WYLE LABORATORIES

5023

5023-501-1

TEST REPORT

SEISMIC ANALYSIS OF CONTROL PANELS

INDEX SHEET

DOCUMENT NO. 54498, 54498-1 & 54498-2

LOG NO. SD23-5 02-5-501-1

ORIG. NO. OF SHTS. REC'D. 1 MANUAL DATE REC'D. 1-19-77 SUB. NO. 0

REVISED ~~OR ADDED SHTS~~		
19	2-9-77	1
SECTION 54498-2 Page 1, 7-18	"	1
18A, B & C (ADDED)	"	1
25, 26, 32 & 41	"	1

IMPORTANT
If the price or schedule is affected by this document approval, Bechtel must be notified prior to fabrication or such claims are waived.
Approval of documents involving calculation, analysis or test report is only an acceptance of the method used by the supplier. Supplier retains full responsibility for design.
Approval of this document does not relieve the supplier from full responsibility for contract or purchase order requirements including, but not limited to, adequacy and suitability of materials and/or equipment represented thereon for the intended function.

DATE RECEIVED 2-9-77

DOC STATUS BY J. S. [signature]

DATE 2-10-77

DOCUMENT STATUS
1 [X] APPROVED - MANUFACTURER MAY PROCEED
3 [ ] APPROVED EXCEPT AS NOTED. MAKE CHANGES AND RESUBMIT. MANUFACTURER MAY PROCEED AS APPROVED.
4 [ ] NOT APPROVED - CORRECT AND RESUBMIT
7 [ ] INFORMATION ONLY [ ] DISTRIBUTION REQUIRED

BECHTEL

PF-1218 (10079) 12/75

MICROFILM QUALITY ACCEPTABLE

FEB 15 1977

REPORT

WYLE LABORATORIES /Norco, California . 737-0871 , 689-2104 . TWX 910-332-1204 . Cable WYLAB

REPORT NO. 54498-2
OUR JOB NO. ND54498
YOUR P. O. NO. 7651
CONTRACT N/A

Revised and Reissued
8 February 1977

68-Page Report

DATE 3 December 1976

Circle AW Products Company
2420 Reservoir Street
Post Office Box 2248
Pomona, California 91766

SEISMIC ANALYSIS

OF

CONTROL PANELS

FOR

CIRCLE AW PRODUCTS COMPANY

POMONA, CALIFORNIA

BY

WYLE LABORATORIES

NORCO, CALIFORNIA

SCE # 0376

SO 23-502-5-501-1

REGISTERED PROFESSIONAL ENGINEER GEORGE D. SHIPWAY No. 12157 MECHANICAL STATE OF CALIFORNIA

STATE OF CALIFORNIA }
COUNTY OF RIVERSIDE } ss.

Ray C. Myrick, being duly sworn, deposes and says: That the information contained in this report is the result of complete and carefully conducted tests and is to the best of his knowledge true and correct in all respects.

Ray C. Myrick

SUBSCRIBED and sworn to before me this 3rd day of December, 1976

N. Kenney

Notary Public in and for the County of Riverside, State of California

My Commission expires 7 March, 1979

OFFICIAL SEAL
N. KENNEY
NOTARY PUBLIC - CALIFORNIA
RIVERSIDE COUNTY
My comm. expires MAR 7, 1979

W-867A

DEPARTMENT DYNAMICS

DEPT. MGR. J. Anderson
J. Anderson

TEST ENGINEER T. Vickers
T. Vickers

Registered Professional Engr. G. D. Shipway
G. Shipway

N/A
DCAS-QAR VERIFICATION

QUALITY CONTROL L. Housteau
L. Housteau

WYLE LABORATORIES Norco, California

IMPORTANT
If the price or schedule is affected by this document approval, Bechtel must be notified prior to fabrication or such claims are waived.
Approval of documents involving calculation, analysis or test report is only an acceptance of the method used by the supplier. Supplier retains full responsibility for design.
Approval of this document does not relieve the supplier from full responsibility for contract or purchase order requirements including, but not limited to, adequacy and suitability of materials and/or equipment represented thereon for the intended function.

DATE RECEIVED 1-19-77	DOC STATUS BY T. E. Lewis
DOCUMENT STATUS 1 ☐ APPROVED - MANUFACTURER MAY PROCEED 3 ☒ APPROVED EXCEPT AS NOTED. MAKE CHANGES AND RESUBMIT. MANUFACTURER MAY PROCEED AS APPROVED. 4 ☐ NOT APPROVED - CORRECT AND RESUBMIT 7 ☐ INFORMATION ONLY ☐ DISTRIBUTION REQUIRED	DATE 2-10-77 BECHTEL PF-1218 (10079) 12/75

MICROFILM QUALITY ACCEPTABLE

REVISED AND REISSUED

ENGINEER T. Vickers
T. Vickers

REGISTERED PROFESSIONAL ENGINEER G. Shipway
G. Shipway

QUALITY CONTROL A. Heeseman
A. Heeseman

TABLE OF CONTENTS

1.0 PURPOSE

The purpose of this report is to verify the adequacy of the design of the control panels to withstand the seismic requirements of Reference 2.0. The verification is demonstrated by similarity to two of the sections which were subjected to a seismic test program and with supplementary analysis.

2.0 REFERENCES

2.1 Circle AW Purchase Order Number 7651.

2.2 Bechtel Specification Number S023-502-5, Appendix 4F.

2.3 Circle AW Drawings:

Title	Number	Sheets
Fabrication Details	702-E-348	1 to 7
Cut-outs	702-E-349	1 to 3
Shipping Section 1	702-E-350	1 to 5
Panel Assembly Shipping Section 1	702-E-301	1 of 1
Shipping Section 2	702-E-355	1 to 5
Panel Assembly Shipping Section 2	702-E-302	1 of 1
Shipping Section 3	702-E-360	1 to 5
Panel Assembly Shipping Section 3	702-E-303	1 of 1
Shipping Section 4	702-E-365	1 to 5
Panel Assembly Shipping Section 4	702-E-304	1 of 1
Shipping Section 5	702-E-370	1 to 5
Panel Assembly Shipping Section 5	702-E-305	1 of 1
Shipping Section 6	702-E-375	1 to 4
Panel Assembly Shipping Section 6	702-E-306	1 of 1

2.0 REFERENCES (Continued)

2.3 (Continued)

Title	Number	Sheets
Shipping Section 7	702-E-380	1 to 3
Panel Assembly Shipping Section 7	702-E-307	1 of 1
Shipping Section 8	702-E-385	1 to 4
Panel Assembly Shipping Section 8	702-E-308	1 of 1
Shipping Section 9	702-E-390	1 to 11
Panel Assembly Shipping Section 9	702-E-309	1 to 4
Shipping Section 10	702-E-395	1 to 4
Panel Assembly Shipping Section 10	702-E-310	1 of 1
Shipping Section 11	702-E-400	1 to 3
Panel Assembly Shipping Section 11	702-E-311	1 of 1
Shipping Section 17	702-E-430	1 to 3
Panel Assembly Shipping Section 17	702-E-317	1 of 1

2.4 TRW Systems Group Computer Programs "Two Dimensional and Three Dimensional Frame Modal Analysis Programs" as maintained in the Library of Control Data Corporation's Cybernet System. CDC Publication Number 86612000.

3.0 APPROACH

The control panel shipping sections 1 through 17 are connected together to form three assemblies as shown in plan view in Figure 1. This report will treat the sections in groups as follows:

a. Sections 1 through 5 and 12 through 16.

b. Section 6.

c. Sections 8, 9, and 17.

d. Sections 7, 10, and 11.

The appendix presents the cabinet weight summary sheets as prepared by Circle AW.

4.0 SECTIONS 1-6 AND 12-16

Control panel shipping sections 1 through 5 form a horseshoe configuration of the control console. Shipping sections 12 through 16 form an essentially identical horsehsoe configuration of the console as shown in Figure 1.

4.1 Intra-Section Response

Shipping section 3 was selected as a representative portion of this part of the console and was subjected to a seismic test program as reported in Wyle Laboratories' Report No. 54498-1. It should be noted that the test was performed with the section as a free standing unit without the support of the adjacent sections. The angle of the adjacent sections will add stiffness in the front-to-back direction and will tend to reduce the response of the cabinet. The test was therefore a conservative demonstration of console response. The following paragraphs will show that the structure and weight loading of the remaining sections are sufficiently similar to justify qualification by similarity.

All of the sections are much more rigid in the side-to-side direction due to the shear support of the front panels and due to the mutual support of the adjacent sections. Accordingly, the front-to-back direction is the critical horizontal direction and is the direction considered herein in combination with the vertical direction. Figure 2 illustrates a cutaway view of a typical section showing the major structural members.

Figure 3 illustrates one typical front-to-back cross section of section 1 and Figure 4 illustrates the other typical cross section for section 1. In similar fashion, Figures 5 through 12 illustrate typical cross sections for all shipping sections 1 through 5 and 12 through 16. A review of these figures shows that all of the sections have similar front-to-back support structure.

4.0 SECTIONS 1-6 AND 12-16 (Continued)

4.1 Intra-Section Response (Continued)

Table 1 is a tabulation of the average weight distribution for these sections, and shows close correlation of the weight loading of the several sections. The structure and weight correlations are close enough to expect essentially the same dynamic response from all sections. The results of the conservative test of section 3 showed a comfortable margin better than specification requirements (Reference 2.2), and it is therefore reasonable to qualify all of these sections by similarity.

