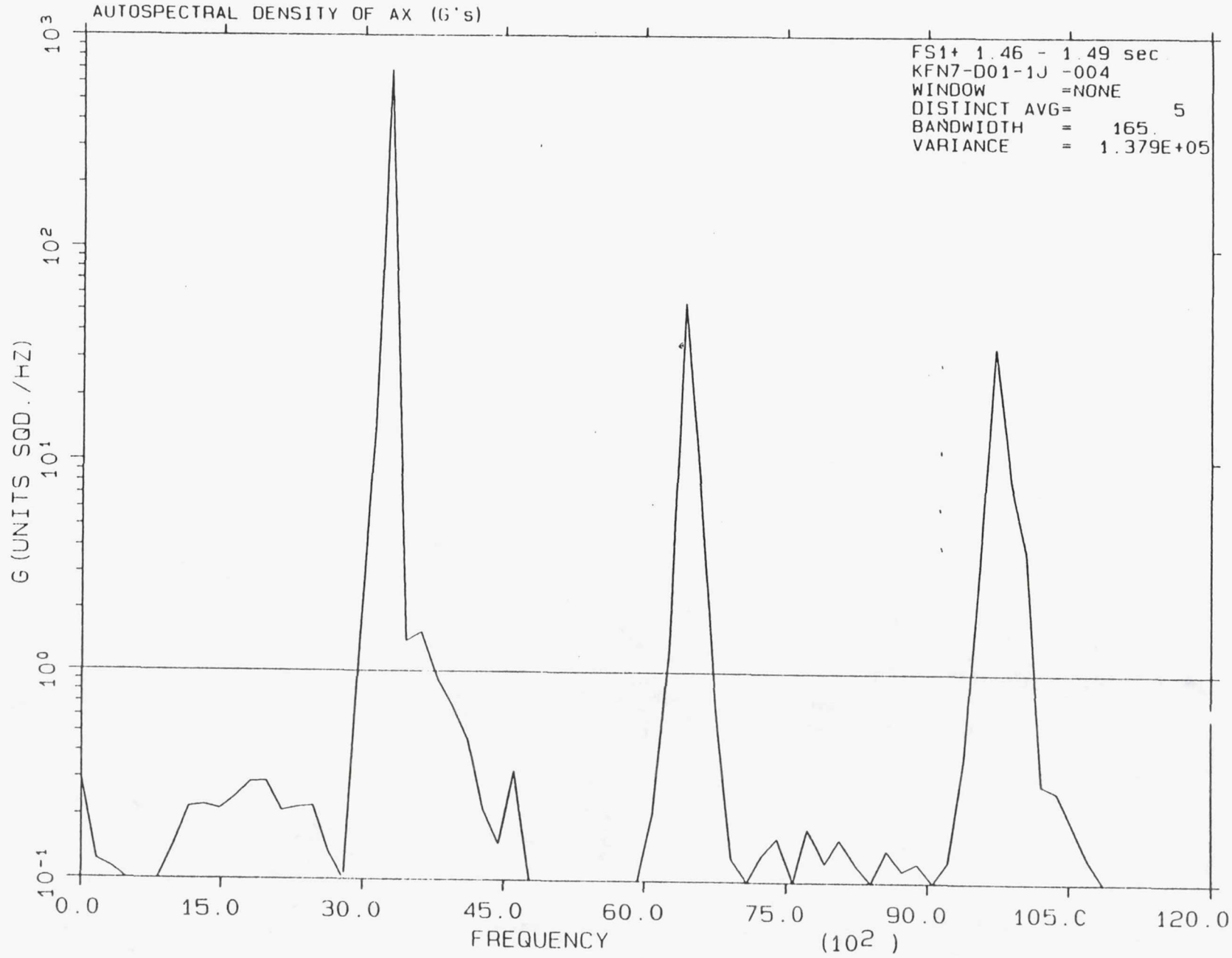

ROCCID Test Program
Time zero = FS1+1.4 sec
KFN7-D01-1J -004
PFJHF (PSI)
(10^1)
60.0
40.0
20.0
0.0
-20.0
-40.0
-60.0
0.00
1.25
2.50
3.75
5.00
6.25
7.50
8.75
10.00
TIME (SEC)
(10^-2)

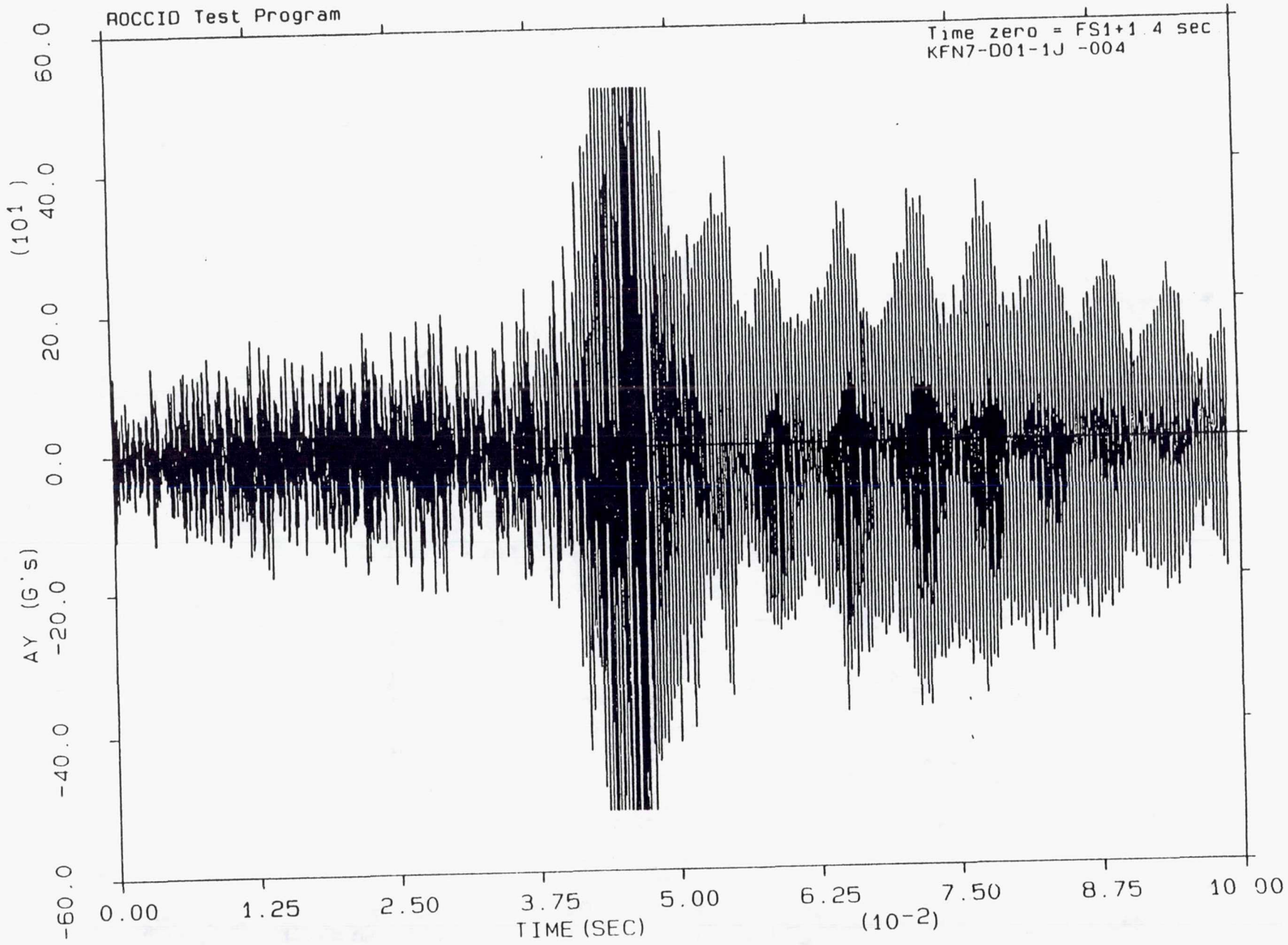
SPECTRA OF PFJHF (PSI) : 19 SEGMENTS
FS1+1.4 to FS1+1.5 sec
KFN7-001-1J -004
SEGMENT TIME= 5.000E-03
DAMPLITUDE = 20.0
DF / SEGMENT= 200.
DH / SEGMENT= 15.8
G (UNITS**2) /HZ
(10¹)
60.0
50.0
40.0
30.0
20.0
10.0
0.0
-4.0
-2.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
FREQUENCY (HZ)
(10³)

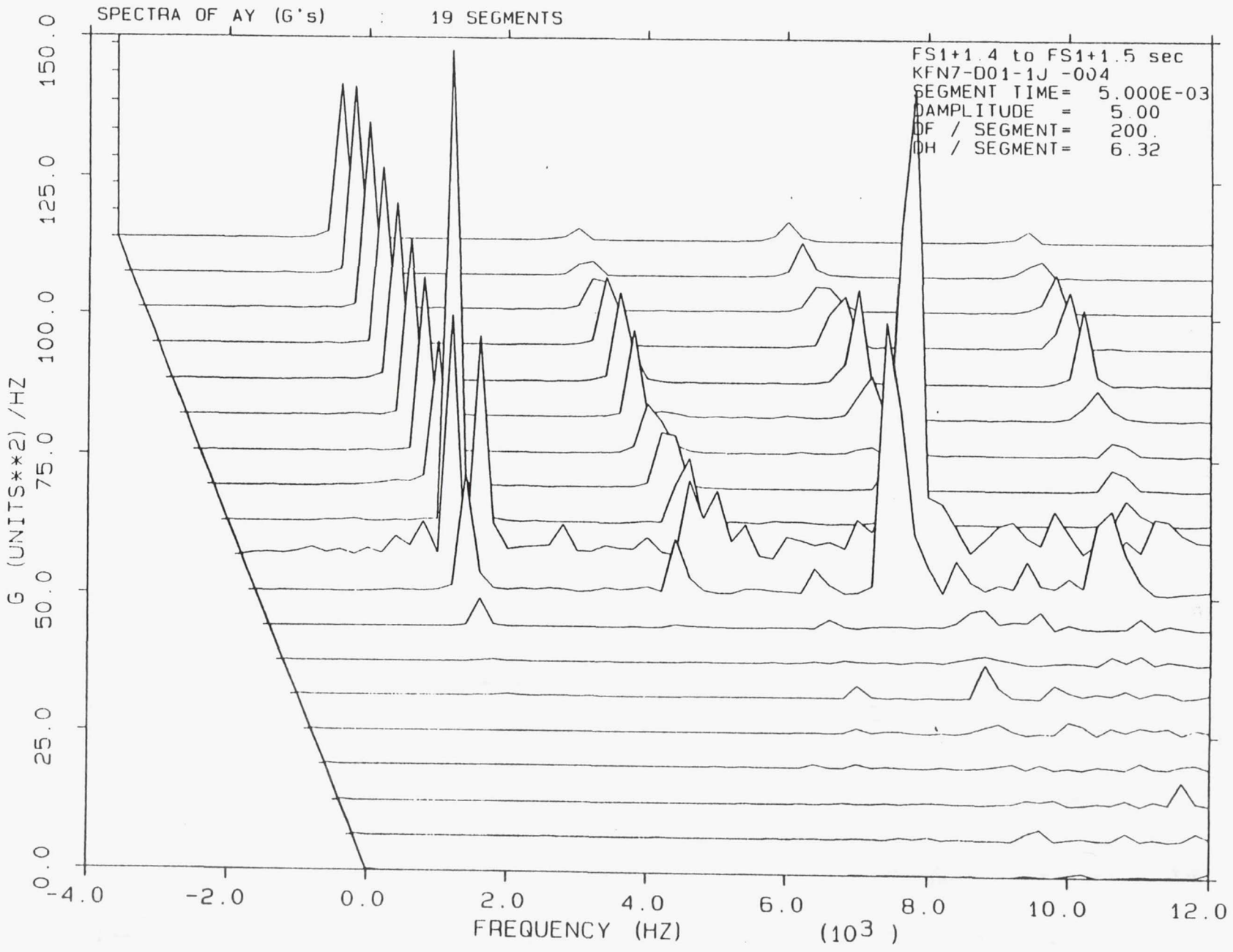

AUTOSPECTRAL DENSITY OF PFJHF (PSI)
FS1+ 1.46 - 1.49 sec
KFN7-D01-1J -004
WINDOW =NONE
DISTINCT AVG= 5
BANDWIDTH = 165.
VARIANCE = 2.681E+04
G (UNITS SQD./HZ)
10³
10²
10¹
10⁰
10⁻¹
0.0
15.0
30.0
45.0
60.0
75.0
90.0
105.0
120.0
FREQUENCY
(10²)

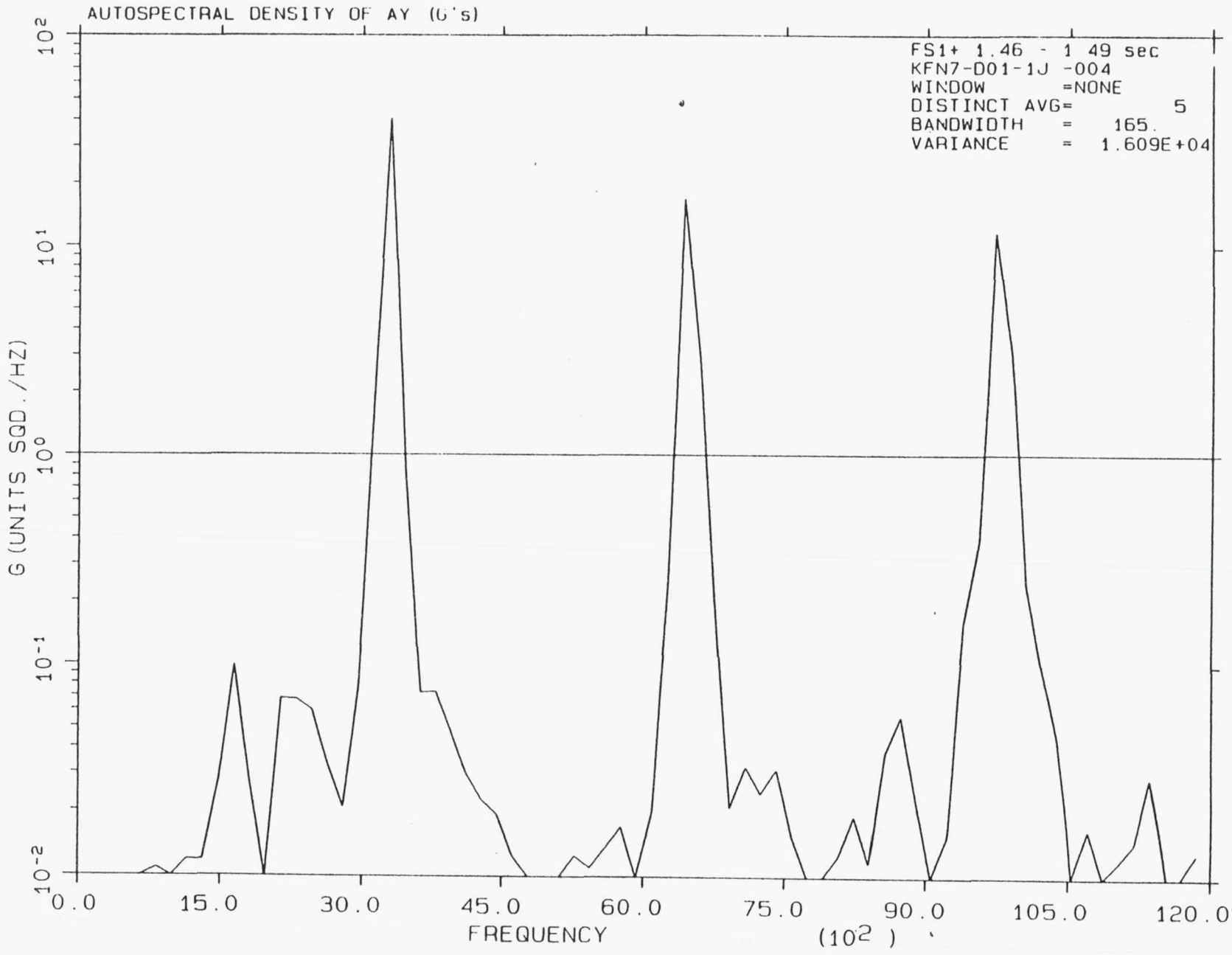

ROCCID Test Program
Time zero = FS1+1 4 sec
KFN7-D01-1J -004
AX (G's)
(10^1)
60.0
40.0
20.0
0.0
-20.0
-40.0
-60.0
0.00
1.25
2.50
3.75
5.00
6.25
7.50
8.75
10.00
TIME (SEC)
(10^-2)

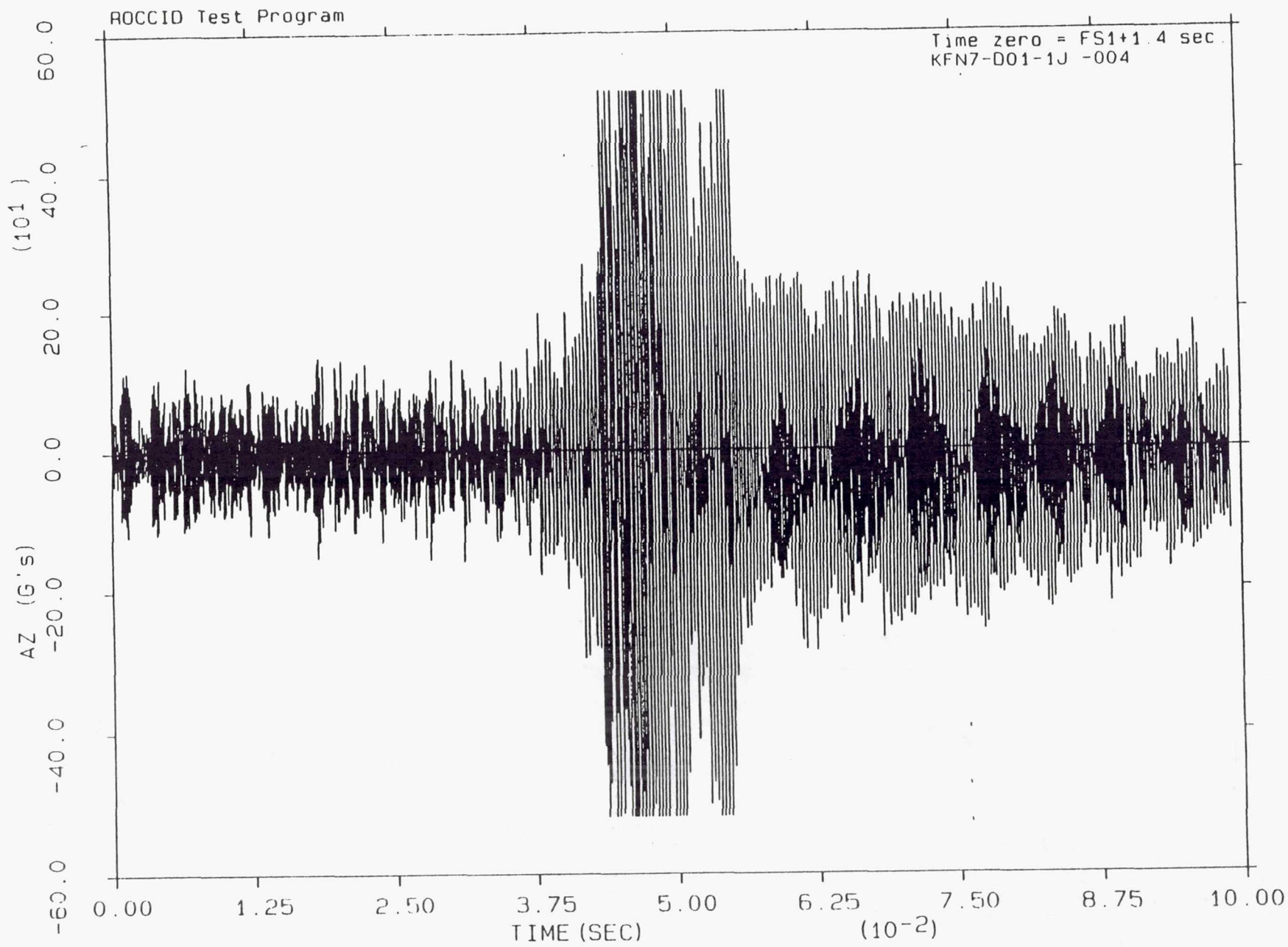

SPECTRA OF AX (G's)
19 SEGMENTS
FS1+1.4 to FS1+1.5 sec
KFN7-D01-1J -004
SEGMENT TIME= 5.000E-03
DAMPLITUDE = 50.0
DF / SEGMENT= 200.
DH / SEGMENT= 39.5
G (UNITS**2)/HZ
(10^1)
0.0
25.0
50.0
75.0
100.0
125.0
150.0
-4.0
-2.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
FREQUENCY (HZ)
(10^3)

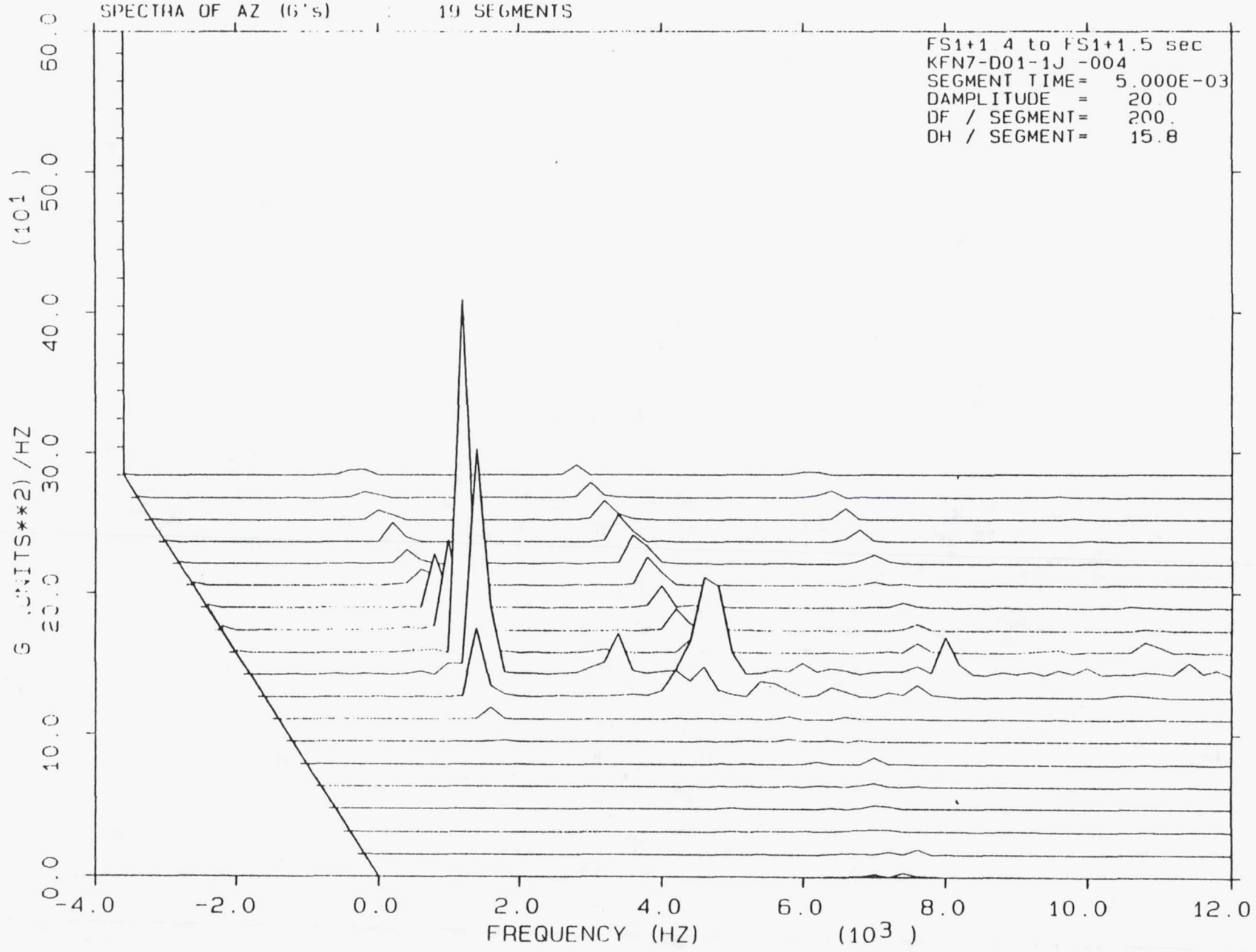

AUTOSPECTRAL DENSITY OF AX (G's)
FS1+ 1.46 - 1.49 sec
KFN7-D01-1J -004
WINDOW =NONE
DISTINCT AVG= 5
BANDWIDTH = 165.
VARIANCE = 1.379E+05
G (UNITS SQD./HZ)
10³
10²
10¹
10⁰
10⁻¹
0.0
15.0
30.0
45.0
60.0
75.0
90.0
105.0
120.0
FREQUENCY
(10²)

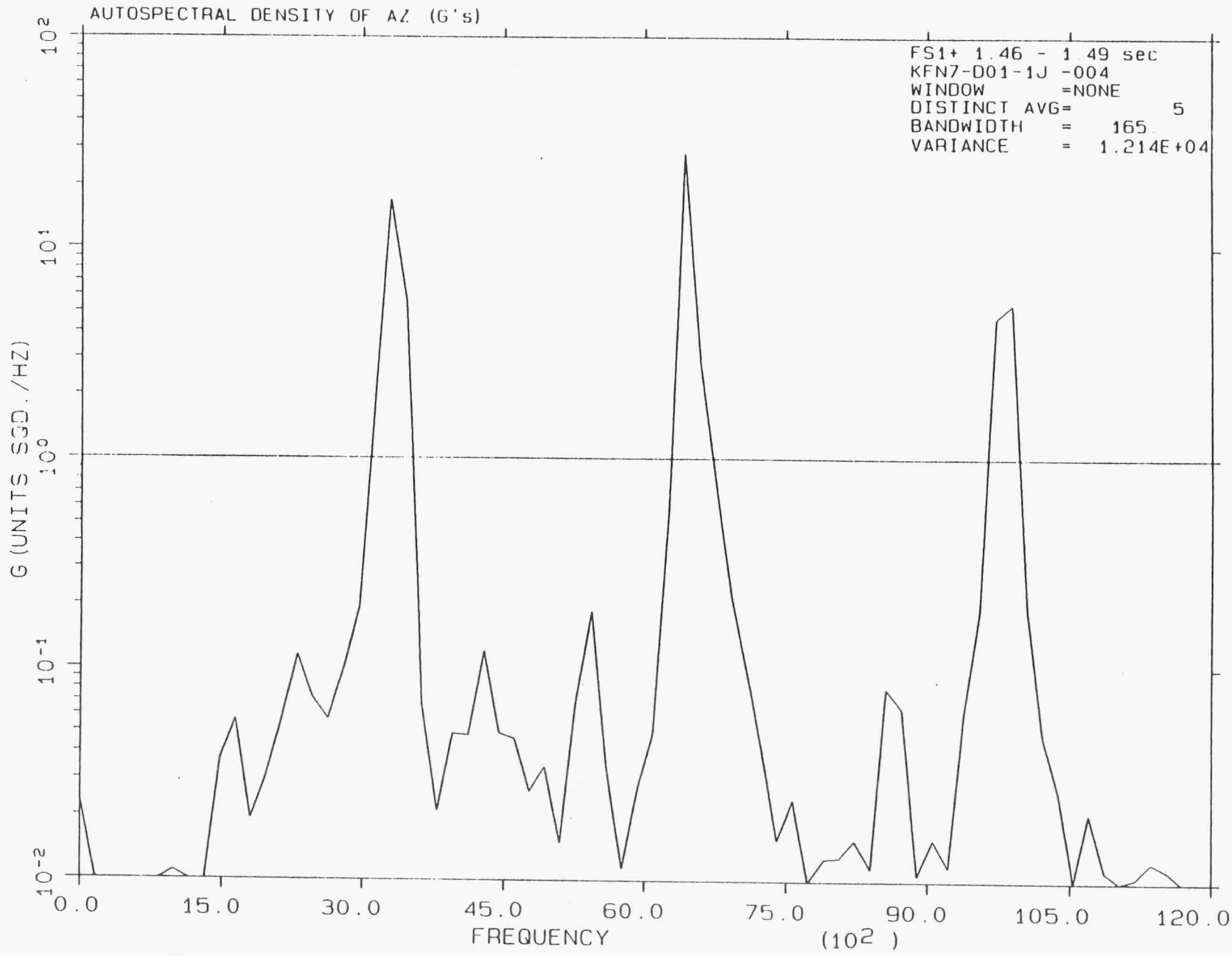

AOCCID Test Program
Time zero = FS1+1.4 sec
KFN7-D01-1J -004
AY (G's)
(10^1)
60.0
40.0
20.0
0.0
-20.0
-40.0
-60.0
0.00
1.25
2.50
3.75
5.00
6.25
7.50
8.75
10.00
TIME (SEC)
(10^-2)


SPECTRA OF AY (G's)
19 SEGMENTS
FS1+1.4 to FS1+1.5 sec
KFN7-D01-1J -004
SEGMENT TIME= 5.000E-03
DAMPLITUDE = 5.00
DF / SEGMENT= 200.
DH / SEGMENT= 6.32
G (UNITS**2) /HZ
0.0
25.0
50.0
75.0
100.0
125.0
150.0
-4.0
-2.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
FREQUENCY (HZ)
(10^3)


AUTOSPECTRAL DENSITY OF AY (G's)
FS1+ 1.46 - 1 49 sec
KFN7-D01-1J -004
WINDOW =NONE
DISTINCT AVG= 5
BANDWIDTH = 165.
VARIANCE = 1.609E+04
G (UNITS SQD./HZ)
10²
10¹
10⁰
10⁻¹
10⁻²
0.0
15.0
30.0
45.0
60.0
75.0
90.0
105.0
120.0
FREQUENCY
(10²)


ROCCID Test Program
Time zero = FS1+1.4 sec
KFN7-D01-1J -004
60.0
40.0
20.0
0.0
-20.0
-40.0
-60.0
(10^1)
AZ (G's)
0.00
1.25
2.50
3.75
5.00
6.25
7.50
8.75
10.00
TIME (SEC)
(10^-2)


SPECTRA OF AZ (G's)
19 SEGMENTS
FS1+1 4 to FS1+1.5 sec
KFN7-D01-1J -004
SEGMENT TIME= 5.000E-03
DAMPLITUDE = 20.0
DF / SEGMENT= 200.
DH / SEGMENT= 15.8
(10^1)
60.0
50.0
40.0
30.0
20.0
10.0
0.0
-4.0
-2.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
FREQUENCY (HZ)
(10^3)


AUTOSPECTRAL DENSITY OF AZ (G's)
FS1+ 1.46 - 1.49 sec
KFN7-D01-1J -004
WINDOW =NONE
DISTINCT AVG= 5
BANDWIDTH = 165
VARIANCE = 1.214E+04
G (UNITS SQD./HZ)
10^2
10^1
10^0
10^-1
10^-2
0.0
15.0
30.0
45.0
60.0
75.0
90.0
105.0
120.0
FREQUENCY
(10^2)

APPENDIX D

ROCCID VALIDATION HARDWARE DESIGN DRAWING PACKAGE

LIST OF DRAWINGS

Drawing Description	Drawing No.	No. of Sheets	Figure Nos.
Engine assembly	1206430	2	D-3/D-4
Injector Assembly	1206427	1	D-5
Injector Flange	1200773A	3	D-6/D-8
Injector Core Assembly	1206423	2	D-9/D-10
Injector Core	1200729	7	D-11/D-17
Thrust Chamber Assembly	1206428	3	D-18/D-20
Chamber Body Forging	1206432	1	D-21
Chamber Liner	1206429	1	D-22
Chamber Retaining Plate	1200976A	1 + ADCN	D-23/D-24
Chamber Proof Plate	1200977A	1 + ADCN	D-25/D-26
1/4 Wave Tube Resonator	1206426	1	D-27
Resonator Cavity Blank	1206431	1	D-28
Bomb Adapters	1201080A	1	D-29

NOTES:

1. INTERPRET DRAWING PER ATC-STD-4926.
2. MULTIPLE WASHERS MAY BE USED UNDER ANY HEAD LOCATED UNDER FUEL INLET ONLY.
3. SEAL AND PACKING REQUIREMENTS:
   A. HANDLING AND ASSEMBLY PER ATC-46217.
   B. NO LUBRICANT REQUIRED FOR SEALS.
4. APPLY (45) TO ALL THREADS, PRIOR TO INSTALLATION, PER ATC-STD-4851.
5. SAFETY LOCKWIRE PER ATC-46137, CLASS 1A.
6. ALL TUBE FITTINGS TO BE INSTALLED PER ASD 5040.
7. TORQUE ALL BOLTS IN SEQUENCE PER ASD 5226.
8. TORQUE INFORMATION PER ATC-STD-4899.
9. FILL AREA SHOWN WITH (44).
10. -19 AND -29 ASSEMBLIES SHALL BE LEAK CHECKED AS FOLLOWS: PRESSURIZE EACH ASSEMBLY TO APPROXIMATELY 50 PSI USING CLEAN FILTERED NITROGEN (ATC-STD-4940 LEVEL 500). LEAK CHECK ALL FITTINGS AND JOINTS. REPEAT PROCESS INCREASING NITROGEN PRESSURE TO APPROXIMATELY 350 PSI.
11. -9 ASSEMBLY SHALL BE PROOF TESTED AS FOLLOWS: PRESSURIZE ASSEMBLY USING 3800 ± 100 PSI WATER FILTERED TO ATC-STD-4940, LEVEL 1000. HOLD PRESSURE FOR APPROXIMATELY 5 MINUTES.