4.2 Assembly of Sections 1-6, 12-16

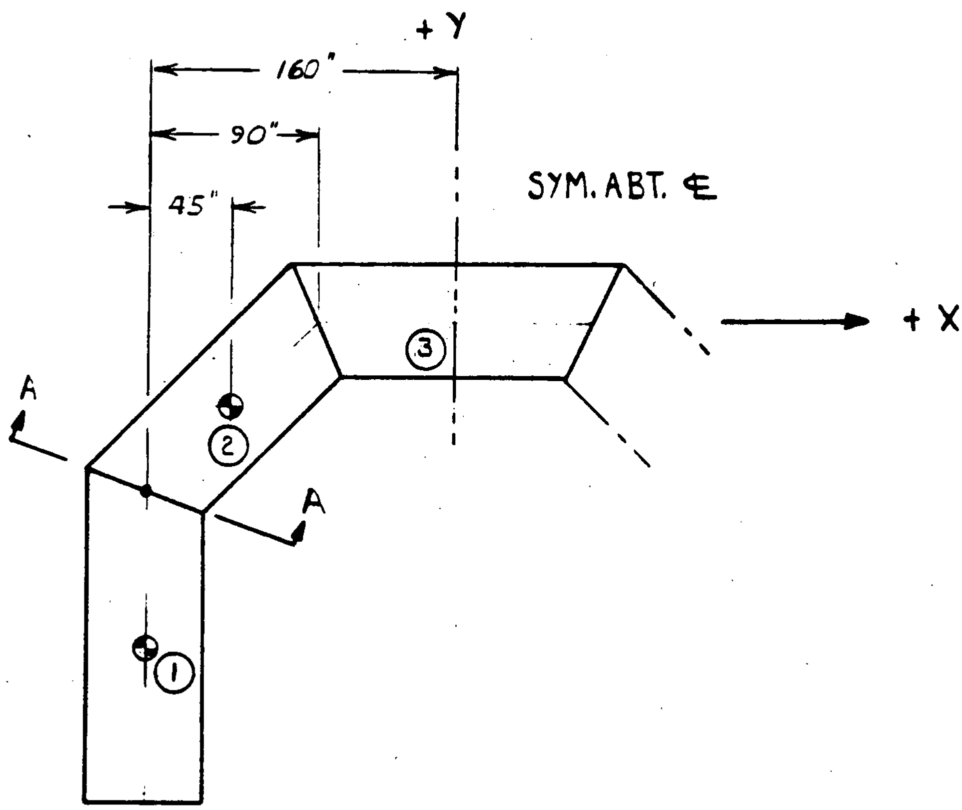
The capabilities of the cabinets as individual free standing units has been demonstrated by the test of section 3. When installed as an assembly the cabinets will be bolted together. Since the cabinets have different stiffness characteristics in the different directions, there are potential interface loads during a seismic event. It is required that these loads not cause structural failures in the cabinets.

Consider first sections 1, 2 and 3 with loading in the Y direction as shown on the following page. Sections 1, 2 and 1/2 of 3 will be considered and will be representative of the other three identical half assemblies.

To develop the interface loading, assume the upper portion or 1/3 of the weight of section 3. This conservatively assumes that only the lower section--2/3 of the weight--as supported by the cabinet's internal structure and that the upper 1/3 of the weight is supported by the adjacent cabinets through the interface connections. Multiply this weight by 2.2. (This was the maximum g level measured at the top of the cabinet during the free standing test.) Apply this load of 1,862 lbs. to the interface between sections 2 and 3.

4.0 SECTIONS 1-6 AND 12-16 (Continued)

4.2 Assembly of Sections 1-6, 12-16 (Continued)



For section 2 assume the top 1/3 of the weight times 1.6 g (Y component of 2.2 g's), which gives 2,442 lbs. Section 1 is approximately twice as stiff in the Y direction as section 2. Therefore, assume that 1/3 of the loads are distributed internally in section 2 and 2/3 (2,870 lbs.) are applied to the interface between sections 1 and 2. The internal distribution in section 2 will be shared by the internal X-brace and the front panel. For simplicity of calculation, the conservative assumption is made that the internal X-brace carries all of the load, i.e., 1,435 lbs. It will be shown below that the loading on the X-brace in section 1 is higher and is therefore the governing case.

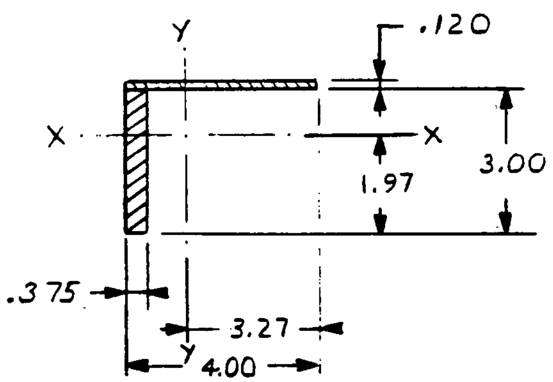
502-5-50-1

4.0 SECTIONS 1-6 AND 12-16 (Continued)

4.2 Assembly of Sections 1-6, 12-16 (Continued)

To demonstrate the capability of the top of the cabinets to carry the loading a math model was analyzed using the TRW Systems Group 2-dimensional structural analysis program. The model assumed that the loading was carried in the 2 x 2 square tubes underneath the top sheet without benefit of the top sheet except to reduce the L/r ratios. (The maximum L/r ratio is 113 without the top sheet.) The math model is illustrated on the following page. The model is restrained in the Y direction at the two ends of the section 1 X brace (joints 2 and 8) and in the X direction in the center of section 1 (joint 5), and at the centerline of symmetry (joints 17 and 18). The loads described above (2,870 lbs.) were distributed among the several joints of sections 2 and 3. 1/3 of its weight (1,570 lbs.) was distributed among the joints of section 1. The analysis results show reaction loads of 2,909 lbs. at the 1-2 interface end of the section 1 X brace (joint 8), and 1,520 lbs. at the opposite end of the X brace (joint 2). The maximum computed stress for any of the 2 in. square tubes was less than 9,000 psi. The computer printout of the member loads is included on the following pages.

The horizontal reaction loads in the top of the cabinet will be carried to the X-braces by the cabinet end members. The end members were modeled as follows:



$A = 1.61$

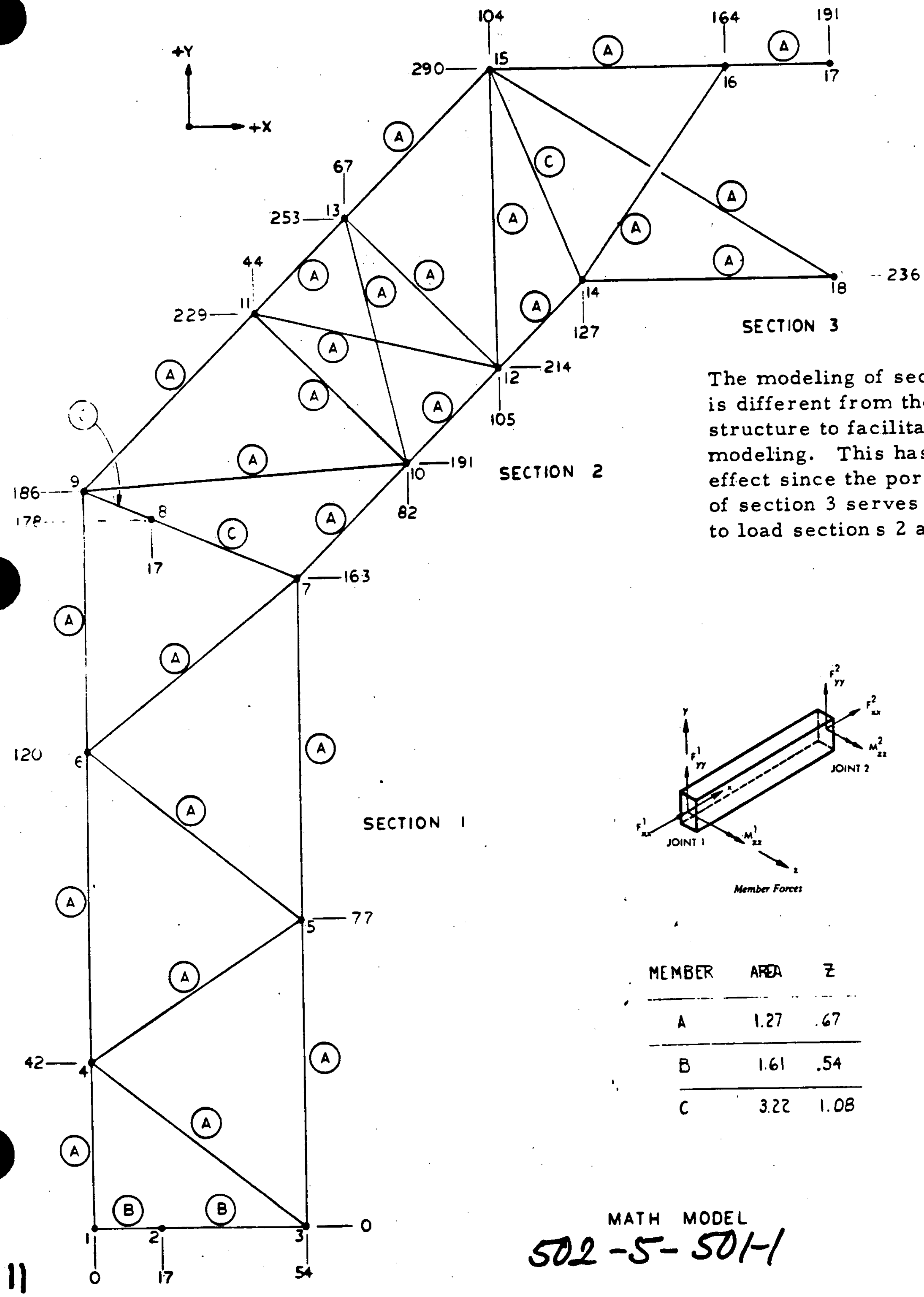
$I_{x\text{-}x} = 1.66$

$Z_{x\text{-}x} = .84$

$I_{y\text{-}y} = 1.76$

$Z'_{y\text{-}y} = .54$

502-5-5011



The modeling of section 3 is different from the actual structure to facilitate modeling. This has no effect since the portion of section 3 serves only to load section s 2 and 1.

MEMBER	AREA	Z
A	1.27	.67
B	1.61	.54
C	3.22	1.08

MATH MODEL

502-5-501-1

11

MEMBER LOADS

MEM	JT	F-XX	F-YY	M-ZZ
1	1	-1.670E+02	1.060E+03	5.005E+03
	2	1.670E+02	-1.060E+03	1.301E+04
2	2	-1.670E+02	-4.600E+02	-1.301E+04
	3	1.670E+02	4.600E+02	-4.014E+03
3	1	-9.656E+02	-1.670E+02	-5.005E+03
	4	9.656E+02	1.670E+02	-2.007E+03
4	3	1.337E+02	5.616E+01	2.363E+03
	4	-1.337E+02	-5.616E+01	1.479E+03
5	3	-4.028E+02	2.696E+01	1.651E+03
	5	4.028E+02	-2.696E+01	4.249E+02
6	4	4.040E+01	-5.806E+00	7.649E+01
	5	-4.040E+01	5.806E+00	-4.501E+02
7	4	-5.940E+02	1.010E+01	4.513E+02
	6	5.940E+02	-1.010E+01	3.364E+02
8	5	1.400E+03	-8.490E+00	-4.735E+02
	6	-1.400E+03	8.490E+00	-1.125E+02
9	5	-9.222E+02	2.480E+01	4.987E+02
	7	9.222E+02	-2.480E+01	1.634E+03
10	6	-1.455E+03	5.143E+01	1.248E+03
	7	1.455E+03	-5.143E+01	2.302E+03
11	6	1.586E+03	-7.098E+01	-1.472E+03
	9	-1.586E+03	7.098E+01	-3.213E+03
12	8	-1.900E+03	1.804E+03	2.419E+04
	9	1.900E+03	-1.804E+03	9.704E+03
13	7	-7.059E+02	-7.909E+02	-7.381E+03
	8	7.059E+02	7.909E+02	-2.419E+04
14	7	-2.910E+03	1.255E+02	3.445E+03
	10	2.910E+03	-1.255E+02	1.524E+03
15	9	1.522E+03	-5.294E+01	-2.853E+03
	10	-1.522E+03	5.294E+01	-1.495E+03
16	9	-7.823E+02	-8.491E+01	-3.638E+03
	11	7.823E+02	8.491E+01	-1.586E+03
17	10	-2.168E+02	1.224E+01	1.926E+02
	11	2.168E+02	-1.224E+01	4.654E+02
18	10	-1.294E+03	-6.773E+00	-1.568E+02
	12	1.294E+03	6.773E+00	-6.346E+01
19	10	-5.919E+02	-2.009E+00	-6.458E+01
	13	5.919E+02	2.009E+00	-6.356E+01
20	11	1.402E+02	1.012E+01	4.103E+02
	12	-1.402E+02	-1.012E+01	2.252E+02
21	11	-6.832E+02	2.954E+01	7.105E+02
	13	6.832E+02	-2.954E+01	2.714E+02

MEMBER LOADS (CONT.)

MEM	JT	F-XX	F-YY	M-ZZ
22	12	3.132E+02	-4.053E-01	1.626E+01
	13	-3.132E+02	4.053E-01	-3.833E+01
23	12	-8.073E+02	-1.642E+01	-1.630E+02
	14	8.073E+02	1.642E+01	-3.478E+02
24	12	-3.446E+02	-1.463E+00	-1.504E+01
	15	3.446E+02	1.463E+00	-9.616E+01
25	13	-8.155E+02	-7.644E+00	-1.695E+02
	15	8.155E+02	7.644E+00	-2.305E+02
26	14	5.605E+02	-7.309E+00	-2.110E+02
	15	-5.605E+02	7.309E+00	-2.180E+02
27	15	-9.490E+02	3.493E+01	6.112E+02
	16	9.490E+02	-3.493E+01	1.485E+03
28	14	2.154E+02	-1.097E+00	-7.844E+01
	18	-2.154E+02	1.097E+00	8.233E+00
29	14	-9.477E+02	3.160E+01	6.372E+02
	16	9.477E+02	-3.160E+01	1.431E+03
30	16	-1.511E+03	-1.080E+02	-2.916E+03
	17	1.511E+03	1.080E+02	-7.276E-11
31	15	2.015E+02	-7.295E-01	-6.646E+01
	18	-2.015E+02	7.295E-01	-8.233E+00

JOINT EQUILIBRIUM CHECK

JOINT	F-X	F-Y	M-Z
1	-2.167E-09	9.400E+01	2.328E-10
2	3.110E-09	-1.520E+03	1.746E-10
3	-6.396E-10	9.500E+01	4.366E-10
4	-4.120E-10	3.510E+02	1.255E-10
5	-1.124E+03	3.420E+02	1.819E-11
6	-1.478E-10	4.350E+02	-6.548E-11
7	-1.179E-09	2.870E+02	-6.548E-10
8	7.603E-10	-2.909E+03	-3.492E-10
9	-8.731E-10	2.880E+02	-2.561E-09
10	1.183E-09	2.730E+02	-2.315E-10
11	1.182E-10	2.730E+02	-8.731E-11
12	9.763E-10	2.410E+02	-1.244E-10
13	1.040E-09	2.410E+02	-1.392E-10
14	7.312E-10	3.360E+02	-1.382E-10
15	7.494E-10	3.360E+02	2.228E-11
16	2.547E-10	6.210E+02	8.731E-11
17	1.511E+03	1.080E+02	-7.276E-11
18	-3.863E+02	1.080E+02	-9.504E-11

502-5-50H

4.0 SECTIONS 1-6 AND 12-16 (Continued)

4.2 Assembly of Sections 1-6, 12-16 (Continued)

The member at joint 2 is subjected to a shear load of 1,060 lbs. and a moment of 13,000 in. lbs. The resultant stress is

$$S_s = \frac{P}{A} = \frac{1,060 \text{ lbs.}}{1.61 \text{ in.}^2} = 658 \text{ lbs./in.}^2$$

$$S_b = \frac{M}{Z} = \frac{13,000 \text{ in. lbs.}}{.54 \text{ in.}^3} = 27,047 \text{ lbs./in.}^2$$

The members at joint 8, the combined members of sections 1 and 2, which are bolted together, are subjected to a shear load of 1,804 lbs. and a moment of 24,190 in. lbs. The resultant stress is

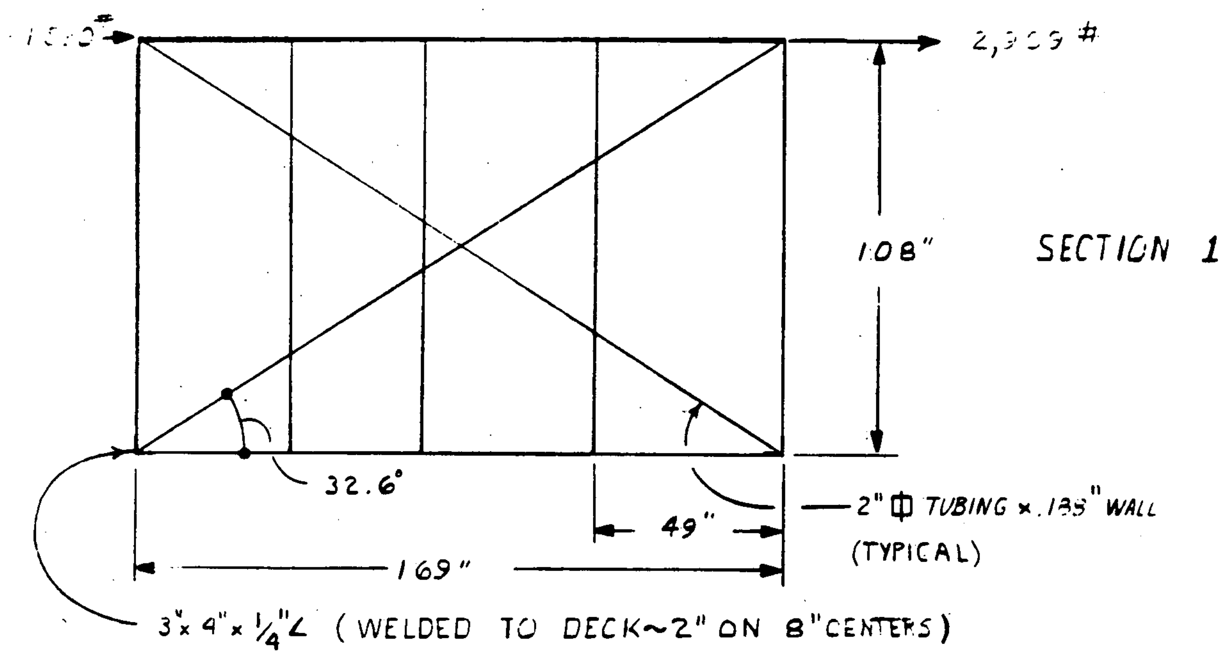
$$S_s = \frac{P}{A} = \frac{1,804 \text{ lbs.}}{3.22 \text{ in.}^2} = 560 \text{ lbs./in.}^2$$

$$S_b = \frac{M}{Z} = \frac{24,190 \text{ in. lbs.}}{1.08 \text{ in.}^3} = 22,398 \text{ lbs./in.}^2$$

The horizontal loads will be reacted by the X'brace of section 1 as follows:

4.0 SECTIONS 1-6 AND 12-16 (Continued)

4.2 Assembly of Sections 1-6, 12-16 (Continued)



The higher load shown above (2,909 lbs.) may be assumed to be reacted by one of the 2 in. sq. tube cross braces. The maximum L/r is less than 82.