REVISIONS

LTR	DESCRIPTION	RELEASE DATE	APPROVED

QTY REQ'D PER ASSY -29	-19	-9	FSCM-CAGE NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION	ZONE	ITEM NO.
								47
36	36	36	56878	SPS72789-1612	NUT		2 1D 4E	46
AR	AR	AR			LUBRICANT	ATC 44159		45
AR	AR	AR	00426	RTV60	SEALANT		2 3F	44
								43
AR	AR	AR		AS1425-506	TAPE		2 6B 6D 6E	42
AR	AR	AR		AS1425-387			2 6B 6D 6E	41
AR	AR	AR		AS1425-376			2 6B 6D 6E	40
								39
AR	AR	AR		AS1425-230			2 6E	38
AR	AR	AR		AS1425-181			2 6D 6E	37
AR	AR	AR		AS1425-133	TAPE		2 6D 6E	36
-29	-19	-9	FSCM-CAGE NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION	ZONE	ITEM NO.

PARTS LIST

QTY REQ'D PER ASSY -29	-19	-9	FSCM-CAGE NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION	ZONE	ITEM NO.
AR	AR	AR		AS1425-116	TAPE		2 6B 6E	35
AR	AR	AR		AS1425-103	TAPE		2 6E	34
AR	AR	AR		AS1425-102	TAPE		2 5D	33
4	4	4		NAS334CPA10	BOLT		2 5B	32
16	16	16		NAS628H30	BOLT		2 5A	31
9	9	9		NAS334 CPA13	BOLT		2 4A	30
								29
								28
								27
2	2	2		MS28782-25	RETAINER		2 3G	26
20	20	20		MS21250 16072	BOLT		2 4E	25
		16		MS21250 16061	BOLT		2 1D	24
16	16			MS21250 16032	BOLT		2 1D 5E	23
1	1	1		MS9068-453	O-RING		2 3E	22
1	1	2		MS9068-450	O-RING		2 1D 4E	21
		1		MS9068-444	O-RING		2 1B	20
								19
2	2	2		MS9068-221	O-RING		2 3G	18
2	2	2		MS9068-120	O-RING		2 3G	17
								16
72	72	72		AN960C616L	WASHER		2 4E 1D	15
16	16	16		AN960C316L	WASHER		2 9A	14
								13
								12
1	1	2		1201080-19	130MB ADAPTER		2 3H	11
1				1206431-1	RESONATOR BLANK		2 3D	10
	1			1206426-1	THRUST CHAMBER		2 2D	9
1	1			1206428-9	THRUST CHAMBER		2 2D	8
1	1	1		1206427-9	INJECTOR ASSY		2 5Z	7
	1			1206426-1	RESONATOR, 1/4 WAVE		2 3D	6
								5
								4
1	1	1		1201080-69	30MB, ADAPTER		2 3H	3
		1		1200977-19	PLATE, CLOSURE		2 1A	2
1	1	1		1200976-2	PLATE, RETAINER		2 2D	1
-29	-19	-9	FSCM-CAGE NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION	ZONE	ITEM NO.

DEVELOPMENT HARDWARE
FOR TEST OR EXPERIMENTATION

CONTRACT NO. NAS 3-25556	DO/DS DEMETER	DATE 90-515	GENCORP AEROJET TechSystems SACRAMENTO CALIFORNIA
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES DECIMALS ANGULAR .XX ± .05 ± 0.5° .XXX ± .010	DRAWN	90-7-20	TITLE ENGINE ASSY, OX/HC-3D SUBSCALE (ROCCID TEST VALIDATION)
	DESIGN APPROVAL	90-7-19	
	MANUFACTURING APPROVAL	90-7-19	
SURFACE ROUGHNESS DO NOT SCALE DRAWING	PRODUCIBILITY	90-7-19	SIZE E FSCM-CAGE NO. 05824 DWG NO. 1206430
	QUALITY ASSURANCE	90-7-19	
	CONFIG MGMT	90-7-19	SCALE 1/2 RELEASE DATE 90-7-23 REV R SHEET 1 OF 2
NEXT ASSY			

THIS DWG HAS BEEN REVISED PER PROJECT 91-4, 90-515

P.C. 561

Figure D-1

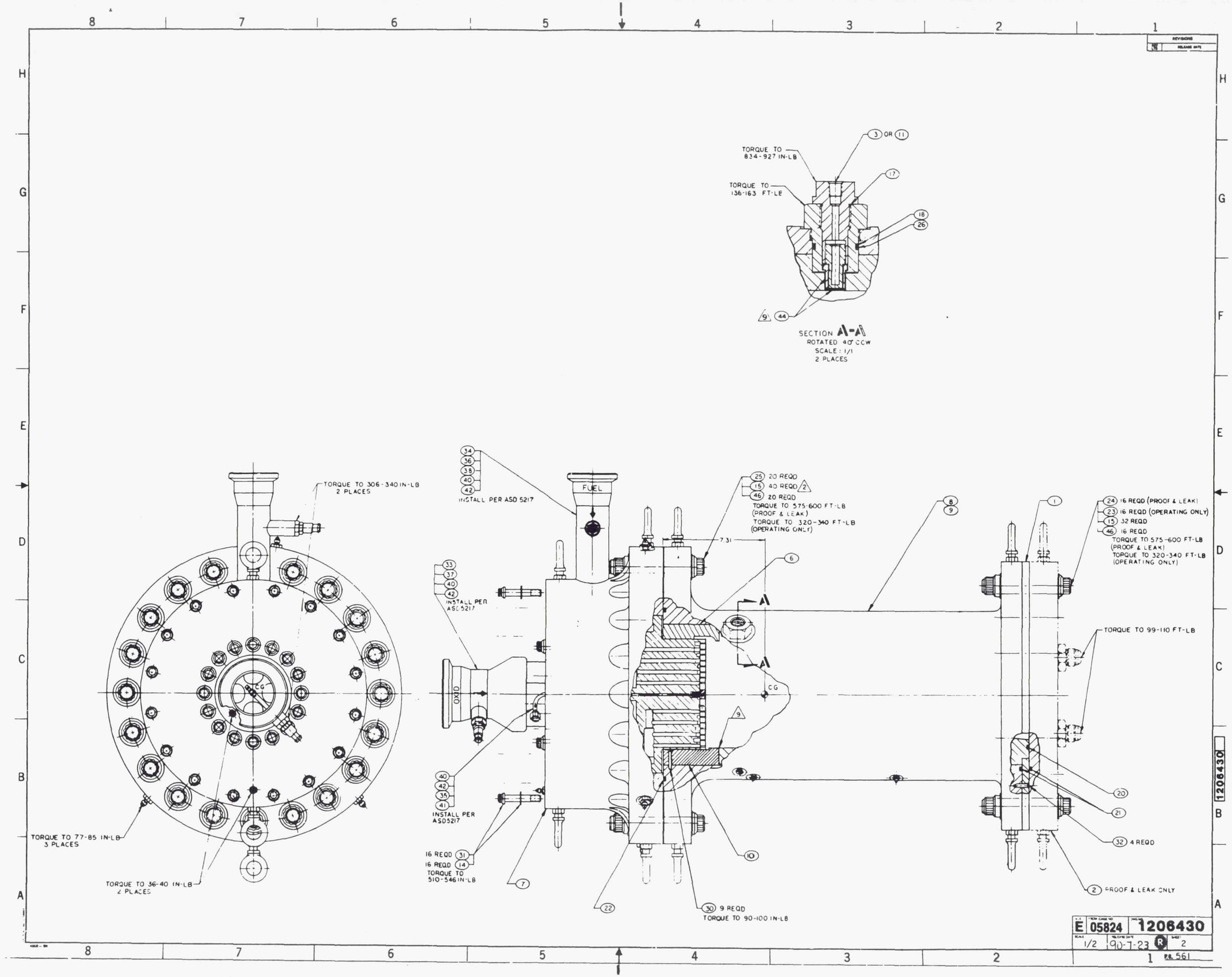
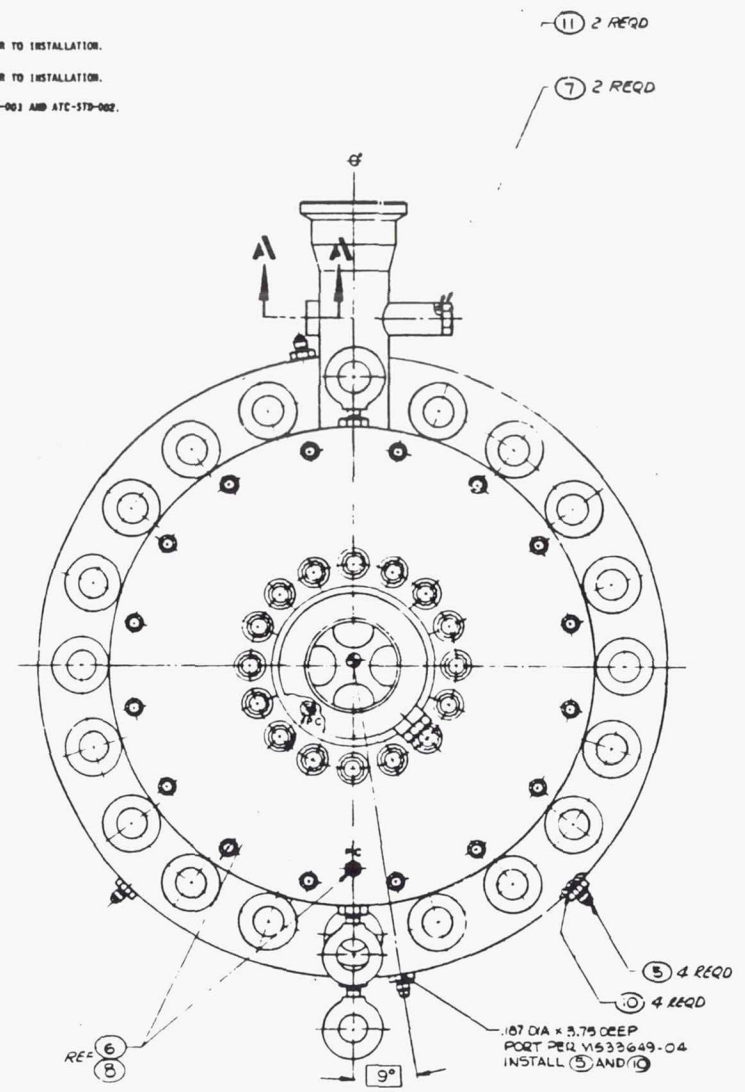

REVISIONS
SECTION A-A
ROTATED 40° CCW
SCALE : 1/1
2 PLACES
TORQUE TO 834-927 IN-LB
TORQUE TO 136-163 FT-LB
3 OR 11
17
18
26
9
44
TORQUE TO 306-340 IN-LB
2 PLACES
TORQUE TO 77-85 IN-LB
3 PLACES
TORQUE TO 36-40 IN-LB
2 PLACES
CG
INSTALL PER ASD 5217
34
36
38
40
42
33
37
INSTALL PER ASD5217
40
42
35
41
16 REQD 31
16 REQD 14
TORQUE TO 510-546 IN-LB
FUEL
OXID
25 20 REQD
15 40 REQD 2
46 20 REQD
TORQUE TO 575-600 FT-LB (PROOF & LEAK)
TORQUE TO 320-340 FT-LB (OPERATING ONLY)
7.31
6
A
A
9
10
7
22
30 9 REQD
TORQUE TO 90-100 IN-LB
8
9
1
24 16 REQD (PROOF & LEAK)
23 16 REQD (OPERATING ONLY)
15 32 REQD
46 16 REQD
TORQUE TO 575-600 FT-LB (PROOF & LEAK)
TORQUE TO 320-340 FT-LB (OPERATING ONLY)
TORQUE TO 99-110 FT-LB
20
21
32 4 REQD
2 PROOF & LEAK ONLY
1206430
E 05824
1206430
SCALE 1/2
90-7-23 R
SHEET 2
PR 561

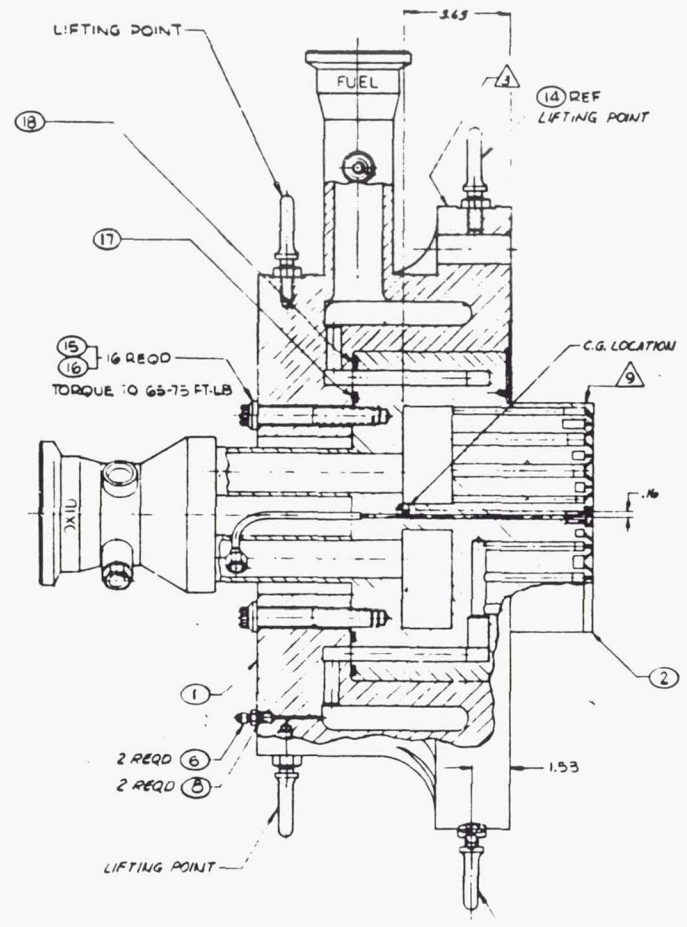
Figure D-2

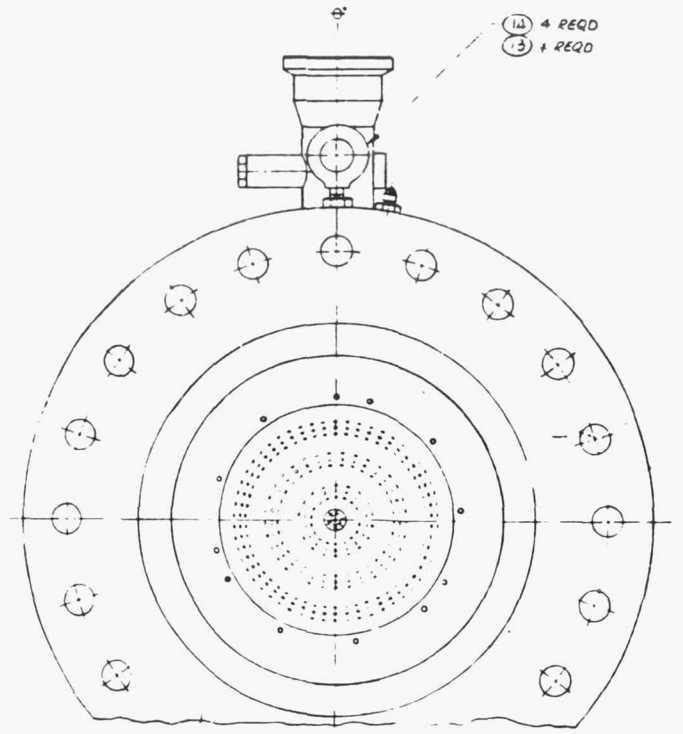
REVISIONS			
LTR	DESCRIPTION	RELEASE DATE	APPROVED
A	SEE A DCN	R 90-3-29	

NOTES:

1. INTERPRET DRAWING PER ATC-STD-4926.
2. LOX CIRCUIT CLEANLINESS PER MSFC-SPEC-164; SSA IS 2.75 SQ FT. FUEL CIRCUIT PER ATC-STD-4940, LEVEL 1000. CORE SSA IS 3.0 SQ FT. AND FLANGE SSA IS 5.2 SQ FT.
3. MARK PER AS478-7A WITH 1206427, APPLICABLE DASH NUMBER AND AEROJET TECHSYSTEMS ASSIGNED SERIAL NUMBER.
4. ASSEMBLED WEIGHT IS 600 LB.
5. PROTECTIVE CLOSURES REQUIRED.
6. APPLY ITEM 20 TO ALL THREADS PRIOR TO INSTALLATION.
7. APPLY ITEM 21 TO ALL O-RINGS PRIOR TO INSTALLATION.
8. STORAGE AND USE CONTROL PER ATC-STD-003 AND ATC-STD-002.







(9) TEST ASSEMBLY IN THE FOLLOWING ORDER:

A. ULTRASONIC INSPECT BRAZE JOINT PER ATC-STD-4819, TYPE I. ACCEPTANCE PER COGNIZANT DESIGN ACTIVITY.

B. PROOF TEST BRAZE JOINT BY FLOW1 & CLEAR WATER (PER ATC-STD-4940, LEVEL 1000) SIMULTANEOUSLY THRU THE OXIDIZER AND FUEL CIRCUITS TO ATMOSPHERE. HOLD FOR APPROXIMATELY FIVE MINUTES.

OXIDIZER CIRCUIT: MANIFOLD P = 750 ± 10 PSI; APPROX FLOW = 175 LB\SEC
FUEL CIRCUIT MANIFOLD P = 710 ± 10 PSI; APPROX FLOW = 85 LB\SEC

C. REPEAT ULTRASONIC INSPECT OF BRAZE JOINT PER ATC-STD-4819, TYPE I. NOTE ANY DIFFERENCES. ACCEPTANCE PER COGNIZANT DESIGN ACTIVITY.

D. LEAK TEST ASSEMBLY PER ATC-47063, METHOD II, USING CLEAR DRY NITROGEN AT 50 ± 5 PSIA. HOLD FOR 5 MINUTES MINIMUM. NO LEAKAGE ALLOWED.

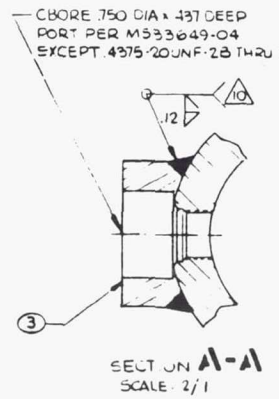
E. FLOW TEST WITH CLEAR WATER (ATC-STD-4940, LEVEL 1000) AS FOLLOWS:

1. PERFORM VISUAL PATTERN CHECK PER COGNIZANT DESIGN ACTIVITY.
2. THE OXIDIZER AND FUEL SHALL BE FLOWED SEPARATELY AT THE FOLLOWING FLOW RATES: OXIDIZER: 25, 35, 45, 55, 65; FUEL: 20, 25, 35, 40, 45. FOR EACH DATA POINT RECORDED THE MANIFOLD P, FLOWRATE, NOMINAL WATER FLOW TEMPERATURE AND ACTUAL OUTPUT FREQUENCY OF FLOWMETER. CALCULATE K_f:

$$K_f = \frac{\dot{w}}{(\Delta P)(S_g)}$$

WHERE: $\dot{w}$ = FLOWRATE, LB/SEC
ΔP = INLET-OUTLET PRESSURE, PSI
S_g = SPECIFIC GRAVITY OF WATER AT FLOW TEMPERATURE

(10) FUSION WELD PER ATC-46351 USING (22).



SECTION A-A
SCALE: 2/1

	AR			WELD ROD	ER316 AWS A5.9		22
(A)	AR			LUBRICANT	ATC-44108-1		21
(6)	AR	1859B	MS122	LUBRICANT			20
							19
	1		AS8040K2 -450	O-RING			18
	1		AS8040K2 -443	O-RING			17
	16		MS21250 -10048	BOLT			16

16		MS20002C10	WASHER		15
4		MS51937-5C	BOLT EYE		14
4		MS35691-33	NUT		13
					12
2		AS8040K2 -908	O-RING		11
4		AS8040K2 -904	O-RING		10
					9
2		AS9040K2 -902	O-RING		8
2		AN893-3J	BUSHING		7
2		AN815-2J	UNION		6
4		AN815-4J	UNION		5
					4
1		1200773-B	BOSS		3
1		1206423-9	INJECTOR CORE ASSY		2
1		-3	INJECTOR FLANGE ASSY	MAKE FROM 1200773-13	1

DEVELOPMENT HARDWARE
FOR TEST OR EXPERIMENTATION

DO NOT SCALE DRAWING

NAS3-25956

O.D. REMETER 90-5-9
90-3-20
90-7-9
90-7-9
90-7-9
90-7-9
90-7-16

GENCORP AEROJET TechSystems

INJECTOR ASSY, OX/HC-3D SUBSCALE (ROCCID TEST VALIDATION)

E 05824 1206427

90-7-23 R 1 OF 1

THIS DWG HAS BEEN REVIEWED PER POLICY 77-1, 90-8-9

P.C. 561

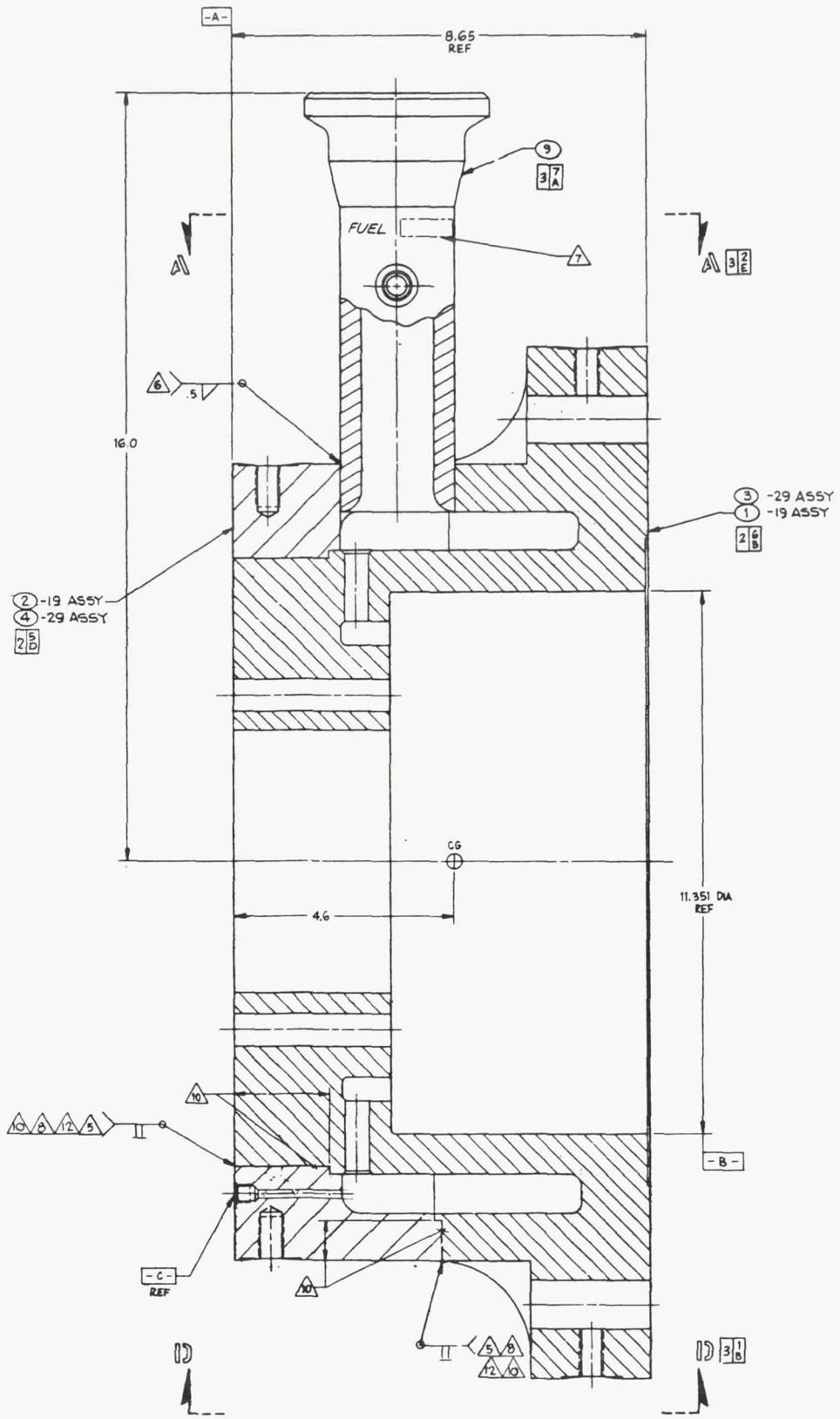
1206427 A

Figure D-3

REVISIONS			
LTR	DESCRIPTION	RELEASE DATE	APPROVED
A	SEE A DCN	R 90-4-20	

NOTES:

1. INTERPRET DRAWING PER ATC-STD-4926.
2. ALL DIAMETERS ON A COMMON AXIS ⌀.010 CIRCULAR UNLESS OTHERWISE NOTED.
3. CLEANLINESS PER ATC-STD-4946, LEVEL 1000 INTERNAL SURFACES AND LEVEL VC EXTERNAL SURFACES. SSA IS 8.2 SQUARE FOOT.
4. ALIGN SCRIBE LINES 0° OF (1) AND (2) OR (3) AND (4) AT ASSY WITHIN .060. 3 6 D
5. ELECTRON BEAM WELD PER ATC-STD-4007-1. 1 4 B 6 C 7 C
6. FUSION WELD PER ATC-46381, USING (8). 1 6 F 3 C
7. MARK PER AS478-7A3 WITH 1200773, APPLICABLE DASH NUMBER AND AEROJET TECHSYSTEMS COMPANY (ATC) ASSIGNED SERIAL NUMBER. 1 6
8. WHEN MACHINING MATING SURFACES OF (1) AND (2) OR (3) AND (4) MATCH MACHINE TO ACCOMPLISH CO-PLANER REQUIREMENT NO GREATER THAN 0.010 INCH. 2 6 B 3 D F
9. MATCH MACHINE DIMENSION WITHIN .002 TO .000 WITH MATING PART. 2 4 A 2 E · 3 6 B D F G
10. MATCH MACHINE TO MAINTAIN GAP OF .004 MAXIMUM OVER LENGTH NOTED BETWEEN MATING SURFACES OF (1) AND (2) OR (3) AND (4) PRIOR TO EBW. 1 6 C 2 B E 3 D E
11. MARK PER AS478-7A3 IN APPROXIMATE LOCATION WITH INFORMATION SHOWN IN .125 INCH CHARACTERS. 3 B
12. VENDOR TO SUPPLY COUPON WELD SAMPLE OF SPECIFIED MATERIAL MACHINED TO TYPICAL EBW JOINT AS SHOWN. 1 B 2 C
13. FUSION WELD PER ATC-46381, USING (18). 3 D
14. MARK PER AS478-3SD WITH 1200773 AND APPLICABLE DASH NUMBER. 3 D
15. SURFACE FINISH OF 32 TO BE BETWEEN DIAMETERS NOTED. 2 5 F
16. ASSEMBLED WEIGHT: 430 LB.
17. ALL DIMENSIONS APPLY AFTER WELDING.
18. MATERIAL TO MEET ALL REQUIREMENTS EXCEPT CARBON CONTENT TO BE .030% MAX. (MINIMUM YIELD STRENGTH IS 30 KSI).
19. PRIOR TO WELDING, PARTS TO BE FREE OF OXIDATION SCALE AND OXYGEN CONTAMINATED LAYERS AND CLEANED PER ATC-STD-4839, METHOD II.
20. PENETRANT INSPECT WELDS PER ATC-STD-4816, TYPE I. ACCEPTANCE CRITERIA PER ATC-STD-4009, CL II.



-19 ASSY
-29 ASSY

		AR			WELD ROD	ER316	AWS A5.9	1	10
1	1			-9	ASSY			1 4 C	9
AR	AR	AR			WELD ROD	ER308	AWS A5.9		8
		1	14713	52823	BUTT WELD HUB	2"GR 20 SCH 160	SA182-F316	3 B C	7
		1		-4	TUBE	2.0 SCHED 160 CRES P. c	ASTM-A312 TYPE 304	3 C C	6
		1		-3	BOSS	CRES	QQ-S-763 CL304 COND A	2 6 C	5
18	1			-6	OUTER RING	CRES	ASTM A479 OR ASTM A167 TYPE 304	1 6 F	4
16	1			-5	INNER RING			3 F	3
	1			-2	OUTER RING	CRES	ASTM A479 OR ASTM A167 TYPE 304	1 6 F	2
	1			-1	INNER RING	CRES	ASTM A479 OR ASTM A167 TYPE 304	1 3 F	1
-29	-19	-9	ITEM NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION		MATERIAL SPECIFICATION		

1200773 A

CONTRACT NO. F04611-86-C-0100	DRAWN R. JACKSON	DATE 86-9-11	AEROJET TechSystems COMPANY
UNLESS OTHERWISE SPECIFIED DIMENSIONS & TOLERANCES ARE IN INCHES & PER ANSI Y 14.5	CHECK		TITLE INJECTOR FLANGE ASSY, OXYGEN / HYDROCARBON- 3D SUBSCALE
TOLERANCES DECIMALS ANGULAR .XX ±.05 ±2° .XXX ±.010	DESIGN D.M. Beckwith	2-2-87	
V SURFACE ROUGHNESS DO NOT SCALE DRAWING	ENGRG AUTHORITY W.E. Logan	87-2-3	SIZE E FSCM NO. 05824 DWG NO. 1200773
EST WT 430 LBS	DWG LEVEL 1		SCALE 1/1 RELEASE DATE R 87-2-3 SHEET 1 OF 2

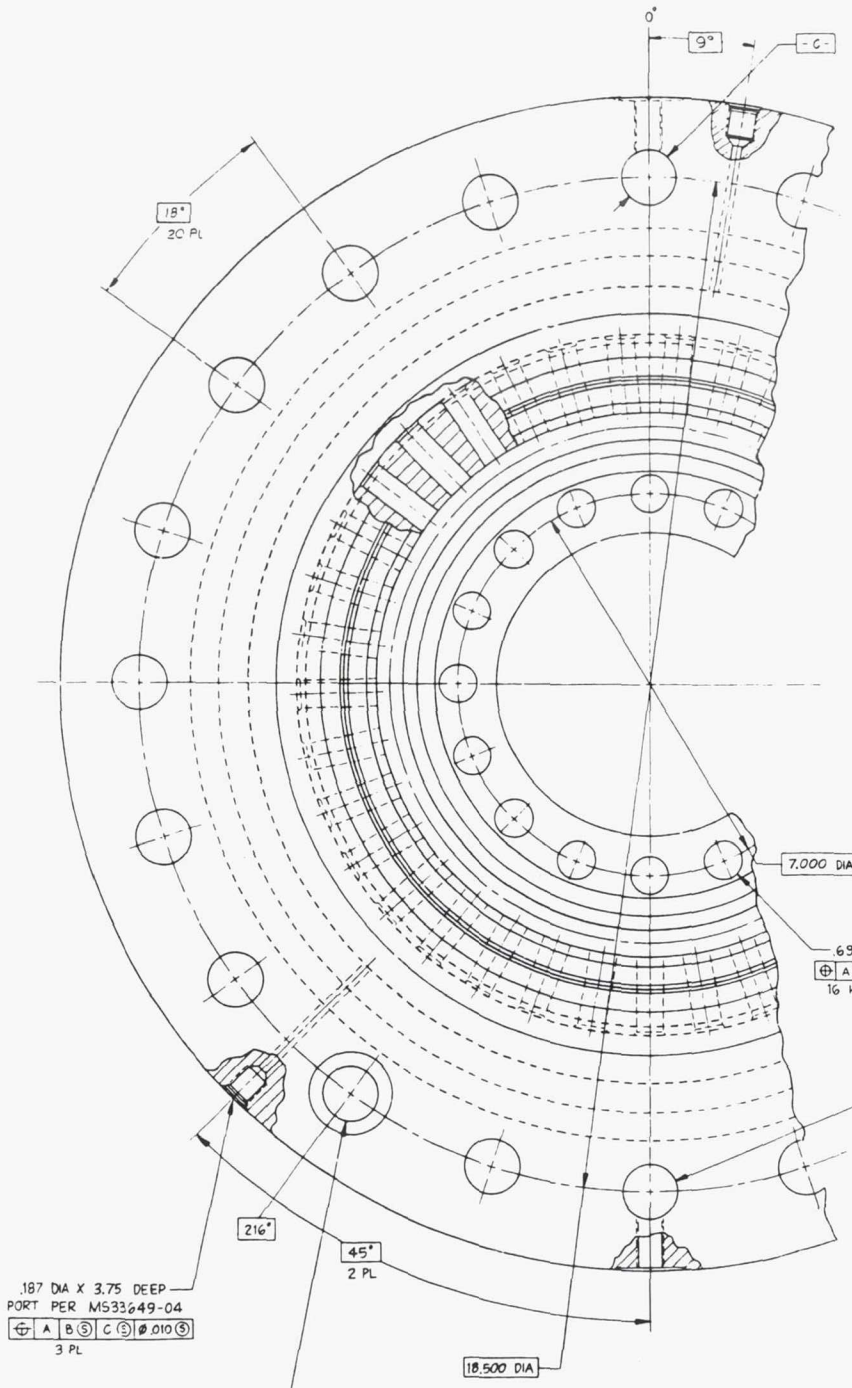
THIS DWG HAS BEEN REVISED PER POLICY 89-4 1-19-87

P.S. 953,604

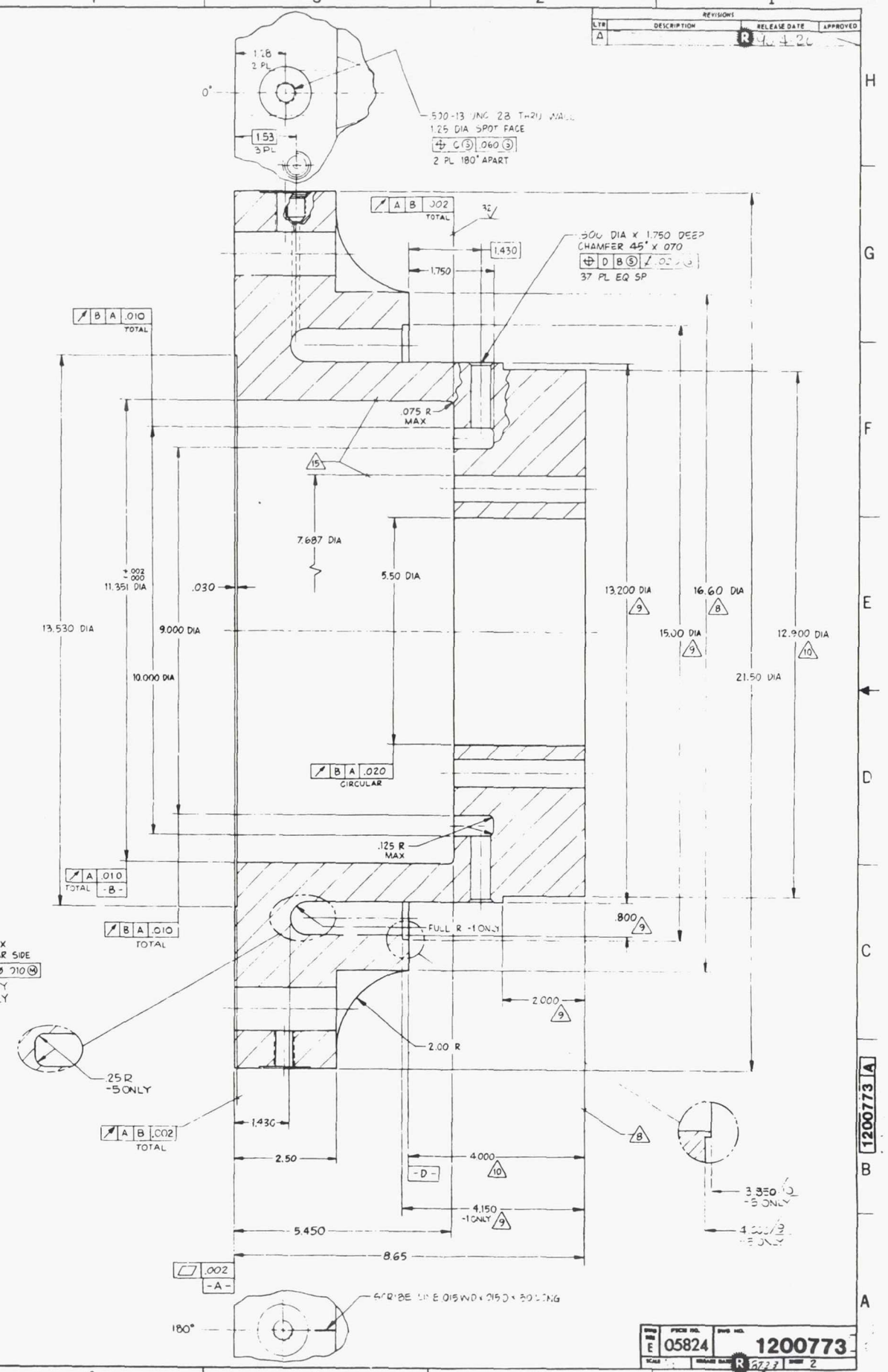
DEVELOPMENT HARDWARE
FOR TEST OR EXPERIMENTATION

Figure D-4

NOTES:



1 DETAIL 3 F



REVISIONS			
LTR	DESCRIPTION	RELEASE DATE	APPROVED
A		R 4-1-20	

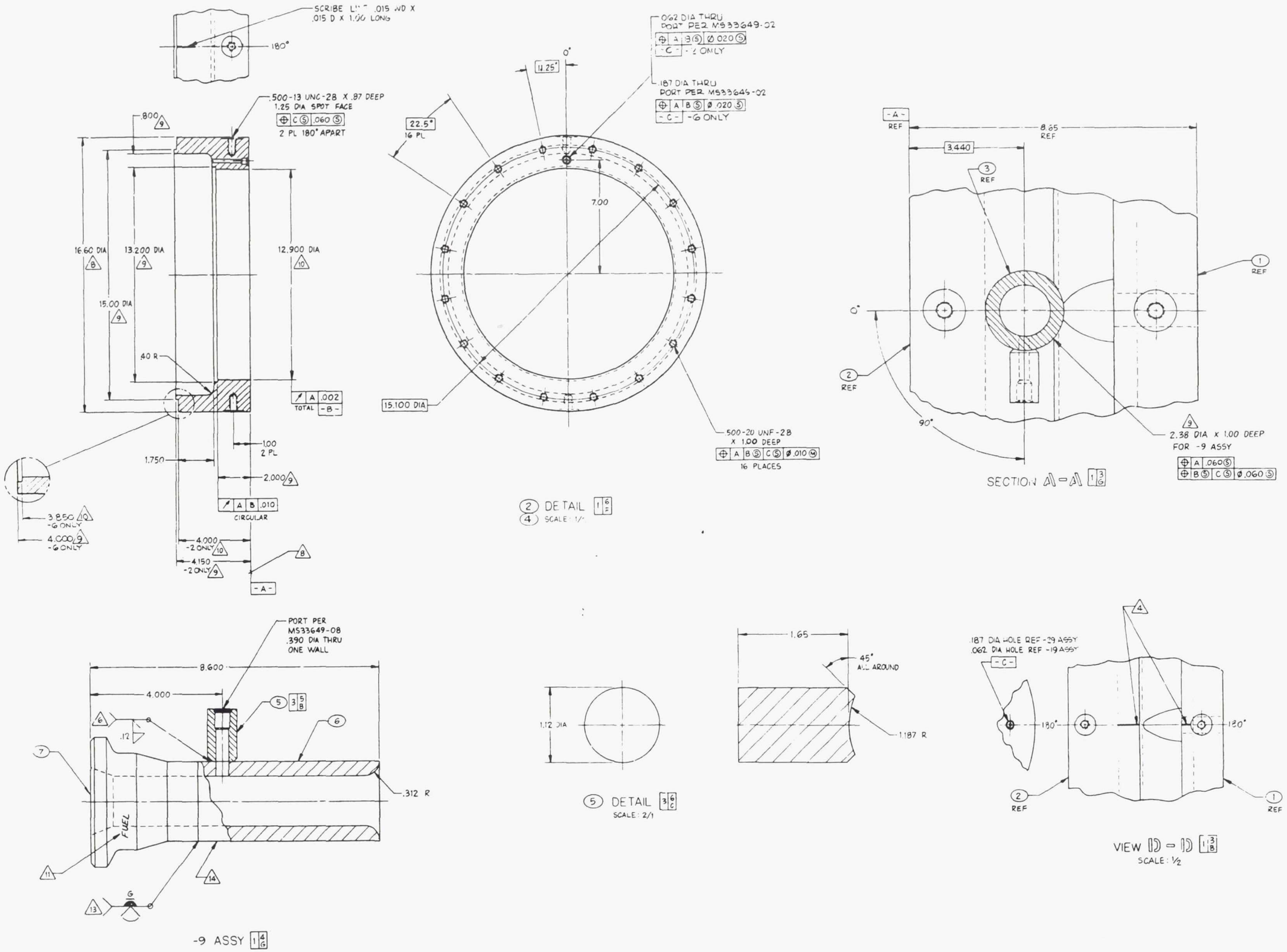
SIZE	FSCM NO.	DWG NO.	REV
E	05824	1200773	R

SCALE — WEIGHT — SHEET 2

1200773 A

REVISIONS			
LTR	DESCRIPTION	RELEASE DATE	APPROVED
A		R 10-9 20..	

NOTES:



② DETAIL
④ SCALE: 1/1

-9 ASSY

⑤ DETAIL
SCALE: 2/1

SECTION A-A

VIEW ⇨

SCALE: ½

1200773 A

SIZE	FSCM NO.	DWG NO.
E	05824	1200773

SCALE 1/1 WEIGHT SHEET 3

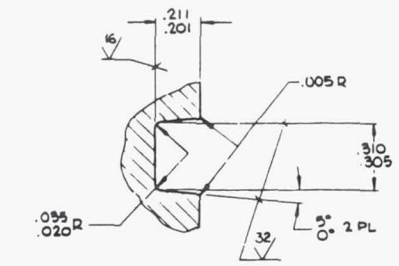
PE 393.604

Figure D-6

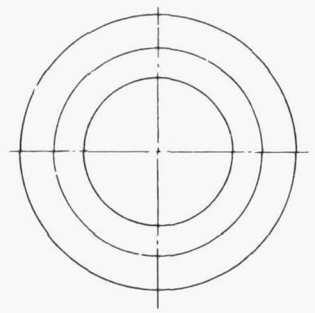
NOTES:

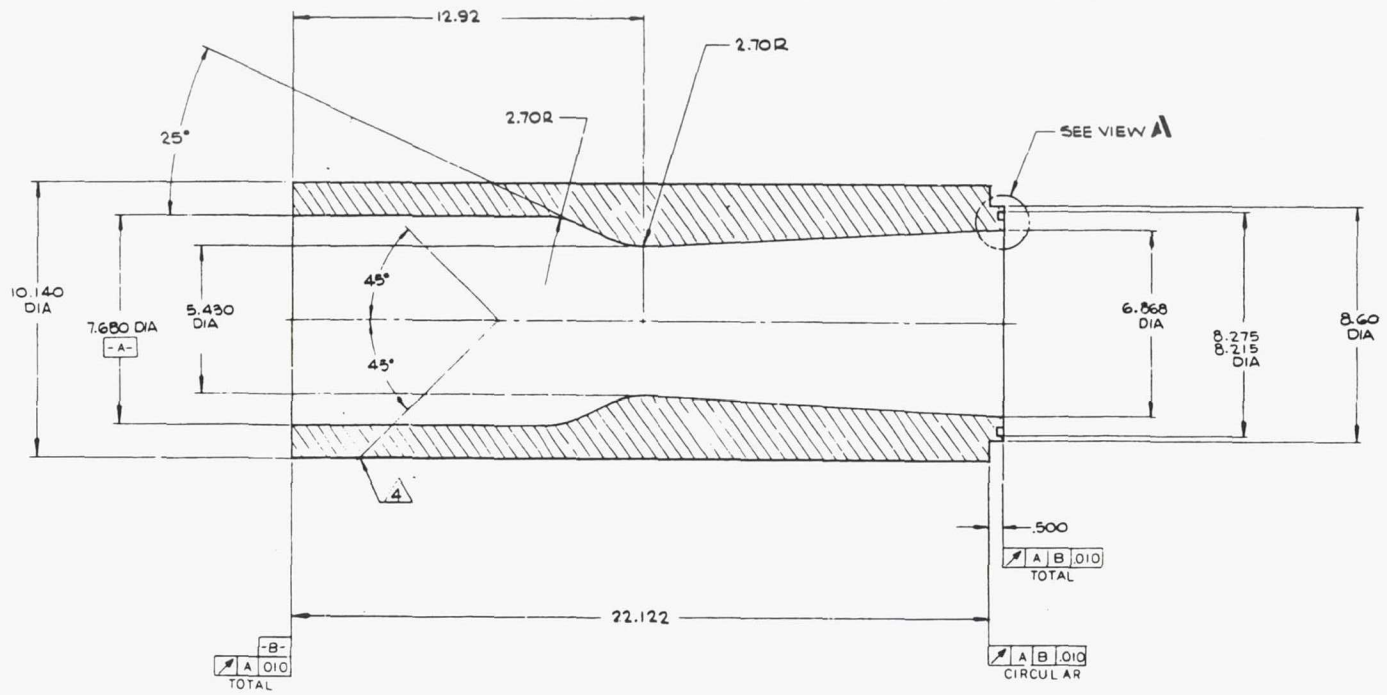
1. INTERPRET DRAWING PER ATC-STD-4926.
2. ALL DIAMETERS ON A COMMON AXIS ⌀.010 CIRCULARITY UNLESS OTHERWISE NOTED.
3. MARK PER AS478-350 WITH 1206429 AND APPLICABLE DASH NO.
4. FABRIC SHALL BE ORIENTED AT AN ANGLE OF 45° ± 5° RELATIVE TO CHAMBER CENTERLINE.

REVISIONS			
LTR	DESCRIPTION	RELEASE DATE	APPROVED



VIEW A
SCALE: 4/1





DEVELOPMENT HARDWARE
FOR TEST OR EXPERIMENTATION
DO NOT SCALE DRAWING

	-1		SILICA PHENOLIC

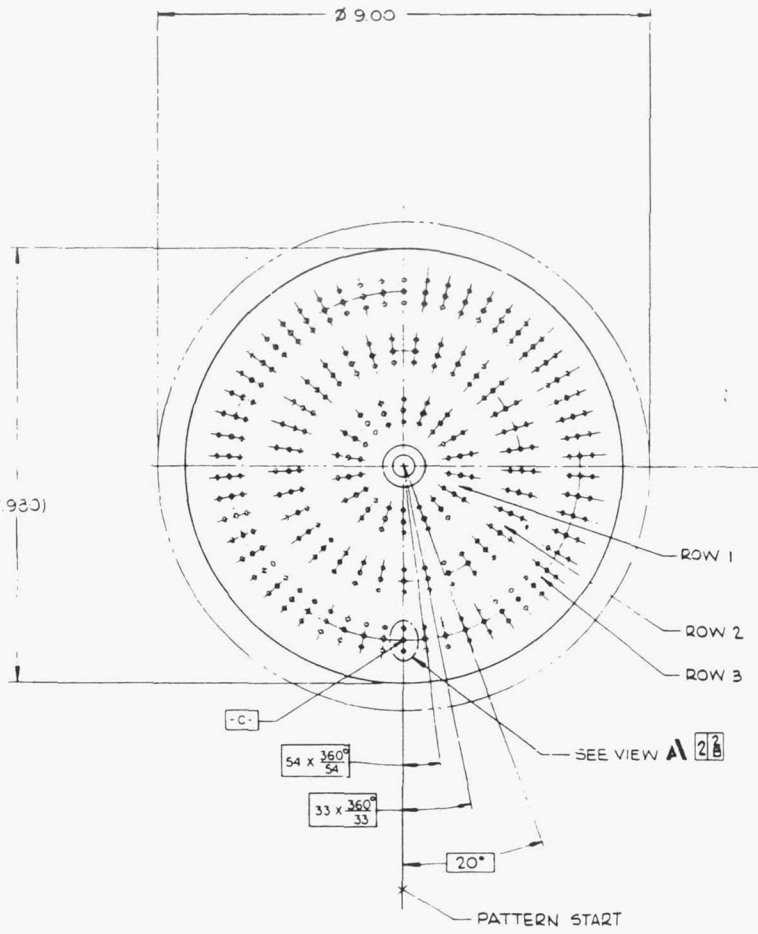
CONTRACT NO. NAS3-25566
SCALE: 0.3 DIAMETER
GenCorp AEROJET TechSystems SACRAMENTO, CALIFORNIA
TITLE: INSERT, THRUST CHAMBER- OX/HC 3DS (ROCCID TEST VALIDATION)
SIZE E | 05824 | 1206429
SCALE 1/2 | 90-7-23 | R | SHEET 1 OF 1
P.C. 561

1206429 -1

Figure D-7

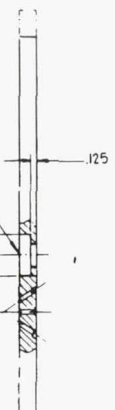
REVISIONS			
LTR	DESCRIPTION	RELEASE DATE	APPROVED

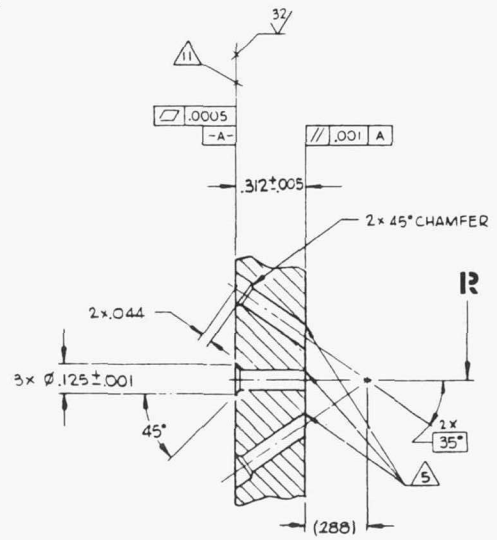
NOTES:



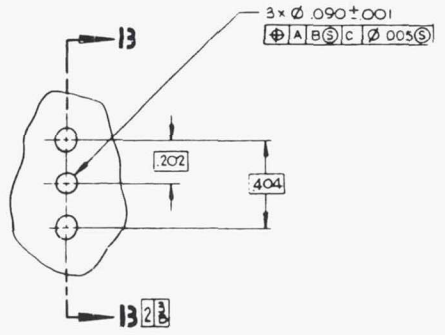
2 DETAIL

ROW NO.	R BASIC	START ANGLE	REPEAT ANGLE BSC	NO. OF PATTERNS
1	1.022	0°	20°	18
2	2.124	0°	10.909°	33
3	3.227	0°	6.666°	54





SECTION B-B 2 2B
SCALE: 4/1



VIEW A 2 5B
TYPICAL PATTERN 105 PLACES
SCALE: 4/1

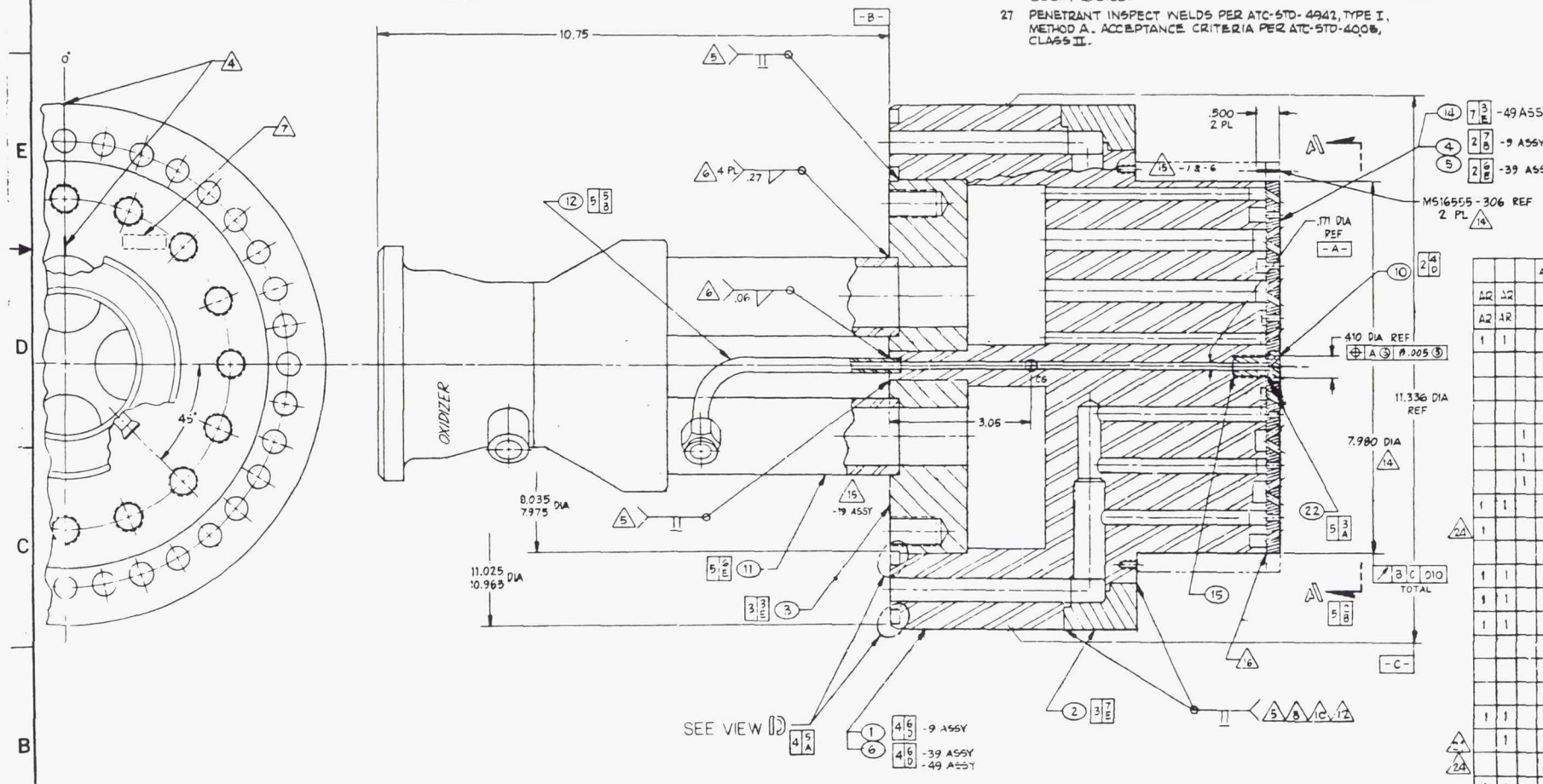
SIZE	FSCM NO.	DWG NO.
E	05824	1206423
SCALE 1/1	WEIGHT	SHEET 2 OF 2

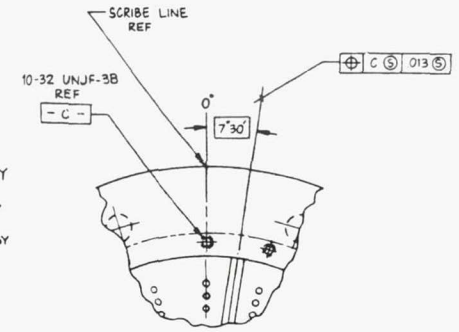
1206423

Figure D-8

REVISIONS			
LTR	DESCRIPTION	RELEASE DATE	APPROVED
A	SEE A DCN	R 90-4-20	

NOTES:
1. INTERPRET DRAWING PER ATC-STD-4028.
2. ALL DIAMETERS ON A COMMON AXIS ⌖ .010 Ⓜ CIRCULAR UNLESS OTHERWISE NOTED.
3. CLEANLINESS PER MSFC-SPEC-164. FOR OX CIRCUIT: 55A IS 2.75 SQ FT. FUEL CIRCUIT PER ATC-STD-4940, LEVEL 1000; 55A IS 3.0 SQ FT. EXTERNAL SURFACES LEVEL VC.
4. ALIGN SCRIBE LINES WITHIN .060 TOTAL.
5. ELECTRON BEAM WELD PER ATC-STD-4057-1.
6. FUSION WELD PER ATC-46351, USING (23).
7. MARK PER AS478-7A3 WITH 1200729, APPLICABLE WASH NO. AND AEROJET TECHSYSTEMS COMPANY ASSIGNED SERIAL NO.
8. WHEN MACHINING MATING SURFACES OF (1) OR (6), (2) AND (3) MATCH MACHINE TO ACCOMPLISH CO-PLANER REQUIREMENT NO GREATER THAN .010 INCH.
9. MATCH MACHINE DIMENSION WITHIN .002 TO .005 CLEARANCE BOTH MATING PART.
10. MATCH MACHINE TO MAINTAIN GAP OF .004 MAX OVER LENGTH NOTED BETWEEN MATING SURFACES OF (1) OR (6), (2) AND (3) PRIOR TO EBW.
11. MARK PER AS478-7A IN APPROXIMATE LOCATION WITH INFORMATION SHOWN IN .125 INCH CHARACTERS.
12. VENDOR TO SUPPLY COUPON WELD SAMPLE OF SPECIFIED MATERIAL MACHINED TO TYPICAL EBW JOINTS AS SHOWN.
13. SHARP EDGE REQUIRED ON FACE SIDE. ORIFICE DIAMETER SHALL NOT BE DAMAGED DURING INSPECTION.
14. (FOR MANUFACTURING USE ONLY) PERMISSIBLE TO INSTALL DOWEL PINS MS16555-306 AS SHOWN. DOWEL PINS TO BE REMOVED AND EXCESSIVE MATERIAL TO BE MACHINED AWAY TO MEET DIMENSIONS OF END ITEM CONFIGURATION.
15. ASSEMBLY TO BE LIFTED SIMULTANEOUSLY WITH STRAPS AT TWO LOCATIONS.
16. BRAZE AND LEAK TEST PER CDN-8959 AND INSTRUCTIONS OF COGNIZANT DESIGN ACTIVITY, USING (34).
17. ALL DIMENSIONS APPLY AFTER BRAZING AND WELDING.
18. DEFORM ITEMS (10) AND (4), (5) OR (14) (AS SHOWN) AFTER ASSY TO CREATE LOCKING OF ITEMS (10) TO (4), (5) OR (14).
19. ASSEMBLED WEIGHT: 165 LB
20. SURFACES TO BE SUBSEQUENTLY MACHINED.
21. BEND TUBING PER ASD5227.
22. FLARE TUBING PER ASD5220.
23. FUSION WELD PER ATC-46351 USING (25).
24. AMZIRC ZIRCONIUM COPPER ALLOY (CDA 150) OF THE FOLLOWING COMPOSITION:
    99.8 % OFHC COPPER (INCLUDING SILVER AND .001 % MAXIMUM OXYGEN).
    .10 - .20 % ZIRCONIA.
    FORGING REQUIREMENTS:
    HOT, UPSET AND CROSS GRAIN FORGED WITH DIAMETRAL SECTIONS TO BE TAKEN FOR UNIFORMITY OF MICRO-STRUCTURE, GRAIN SIZE, COMPOSITION AND FREEDOM FROM CENTER DEFECTS (BURSTS, CRACKS, VOIDS, PIPING, ETC.).
25. PRIOR TO WELDING, PARTS TO BE FREE OF OXIDATION SCALE AND OXYGEN CONTAMINATED LAYERS, AND CLEANED PER ATC-STD-4833, METHOD II.
26. ELECTROPOLISH INDICATED SIDE USING A SOLUTION OF 50% PHOSPHORIC ACID/50% DEIONIZED WATER AND 100 AMP/FT² CURRENT. CONTINUE PROCESS UNTIL 0.001-0.0013 INCHES OF MATERIAL IS REMOVED AND ORIFICE INLETS HAVE A SLIGHT RADIUS.
27. PENETRANT INSPECT WELDS PER ATC-STD-4942, TYPE I, METHOD A. ACCEPTANCE CRITERIA PER ATC-STD-4005, CLASS II.