The resultant load in the cross brace is 3,445 lbs. Therefore, the stress in the tube would be:

$$S = \frac{3{,}445 \text{ lbs.}}{1.27 \text{ in.}^2} = 2{,}713 \text{ lbs./in.}^2$$

The 3,445 lb. load is terminated at the bottom into a 3 x 4 x 1/4 angle which is welded 2 in. in 8 in. centers (1/4 in. fillet minimum). If one 2 in. long weld carries the load, then the stress is:

$P/A = 3{,}445 \text{ lbs.}/.35 \text{ in.}^2 = 9{,}745 \text{ lbs./in.}^2$ which is well below the allowable stress for welds of $13{,}600 \text{ lbs./in.}^2$

502-5-501-1

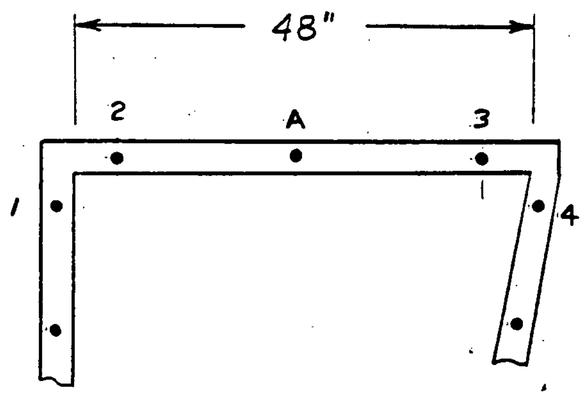
4.0 SECTIONS 1-6 AND 12-16 (Continued)

4.2 Assembly of Sections 1-6, 12-16 (Continued)

The 3" x 4" x 1/4" base angle at the intersection of sections 1 and 2 is not considered here since it is considered at the interface of sections 2-3 which carries a greater force.

The vertical component of the X brace load shown above will be primarily offset by the adjacent X brace in section 2 which will produce a vertical reaction in the opposite direction. The portion of the vertical load carried in the cabinet end frame is negligible.

The results of the analysis of the previous model may also be used to indicate the interface loading between sections 1 and 2. The maximum tension load occurs at the inside of the angle and is 2,371 lbs. The shear load is negligible.



SECTION "A-A"

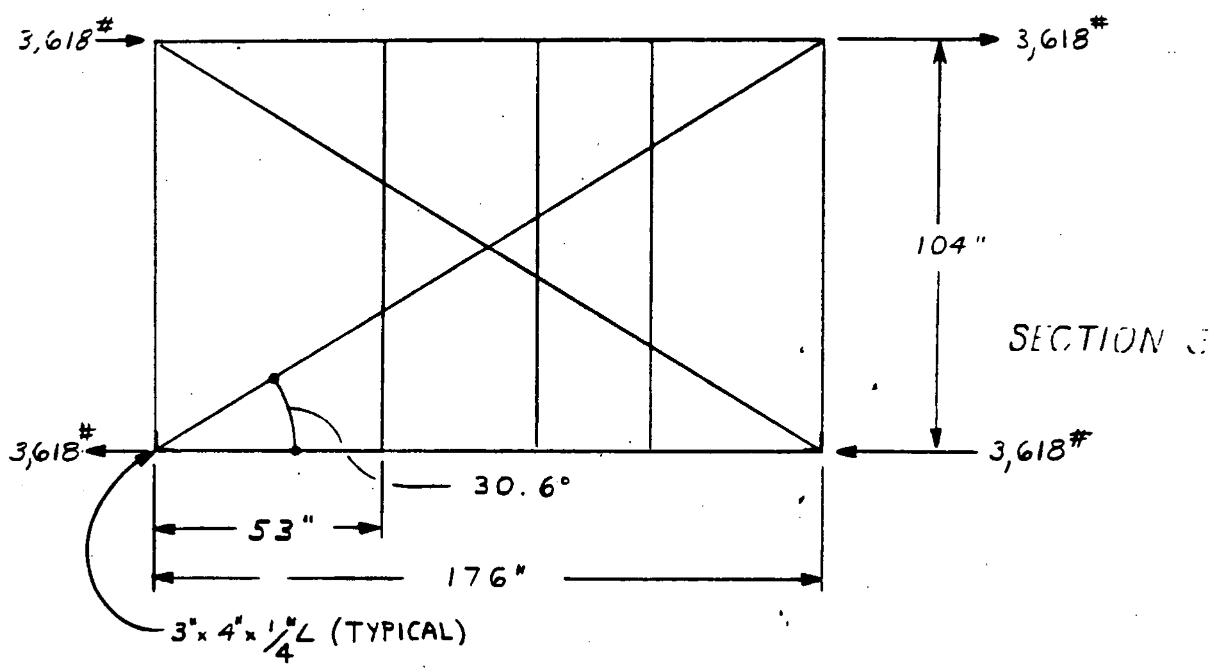
The tension load of 2,371 lbs. may be carried by bolts #3 and #4. The bolts under consideration are 5/16-24 UNF, SAE Grade 5 (92,000 psi min. yield - 120,000 psi ultimate). The nominal stress area is .058 in.^{2}. Therefore, the axial bolt stress is P/A or 2,371 lbs. - (area of two bolts = .116 in.^{2}) = 20,440 lbs./in.^{2}

502-5-501-1

4.0 SECTIONS 1-6 AND 12-16 (Continued)

4.2 Assembly of Sections 1-6, 12-16 (Continued)

To consider loading in the X direction, a similar rationale will be followed. The loads are all within 10% of the above except for the translational load in the X direction applied to section 3. As before, the load is developed by assuming 1/2 of the upper portion of section 1 (the outer 1/2 is supported by the internal structure in the free standing mode) and mutiplying it by the 2.2 g factor. The same load for section 2 of 2,442 lbs. is added. 2/3 of the total is applied to section 3. Section 3 also supports the static weight of 1/2 of the upper portion for a total of 3,618 lbs. The load of 3,618 lbs. is applied to one side of section 3. Symmetry of the other portion of the assembly applies the same load to the opposite side of section 3. The detailed calculations follow.

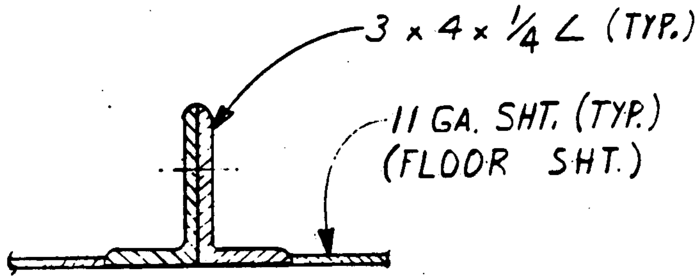


502-5-501-1

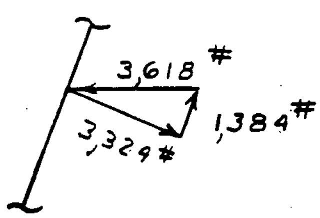
4.0 SECTIONS 1-6 AND 12-16 (Continued)

4.2 Assembly of Sections 1-6, 12-16 (Continued)

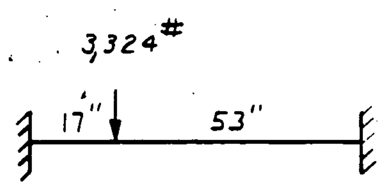
A load of 3,618 lbs. is applied at the top of each end of section 3. These two loads will be reacted through their respective X member to a 3" x 4" x 1/4" angle at the lower corner which is bolted back to back to an identical angle in the adjacent cabinet. Since the front and back base angles of the sections are intermittently welded to the floor, the double angle beam will be considered greater than 1.2 in.^{3}.



CROSS SECTION OF BOTTOM ANGLES



PLAN VIEW
SECTIONS 3-4 INTERFACE



BEAM MODEL

4.0 SECTIONS 1-6 AND 12-16 (Continued)

4.2 Assembly of Sections 1-6, 12-16 (Continued)

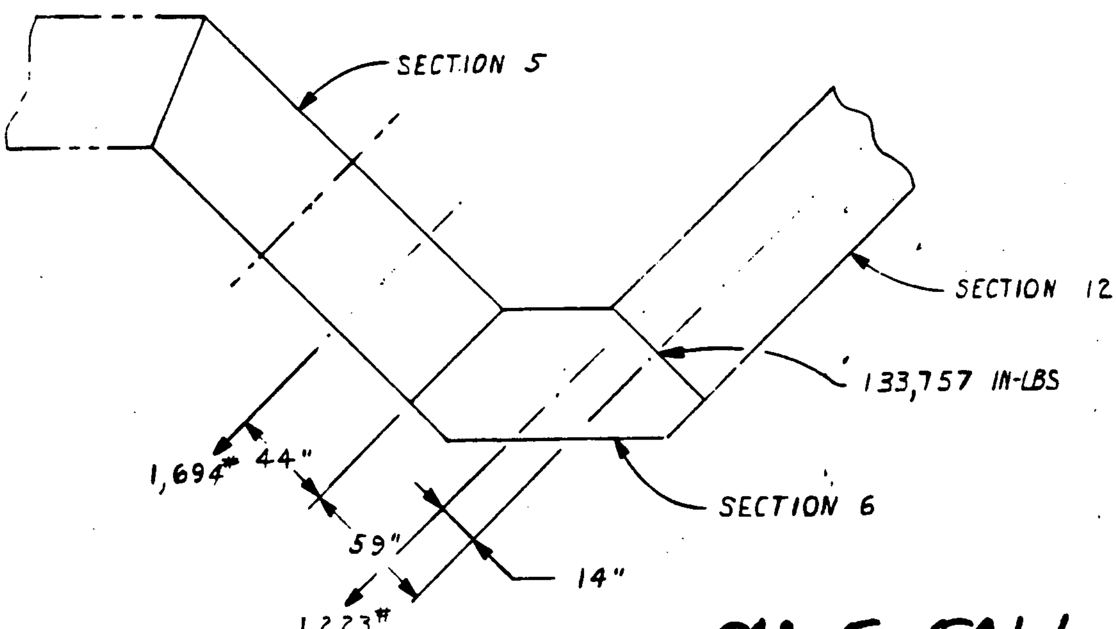
$$M = \frac{Pa\,b^2}{l^2} = \frac{3,324 \times 17 \times 53^2}{70^2} = 33,294 \text{ in. lbs.}$$

$$\text{Stress} = S = \frac{M}{Z} = \frac{33,294}{1.2} = 26,995 \text{ lbs./in.}^2$$

The actual stress will be lower than this value because of the support provided by the floor sheets.