-9 ASSY SHOWN
-39 ASSY
-49 ASSY

QTY REQ'D PER ASSY -99	-39	-29	-19	-9	FSCM NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION	ZONE	ITEM NO.
AR							WELD ROD	ER 316 AWS A5.9		25
AR	AR		AR				BRAZE ALLOY	NICORO 80 AGC-44254		24
AR	AR		AR				WELD ROD	ER 308 AWS A5.9		23
1	1		1			-12	WASHER	OFHC COPPER COML GRADE	1	3C 22
		1				-15	OX INLET MANIFOLD	CRES ASTM A276 TYPE 304	5	6F 21
		1		14713	82346		BUTT WELD HUB	3"GR 25 SCH160 SA182-F316	5	7G 20
										19
	1					-11	TUBING	.250 OD x .035 WALL CRES 304 AMS-5567	5	4B 18
	1				MS51931B45		NUT		5	5B 17
	1				MS20819-4J		SLEEVE		5	5B 16
1	1		1	83259	2010561360		O-RING	SILICONE	1	4C 15
1						-14	INJECTOR FACE PLATE	AMZIRC ZIRCONIUM COPPER ALLOY (CDA 150)	7	3E 14
										13
1	1		1			-29	ASSY		1	8E 12
1	1		1			-19	ASSY		1	8E 11
1	1		1			-10	IGNITER PLUG	CRES 20-5-763 CL 304 COND A	1	3D 10
										9
		1				-3	BOSS	CRES 20-5-763 CL 304 COND A	5	7A 8
		4				-7	INLET TUBE	1.25 SCHED 80 CRES PE ASTM A312 CL 304 COND A	5	6J 7
1	1					-6	INJECTOR CORE - INLET	CRES ASTM A473 OR ASTM A276 TYPE 304	1	6
	1					-5	INJECTOR FACEPLATE (QUAD)	AMZIRC ZIRCONIUM COPPER ALLOY (CDA 150)	1	3E 5
			1			-4	INJECTOR FACEPLATE (DUAL)	AMZIRC ZIRCONIUM COPPER ALLOY (CDA 150)	1	3E 4
1	1		1			-3	OX INLET PLATE	CRES ASTM A473 OR ASTM A167 TYPE 304	1	6C 3
1	1		1			-2	OUTER RING	CRES ASTM A473 OR ASTM A167 TYPE 304	1	5B 2
			1			-1	INJECTOR CORE (TRIPLET)	CRES ASTM A473 OR ASTM A167 TYPE 304	1	5B 1

PARTS LIST

CONTRACT NO F04611-85-C-0100
UNLESS OTHERWISE SPECIFIED: DIMENSIONS & TOLERANCING ARE IN INCHES & PER ANSI Y14.5
TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; ANGULAR ± 2°
SURFACE ROUGHNESS
DO NOT SCALE DRAWING
SIZE E | CAGE 05824 | DWG NO 1200729 | REV A
WT 165 LBS | DWG LEVEL 1 | SCALE 1/1 | SHEET 1 OF 7

DRAWN	R. JACKSON	86-9-5
CHECKED		87-2-3
ENGINEERING		2-3-87
QUALITY		87-2-3

AEROJET TechSystems COMPANY

TITLE: INJECTOR CORE ASSY OXYGEN / HYDROCARBON 3D SUBSCALE

RELEASE DATE R 87-2-3

THIS DWG HAS BEEN REVIEWED PER POLICY PP-4, 1-21-87

DEVELOPMENT HARDWARE
FOR TEST OR EXPERIMENTATION

PE 653,604

Figure D-9

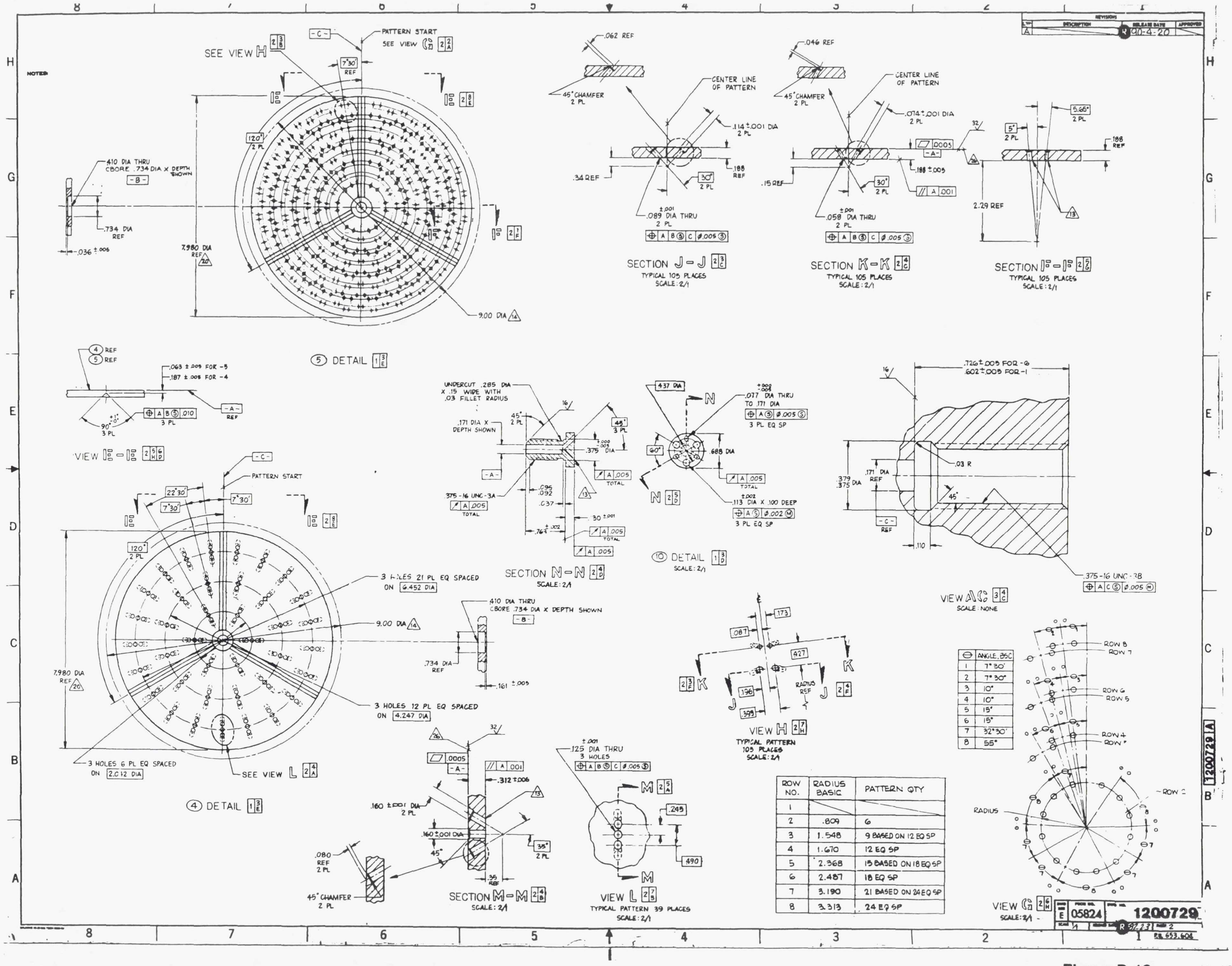
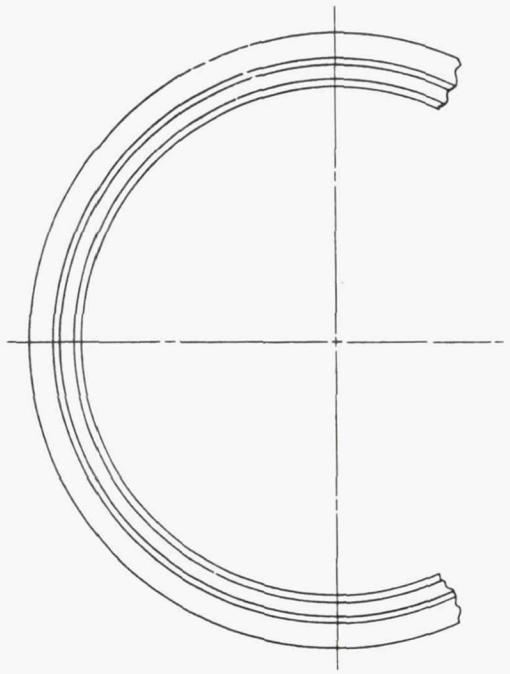
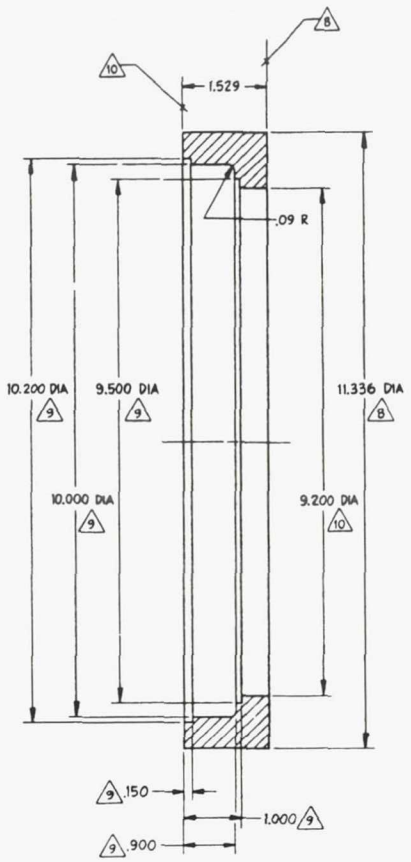

REVISIONS
LTR A
DESCRIPTION
RELEASE DATE 10-4-20
APPROVED
NOTES:
SEE VIEW H
PATTERN START
SEE VIEW G
7°30' REF
120° 2 PL
.410 DIA THRU CBORE .734 DIA X DEPTH SHOWN
-B-
.734 DIA REF
.036 ±.006
7.980 DIA REF
9.00 DIA
.062 REF
45° CHAMFER 2 PL
CENTER LINE OF PATTERN
.114 ±.001 DIA 2 PL
.34 REF
.188 REF
30° 2 PL
±.001 .089 DIA THRU 2 PL
A B C Ø.005
SECTION J-J
TYPICAL 105 PLACES
SCALE: 2/1
.046 REF
.074 ±.001 DIA 2 PL
.0005 -A-
.188 ±.005
.A .001
.15 REF
±.001 .058 DIA THRU 2 PL
SECTION K-K
TYPICAL 105 PLACES
SCALE: 2/1
5.66° 2 PL
5° 2 PL
32
2.29 REF
SECTION
TYPICAL 105 PLACES
SCALE: 2/1
4 REF
5 REF
.063 ±.005 FOR -5
.187 ±.005 FOR -4
-A- REF
90° ±1° 3 PL
A B Ø.010 3 PL
VIEW
DETAIL
UNDERCUT .285 DIA X .15 WIDE WITH .03 FILLET RADIUS
.171 DIA X DEPTH SHOWN
45° 2 PL
45° 3 PL
.375 DIA
A .005 TOTAL
.375-16 UNC-3A
.095 .092
.637
.764 ±.002
.30 ±.001
SECTION N-N
SCALE: 2/1
437 DIA
.077 DIA THRU TO .171 DIA
A Ø.005 3 PL EQ SP
60°
.688 DIA
.113 DIA X .100 DEEP
A Ø.002 M 3 PL EQ SP
DETAIL
SCALE: 2/1
.726 ±.005 FOR -6
.602 ±.005 FOR -1
.03 R
.379 .375 DIA
.171 DIA REF
45°
-C- REF
.110
.375-16 UNC-7B
A C Ø.005 M
VIEW
SCALE: NONE
22°30'
7°30'
3 HOLES 21 PL EQ SPACED ON 6.452 DIA
3 HOLES 12 PL EQ SPACED ON 4.247 DIA
3 HOLES 6 PL EQ SPACED ON 2.612 DIA
SEE VIEW L
DETAIL
.410 DIA THRU CBORE .734 DIA X DEPTH SHOWN
.734 DIA REF
.161 ±.005
.0005 -A-
.A .001
.312 ±.006
.160 ±.001 DIA 2 PL
.160 ±.001 DIA
45°
35° 2 PL
.080 REF 2 PL
45° CHAMFER 2 PL
SECTION M-M
SCALE: 2/1
±.001 .125 DIA THRU 3 HOLES
A B C Ø.005
.245
.490
VIEW L
TYPICAL PATTERN 39 PLACES
SCALE: 2/1
.173
.087
.027
.196
.399
RADIUS
VIEW H
TYPICAL PATTERN 105 PLACES
SCALE: 2/1
ROW NO. | RADIUS BASIC | PATTERN QTY
1 | | |
2 | .809 | 6
3 | 1.548 | 9 BASED ON 12 EQ SP
4 | 1.670 | 12 EQ SP
5 | 2.368 | 15 BASED ON 18 EQ SP
6 | 2.487 | 18 EQ SP
7 | 3.190 | 21 BASED ON 24 EQ SP
8 | 3.313 | 24 EQ SP
ANGLE, BSC
1 7°30'
2 7°30'
3 10°
4 10°
5 15°
6 15°
7 32°30'
8 55°
ROW 8
ROW 7
ROW 6
ROW 5
ROW 4
ROW 3
ROW 2
RADIUS
VIEW
SCALE: 2/1
SIZE E
CAGE CODE 05824
1200729
SCALE 1/1
WEIGHT R 57.73 LBS
SHEET 2
PO 653.606
1200729 A

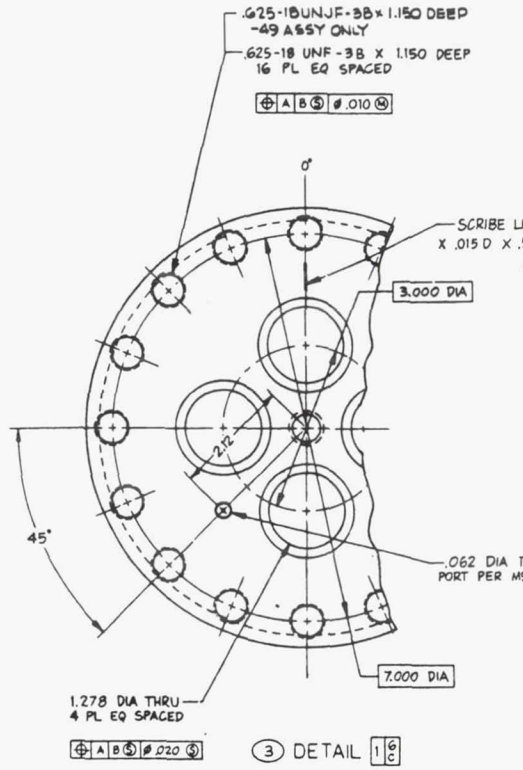
Figure D-10

NOTES:

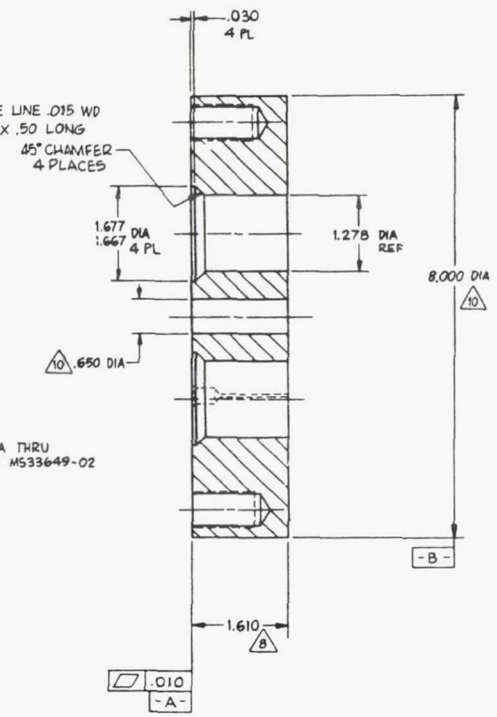


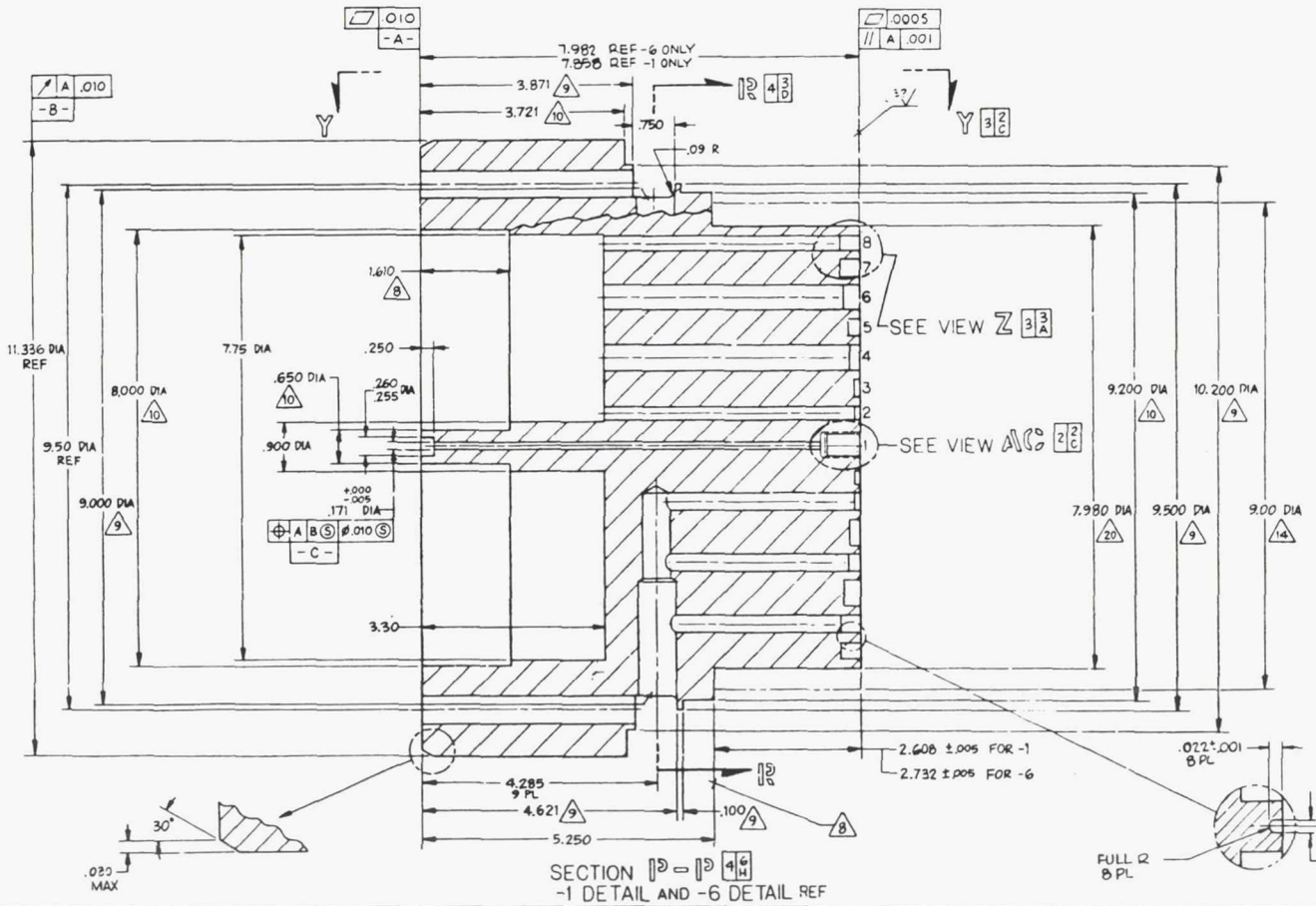
② DETAIL 1 [5B]



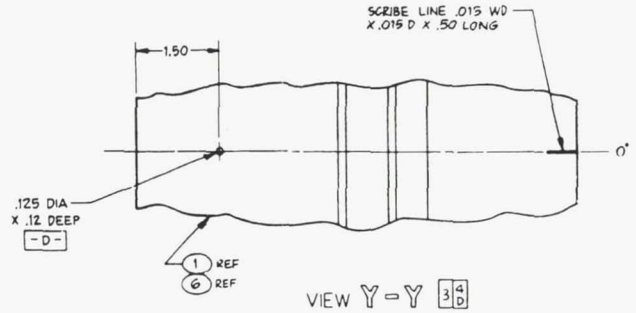


③ DETAIL 1 [6C]

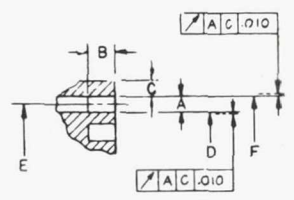




SECTION ⌦ - ⌦
-1 DETAIL AND -6 DETAIL REF



VIEW Y - Y [4D]



VIEW Z [4C]
-1 ONLY

-1 DETAIL TABULATION BLOCK

RON NO.	A CHANNEL WIDTH REF	B DEPTH	C LAND WIDTH BSC	D INNER RADIUS BSC	E DIA REF	F OUTER RADIUS BSC	G RADIUS ±.003
1	—	—	.238	—	—	—	.524
2	.268	.098	.150	.443	1.154	.711	.593
3	.321	.101	.150	.861	2.043	1.182	1.067
4	.481	.181	.150	1.332	3.145	1.813	1.655
5	.321	.202	.150	1.763	4.048	2.235	2.119
6	.481	.283	.150	2.435	5.351	2.916	2.781
7	.321	.353	.150	3.066	6.453	3.357	3.240
8	.268	.345	.185	3.337	7.342	3.805	3.678

1200729 A

SIZE	FSCM NO.	DWG NO.
E	05824	1200729

SCALE 1/1 WEIGHT R 8.23 SHEET 3
REF 353.603

Figure D-11 D-13

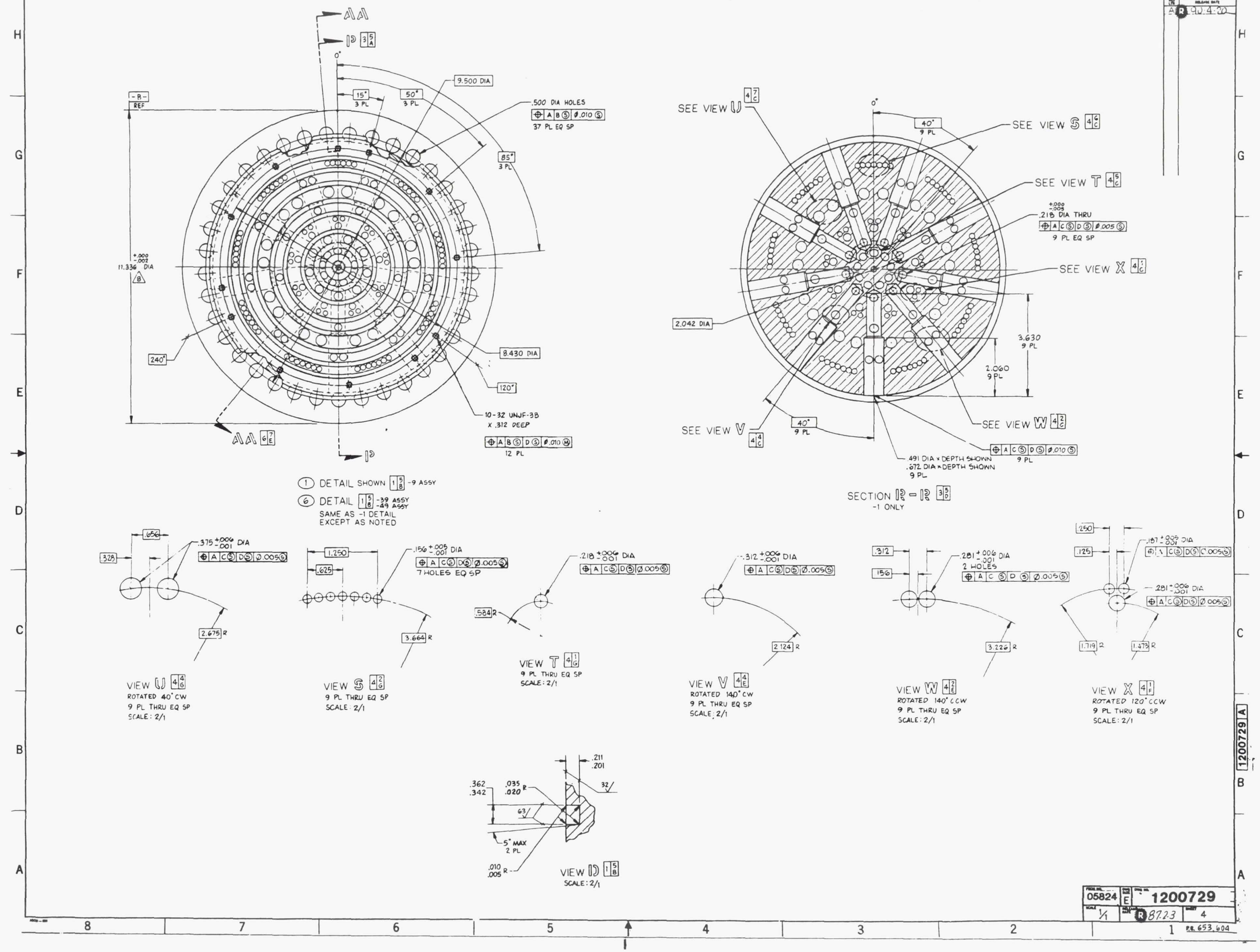
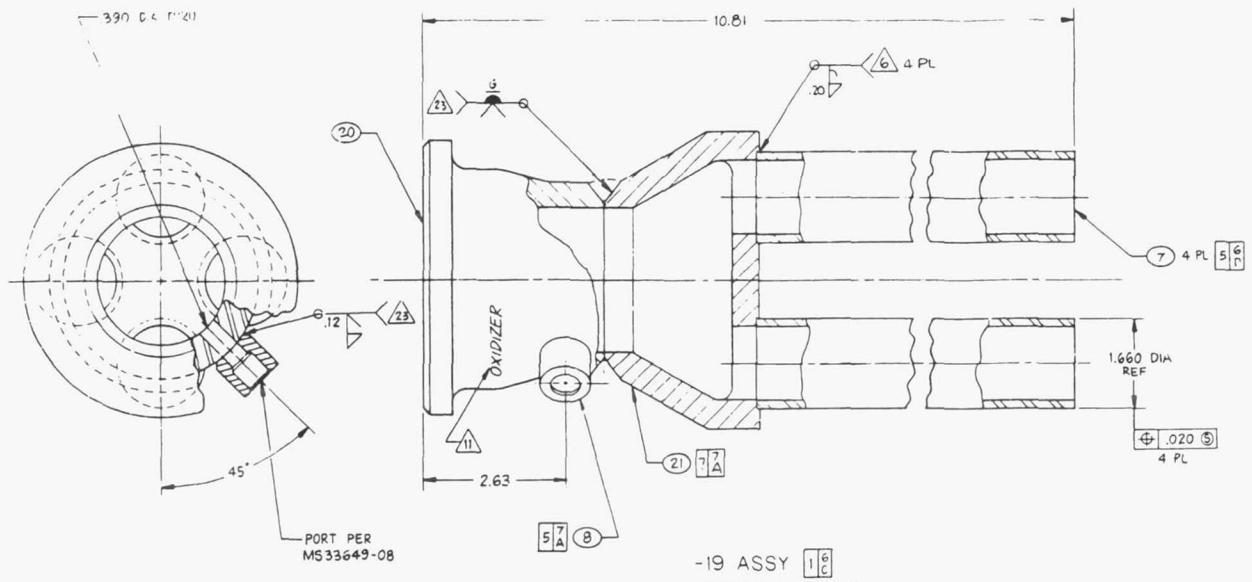


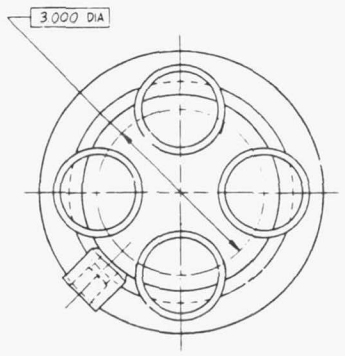
Figure D-12 D-14

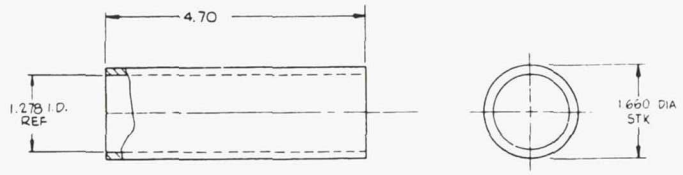
REVISIONS			
LTR	DESCRIPTION	RELEASE DATE	APPROVED
R			

NOTES:

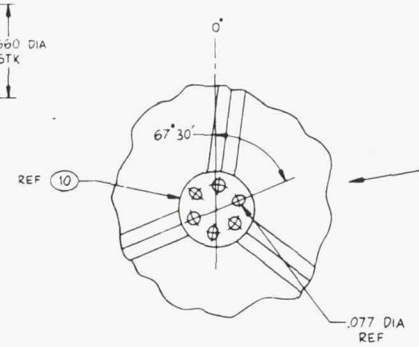


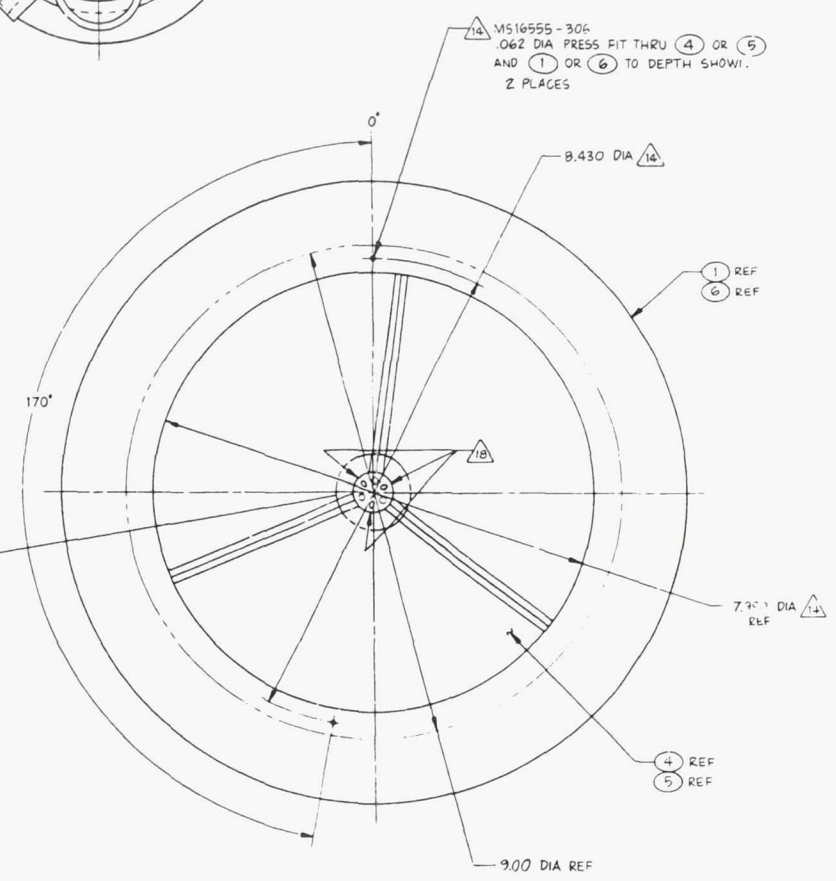
-19 ASSY 1 6 C
OXIDIZER MANIFOLD



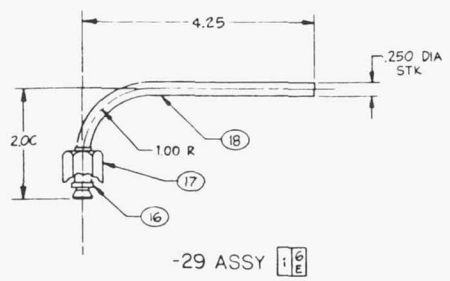


7 DETAIL 5 4 G

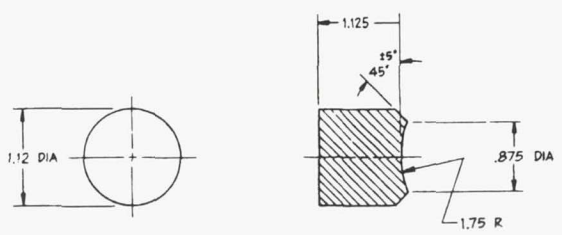




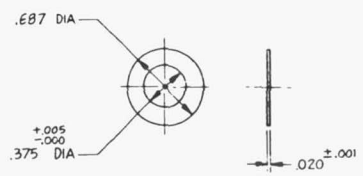
VIEW A-A 1 3 C



-29 ASSY 1 6 E
IGNITER LINE



8 DETAIL 5 6 F
SCALE: NONE



22 DETAIL 1 3 L
SCALE: 2/1

1200729 A

SIZE	FSCM NO.	DWG NO.
E	05824	1200729

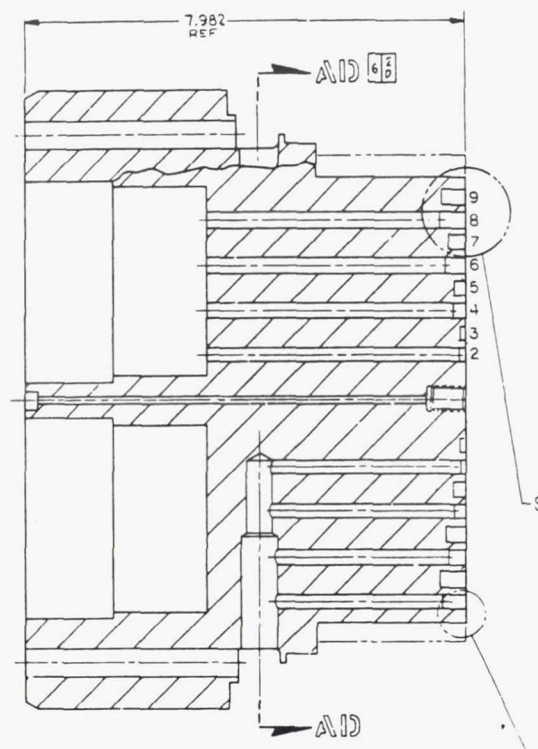
SCALE 1/1 WEIGHT R 2223 SHEET 5

PE 653,604

Figure D-13 D-15

REVISIONS			
LTR	DESCRIPTION	RELEASE DATE	APPROVED
R		10-4-20	

NOTES:

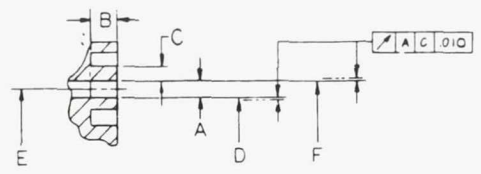


SECTION A10-A10 4/E
-6 DETAIL

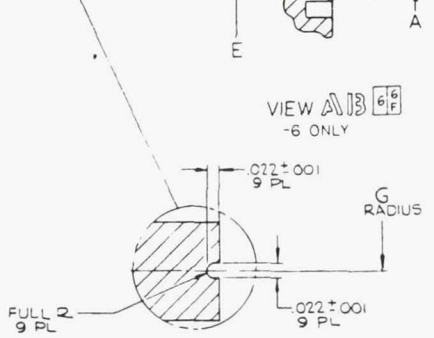
SEE VIEW A13 5/E

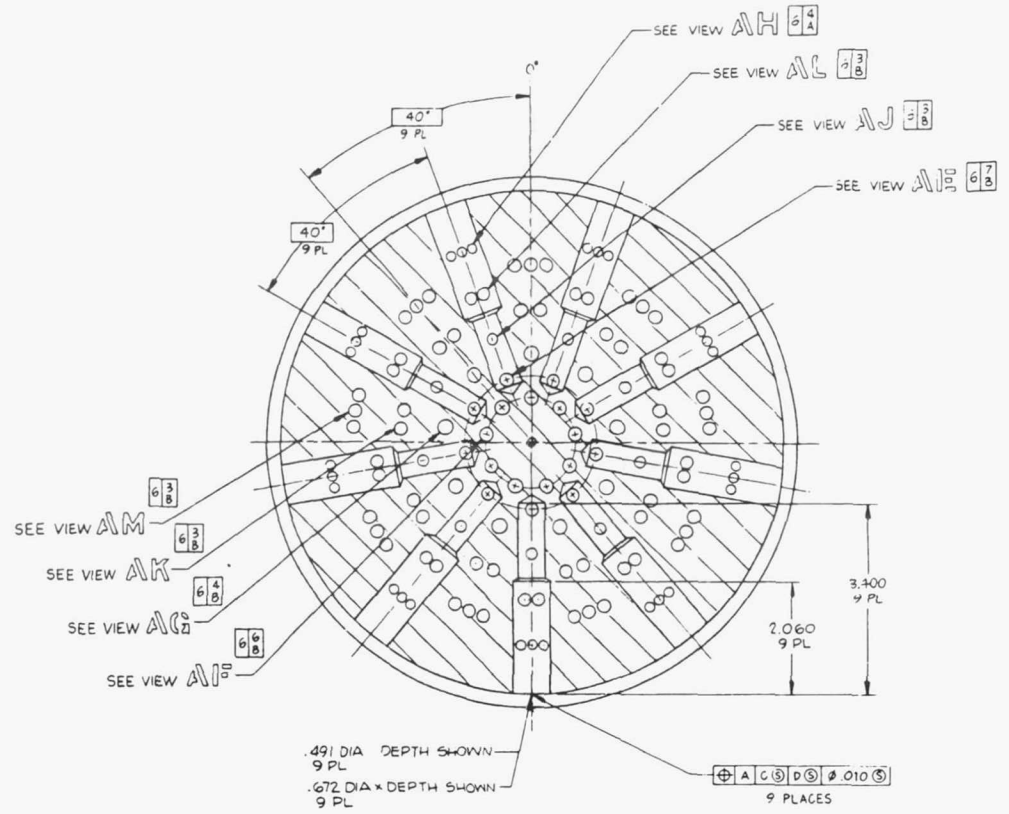
-6 DETAIL TABULATION BLOCK

ROW NO.	A CHANNEL WIDTH REF	B DEPTH	C LAND WIDTH REF	D INNER RADIUS BASIC	E DIA REF	F OUTER RADIUS BASIC	G RADIUS ±.005
1	—	—	.451	—	—	—	.464
2	.268	.104	.150	.689	1.648	0.957	.882
3	.233	.090	.133	1.107	2.947	1.340	1.274
4	.289	.224	.150	1.475	3.235	1.762	1.687
5	.253	.196	.120	1.912	4.077	2.165	2.105
6	.294	.347	.150	2.285	4.864	2.579	2.504
7	.255	.300	.121	2.729	5.713	2.984	2.924
8	.300	.464	.150	3.105	6.519	3.405	3.330
9	.260	.418	.180	3.555	7.362	3.810	3.720

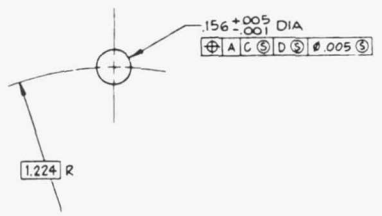


VIEW A13 6/F
-6 ONLY

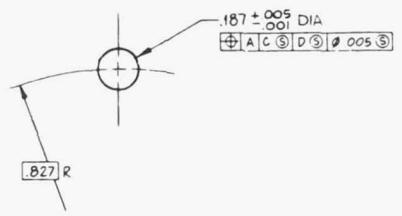




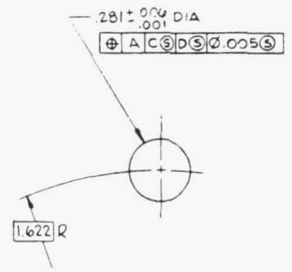
SECTION A17-A17 6/H
-6 DETAIL ONLY
REF



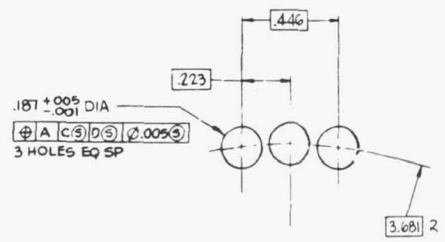
VIEW A15 6/G
ROTATED 20° CW
9 PL THRU EQ SP
SCALE: 4/1



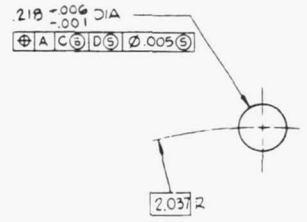
VIEW A11 6/E
ROTATED 80° CW
9 PL THRU EQ SP
SCALE: 4/1



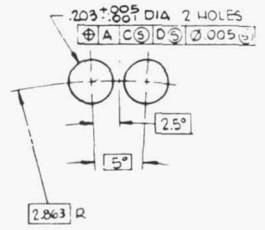
VIEW A9 6/E
ROTATED 80° CW
9 PL THRU EQ SP
SCALE: 4/1



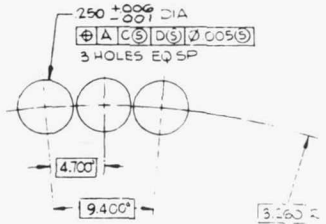
VIEW A7 6/H
ROTATED 20° CW
9 PL THRU EQ SP
SCALE: 4/1



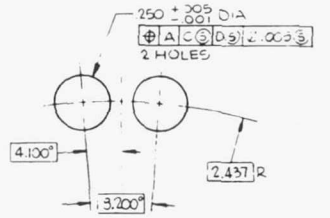
VIEW A6 6/H
9 PL THRU EQ SP
SCALE: 4/1



VIEW A5 6/H
9 PL THRU EQ SP
SCALE: 4/1



VIEW A4 6/E
9 PL THRU EQ PL
SCALE: 4/1



VIEW A3 6/F
9 PL THRU EQ SP
SCALE: 4/1

SIZE	FSCM NO.	DWG NO.
E	05824	1200729

SCALE 1/1 WEIGHT SHEET 6

P.E. 893,504

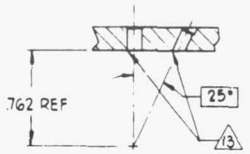
1200729 A

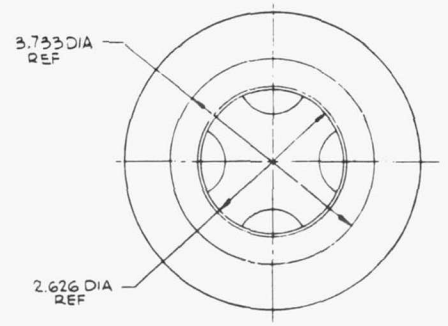
Figure D-14

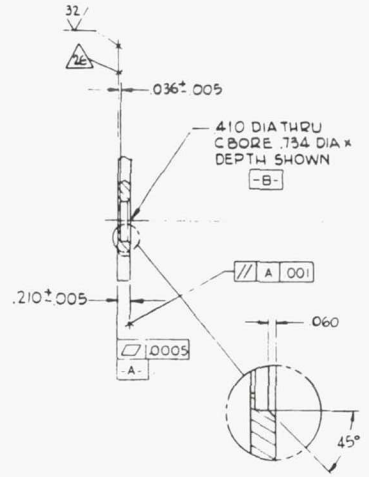
REVISIONS

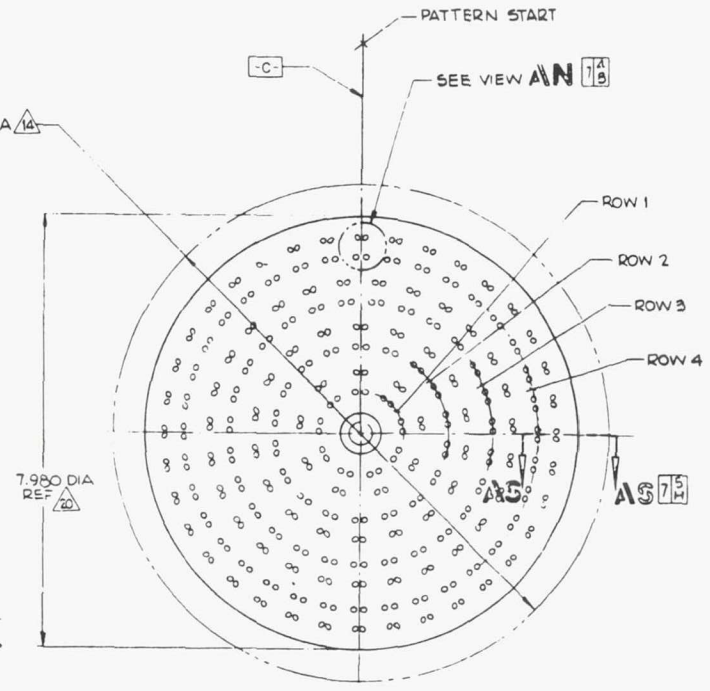
LTR	DESCRIPTION	RELEASE DATE	APPROVED
A		10-4-201	

NOTES:

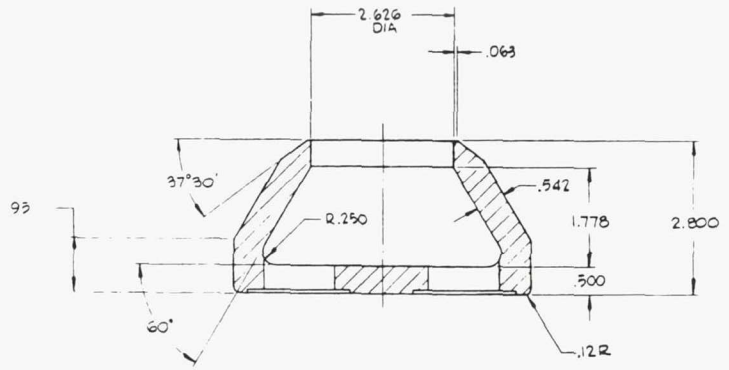


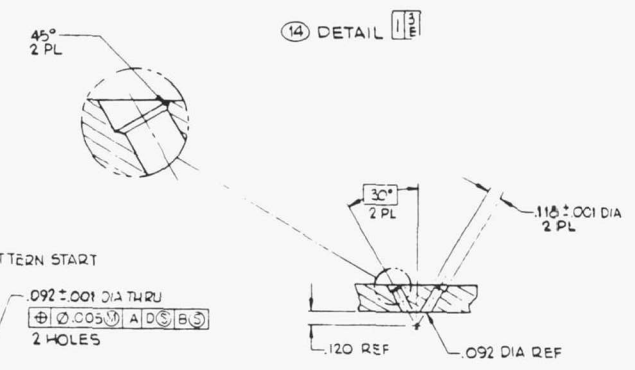




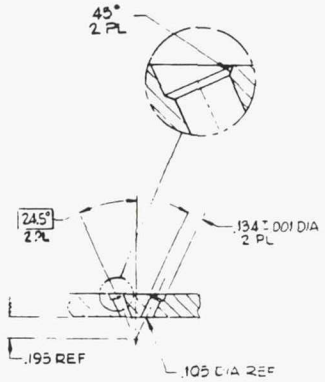


14 DETAIL 1/E

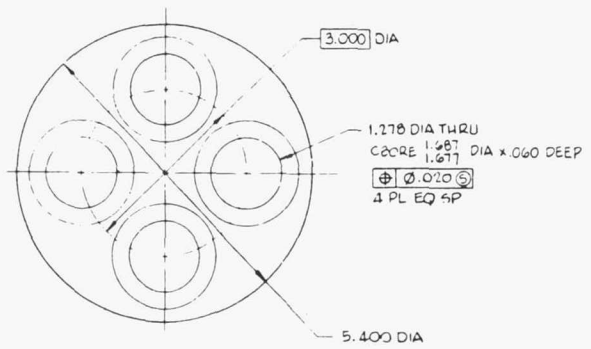




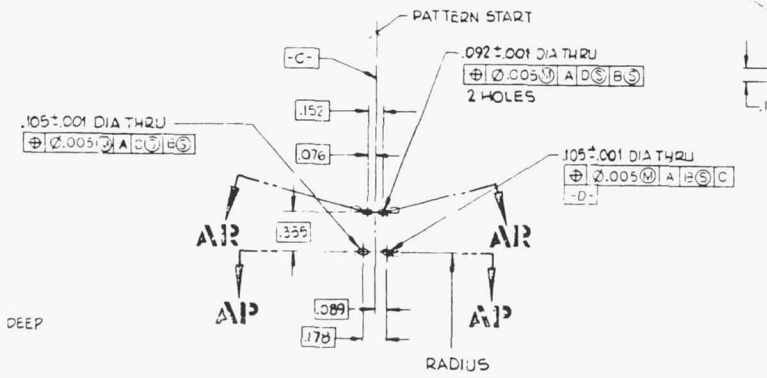
SECTION AR
TYPICAL 90 PL
SCALE: 2/1



SECTION AP
TYPICAL 90 PL
SCALE: 4/1



21 DETAIL 3/G



VIEW AN 7/H
TYPICAL PATTERN
90 PLACES
SCALE: 2/1

ROW NO	RADIUS BASIC	START ANGLE BAS.C	REPEAT ANGLE BASIC	NUMBER OF PATTERNS
1	.764	0°	40°	9
2	1.577	0°	20°	18
3	2.391	6.67°	13.33°	27
4	3.205	0°	10°	36

SIZE	FSCM NO.	DWG NO.
E	05824	1200729

SCALE | RELEASE DATE 12-2-3 | SHEET 7

P.S. 633,604

1200729 A

Figure D-15

NOTES:

1. INTERPRET DRAWING PER ATC-STD-4926.
2. ALL DIAMETERS ON A COMMON AXIS Ø .010 CIRCULAR UNLESS OTHERWISE SPECIFIED.
3. MARK PER AS478-2A WITH 1206428, APPLICABLE DASH NO., AND AEROJET TECHSYSTEMS ASSIGNED SERIAL NO.
4. MARK PER AS478-2A2 WITH INFORMATION SHOWN.
5. INSTALL (3) PER CDM-8516.
6. HEAT TREAT PRIOR TO FINAL MACHINE AS FOLLOWS:
   - STEP 1. AUSTENITIZE AT 1675°F TO 1550°F FOR ONE HOUR AND OIL QUENCH TO BELOW 150°F.
   - STEP 2. TEMPER AT 1000°F TO 1025°F FOR 5 HOURS. COOL TO ROOM TEMPERATURE.

   FURNACE CONTROLS AND GENERAL PROCEDURES PER MIL-H-6875. 2 THERMOCOUPLES, T1 AND T2, SHALL BE ATTACHED TO PART DURING HEAT TREATMENT.
7. 3 TENSILE SPECIMEN BLANKS MACHINED FROM THE FORGING SHALL BE HEAT TREATED WITH THE FORGING PER (6). BLANKS SHALL BE FINAL MACHINED INTO 0.250 INCH TENSILE SPECIMENS AND TENSILE TESTED AT ROOM TEMPERATURE PER ASTM-E8. DATA SHALL BE SUBMITTED TO AEROJET MATERIALS AND PROCESSES FOR REVIEW. MINIMUM YIELD 1.0 KSI. MINIMUM ELONGATION 10 PERCENT (4D).
8. PENETRANT INSPECT CHAMBER AFTER FINAL MACHINE PER ATC-STD-4816, TYPE 1, CLASS 1. ACCEPTANCE CRITERIA PER ATC-STD-4006, CLASS II.

REVISIONS

LTR	DESCRIPTION	RELEASE DATE	APPROVED

250-28UNJF-3B×.65 DEEP
⊕ D Ⓜ B Ⓢ C Ⓢ Ø.010 Ⓜ
4 PLACES EQ SP

13.000 DIA

VIEW L (1 | 1 F)
SCALE: 1/1

SCRIBE LINE .010 MAX WIDE X .010 DEEP X LENGTH SHOWN

.375 APPROX

1.062 DIA THRU SPOTFACE 2.50 DIA FAR SIDE ONLY, 18 HOLES
⊕ A Ⓜ B Ⓢ C Ⓢ Ø.010 Ⓜ

0° 18° 20 PL 40° 90° 102.50° 124° 133° 137.144° 142.500° 146° 150° 154.287° 163° 171.430° 188.573° 225° 231.490° 248.573° 270° 300°

- C -

1.062-18 NEF-3B
⊕ A Ⓜ B Ⓢ C Ⓢ Ø.005 Ⓜ
2 PL 144° AND 306°

SEE VIEW M (3 | 3 B)

/ B .030 CIRCULAR

/ B .010 - A -

SEE VIEW B (2 | 2 F)

21.50 DIA REF
18.500 DIA
7.680 DIA REF
12.525 DIA REF
10.180 DIA REF
13.490 DIA
4.26
- B -

.562-12 UNC-2B THRU TO 1.062 DIA HOLE SPOTFACE 1.250 DIA 2 PL EQL SP

SEE VIEW C (2 | 2 F)

1.00
.092
26.092 REF

(2.50)

MS33649-04 PORT REF LOCATE 11°15' FROM ANY BOLT HOLE (2 PLACES 180° APART)

/ B .030 CIRCULAR

SEE VIEW L (1 | 3 G)

SEE VIEW C (2 | 2 F)

8.20 DIA REF
11.025 10.965 DIA
14.000 DIA
13.50 DIA REF

T2 (6)
/ B .005 CIRCULAR

.562-12 UNC-2B THRU TO 1.062 DIA HOLE SPOTFACE 1.250 DIA 2 PL EQL SP

.75

1.062 DIA THRU SPOTFACE 2.50 DIA FAR SIDE ONLY
⊕ D Ⓜ B Ⓢ C Ⓢ Ø.020 Ⓜ
16 PL EQ SP

AR	00426	RTV GE 560	SILICON SEALANT				7
4		MS51937-6C	BOLT, EYE		2	3 D	6
4		MS35691-41	NUT, HEX		2	3 C	5
							4
1		1206429-1	INSERT		1	3 F	3
							2
1		-1	CHAMBER	MAKE FROM 1206432-1	1	3 E	1
(6)	(3) ITEM/CAGE NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION	ZONE		ITEM NO.