The material is ASTM-A36 with a minimum yield of 36,000 lbs./in.^{2}

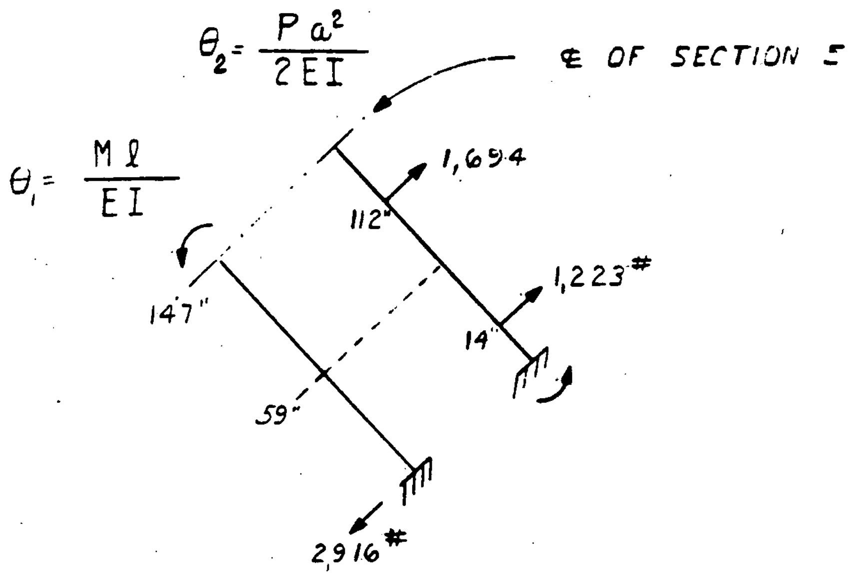
Considering the potential interface loads between sections 5, 6 and 12, a seismic load parallel to the 5-6 interface is assumed. It will be assumed that section 6 will transmit this loading through its upper portion into section 12. 1/2 of the upper portion of section 5 is multiplied by the very conservative 2.2 g loading factor. This translational load of 1,694 lbs. is applied to the 5-6 interface. The static weight of the upper portion of section 6, 1,223 lbs., is added and the translational load of 2,917 lbs. is applied to the 6-12 interface. The moment across the 6-12 interface is computed as shown below and is 133,000 in. lbs.



502-5-501-1

4.0 SECTIONS 1-6 AND 12-16 (Continued)

4.2 Assembly of Sections 1-6, 12-16 (Continued)



$$\Theta_1 = \frac{(1,223 \times 14^2) + (1,694 \times 112^2)}{2\ EI} = \frac{10,740,000}{EI}$$

$$\Theta_2 = \frac{M \times 147}{EI}$$

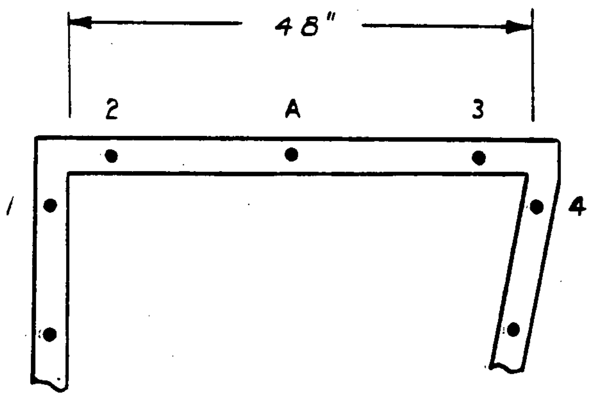
Since $\Theta_1 = \Theta_2$ then $\frac{10,740,000}{EI} \quad \frac{M \times 147}{EI}$

$M_{℄}$ = 73,093 in. lbs.

M_R = (1,223 x 14) + (1,694 x 112) - 73,093 = 133,757 in. lbs.

4.0 SECTIONS 1-6 AND 12-16 (Continued)

4.2 Assembly of Sections 1-6, 12-16 (Continued)



SECTION "A-A"

The total moment is assumed to be reacted by 2 groups of 2 bolts (1, 2, 3 and 4) over a distance of 48". The bolts under consideration are 5/16-24 UNF, SAE Grade 5 bolts (92,000 psi min. yield - 120,000 psi ultimate). Nominal stress area is .058 in.^{2}

Therefore bolt stress is (133,757# ÷ 48") ÷ 2 bolts = 1,393#/bolt

1,393# ÷ .058 in.^{2} = 24,022 lbs./in.^{2}

The above calculations show that in spite of the conservative loading assumptions made, the maximum stress computed was less than 82% of the minimum yield of any material used.

5.0 SECTION 6

Shipping section 6 is the section that connects the two horse-shoes. Its structure is different from the others in that in the plan view it curves in the opposite direction from the others.

The front-to-back cross sections are similar to that of the other sections as shown in Figures 13 and 14. The cabinet is also supported quite rigidly in both horizontal directions by the side-to-side stiffness of the adjacent sections 5 and 12. The effective structure of this section is therefore significantly more rigid than the other sections.

The front panels are supported by an arrangement similar to the other sections and the weight loading is similar as shown in Table 1. The combination of similar loading and stiffer structure will result in a lower response level than that observed in the test of section

Section 6 is therefore an acceptable design.

6.0 SECTIONS 8, 9, AND 17

Shipping sections 8, 9, and 17 are similar in shape to section 3 except that they are connected together in a straight line and the top section is removable. The following paragraphs will show that sections 8, 9, and 17 are dynamically similar to section 3. Figures 15 through 19 show representative cross sections of these sections.

A representative front-to-back cross section of section 3 was modeled and loaded with representative joint weights. Figure 20 illustrates the math model, and Table 2 tabulates the joint weights. A two dimensional modal analysis of this model with the 2DFMAP computer program (Reference 2.4) showed a first mode frequency of 7.3 Hz which compares with a first mode frequency of 9-10 Hz noted during the test. The mode shape is shown in Figure 21 and Table 2 tabulates the modal displacement. This comparison serves to validate the modeling techniques and the computer program.

Section 9 was then modeled in a similar way. Figure 22 shows the math model. A two dimensional modal analysis of this section indicated a first mode frequency of 10.4 Hz. The mode shape is shown in Figure 23, and Table 3 tabulates the joint weights and the modal displacements. This higher frequency is still in the excitation range of the postulated environment and therefore these sections will exhibit essentially the same dynamic response and will be able to withstand the postulated environment as did section 3. Figures 15 through 19 show repersentative cross sections of sections 8, 9, and 17, which are all essentially the same. Table 1 tabulates the weight loading distribution for these three sections.

As before, the side-to-side direction was not modeled due to the greater stiffness and resultant lower response of the sections in that direction.

The similarity of these three sections to section 3 along with the supplemental analysis justifies their qualification.

7.0 SECTIONS 7, 10 AND 11

The control panel shipping sections 10 and 11 are identical. Section 7 is similar to sections 10 and 11, but there are some differences in structural details. Sections 10 and 11 may be qualified largely by similarity to section 7 which was tested (reference Wyle Test Report No. 54498). Due to the structural differences, a modal analysis of section 10 was performed to further demonstrate that the modal frequencies of sections 10 and 11 were similar to or higher than those of section 7.

The following is a description of the computer modeling and results of the modal analysis. The analysis was performed with the 3DFMAP special program (Reference 2.4 and previous page).

The front-to-back horizontal direction is obviously more flexible than the side-to-side direction because the front panels provide considerable shear stiffness in the side-to-side direction. The front-to-back direction is therefore the critical horizontal direction. Accordingly the model was fixed in the side-to-side direction with the vertical and front-to-back directions free to move. The cabinet was modeled with 64 joints and 107 members as shown in Figure 24. Several internal equipment support members were combined for the purpose of the analysis. Figures 25 through 30 show the details of the member properties. Since the cabinet will be installed by welding to the floor, all of the vertical members at the base level were fixed. The weight of the structural members was evenly divided between the 64 joints. The weight of the 1/4" front panel was distributed on the front joints, and the weight of the instruments was distributed as realistically as possible between the front and internal joints. The resulting weight assigned to each of the joints is tabulated in Table 4.

7.0 SECTIONS 7, 10 AND 11 (Continued)

The analysis of section 10 shows a first mode frequency of 20 Hz which compares favorably with the first mode frequency of 17.5 Hz which was observed in the test of section 7. The first four computed modal frequencies are as follows:

Natural Frequencies

Mode	Freq. (CPS)
1	1.9974173E+01
2	3.6480252E+01
3	4.1573218E+01
4	5.4320627E+01

The first mode shape is illustrated in Figures 31 and 32, and the modal displacements are tabulated in Table 5.

A second modal analysis was performed with the vertical members at the base level pinned in the front-to-back direction. The first mode frequency computed for this condition was 16.6 Hz. This condition is clearly more flexible than the real case and therefore compares favorably with both the 20 Hz frequency computed above and the 17.5 Hz test results.