CONTRACT NO. NAS3-25556
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES PER ANSI Y14.5 TOLERANCES DECIMALS XX ± .03 XXX ± .010 ANGULAR ± 0.5°
SURFACE FINISH IN MICRO INCHES DO NOT SCALE DRAWING
DWG LEVEL 1

DRAWN	O.S. DEMETER	90-5-10
CHECK	R.E. Wilson	90-7-20
DESIGN		90-7-19
MANUFACTURING		90-7-19
QUALITY		90-7-19
PROJECT ENGINEER		90-7-18
PROGRAM MANAGER		90-7-19
CONTRACTOR APPROVAL		90-7-20

GENCORP AEROJET — TechSystems — SACRAMENTO, CALIFORNIA

THRUST CHAMBER(MACH.), OX/HC INJ.CHAMBER-3DS. (BOCCID TEST VALIDATION)

SIZE E | FSCM NO. 05824 | DWG NO. 1206428 | SCALE 1/2 | RELEASE DATE 90-7-23 | REV R | SHEET 1 OF 3

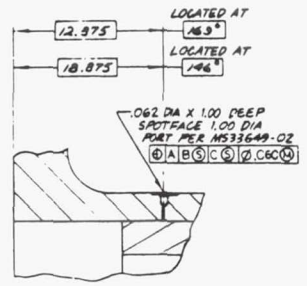
P.C. 561

DEVELOPMENT HARDWARE
FOR TEST OR EXPERIMENTATION

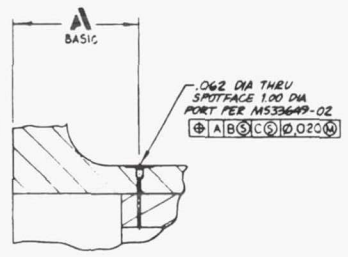
1206428

Figure D-16

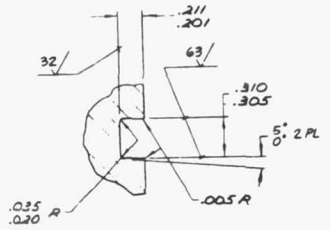
A BASIC	RADIAL LOCATION FROM A BASIC
2.875	137.144°
3.175	154.287°
3.475	171.430°
3.775	188.573°
4.275	169°
4.775	146°
5.275	135°
5.575	158°
5.975	124°
6.475	169°
6.975	146°
7.975	135°
8.975	158°
9.975	124°



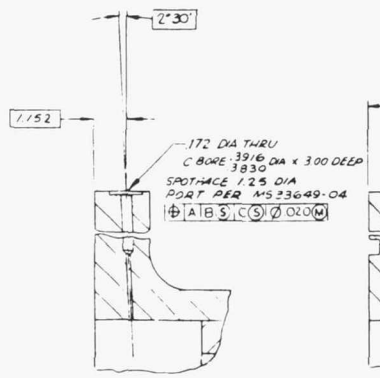
SECTION H-H 1|6|D
LOCATED AT 146°



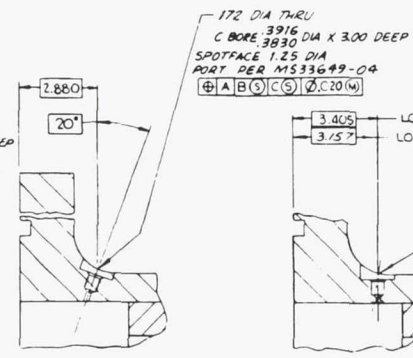
SECTION J-J 1|6|D
14 PLACES - SEE TABULATION



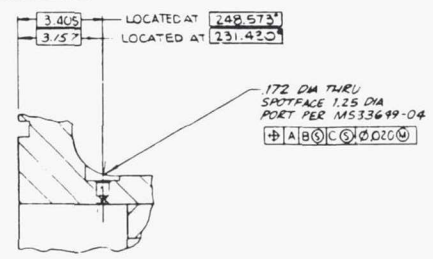
VIEW C 1|1|5|E|C
SCALE: 2/1



SECTION K-K 1|6|C
LOCATED AT 142.500°



SECTION F-F 1|6|B
LOCATED AT 102.500°

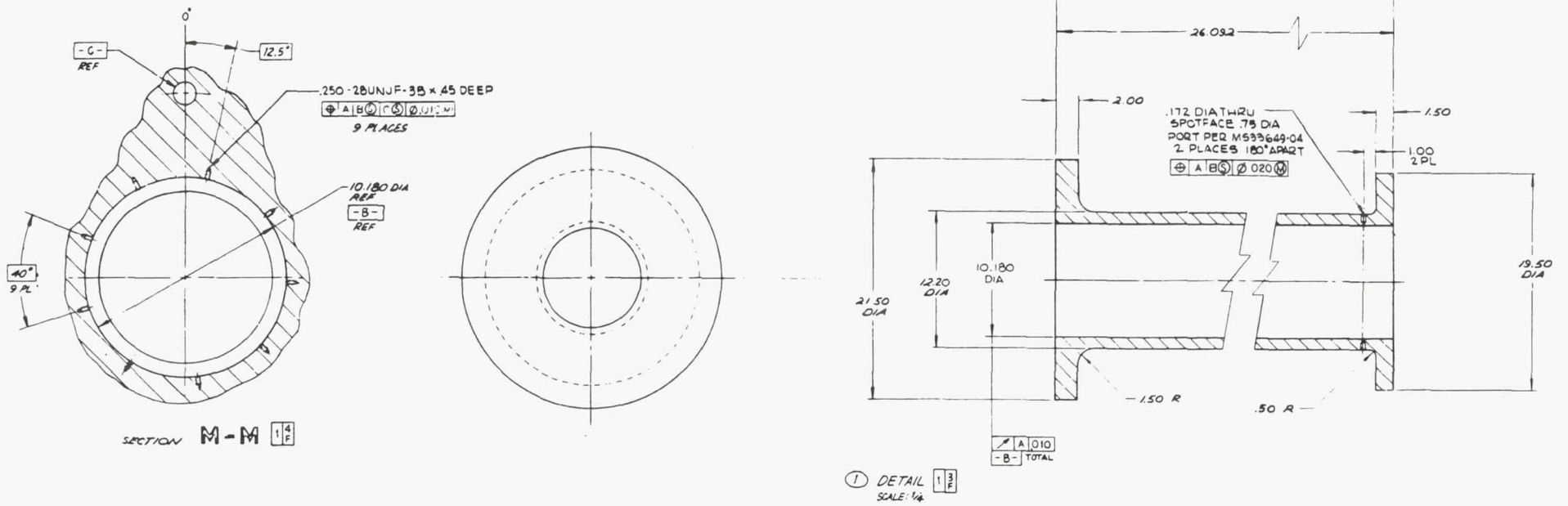


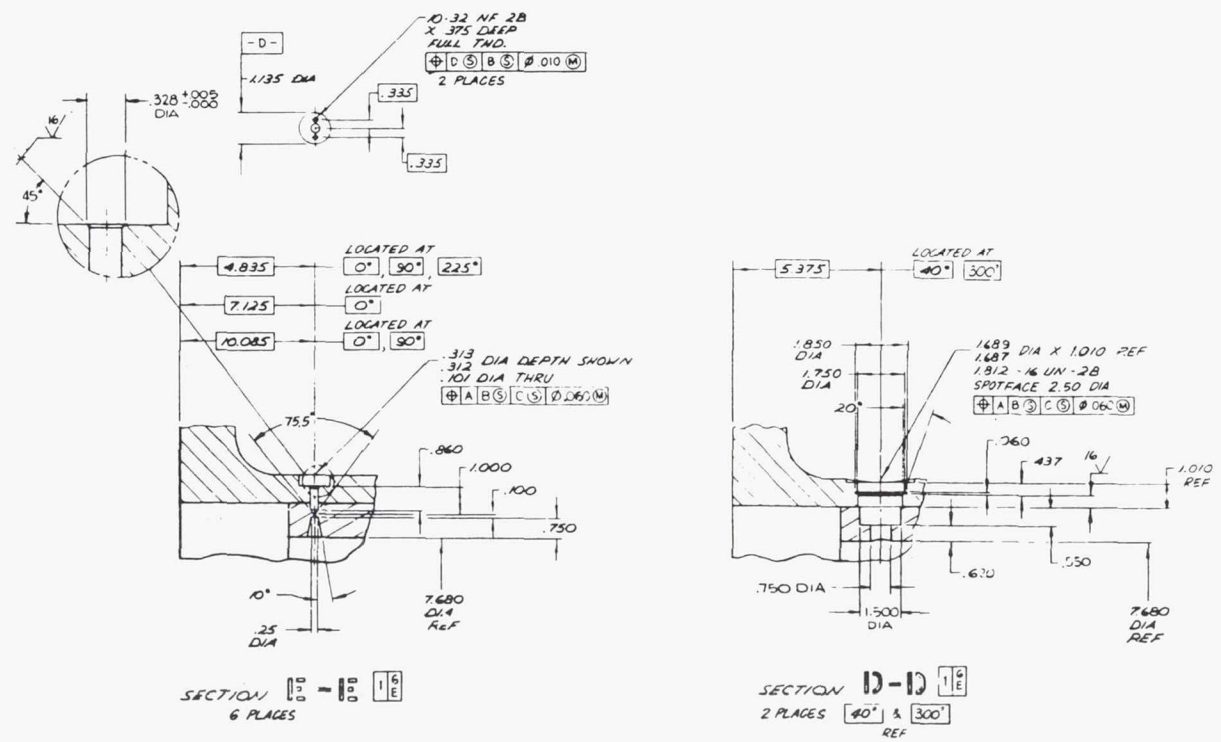
SECTION G-G 1|7

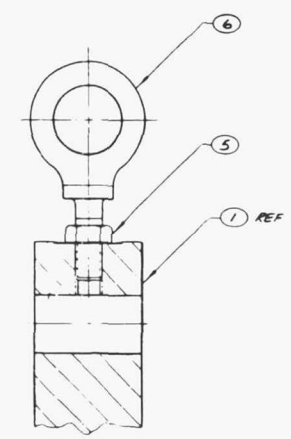
E	05824	1206428	
SCALE 1/2	90-7-23	R	SHEET 2

P.B. 561

1206428







VIEW B
EYE BOLT INSTALLATION
LOCATED 4 PLACES AT
0° AND 180° BOTH ENDS
LIFTING POINT
SCALE: 1/1

E 05824 | 1206428
1/2 | 90-7-23 R | 3
P.N. 561

NOTES:

1 INTERPRET DRAWING PER ATC-STD-4926.

2 (flag) MARK PER AS478-2A WITH FORGING 1206432 AND APPLICABLE DASH NO.

3 NORMALIZE AND TEMPER PRIOR TO ROUGH MACHINING AS FOLLOWS:

A. NORMALIZE AT 1550°F TO 1650°F FOR ONE HOUR. AIR COOL TO ROOM TEMPERATURE.

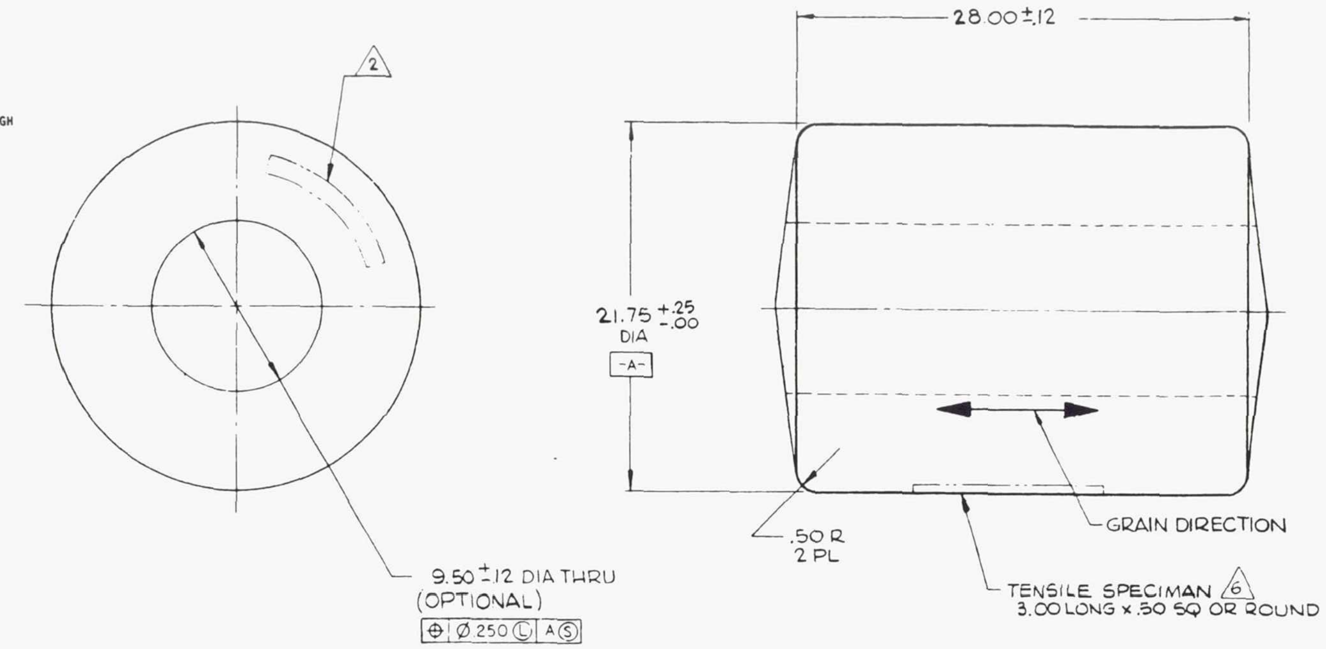
B. TEMPER AT 1200°F ± 25°F FOR 8 HOURS. AIR COOL TO ROOM TEMPERATURE.

C. FURNACE CONTROLS AND GENERAL PROCEDURES PER MIL-H-6875.

4 ROUGH MACHINED FORGING TO BE SUBSEQUENTLY HEAT TREATED AND FINAL MACHINED ALL OVER.

5 ULTRASONIC INSPECT PER ATC-STD-4819. ACCEPTANCE CRITERIA PER ATC-STD-4006, CLASS II.

6 (flag) 3 TENSILE SPECIMEN BLANKS SHALL BE TAKEN FROM FORGING DURING ROUGH MACHINING. BLANKS SHALL BE SUBSEQUENTLY HEAT TREATED WITH THE FORGING, MACHINED INTO 0.250 INCH ROUND TENSILE SPECIMENS, AND TENSILE TESTED AT ROOM TEMPERATURE PER ASTM E8-79.



REVISIONS			
LTR	DESCRIPTION	RELEASE DATE	APPROVED

DWG NO 1206432 SH - REV

QTY REQD PER ASSY	FSCM/CAGE NO	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION	ZONE	ITEM NO
		-1		4340 STEEL FORGING MIL-S-5000		

PARTS LIST

CONTRACT NO NAS 3-25556

UNLESS OTHERWISE SPECIFIED DIMENSIONS & TOLERANCING ARE IN INCHES & PER ANSI Y14.5

TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; ANGULAR ± 0.5°

SURFACE ROUGHNESS 250

DO NOT SCALE DRAWING

DWG LEVEL 1

		DATE
DRAWN	O.S. DEMETER	90-5-24
CHECK	[signature]	90-6-13
	[signature]	90-6-13
DESIGN	[signature]	90-6-13
COMBUSTION ANALYSIS	R.C. Wolk	6-18-90
PRODUCIBILITY	[signature]	90-6-13
MATERIALS	[signature]	6-22-90
STRESS	[signature]	6-13-90

GENCORP AEROJET — TechSystems, SACRAMENTO CALIFORNIA

TITLE: FORGING, CHAMBER BODY

SIZE D | FSCM/CAGE NO 05824 | DWG NO 1206432

SCALE 1/4 | RELEASE DATE 90-6-13 | R | SHEET 1 OF 1

THIS DWG HAS BEEN REVIEWED PER POLICY 37-1, 90-67

P.C. 561

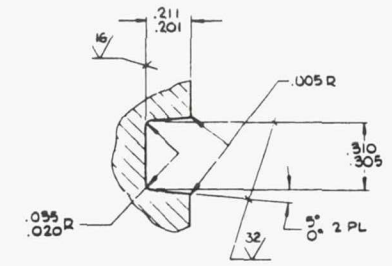
DEVELOPMENT HARDWARE
FOR TEST OR EXPERIMENTATION

Figure D-19

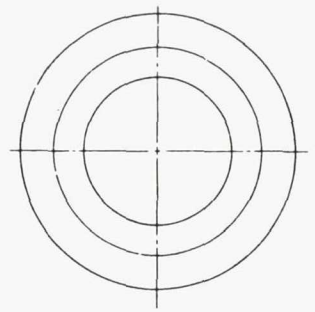
NOTES:

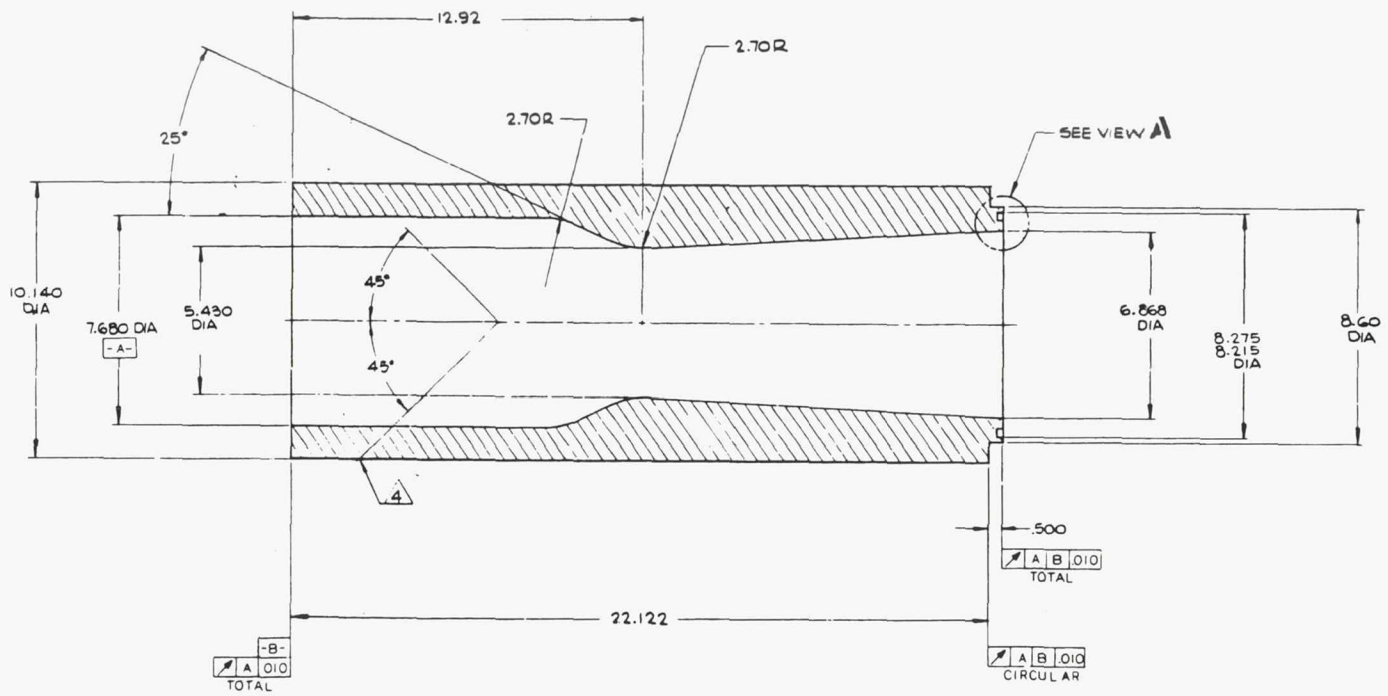
1. INTERPRET DRAWING PER ATC-STD-4926.
2. ALL DIAMETERS ON A COMMON AXIS ⌀.010 CIRCULAR, UNLESS OTHERWISE NOTED.
3. MARK PER AS478-350 WITH 1206429 AND APPLICABLE DASH NO.
4. FABRIC SHALL BE ORIENTED AT AN ANGLE OF 45° ± 5° RELATIVE TO CHAMBER CENTERLINE.

REVISIONS			
LTR	DESCRIPTION	RELEASE DATE	APPROVED



VIEW A
SCALE: 4/1





DEVELOPMENT HARDWARE
FOR TEST OR EXPERIMENTATION

DO NOT SCALE DRAWING

SIZE LEVEL 1

	-1		SILICA PHENOLIC
CONTRACT NO.	NAS 3-25956	03 DEMETER	90-3-8
			90-7-3
			90-2-28
			90-2-12
			90-7-19
			90-7-10
			90-7-19
			90-7-4

GENCORP AEROJET TechSystems SACRAMENTO CALIFORNIA

TITLE: INSERT, THRUST CHAMBER-OX/HC 3DS (ROCCID TEST VALIDATION)

SIZE E | FSCM NO. 05824 | DWG NO. 1206429

SCALE 1/2 | RELEASE DATE 90-7-23 | REV R | SHEET 1 OF 1

P.C. 561

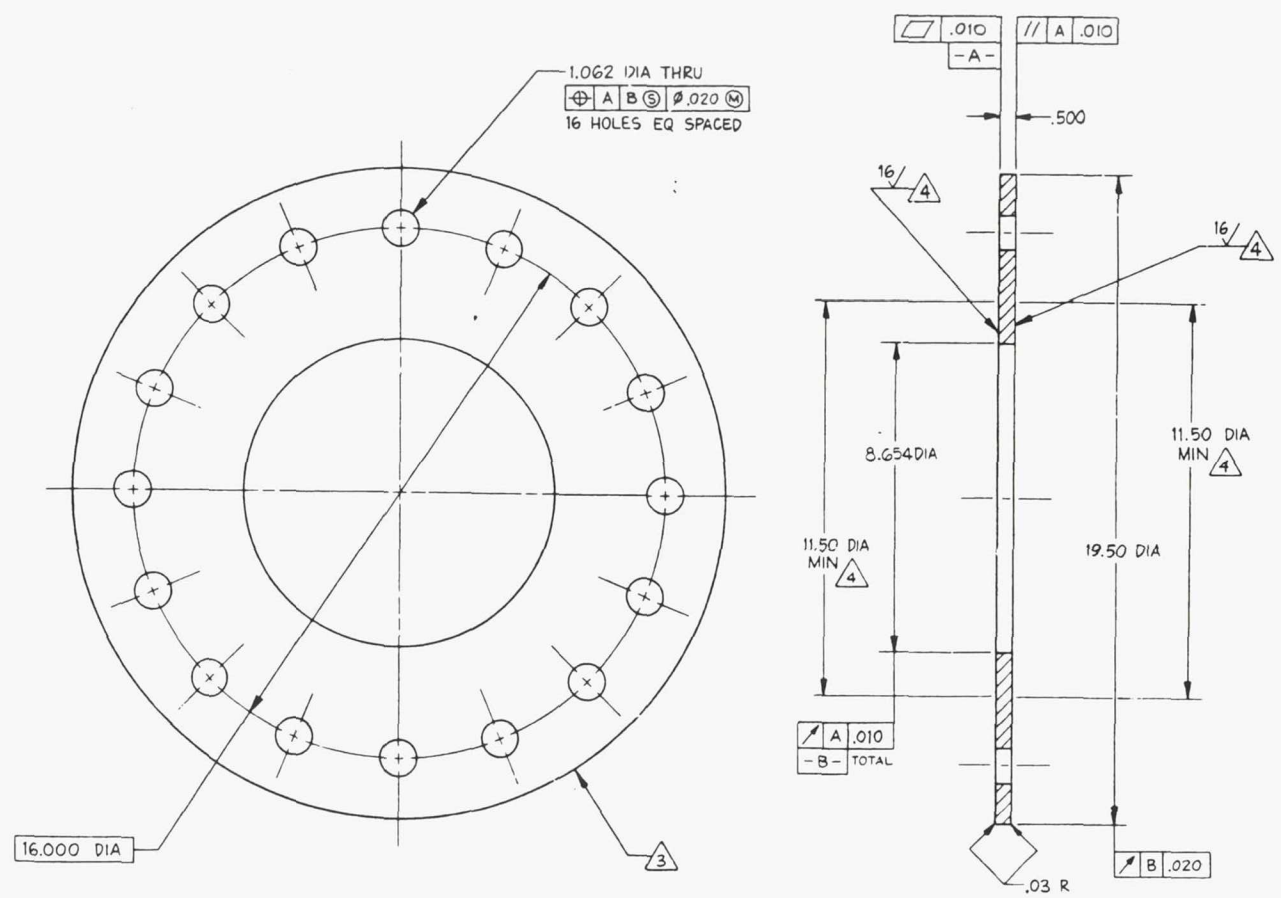
2 THIS SPEC HAS BEEN REVIEWED PER POLICY 89-4, 90-3-8

1206429

REVISIONS			
LTR	DESCRIPTION	RELEASE DATE	APPROVED
A	SEE A DCN	R 90-4-20	90-4-9

NOTES:

1. INTERPRET DRAWING PER ATC-STD-4926.
2. CLEANLINESS PER ATC-STD-4940, LEVEL VC.
3. MARK PER AS478-7A3 WITH 1200976 AND APPLICABLE DASH NO.
4. SURFACE FINISH TO BE WITHIN DIAMETER SHOWN.



DEVELOPMENT HARDWARE
FOR TEST OR EXPERIMENTATION

QTY REQ'D PER ASSY	PSCN NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION	ITEM NO.
		-1	RETAINER	HY 140 STEEL ASTM A579 GRADE 17, QUENCHED AND TEMPERED	

PARTS LIST

CONTRACT NO. F04611-88-C-0100
UNLESS OTHERWISE SPECIFIED: DIMENSIONS & TOLERANCING ARE IN INC. IES & PER ANSI Y14.5
TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; ANGULAR ± 2°
V SURFACE ROUGHNESS
DO NOT SCALE DRAWING
EST WT 35 LB | DWG. LEVEL 1

	NAME	DATE
DRAWN	R JACKSON	86-11-10
CHECK	S Campbell	87-2-3
DESIGN	R J Clifford	87-2-2
DESIGN ACTIVITY	J F Cooper	87-2-3

AEROJET TechSystems COMPANY — SACRAMENTO, CALIFORNIA

TITLE: PLATE, RETAINER - 3D SUBSCALE

SIZE D | PSCN NO. 05824 | DWG NO. 1200976 | SCALE 1/2 | RELEASE DATE R 87-2-3 | SHEET 1 OF 1

THIS DWG HAS BEEN REVIEWED PER POLICY 27-1, 1-15-87

P.C. 653,90

1200976 A

Figure D-21

☑ ADCN ☐ DCN | DATE 90-5-15 | DOCUMENT CHANGE NOTICE | DWG. LVL 1 | DOCUMENT NUMBER 1200976 | REV. LTR A-1

GENCORP AEROJET — TechSystems, SACRAMENTO, CALIFORNIA

ECN NO. | RELEASE DATE (R) 90-7-23 | DOCUMENT TITLE: PLATE, RETAINER - 3D SUBSCALE | SHEET 1 of 1

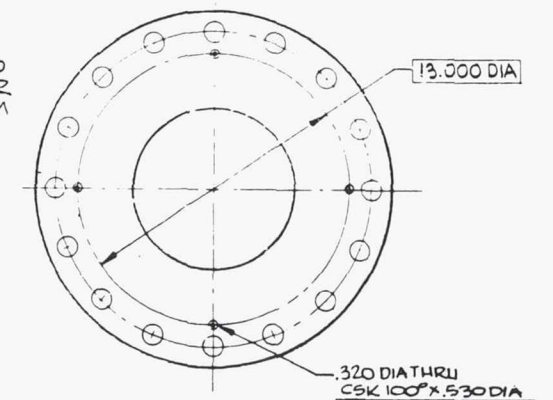
PREPARED BY: DEMETER

APPROVALS

DESIGN	DESIGN ACTIVITY	CHECK	STRESS	WP CONFIG. MGR.
	F.H. Cooper 90-7-18	R.G. Widener 90-7-23	R. Zahn 90-7-19	R.E. Walk 90-7-18
QA		MANUF Bruce Meyers 90-7-18	MATL	CMO

SH	ZONE	ITEM	
	PL	1	ADD: (5)-2 RETAINER 4340 STEEL VACUUM MELT PER AMS 6414E
	F/D	2	ADD CALLOUTS & DIMENSION SHOWN
	GN	3	ADD NOTE:

(5) HEAT TREAT PRIOR TO FINAL MACHINE PER MIL-H-6875. MINIMUM YIELD 130-140 KSI.



BRUNING 40-22 TECH 00010

PC 653, 604, 561

Figure D-22

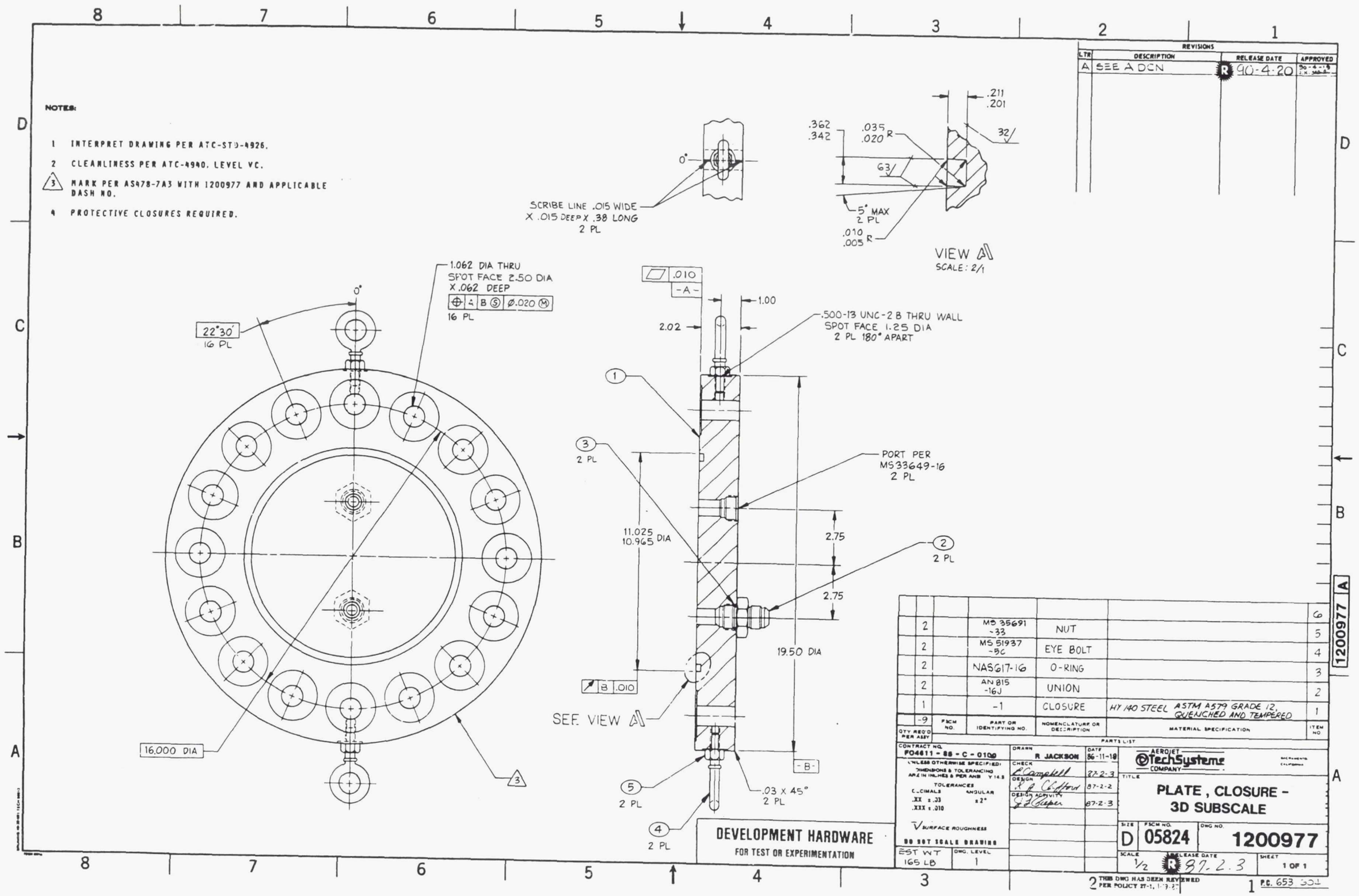

NOTES:
1 INTERPRET DRAWING PER ATC-STD-4926.
2 CLEANLINESS PER ATC-4940, LEVEL VC.
3 MARK PER AS478-7A3 WITH 1200977 AND APPLICABLE DASH NO.
4 PROTECTIVE CLOSURES REQUIRED.
REVISIONS
LTR DESCRIPTION RELEASE DATE APPROVED
A SEE A DCN R 90-4-20
SCRIBE LINE .015 WIDE X .015 DEEP X .38 LONG 2 PL
VIEW A
SCALE: 2/1
22°30' 16 PL
1.062 DIA THRU SPOT FACE 2.50 DIA X .062 DEEP
16 PL
.010 -A-
1.00
2.02
.500-13 UNC-2B THRU WALL SPOT FACE 1.25 DIA 2 PL 180° APART
PORT PER MS33649-16 2 PL
11.025 10.965 DIA
2.75
2.75
19.50 DIA
B .010
SEE VIEW A
.03 X 45° 2 PL
16.000 DIA
DEVELOPMENT HARDWARE
FOR TEST OR EXPERIMENTATION
6 MS 35691 -33 NUT
5 2 MS 51937 -8C EYE BOLT
4 2 NAS617-16 O-RING
3 2 AN 815 -16J UNION
2 1 -1 CLOSURE HY 140 STEEL ASTM A579 GRADE 12, QUENCHED AND TEMPERED
1 -9 FSCM NO. PART OR IDENTIFYING NO. NOMENCLATURE OR DESCRIPTION MATERIAL SPECIFICATION ITEM NO.
QTY REQ'D PER ASSY
PARTS LIST
CONTRACT NO. F04611-88-C-0100
DRAWN R JACKSON 86-11-18
CHECK 87-2-3
DESIGN 87-2-2
DESIGN ACTIVITY 87-2-3
AEROJET TechSystems COMPANY
TITLE PLATE, CLOSURE - 3D SUBSCALE
SIZE D FSCM NO. 05824 DWG NO. 1200977
SCALE 1/2 RELEASE DATE 87.2.3 SHEET 1 OF 1
EST WT 165 LB DWG. LEVEL 1
DO NOT SCALE DRAWING
THIS DWG HAS BEEN REVIEWED PER POLICY 27-1, 1-7-2-3
P.C. 653 304
1200977 A