The flexibility of the 1/4" front panel was not included in the model because: (1) the large instruments are supported on internal tubular members as well as the front panel; and (2) the loading of and therefore the response of the panels will be similar to that observed during the test of section 7.

7.0 SECTIONS 7, 10 AND 11 (Continued)

The computed model for section 10 compares favorably with the experimental data from the test of section 7. It is reasonable to expect the dynamic response of sections 10 and 11 to be similar to that of section 7. It is therefore reasonable to qualify sections 10 and 11 by similarity to section 7.

Sections 7 and 11 are bolted together in the assembly of the system. Since the two cabinets are essentially identical, their response in the horizontal directions will be essentially equal. It is therefore reasonable to expect no inter-section loading nor amplification of motion in the assembly.

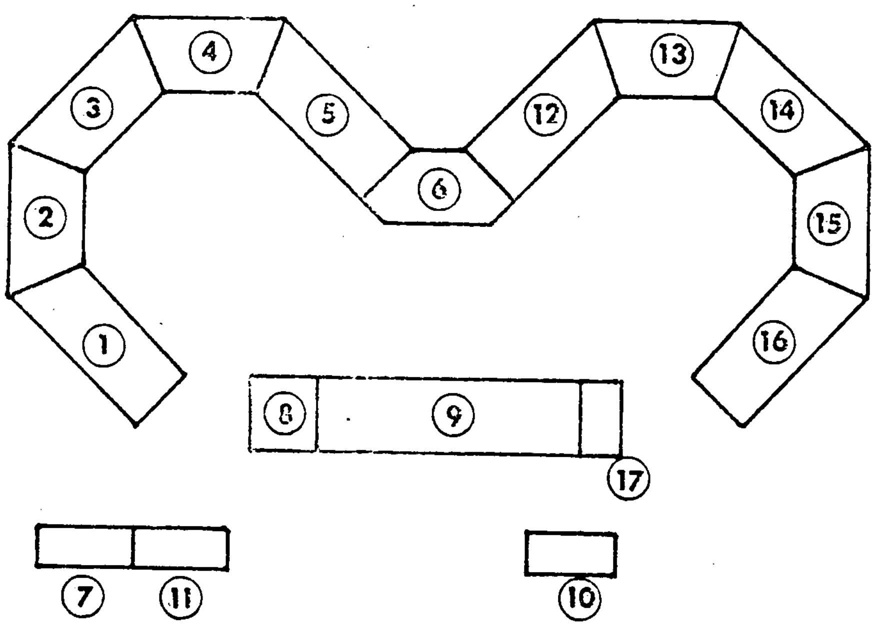


FIGURE 1

PLAN VIEW OF CONTROL CONSOLE

Note: For clarity all framing members not shown.

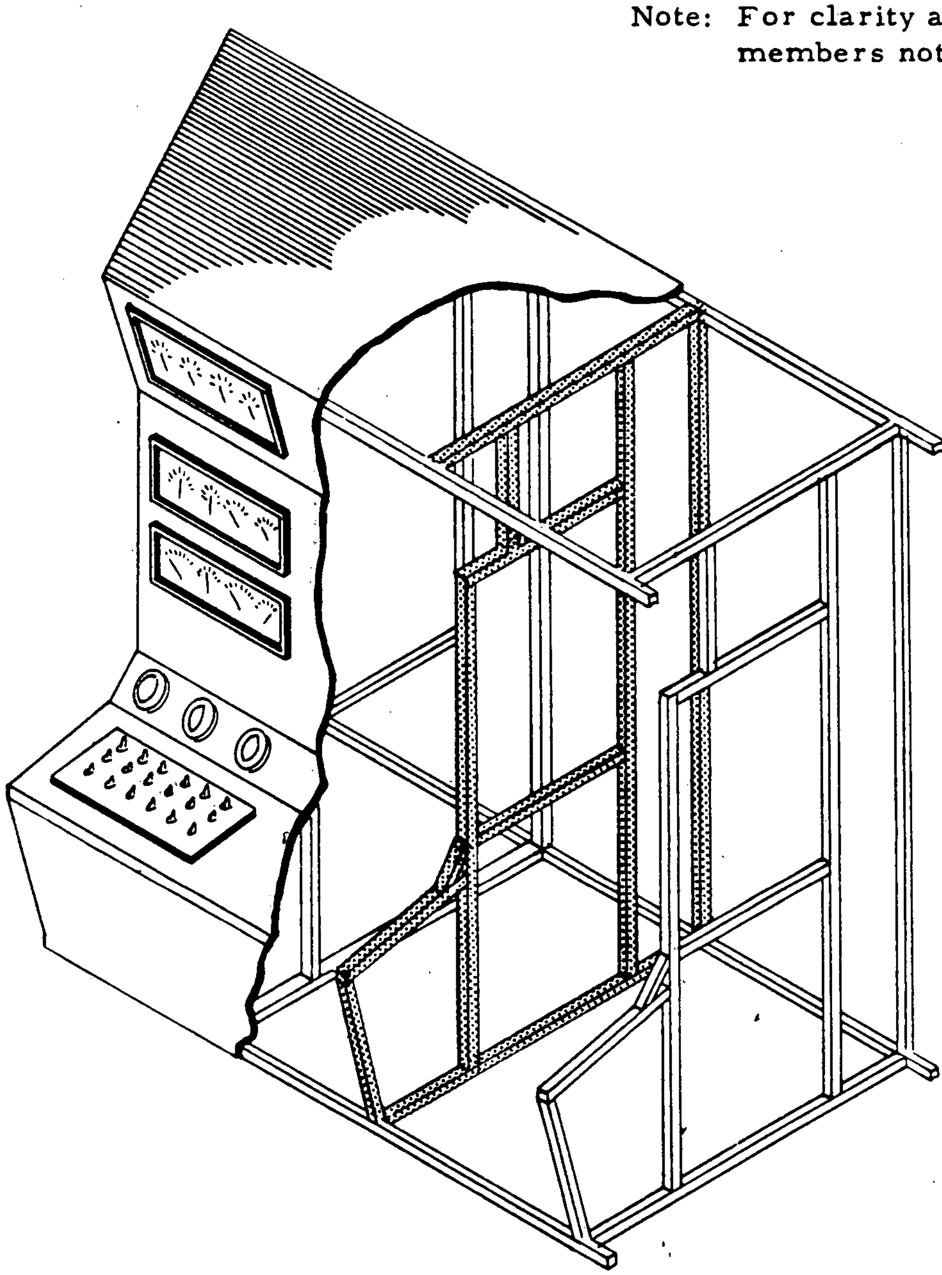
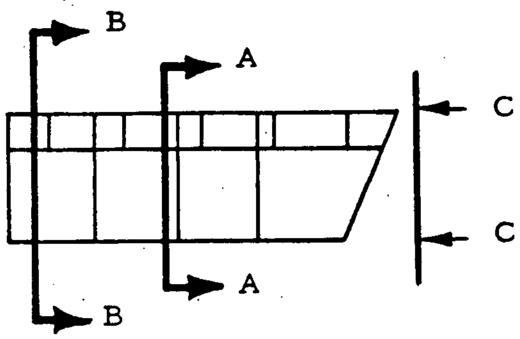


FIGURE 2

CUTAWAY OF A TYPICAL SECTION

502-5-501-1



Note: View C-C is similar to Figure 9.

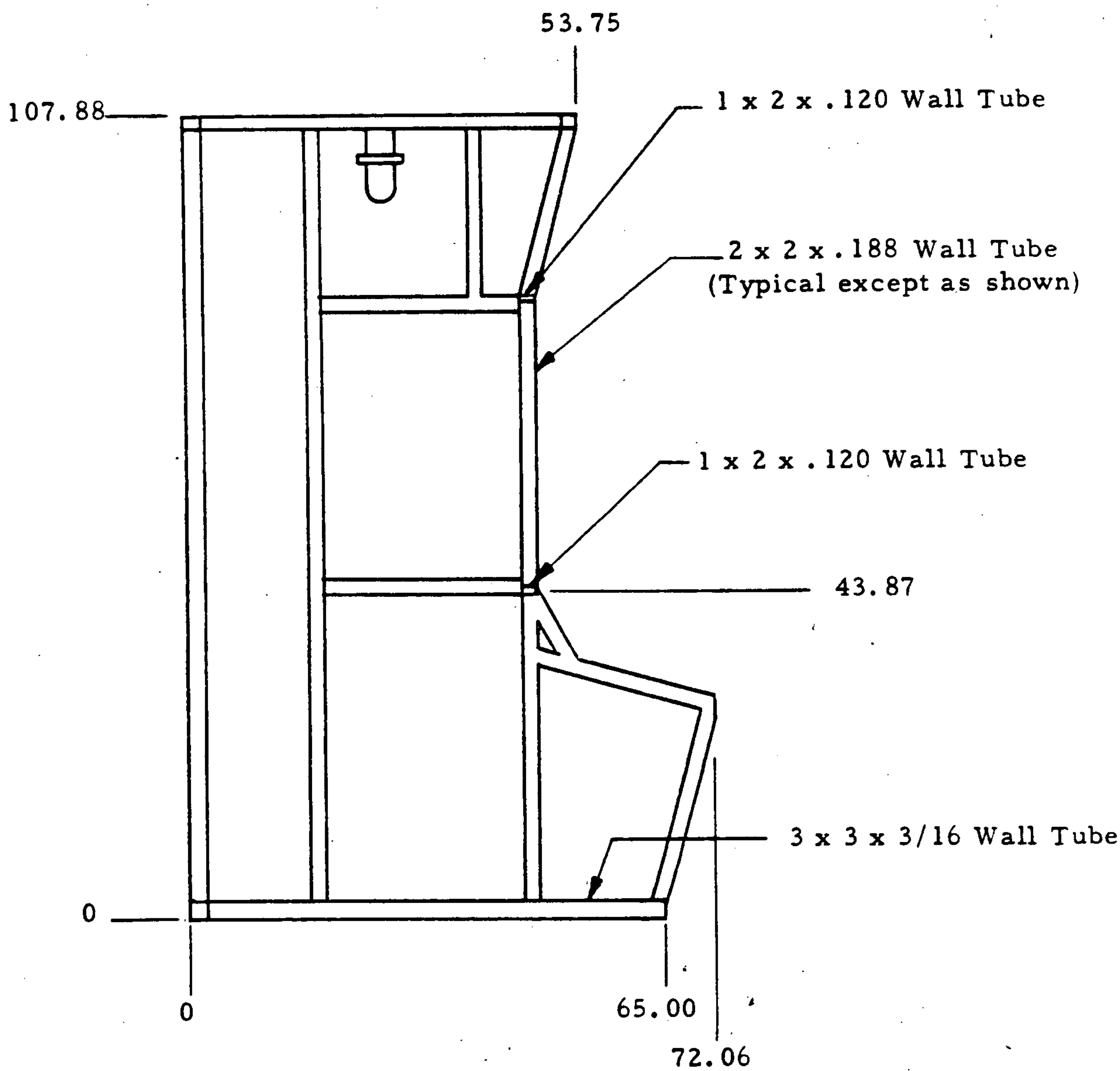
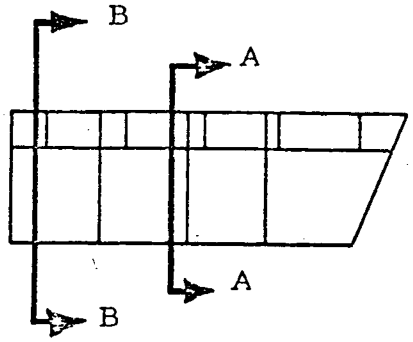