Figure D-23

☑ ADCN ☐ DCN | DATE 90-5-15 | RELEASE DATE 90-7-23 (R) | ECN NO | PREPARED BY DEMETER

DOCUMENT CHANGE NOTICE

GENCORP AEROJET — TechSystems, SACRAMENTO, CALIFORNIA

DWG LVL	DOCUMENT NUMBER	REV LTR
1	1200977	A-1

DOCUMENT TITLE: PLATE, CLOSURE - 3D SUBSCALE — SHEET 1 of 1

APPROVALS

DESIGN	MFG ENGR	CHECK	STRESS	MAT'L	NDE COMPLETION	CMO
	90-7-18	90-7-23	90-7-19	90-7-13	90-7-18	
	90-7-18	90-7-18				

SH	ZONE	ITEM	DESCRIPTION
	PL	1	ADD -19 ASSY AS SHOWN
	GN	2	ADD NOTE (5) HEAT TREAT PRIOR TO FINAL MACHINE PER MIL-H-6875. MINIMUM YIELD 130-140 Ksi.
	5C	3	ADD CALLOUT: (1) (2) WAS (1)

(5)	1		-2	CLOSURE	4340 STEEL VACUUM MELT PER AMS6414E		6
	2		MS35691 -33	NUT			5
	2		MS51937 -5C	EYE BOLT			4
	2		NAS617-16	O-RING			3
	2		AN815 -16J	UNION			2
							1
	-19						

BRUNING 40-22 TECH C0010

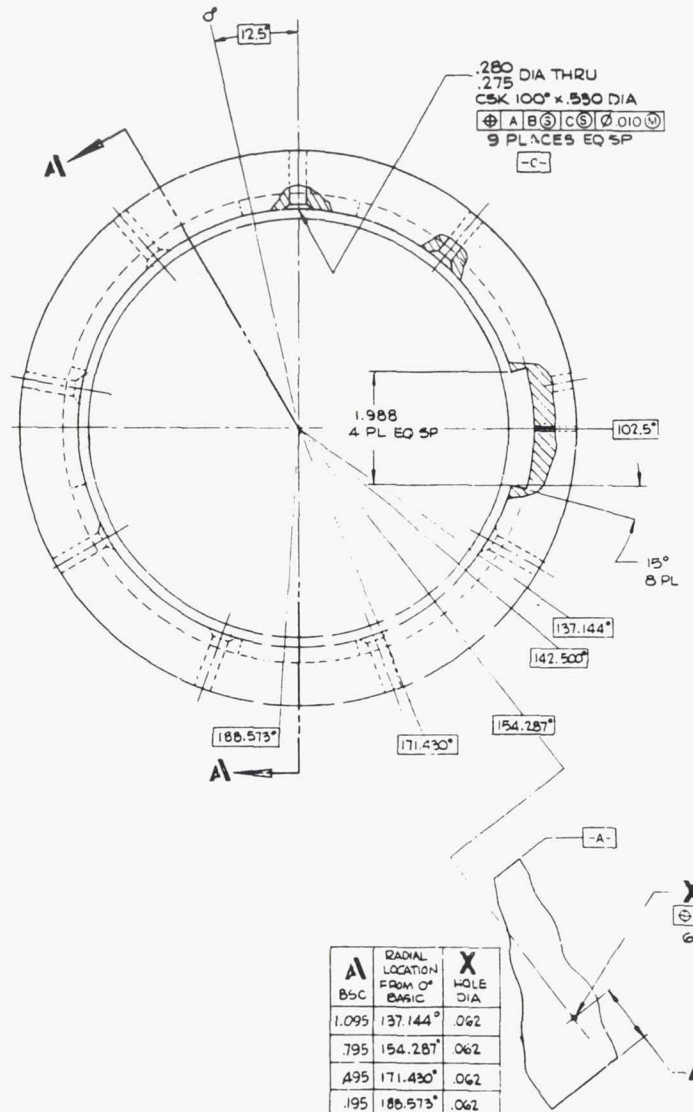
FC 653,604,561

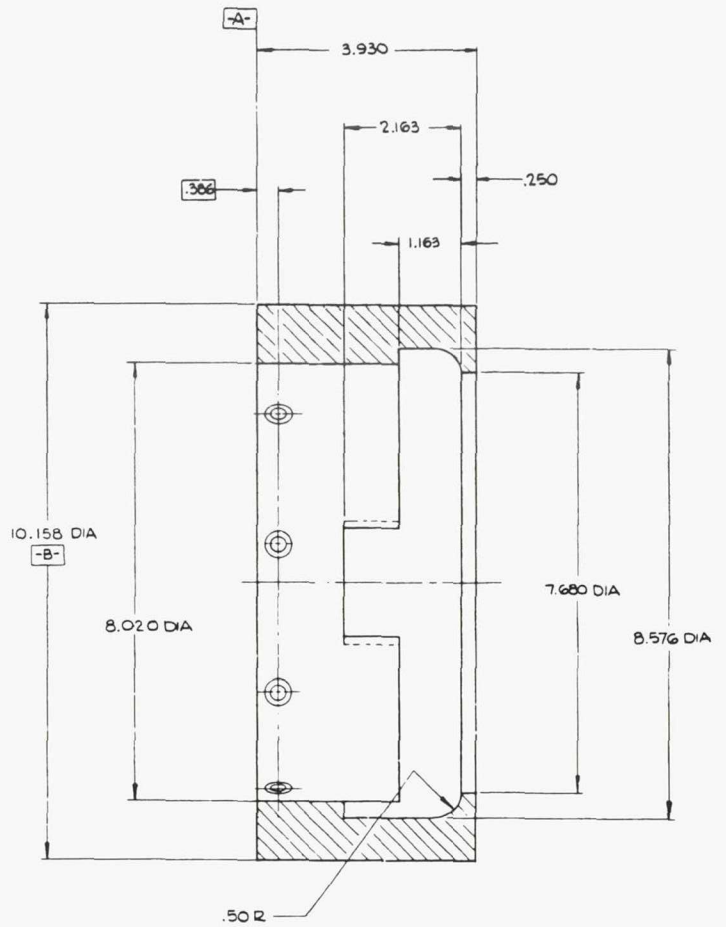
Figure D-24

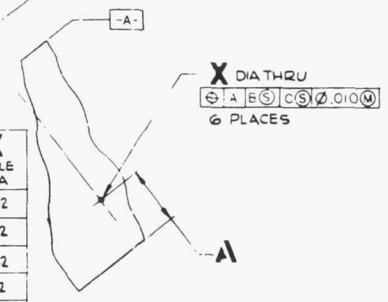
NOTES:

1. INTERPRET DRAWING PER ATC-STD-4926.
2. CLEANLINESS PER ATC-STD-4940, LEVEL VC.
3. MARK PER AS478-7A WITH 1206426 AND APPLICABLE DASH NO.
4. ALL DIAMETERS ⌖ A B .010 TOTAL, UNLESS OTHERWISE SHOWN.

REVISIONS			
LTR	DESCRIPTION	RELEASE DATE	APPROVED







SECTION A-A

A BSC	RADIAL LOCATION FROM 0° BASIC	X HOLE DIA
1.095	137.144°	.062
.795	154.287°	.062
.495	171.430°	.062
.195	188.573°	.062
1.506	102.500°	.172
2.571	142.500°	.172

DEVELOPMENT HARDWARE
FOR TEST OR EXPERIMENTATION

	-1	OFHC COPPER	ASTM B170 OR COML GRADE
FSCM/CAGE NO	PART OR IDENT. NO	NOMENCLATURE OR DESCRIPTION	MATERIAL / SPECIFICATION

CONTRACT NO: NAS3-25536
UNLESS OTHERWISE SPECIFIED DIMENSIONS & TOLERANCES ARE IN INCHES & PER ANSI Y14.5
DECIMALS: XX ± .03, XXX ± .010 — ANGULAR: ± 0.5°
SURFACE TOLERANCES
DO NOT SCALE DRAWING
END ITEM / LEVEL: 1

DRAWN	O.S. DEMETER	90-3-7
CHECK	R.B. Williams	90-7-10
ENGR APPROV		90-7-13
MFG APPROV		90-7-13
QUALITY APPROV		90-7-18
PROGRAM MGR		90-7-18
CONFIG MGT		90-7-19
CONTRACTS		90-7-7

GENCORP AEROJET — TechSystems, SACRAMENTO, CALIFORNIA

TITLE: RESONATOR, 1/4 WAVE, -3D SUBSCALE ROCCID TEST VALIDATION

SIZE	FSCM/CAGE NO	DWG NO
E	05824	1206426

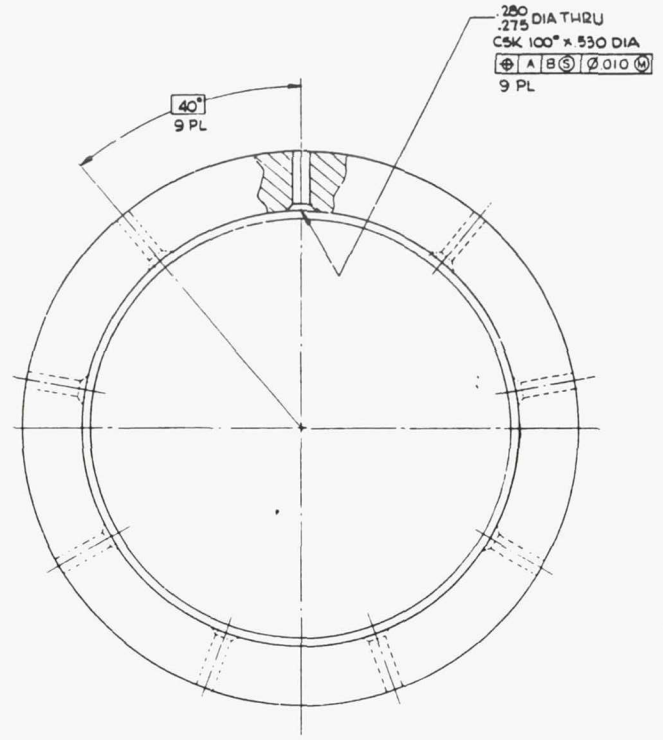
SCALE 1/1 — ROLL-UP DATE 90-7-23 — SHEET R 1 OF 1

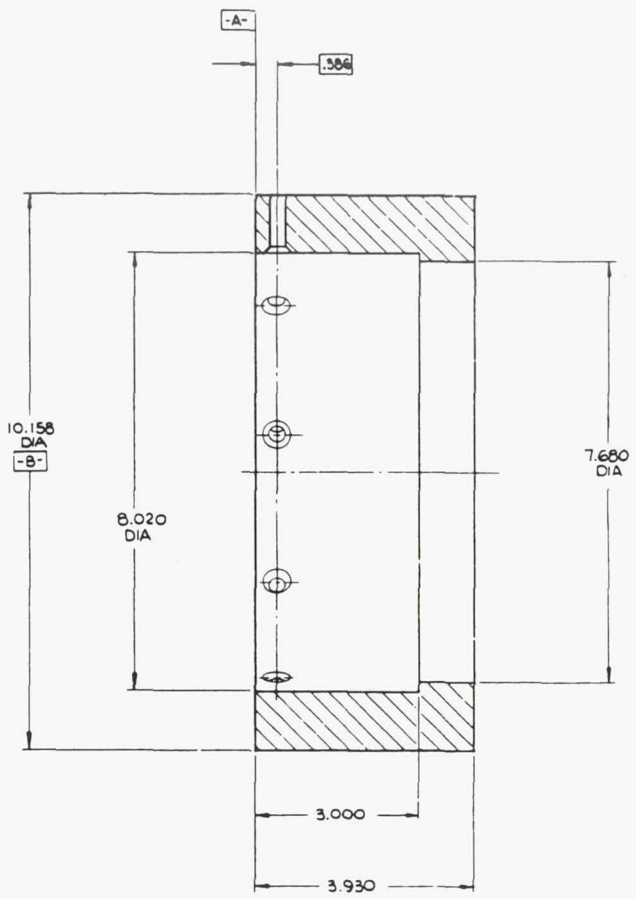
THIS DWG HAS BEEN REVIEWED PER POLICY 89-5, 90-5-7

P.C. 361

NOTES:

1. INTERPRET DRAWING PER MIL-STD-100.
2. CLEANLINESS PER ATC-STD-4940, LEVEL 1C
3. MARK PER AS478-7A WITH 1206431 AND APPLICABLE DASH NO.
4. ALL DIAMETERS Ⓐ A S .010 TOTAL, UNLESS OTHERWISE SHOWN.





DEVELOPMENT HARDWARE
FOR TEST OR EXPERIMENTATION

	-1	OFHC COPPER ASTM B170 OR COML GRADE	
CONTRACT NO	NAS 3-25556	DRAWN O.S. DEMETER	DATE 90-9-8
		CHKD	90-7-30
		ENGR APPR	90-7-13
		PROJECT ENGR	90-7-9
		MFG APPR	90-7-9
		PROCUREMENT	90-7-10
		QUALITY	90-7-11
		CONFIGURATION	90-7-16

GENCORP AEROJET TechSystems SACRAMENTO CALIFORNIA

TITLE: BLANK, RESONATOR -3D SUBSCALE (ROCCID TEST VALIDATION)

SIZE E | FSCM NO 05824 | DWG NO 1206431

SCALE 1/1 | RELEASE DATE 90-7-23 | REV G | SHEET 1 OF 1

DO NOT SCALE DRAWING | SIZE LEVEL 1

2 THIS DWG HAS BEEN REVISED PER POLICY EP-4, 10-6-8

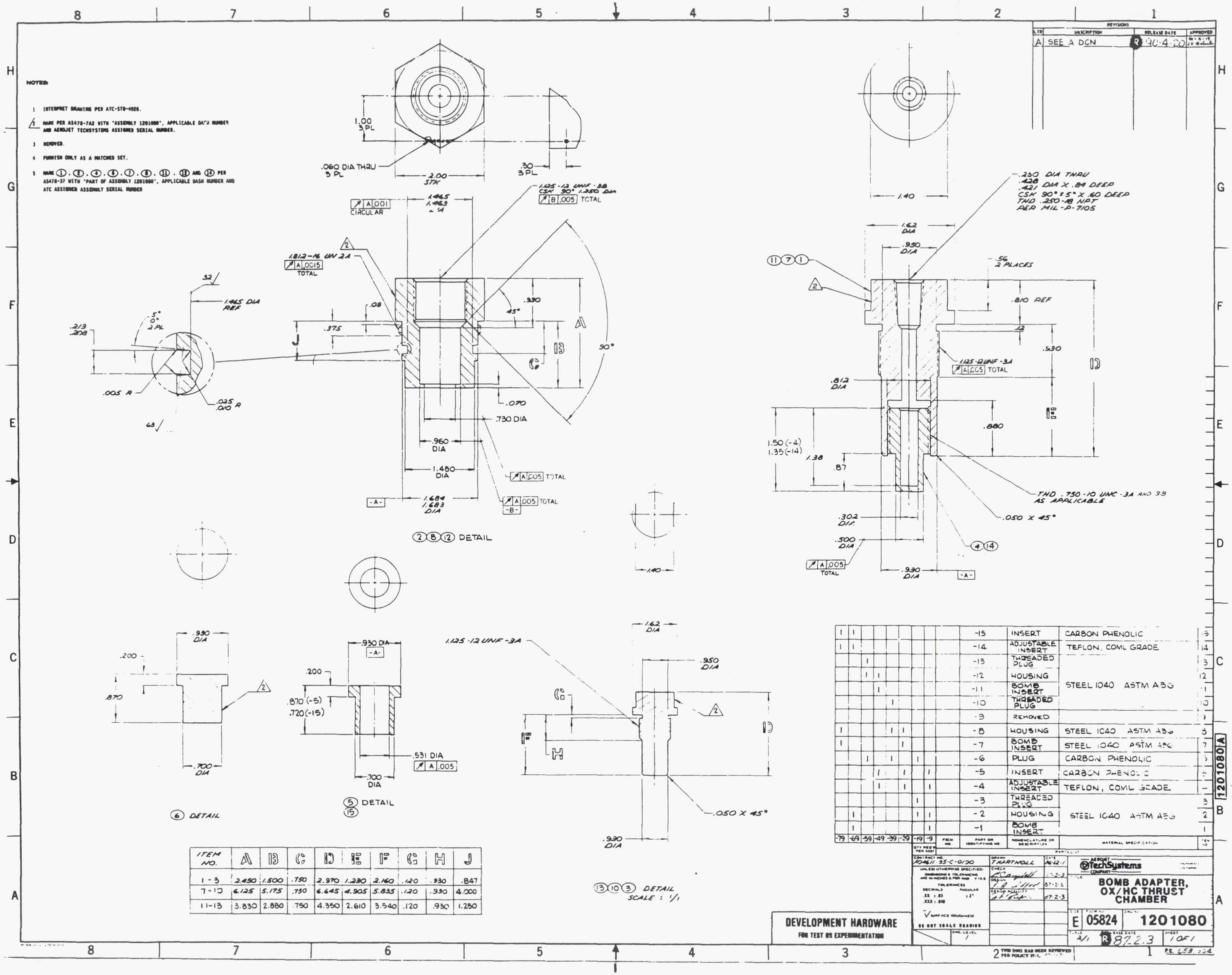
1 P.C. 561

REVISIONS

LTR	DESCRIPTION	RELEASE DATE	APPROVED

1206431

Figure D-26



ITEM NO.	A	B	C	D	E	F	G	H	J
1-3	2.450	1.500	.750	2.970	1.230	2.160	.120	.930	.847
7-10	6.125	5.175	.750	6.645	4.905	5.835	.120	.930	4.000
11-13	3.830	2.880	.750	4.350	2.610	3.540	.120	.930	1.250

PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION	ITEM NO.
-15	INSERT	CARBON PHENOLIC	15
-14	ADJUSTABLE INSERT	TEFLON, COML GRADE	14
-13	THREADED PLUG		13
-12	HOUSING	STEEL 1040 ASTM A36	12
-11	BOMB INSERT		11
-10	THREADED PLUG		10
-9	REMOVED		9
-8	HOUSING	STEEL 1040 ASTM A36	8
-7	BOMB INSERT	STEEL 1040 ASTM A36	7
-6	PLUG	CARBON PHENOLIC	6
-5	INSERT	CARBON PHENOLIC	5
-4	ADJUSTABLE INSERT	TEFLON, COML GRADE	4
-3	THREADED PLUG		3
-2	HOUSING	STEEL 1040 ASTM A36	2
-1	BOMB INSERT		1

Figure D-27

APPENDIX E

ADVANCED DOCUMENT CHANGE NOTICES FOR THE ROCCID DESIGN DISCLOSURE

ADCN ☐ DCN | DATE 91-3-8

DOCUMENT CHANGE NOTICE

GENCORP AEROJET — TechSystems — SACRAMENTO, CALIFORNIA

DWG LVL		DOCUMENT NUMBER	REV LTR
1		1206427	A-1

ECRA NO | RELEASE DATE

DOCUMENT TITLE: INJECTOR ASSY, OX/HC

SHEET 1 OF 3

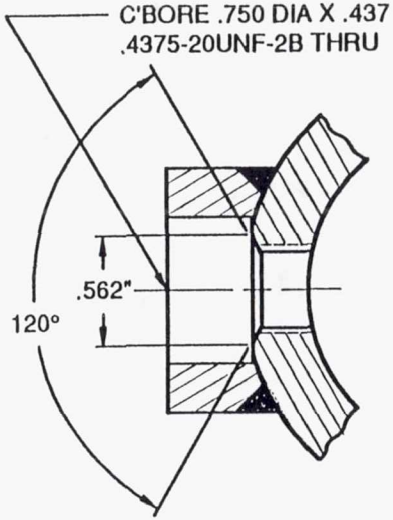
PREPARED BY: L. MYERS

APPROVALS

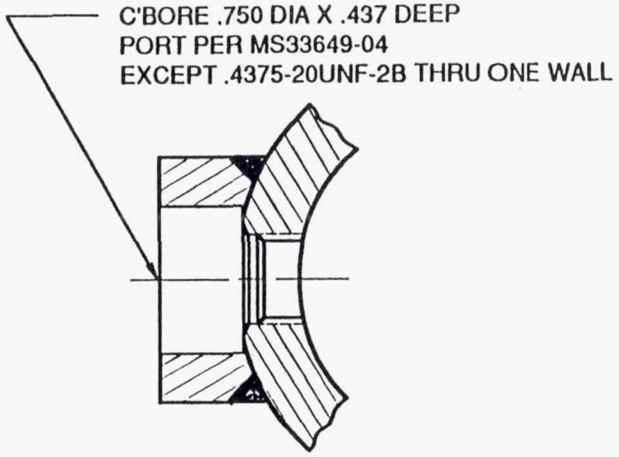
DESIGN	DESIGN ACTIVITY	CHECK	STRESS	WT
91-03-18	15MAR91			
QA	MANUF	MATL	CMO	
	Vince Myers 91-3-15			

SH	ZONE	ITEM
1	6 B	1

IS;



WAS;



E-2

PC _____

■ ADCN	□ DCN	DATE	DWG LEVEL	DOCUMENT NUMBER	REV LTR	SHEET
		91-3-8	1	1206427	NC-1	2 OF 3

SH	ZONE	ITEM
1	GN	2

IS; NOTE (9) TEST ASSEMBLY IN THE FOLLOWING ORDER:

A. LEAK TEST ASSEMBLY PER ATC-47063, METHOD II, USING CLEAN DRY NITROGEN AT 50 ±5 PSIA. HOLD FOR 5 MINUTES MINIMUM. NO LEAKAGE ALLOWED.

B. FLOW TEST WITH CLEAN WATER (PER ATC-STD-4940, LEVEL 1000) AS FOLLOWS:
   1. PERFORM VISUAL PATTERN CHECK PER COGNIZANT DESIGN ACTIVITY.

   2. THE OXIDIZER AND FUEL CIRCUITS SHALL BE FLOWED SEPARATELY AT SEVERAL FLOWRATES BELOW CAVITATION ONSET (~ 50 PSIG ΔP). FOR EACH DATA POINT RECORD THE MANIFOLD ΔP, FLOWRATE, NOMINAL WATER FLOW TEMPERATURE AND ACTUAL OUTPUT FREQUENCY OF FLOWMETER. CALCULATE $K\omega$:

$$Kw = \frac{\dot{w}}{(\Delta P)\,(Sg)}$$

WHERE: $\dot{w}$ = FLOWRATE, LB/SEC
ΔP = INLET - OUTLET PRESSURE, PSI
Sg = SPECIFIC GRAVITY OF WATER AT FLOW TEMPERATURE

PC

DOCUMENTATION CHANGE NOTICE
CONTINUATION SHEET

GENCORP AEROJET — TechSystems
SACRAMENTO, CALIFORNIA

FSCM NO. 05824

■ ADCN ☐ DCN	DATE	DWG LEVEL	DOCUMENT NUMBER	REV LTR	SHEET
	91-3-8	1	1206427	NC-1	3 OF 3

SH	ZONE	ITEM
1	GN	2

WAS; NOTE (9) TEST ASSEMBLY IN THE FOLLOWING ORDER:

A. ULTRASONIC INSPECT BRAZE JOINT PER ATC-STD-4819, TYPE I. ACCEPTANCE PER COGNIZANT DESIGN ACTIVITY.

B. PROOF TEST BRAZE JOINT BY FLOWING CLEAN WATER (PER ATC-STD-4940, LEVEL 1000) SIMULTANEOUSLY THRU THE OXIDIZER AND FUEL CIRCUITS TO ATMOSHERE. HOLD FOR APPROXIMATELY FIVE MINUTES.
OXIDIZER CIRCUIT:
MANIFOLD P = 750 ±10 PSI; APPROX FLOW = 175 LB/SEC
FUEL CIRCUIT:
MANIFOLD P = 710 ±10 PSI; APPROX FLOW = 85 LB/SEC

C. REPEAT ULTRASONIC INSPECT OF BRAZE JOINT PER ATC-STD-4819, TYPE I. NOTE ANY DIFFERENCES. ACCEPTANCE PER COGNIZANT DESIGN ACTIVITY.

D. LEAK TEST ASSEMBLY PER ATC-47063, METHOD II, USING CLEAN DRY NITROGEN AT 50 ±5 PSIA. HOLD FOR 5 MINUTES MINIMUM. NO LEAKAGE ALLOWED.

E. FLOW TEST WITH CLEAN WATER (ATC-STD-4940, LEVEL 1000) AS FOLLOWS:
1. PERFORM VISUAL PATTERN CHECK PER COGNIZANT DESIGN ACTIVITY.

2. THE OXIDIZER AND FUEL SHALL BE FLOWED SEPARATELY AT THE FOLLOWING FLOW RATES: OXIDIZER: 25, 35, 45, 55, 65; FUEL: 20, 25, 35, 40, 45. FOR EACH DATA POINT RECORD THE MANIFOLD ΔP, FLOWRATE, NOMINAL WATER FLOW TEMPERATURE AND ACTUAL OUTPUT FREQUENCY OF FLOWMETER. CALCULATE Kω:

$$Kw = \frac{\dot{w}}{(\Delta P)\,(Sg)}$$

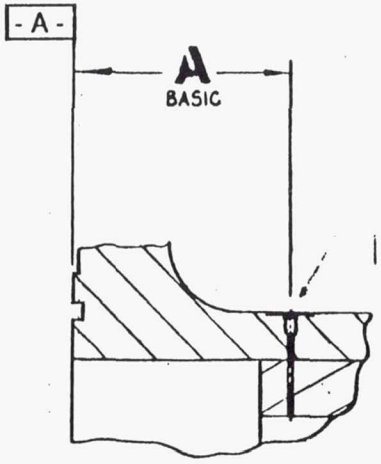
WHERE: $\dot{w}$ = FLOWRATE, LB/SEC
ΔP = INLET - OUTLET PRESSURE, PSI
Sg = SPECIFIC GRAVITY OF WATER AT FLOW TEMPERATURE

PC

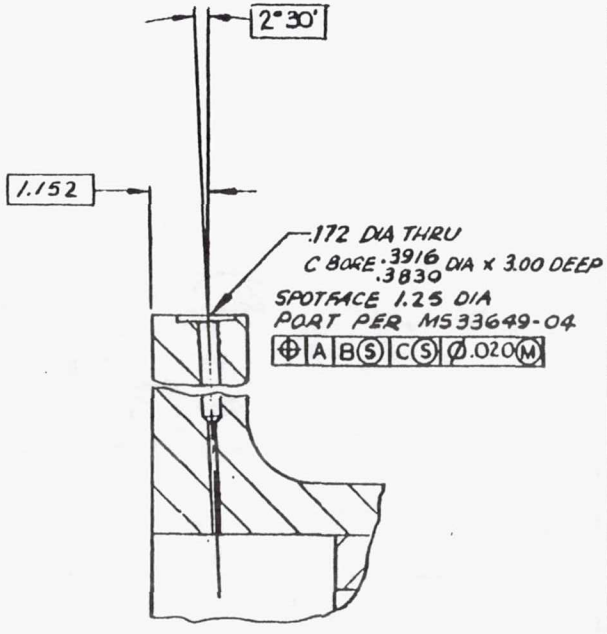
ADCN ☐ DCN	DATE 91-2-25	DOCUMENT CHANGE NOTICE	DWG LVL 1		DOCUMENT NUMBER 1206428	REV LTR NC-1
ECRA NO	RELEASE DATE	GENCORP AEROJET TechSystems SACRAMENTO, CALIFORNIA	DOCUMENT TITLE INJECTOR CORE ASSY,OX/HC			SHEET 1 OF 3
PREPARED BY L. MYERS						

APPROVALS					
DESIGN 91-03-18	DESIGN ACTIVITY 15MAR91	CHECK	STRESS	WT	
	QA	MANUF 91-2-28	MAT'L	CMO	

SH	ZONE	ITEM	
2	5 F	1	**ADDED;**
2	5 C	1	**REMOVED;** SECTION **K-K** LOCATED AT 142.500°



WAS;



SECTION **K-K** 1 6 C
LOCATED AT 142.500°

E-5

PC _____

DOCUMENTATION CHANGE NOTICE
CONTINUATION SHEET

GENCORP AEROJET — TechSystems
SACRAMENTO, CALIFORNIA

FSCM NO. 05824

■ ADCN	☐ DCN	DATE	DWG LEVEL	DOCUMENT NUMBER	REV LTR	SHEET
		91-2-25	1	1206428	NC-1	2 OF 3

SH	ZONE	ITEM		
2	4 F	3	**IS;**	.172 DIA THRU SPOTFACE 1.25 DIA PORT PER MS33649-04 ⌖ A B Ⓢ C Ⓢ Ø.020 Ⓜ
			WAS;	.172 DIA THRU C'BORE .3916 / .3830 DIA X 3.00 DEEP SPOTFACE 1.25 DIA PORT PER MS33649-04 ⌖ A B Ⓢ C Ⓢ Ø.020 Ⓜ
1	6 F	4	**IS;**	1.062 DIA THRU 18 HOLES ⌖ A B Ⓢ C Ⓢ Ø.010 Ⓜ
			WAS;	1.062 DIA THRU SPOTFACE 2.50 DIA FAR SIDE ONLY, 18 HOLES ⌖ A B Ⓢ C Ⓢ Ø.010 Ⓜ
1	1 C	5	**IS;**	1.062 DIA THRU ⌖ D B Ⓢ C Ⓢ Ø.020 Ⓜ 16 PL EQ SP
			WAS;	1.062 DIA THRU SPOTFACE 2.50 DIA FAR SIDE ONLY ⌖ D B Ⓢ C Ⓢ Ø.020 Ⓜ 16 PL EQ SP

PC

DOCUMENTATION CHANGE NOTICE
CONTINUATION SHEET

GENCORP AEROJET — TechSystems
SACRAMENTO, CALIFORNIA

FSCM NO. 05824

■ ADCN ☐ DCN	DATE	DWG LEVEL	DOCUMENT NUMBER	REV LTR	SHEET
	91-2-25	1	1206428	NC-1	3 OF 3

SH	ZONE	ITEM
1	2 A	6

IS;

	4			NAS334CPA10	BOLT				10
	1			-9	ASSY				9
	1			1200976-2	RETAINER				8
		AR	00426	RTV GE 627	SILICON SEALANT				7
		4		MS51937-6C	BOLT, EYE		2	3D	6
		4		MS35691-41	NUT, HEX		2	3C	5
									4
		1		1206429-1	INSERT		1	3F	3
									2
6		1		-1	CHAMBER	MAKE FROM 1206432-1	1	3F	1
-19	-9	FSCM/CAGE NO.		PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL/SPECIFICATION	ZONE		ITEM NO.
QTY REQ'D PER ASSY		PARTS LIST							

WAS;

		AR	00426	RTV GE 560	SILICON SEALANT				7
		4		MS51937-6C	BOLT, EYE		2	3D	6
		4		MS35691-41	NUT, HEX		2	3C	5
									4
		1		1206429-1	INSERT		1	3F	3
									2
6		1		-1	CHAMBER	MAKE FROM 1206432-1	1	3F	1
	-9	FSCM/CAGE NO.		PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL/SPECIFICATION	ZONE		ITEM NO.
QTY REQ'D PER ASSY		PARTS LIST							

PC

ADCN ☐ DCN | DATE 91-2-25

DOCUMENT CHANGE NOTICE

GENCORP AEROJET TechSystems SACRAMENTO, CALIFORNIA

DWG LVL		DOCUMENT NUMBER	REV LTR
1		1200729	A-1

ECTA NO | RELEASE DATE

DOCUMENT TITLE: INJECTOR CORE ASSY,OX/HC

SHEET 1 OF 1

PREPARED BY: L. MYERS

APPROVALS

DESIGN	DESIGN ACTIVITY	CHECK	STRESS	WT
91-03-18	15 MAR 91			
QA	MANUF	MATL	CMO	
	91-3-15			

SH	ZONE	ITEM	IS;	WAS;
1	GN	1	RADIUS THE ORIFICE INLETS USING ONE OF THE FOLLOWING PROCESS: A. ELECTROPOLISH INDICATED SIDE USING A SOLUTION OF 50% PHOSPHORIC ACID/50% DEIONIZED WATER AND 100 AMPS/FT^2 CURRENT. CONTINUE PROCESS UNTIL 0.001-0.0015 INCHES OF MATERIAL IS REMOVED AND ORIFICE INLETS HAVE A SLIGHT RADIUS. B. MICRO BLAST INDICATED SIDE USING 100 MICRON SILICON CARBIDE GLASS BEADS FOR ≈10 SEC. CONTINUE PROCESS UNTIL ALL BURRS ARE REMOVES AND A 0.001-0.0015 INCH RADIUS IS ACHIEVED ON THE ORIFICE INLETS.	ELECTROPOLISH INDICATED SIDE USING A SOLUTION OF 50% PHOSPHORIC ACID/50% DEIONIZED WATER AND 100 AMP/FT^2 CURRENT. CONTINUE PROCESS UNTIL 0.001-0.0015 INCHES OF MATERIAL IS REMOVED AND ORFICE INLETS HAVE A SLIGHT RADIUS.

PC _____

ADCN ☐ DCN	DATE 2-27-91	DOCUMENT CHANGE NOTICE	DWG LVL 1	DOCUMENT NUMBER 1200773	REV LTR A-2
ECRA NO.	RELEASE DATE	GENCORP AEROJET TechSystems SACRAMENTO, CALIFORNIA	DOCUMENT TITLE INJECTOR FLANGE ASSY, OXYGEN/HYDROCARBON		SHEET 1 OF 2
PREPARED BY L. MYERS					

APPROVALS

DESIGN	DESIGN ACTIVITY J.L. Culper 3-7-91	CHECK	STRESS	WT
	QA	MANUF Lance Myers 2-27-91	MAT'L	CMO

SH	ZONE	ITEM
1	1A	1

IS;

QTY REQ'D PER ASSY -49	-39	-29	-19	-9	FSCM NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION	ZONE		ITEM NO.
							PARTS LIST				
1		1				-39	ASSY				12
	1					-8	BOSS	CRES QQ-S-763 CL 304, COND A			11
	AR			AR			WELD ROD	ER316 AWS A5.9			10
			1			-9	ASSY		1	4G	9
AR	AR	AR	AR	AR			WELD ROD	ER308 AWS A5.9			8
	1			1	14713	52823	BUTT WELD HUB	2"GR 20 SCH 160 SA182-F316	3	3C	7
	1			1		-4	TUBE	2.0 SCHED 160 CRES PIPE ASTM-A312 TYPE 304	3	6C	6
	1			1		-3	BOSS	CRES QQ-S-763 CL304 COND A	3	6C	5
	(18)	1				-6	OUTER RING	CRES ASTM A473 OR ASTM A167 TYPE 304	1	6F	4
	(18)	1				-5	INNER RING		1	3F	3
1			1			-2	OUTER RING	CRES ASTM A473 OR ASTM A167 TYPE 304	1	6F	2
1			1			-1	INNER RING	CRES ASTM A473 OR ASTM A167 TYPE 304	1	3F	1

E-9

PC _____

DOCUMENTATION CHANGE NOTICE
CONTINUATION SHEET

GENCORP AEROJET — TechSystems
SACRAMENTO, CALIFORNIA

FSCM NO. 05824

■ ADCN ☐ DCN	DATE	DWG LEVEL	DOCUMENT NUMBER	REV LTR	SHEET
	2-27-91	1	1200773	A-2	2 OF 2

SH	ZONE	ITEM
1	1A	1

WAS;

		AR			WELD ROD	ER316 AWS A5.9			10
1	1			-9	ASSY		1	4G	9
AR	AR	AR			WELD ROD	ER308 AWS A5.9			8
		1	14713	52823	BUTT WELD HUB	2"GR 20 SCH 160 SA182-F316	3	3C	7
		1		-4	TUBE	2.0 SCHED 160 CRES PIPE ASTM-A312 TYPE 304	3	6C	6
		1		-3	BOSS	CRES QQ-S-763 CL304 COND A	3	6C	5
(18) 1				-6	OUTER RING	CRES ASTM A473 OR ASTM A167 TYPE 304	1	6F	4
(18) 1				-5	INNER RING		1	3F	3
	1			-2	OUTER RING	CRES ASTM A473 OR ASTM A167 TYPE 304	1	6F	2
	1			-1	INNER RING	CRES ASTM A473 OR ASTM A167 TYPE 304	1	3F	1
-29	-19	-9	FSCM NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION	ZONE		ITEM NO.
	QTY REQ'D PER ASSY		PARTS LIST						

PC

APPENDIX F

NONCONFORMANCE REPORTS

AEROJET TechSystems COMPANY

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AREA: Supplier

NONCONFORMANCE REPORT

G.F.M. ☐ NO. V21175

PAGE 1 OF 1

1. PART NUMBER	DASH	REV.	2. NOMENCLATURE	3. SERIAL NO.	4. PROGRAM	5. LOT SIZE	6. ACC.	7. DISC.
1206432	1		Forging- Chamber Body	N/A		1	0	1

8. WORK ORDER	9. SHOP ORDER	10. OPER. NO.	11. SUPPLIER NAME	NUMBER	12. P.O. NUMBER	13. DISTRIBUTION NO.	PREVIOUS NR NUMBER
KFN 600	N/A	N/A	Viking Metallurgical		L823696H	N/A	N/A

14. NONCONFORMANCE

(A) DWG. ZONE, SPEC., PARA., SHOP ORDER OPER., ETC AS APPLICABLE
(B) STATE REQUIREMENT (C) INSPECTION RESULTS

15. (A) CAUSE C/C — (B) FREQ. OCCUR

B/P note 5 requires ultrasonic inspection to ATC- STD-4819 with acceptance to ATC-Std 4006 Class II. Forging is rejected to Class II and Class III. Forging is acceptable to Class IV.

☐ MRB ITEMS ____ **16. DISPOSITION/COMMENTS** ☐ ERB ITEMS ____

Accept As Is providing the forging will meet Ultrasonic Inspection per ATC-STD-4819 with acceptance to ATC-STD-4006 Class IV. Also, provide all available records substantiating the material meets Mil-S-5000E requirements.

17. INITIATOR IDENTITY [signature] DATE 10/9/90 — 18. REVIEWED BY [signature] DATE 10-29-90 — 19. PROC. REPR. [signature] DATE 10/11/90 — 20. REINSPECT QTY ACC. DISC. — NEW NR NO. — INSPECTOR DATE

21. MRB/ERB APPROVALS

ENG REPR. [signature] DATE 10/29/90 — QA REPR. DATE — CUST REPR. DATE
[signature] DATE 10-16-90 — DATE — DATE

22. MRB/ERB RESUBMIT DECISIONS

ENG REPR. [signature] DATE 10-16-90 — QA REPR. DATE — RESUBMIT FOR
CUST REPR. DATE — [signature] 10-16-90

23. CAUSE

The heat of 4340AQ used was not adequate for Class II sonic requirement.

24. CORRECTIVE ACTION

Purchase better quality stee;- Next Purchase Order.

C CA SIGNATURE DATE — 25. EFFECTIVITY: (DATE/SERIAL NUMBER/ETC.)

DISCREPANT MATERIAL DISPOSITION	RESPONSIBILITY: ☐ GFM ☐ SUPPLIER ☐ ATC	QTY	RTS	SHIPPER NO.	SALVAGE	PROC/MFG/ILS REPR.	DATE	QA REPR.	DATE	NO. V21175

AEROJET TechSystems COMPANY

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NONCONFORMANCE REPORT

G.F.M. ☐ NO. V21264

AREA: Supplier

PAGE 1 OF ____

1. PART NUMBER	DASH	REV.	2. NOMENCLATURE	3. SERIAL NO.	4. PROGRAM	5. LOT SIZE	6. ACC.	7. DISC.
1206429		N/C	INSERT THRUST CHAMBER	2873-1-001		1	D	1

8. WORK ORDER	9. SHOP ORDER	10. OPER. NO.	11. SUPPLIER NAME / NUMBER	12. P.O. NUMBER	13. DISTRIBUTION NO.	PREVIOUS NR NUMBER
			AAE	L823865H		

ITEM	14. NONCONFORMANCE (A) DWG. ZONE, SPEC., PARA., SHOP ORDER OPER., ETC AS APPLICABLE (B) STATE REQUIREMENT (C) INSPECTION RESULTS	15. (A) CAUSE C/C	15. (B) FREQ OCCUR	☐ MRB ITEMS ____ 16. DISPOSITION/COMMENTS ☐ ERB ITEMS ____
1	RESIN CONTENT 31±4% is 36.83 FWD 36.61 AFT			Us As Is; the higher resin content will not affect the preformance of the liner in the hot fire enviroment.

17. INITIATOR IDENTITY / DATE	18. REVIEWED BY / DATE	19. APPROVED BY / DATE	20. RE-INSPECT QTY / ACC. / DISC.	NEW NR NO.	INSPECTOR / DATE
B. MCCAMMENT 1-14-91	QR 1-14-91	1/14/91			

21. MRB/ERB APPROVALS				22. MRB/ERB RESUBMIT DECISIONS		RESUBMIT FOR
ENG REPR. / DATE	QA REPR. / DATE	CUST REPR. / DATE		ENG REPR. / DATE	QA REPR. / DATE	
J. Sieper 1-14-91						
Lance Myers 1-14-91				CUST REPR. / DATE		

23. CAUSE	24. CORRECTIVE ACTION
BURNOUT METHOD FOR SILICA PHENOLIC MATERIALS HISTORICALLY HAS BEEN HIGHER THAN THE RAW MATERIAL CERTIFICATIONS (IN THIS CASE THE FIBERITE CERTS REPORT 32%) ALSO THE REQ'D CURE CYCLE REDUCES RESIN FLOW DURING CURE	RAISE PART RESIN CONTENT LIMITS, OR PROCURE MX2600 WITH A LOWER RESIN CONTENT WHICH WOULD NOT BE THEIR STANDARD [redacted] PRODUCT.
	C.A.R. NAME / DATE: B. Mc 1-14-91
	25. EFFECTIVITY: (DATE/SERIAL NUMBER/ETC.)

DISCREPANT MATERIAL DISPOSITION	RESPONSIBILITY: ☐ GFM ☐ SUPPLIER ☐ ATC	QTY	RTS	SHIPPER NO.	SALVAGE	PROC/MFG ILS REPR / DATE	QA REPR. / DATE	NO.

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AEROJET TechSystems COMPANY

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NONCONFORMANCE REPORT

G.F.M. ☐ NO. V21274

AREA: _____ PAGE 1 OF _____

1. PART NUMBER	DASH	REV.	2. NOMENCLATURE	3. SERIAL NO.	4. PROGRAM	5. LOT SIZE	6. ACC.	7. DISC.
1206429		N/C	INSERT THRUST CHAMBER	2873-1-002		1	0	1

8. WORK ORDER	9. SHOP ORDER	10. OPER. NO.	11. SUPPLIER NAME NUMBER	12. P.O. NUMBER	13. DISTRIBUTION NO.	PREVIOUS NR NUMBER
			AAE	L823865 H L8225A.		

ITEM	14. NONCONFORMANCE (A) DWG. ZONE, SPEC., PARA., SHOP ORDER OPER., ETC AS APPLICABLE (B) STATE REQUIREMENT (C) INSPECTION RESULTS	15. (A) CAUSE C/C	15. (B) FREQ. OCCUR	☐ MRB ITEMS _____ 16. DISPOSITION/COMMENTS ☐ ERB ITEMS _____
1	RESIN CONTENT 31 ± 4% IS			Us As Is; the higher resin content will not
	36.89 FWD			affect the performance of the Insert in the hot fire
	36.23 AFT			enviroment.

17. INITIATOR IDENTITY / DATE	18. REVIEWED BY / DATE	19. PROC/REPR / DATE	20. REINSPECT QTY ACC. DISC.	NEW NR NO.	INSPECTOR / DATE
B.MCCAMMENT 1-14-91		1/17/91			

21. MRB/ERB APPROVALS				22. MRB/ERB RESUBMIT DECISIONS				RESUBMIT FOR
ENG REPR. / DATE	QA REPR. / DATE	CUST REPR. / DATE		ENG REPR. / DATE	QA REPR. / DATE			
8-1-91								
DATE	DATE	DATE		CUST REPR. / DATE				
2-1-91								

23. CAUSE

BURNOUT METHOD FOR SILICA PHENOLIC MATERIALS HISTORICALLY HAS BEEN HIGHER THAN THE RAW MATERIAL CERTIFICATIONS (FIBERITE CERTS REPORT 32%) ALSO THE REQUIRED CURE CYCLE REDUCES RESIN FLOW DURRING CURE.

24. CORRECTIVE ACTION

RAISE PART RESIN CONTENT LIMITS, OR PROCURE MX2600 WITH A LOWER RESIN CONTENT WHICH WOULD NOT BE THEIR STANDARD PRODUCT.

C/CA SIGNATURE / DATE 1-14-91

25. EFFECTIVITY: (DATE/SERIAL NUMBER/ETC.)

DISCREPANT MATERIAL DISPOSITION	RESPONSIBILITY: ☐ SUPPLIER ☐ GFM ☐ ATC	QTY	RTS	SHIPPER NO.	SALVAGE	PROC/MFG/ILS REPR. / DATE	QA REPR. / DATE	NO.

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TECH-00035A (REV. 9/87)

AEROJET TechSystems COMPANY

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AREA:

NONCONFORMANCE REPORT

G.F.M. ☐ NO. V2284

PAGE 1 OF 1

1. PART NUMBER	DASH	REV.	2. NOMENCLATURE	3. SERIAL NO.	4. PROGRAM	5. LOT SIZE	6. ACC.	7. DISC.
1200729	-1	A	INJECTOR CORE		3D SUBSCALE	1	ø	1

8. WORK ORDER	9. SHOP ORDER	10. OPER. NO.	11. SUPPLIER NAME NUMBER	12. P.O. NUMBER	13. DISTRIBUTION NO.	PREVIOUS NR NUMBER
	S/O 4444		MARTINEZ & TUREK	L823839		

ITEM	14. NONCONFORMANCE (A) DWG. ZONE, SPEC., PARA., SHOP ORDER OPER., ETC AS APPLICABLE (B) STATE REQUIREMENT (C) INSPECTION RESULTS	15. (A) CAUSE Q/C	15. (B) FREQ. OCCUR	☐ MRB ITEMS	16. DISPOSITION/COMMENTS	☐ ERB ITEMS
1	REF. DWG. SHEET 4/7, ZONE: F-8 SHOULD BE: ø11.336±.000 .002 IS: ø11.331 at 68° F				Us As Is; the smaller diametrical dimension will not affect the assembly nor will it jeopardize the seal of the o-ring.	
2	REF. DWG SHEET 3/7, ZONE: A-3 SHOULD BE: .022 + .001 @ 8 places, (BRAZE CHANNEL DEPTH) IS: ACCEPTABLE AT (7) LOCATIONS, (1) LOCATION (ø 1.888) FOUND TO BE .024" DEEP.				Us As Is; the difference of .001" in channel depth will not change the flow charactoristics to detriment the hardware performance.	

17. INITIATOR IDENTITY	DATE	18. REVIEWED BY	DATE	19. PROC. REPR.	DATE	20. REINSPECT QTY	ACC.	DISC.	NEW NR NO.	INSPECTOR	DATE
S. NICKERSON		L.W. Madden	2/4/91	[signature]	1/25/91						

21. MRB/ERB APPROVALS

ENG REPR.	DATE	QA REPR.	DATE	CUST REPR.	DATE
[signature]	2-1-91				
[signature]	2-1-91				

22. MRB/ERB RESUBMIT DECISIONS

ENG REPR.	DATE	QA REPR.	DATE	RESUBMIT FOR
CUST REPR.	DATE			

23. CAUSE	24. CORRECTIVE ACTION
Items 1&2: OPERATOR ERROR	OPERATOR HAD PROPER INSTRUCTIONS AND DID NOT FOLLOW. THIS OPERATOR HAS been COUNSELED ON CRITICAL NATURE OF THIS ASSEMBLY. VERBAL WARNING ISSUED.

C.A.A. SIGNATURE [signature] DATE 1/23/91

25. EFFECTIVITY: (DATE/SERIAL NUMBER/ETC.) 1/23/91

DISCREPANT MATERIAL DISPOSITION	RESPONSIBILITY: ☐ GFM ☐ SUPPLIER ☐ ATC	QTY	RTS	SHIPPER NO.	SALVAGE	PROC/MFG/ILS REPR. DATE	QA REPR. DATE	NO.

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TECH-00035A (REV 9/87)

AEROJET TechSystems COMPANY

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NONCONFORMANCE REPORT

G.F.M. ☐ NO. V21221

PAGE 1 OF 2

AREA:

1. PART NUMBER	DASH	REV.	2. NOMENCLATURE	3. SERIAL NO.	4. PROGRAM	5. LOT SIZE	6. ACC.	7. DISC.
1200729	-1	A	INJECTOR CORE			1	Ø	1

8. WORK ORDER	9. SHOP ORDER	10. OPER. NO.	11. SUPPLIER NAME	NUMBER	12. P.O. NUMBER	13. DISTRIBUTION NO.	PREVIOUS NR NUMBER
KFN 600	Vendor S/O 4444		MARTINEZ & TUREK	MA255	L823839	—	

ITEM	14. NONCONFORMANCE (A) DWG. ZONE, SPEC., PARA., SHOP ORDER OPER., ETC AS APPLICABLE (B) STATE REQUIREMENT (C) INSPECTION RESULTS	15. (A) CAUSE C/C	15. (B) FREQ. OCCUR	☐ MRB ITEMS	16. DISPOSITION/COMMENTS	☐ ERB ITEMS
1	REF: DWG. SHEET -4, Zone: D-5 Should be: Ø .156 $\pm^{.005}_{.001}$, 7-Holes Eq. Spaced ⌖ A C(S) D(S) Ø.005(S) 9 Equal Spaces IS: True position varies up to .020, (See Attached for Discrepant locations)7 pls.				Accept as is providing all metal chips have been deburred so there will be nothing dislodged during testing.	

17. INITIATOR IDENTITY	DATE	18. REVIEWED BY	DATE	19. PROGRAMMER	DATE	20. RE-INSPECT QTY	ACC.	DISC.	NEW NR NO.	INSPECTOR	DATE
[signature]	10-31-90	RR [signature]	11-12-90	[signature]	11/8/90						

21. MRB/ERB APPROVALS

ENG REPR	DATE	QA REPR	DATE	CUST REPR	DATE
[signature]	11/8/91				
[signature]	12-21-90				

22. MRB/ERB RESUBMIT DECISIONS

ENG REPR	DATE	QA REPR	DATE	CUST REPR	DATE	RESUBMIT FOR

23. CAUSE

Due to the length of the drill ~~xx~~ required to complete this configuration (Approx. 5" Long) Deflection occured thus causing drilled hole to be off location.

24. CORRECTIVE ACTION

Operator has been instructed to pilot drill holes first and then bore to size.

25. EFFECTIVITY: (DATE/SERIAL NUMBER/ETC.)

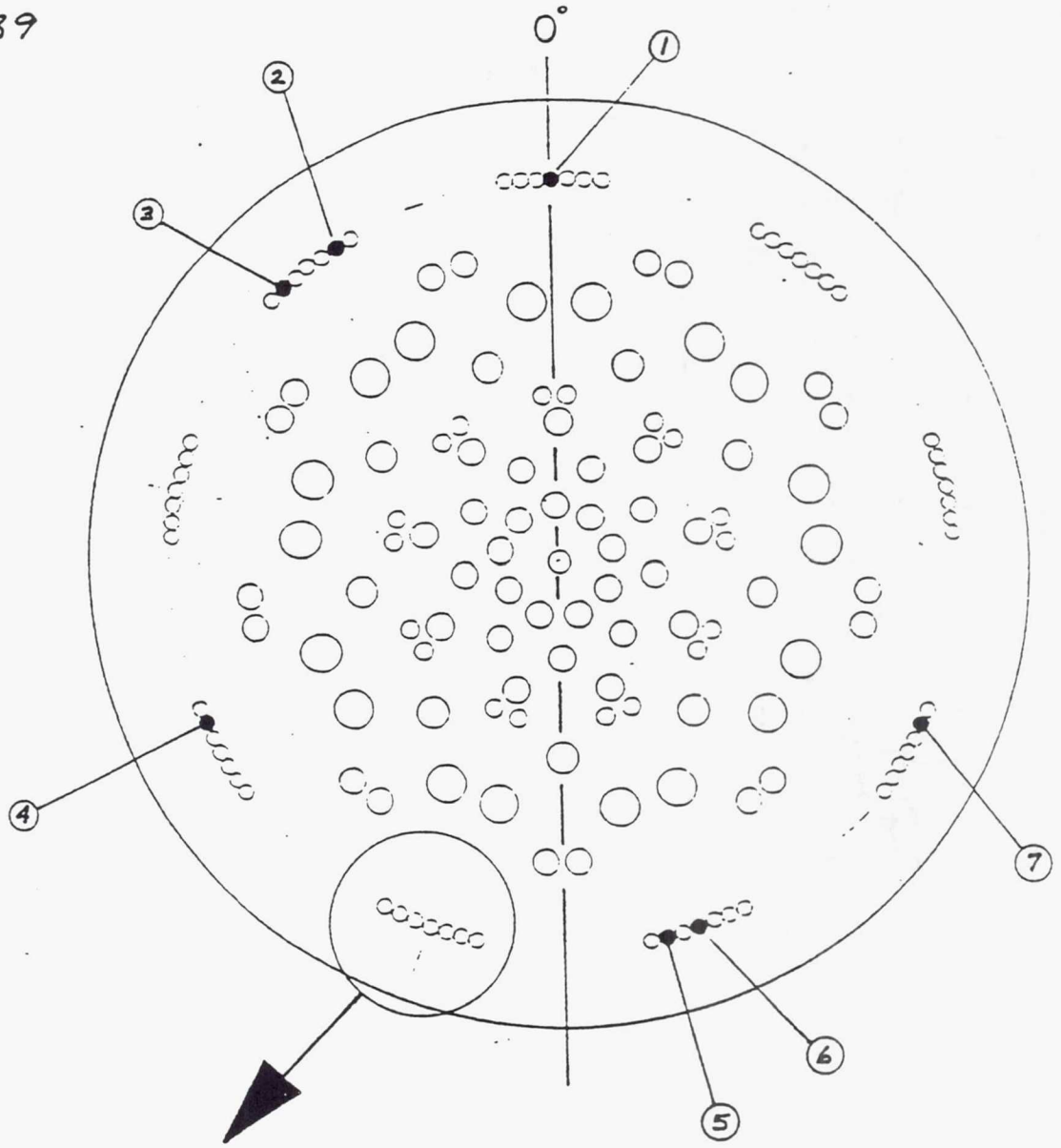
C.A. SIGNATURE [signature] DATE 12/31/90

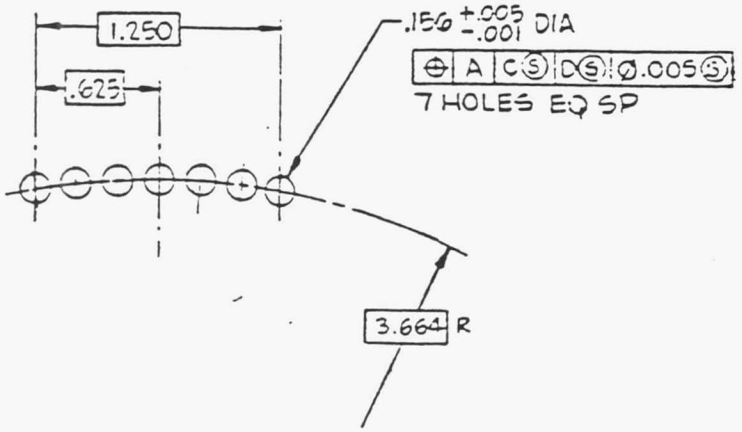
DISCREPANT MATERIAL DISPOSITION	RESPONSIBILITY ☐ SUPPLIER ☐ GFM ☐ ATC	QTY	RTS	SHIPPER NO	SALVAGE	PROC-MFG ILS REPR	DATE	QA REPR	DATE	NO.

F-6

ATC PN# 1200729
-1 INJECTOR CORE
P.O.# L823839

√21221





VIEW S 4 2 G
9 PL THRU EQ SP
SCALE: 2/1

HOLE NO.#	TRUE POSITION
1	.006
2	.020
3	.006
4	.006
5	.012
6	.007
7	.0085

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AREA:

NONCONFORMANCE REPORT

G.F.M. ☐ NO.

1. PART NUMBER	DASH	REV.	2. NOMENCLATURE	3. SERIAL NO.	4. PROGRAM	5. LOT SIZE	6. ACC.	7. DISC.
1206423	-9	A-2	INJECTOR CORE ASSY	S/N-01		1	Ø	1

8. WORK ORDER	9. SHOP ORDER	10. OPER. NO.	11. SUPPLIER NAME	NUMBER	12. P.O. NUMBER	13. DISTRIBUTION NO.	PREVIOUS NR NUMBER
	VENDOR S/O 4444		martinez & Turek		L823839		

ITEM	14. NONCONFORMANCE (A) DWG. ZONE, SPEC., PARA., SHOP ORDER OPER., ETC AS APPLICABLE (B) STATE REQUIREMENT (C) INSPECTION RESULTS	15. (A) CAUSE C/C	15. (B) FREQ. OCCUR	☐ MRB ITEMS	16. DISPOSITION/COMMENTS	☐ ERB ITEMS
1	REF. DWG. # 1200729, Sht #1, Zone: F-6				Us As Is; the difference in length will be	
	SHOULD BE: 10.75 ± .030				accomodated between the seal and the test stand	
	IS: 10.685				interface.	

17. INITIATOR IDENTITY / DATE	18. REVIEWED BY / DATE	19. PROC REPR. / DATE	20 REINSPECT QTY / ACC. / DISC.	NEW NR NO.	INSPECTOR / DATE
S. NICKERSON 2-11-91					

21. MRB/ERB APPROVALS				22. MRB/ERB RESUBMIT DECISIONS				RESUBMIT FOR
ENG REPR. / DATE	QA REPR. / DATE	CUST REPR. / DATE		ENG REPR. / DATE	QA REPR. / DATE			
Lance Myers 2-28-91 / DATE	/ DATE	/ DATE		CUST REPR. / DATE				

23. CAUSE

This is attributed to Weld Shrinkage during the welding of -19 Assembly unto -1 Assembly

24. CORRECTIVE ACTION

This problem has been presented to M&T Engineering & Mfg. Engineer for solution on all ~~XXX future projects~~

C.A. SIGNATURE / DATE 3/4/91

25. EFFECTIVITY: (DATE/SERIAL NUMBER/ETC.) FEB. 11, 91

DISCREPANT MATERIAL DISPOSITION	RESPONSIBILITY: ☐ SUPPLIER ☐ GFM ☐ ATC	QTY	RTS	SHIPPER NO.	SALVAGE	PROC/MFG/ILS REPR. / DATE	QA REPR. / DATE	NO.

F-8

TECH-00035A (REV 9/87)

REPORT DOCUMENTATION PAGE

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1. AGENCY USE ONLY (*Leave blank*)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	May 1993	Final Contractor Report

4. TITLE AND SUBTITLE

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5. FUNDING NUMBERS

WU–590–21–21
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6. AUTHOR(S)

Karen E. Niiya and Richard E. Walker

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Aerojet Propulsion Division
P.O. Box 13222
Sacramento, California 95813

8. PERFORMING ORGANIZATION REPORT NUMBER

E–7827

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Lewis Research Center
Cleveland, Ohio 44135–3191

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11. SUPPLEMENTARY NOTES

Project Manager, Mark D. Klem, Space Propulsion Technology Division, (216) 977–7473.

12a. DISTRIBUTION/AVAILABILITY STATEMENT

Unclassified - Unlimited
Subject Category 20

12b. DISTRIBUTION CODE

13. ABSTRACT ***(Maximum 200 words)***

This final report includes a discussion of the work accomplished on contract NAS 3-25556 during the period from December 1988 through November 1991. The objective of the program was to assemble existing performance and combustion stability models into a usable design methodology capable of designing and analyzing high-performance and stable LOX/Hydrocarbon booster engines. The methodology was then used to design a validation engine. The capabilities and validity of the methodology were demonstrated using this engine in an extensive hot fire test program. The engine used LOX/RP-1 propellants and was tested over a range of mixture ratios, chamber pressures and acoustic damping device configurations. This volume contains time domain and frequency domain stability plots which indicate the pressure perturbation amplitudes and frequencies from approximately 30 tests of a 50K thrust rocket engine using LOX/RP-1 propellants over a range of chamber pressures from 240 to 1750 psia with mixture ratios of from 1.2 to 7.5. The data is from test configurations which used both bitune and monotune acoustic cavities and from tests with no acoustic cavities. The engine had a length of 14 inches and a contraction ratio of 2.0 using a 7.68 inch diameter injector. The data was taken from both stable and unstable tests. All combustion instabilities were spontaneous in the first tangential mode. Although stability bombs were used and generated over pressures of approximately 20%, no tests were driven unstable by the bombs. The stability instrumentation included six high-frequency Kistler transducers in the combustion chamber, a high-frequency Kistler transducer in each propellant manifold, and tri-axial accelerometers. Performance data is presented, both characteristic velocity efficiencies and energy release efficiencies, for those tests of sufficient duration to record steady state values.

14. SUBJECT TERMS

Combustion stability; Combustion efficiency; Rocket engine design; Combustion chambers; Rocket thrust chambers; Design analysis; Injectors

15. NUMBER OF PAGES

160

16. PRICE CODE

A08

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	