FIGURE 3

SECTION A-A (3 PLACES)

SHIPPING SECTIONS 1 AND 12



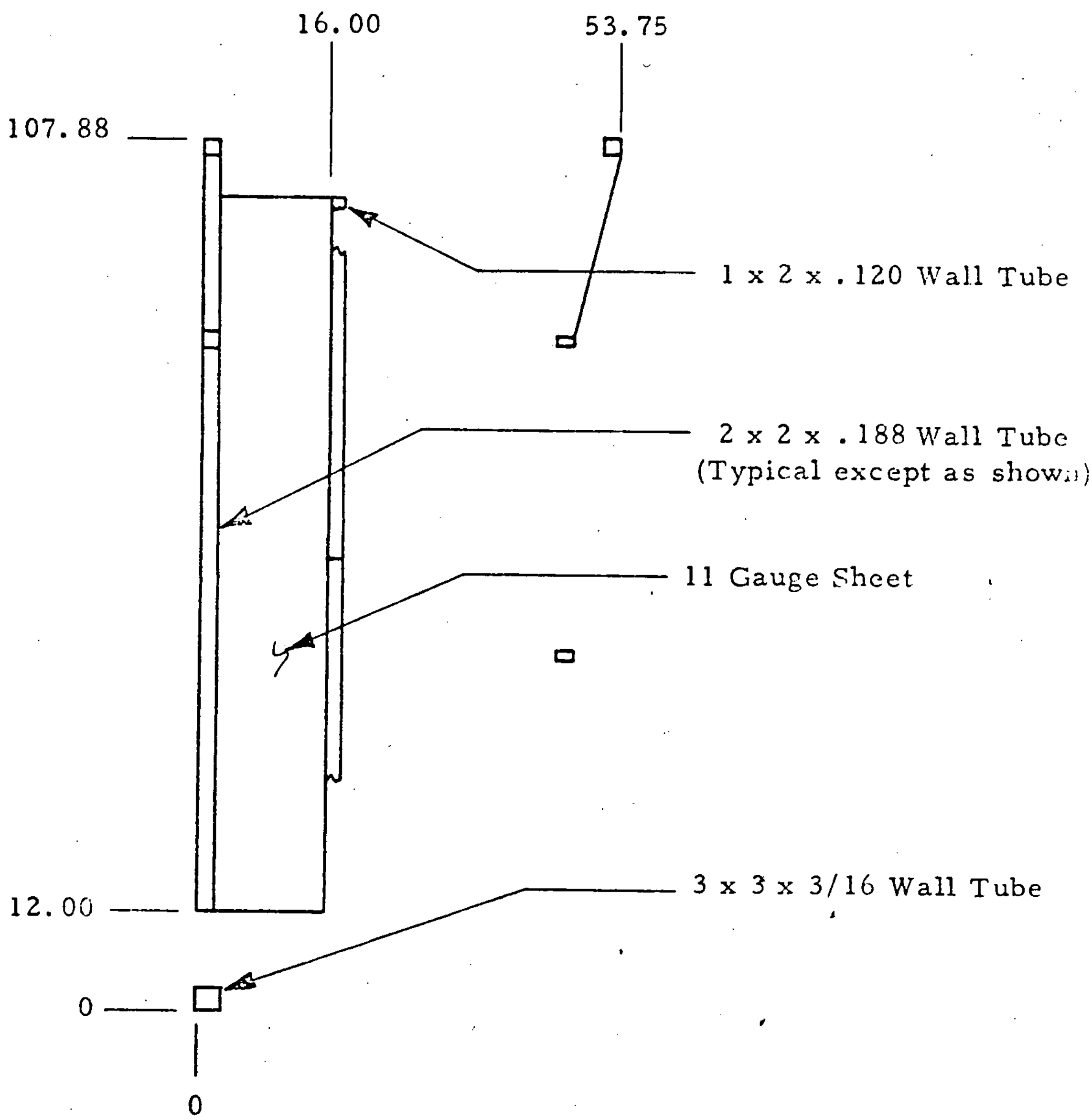
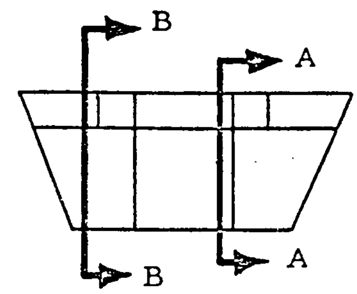


FIGURE 4

SECTION B-B (5 PLACES)

SHIPPING SECTIONS 1 AND 12



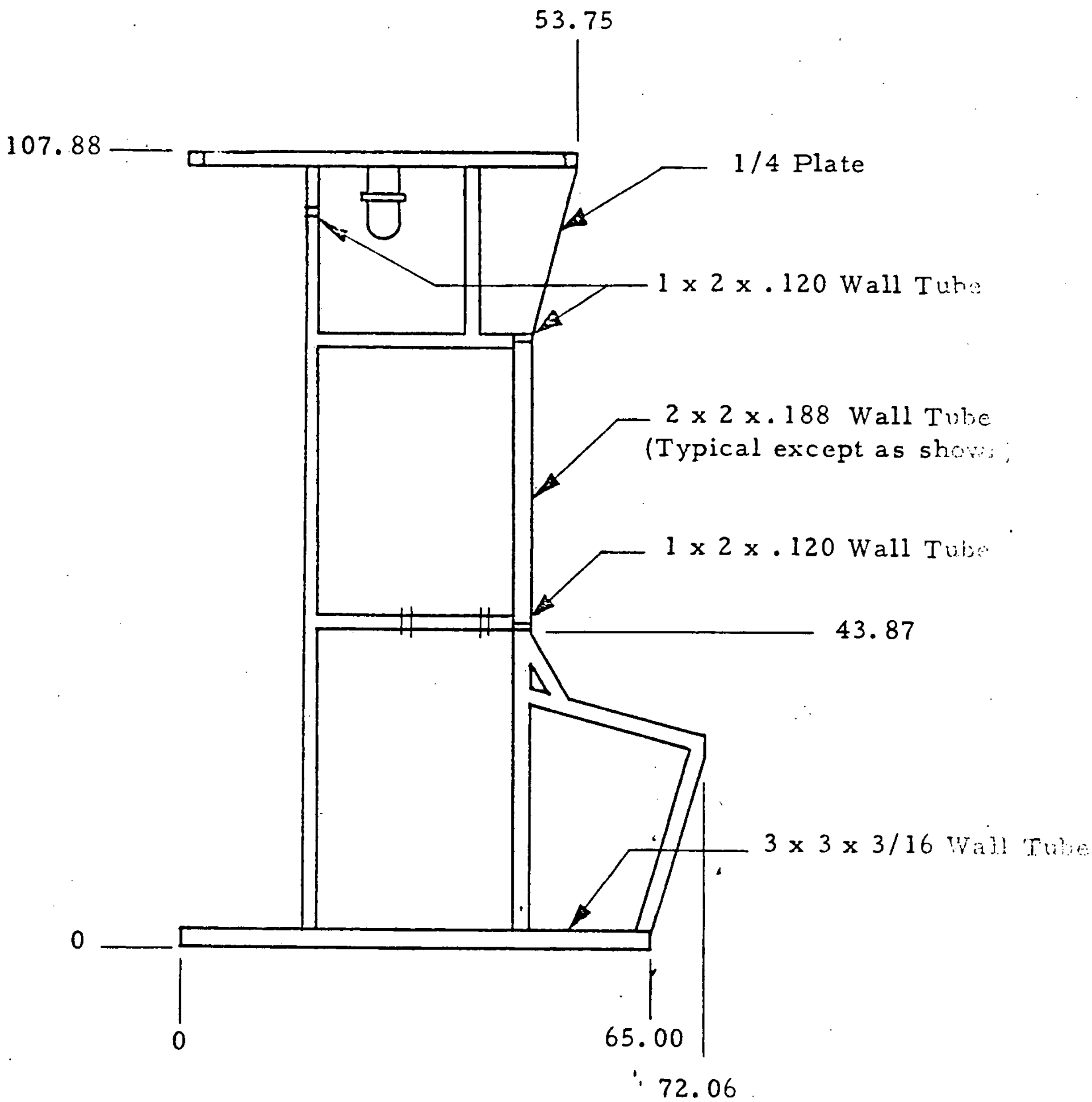


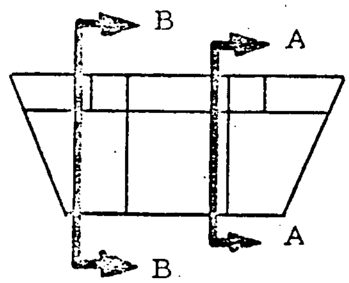
FIGURE 5

SECTION A-A (2 PLACES)

SHIPPING SECTIONS 2 AND 13

REPORT NO. 54498-2

PAGE NO. 20



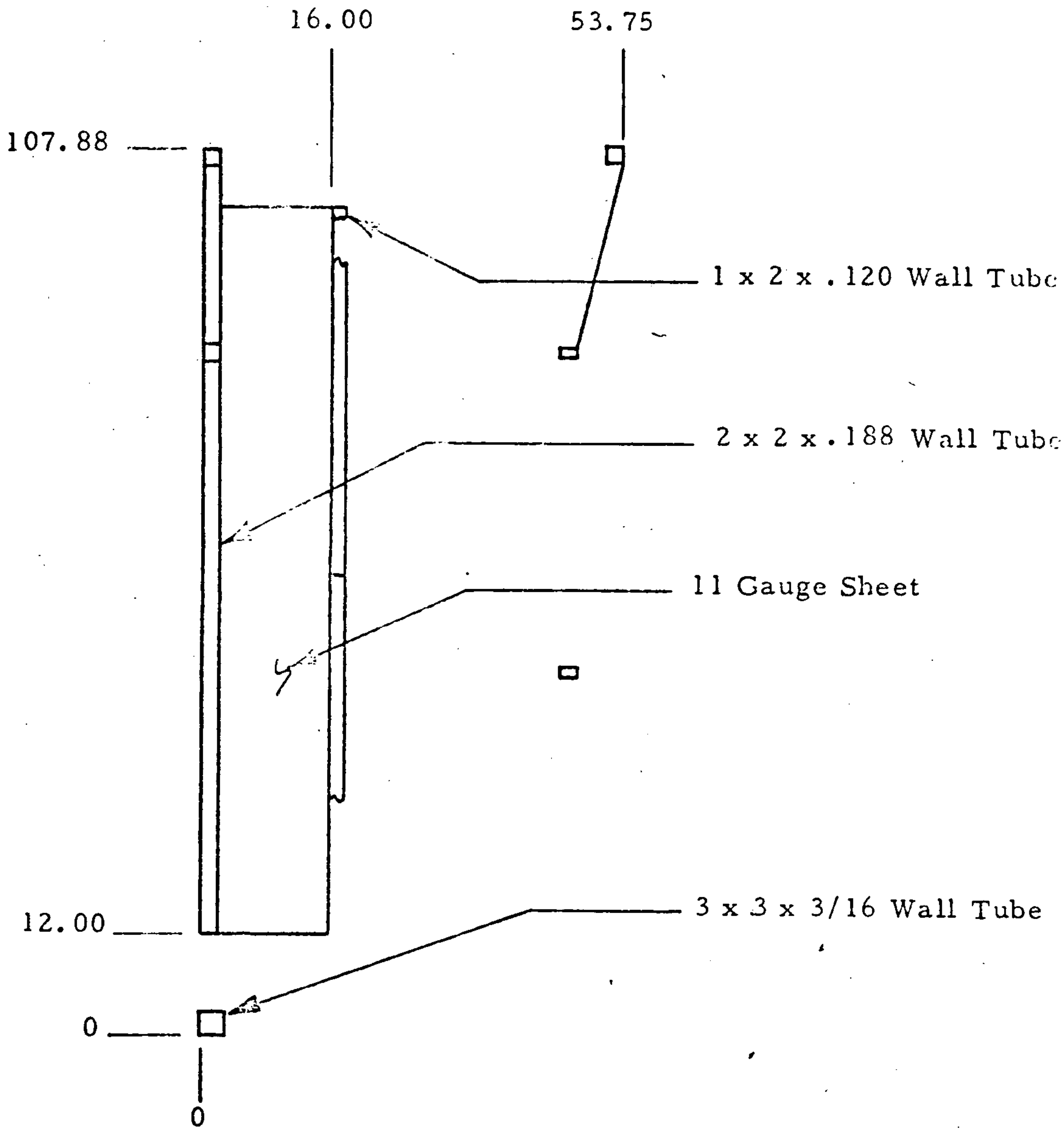
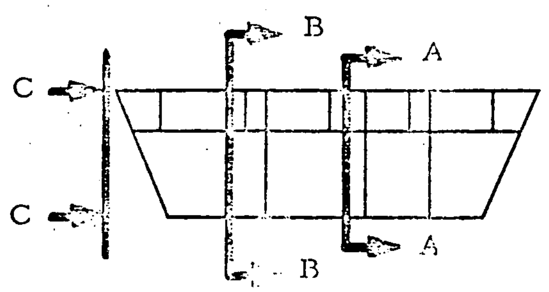


FIGURE 6

SECTION B-B (2 PLACES)

SHIPPING SECTIONS 2 AND 13



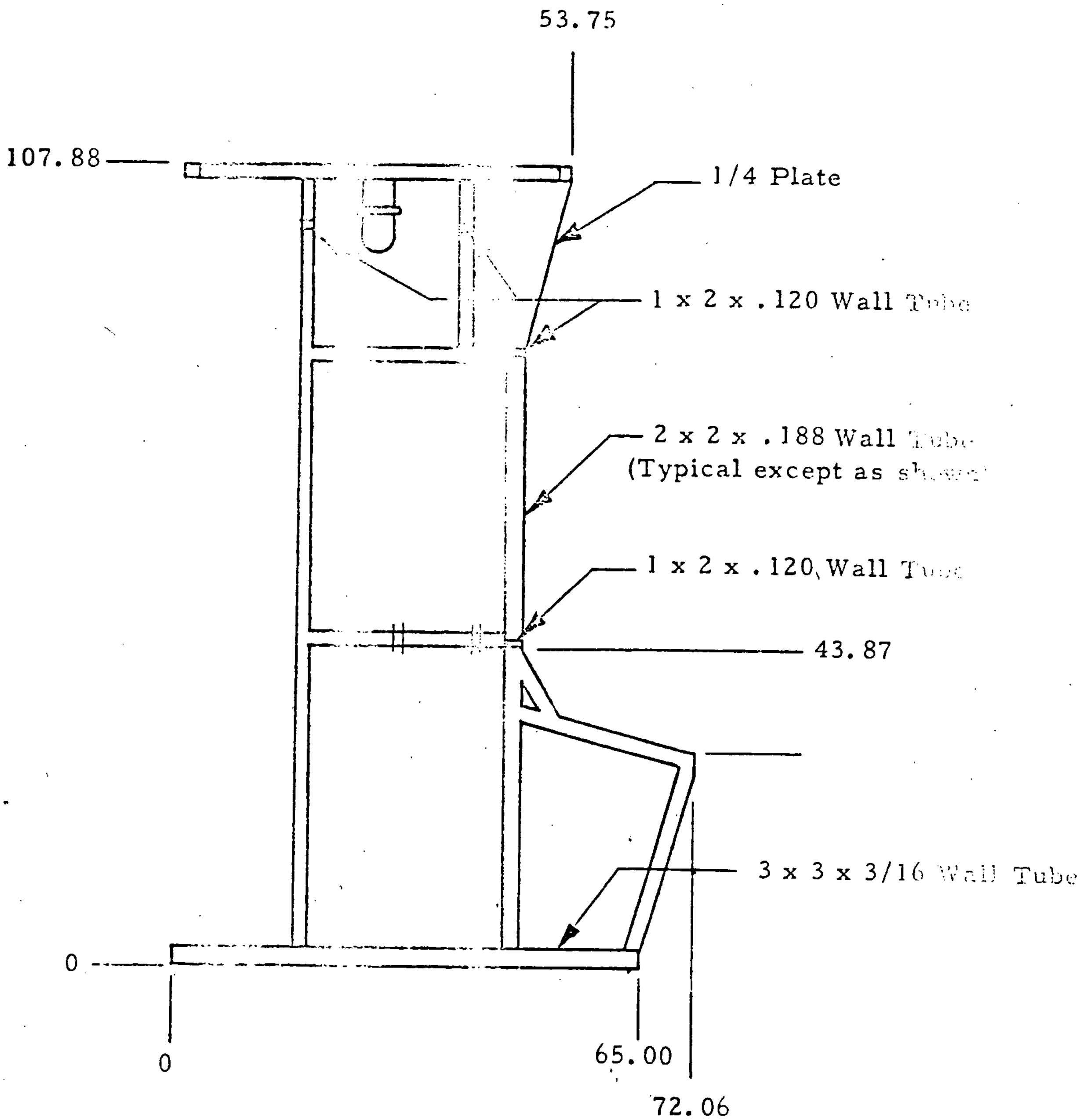
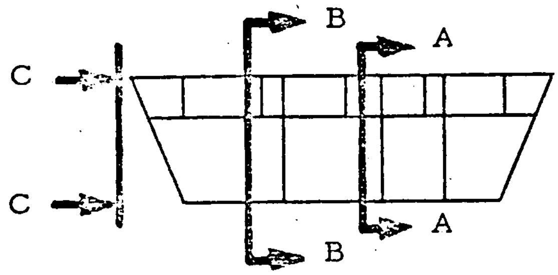


FIGURE 7

SECTION A-A (3 PLACES)

SHIPPING SECTIONS 3 AND 14



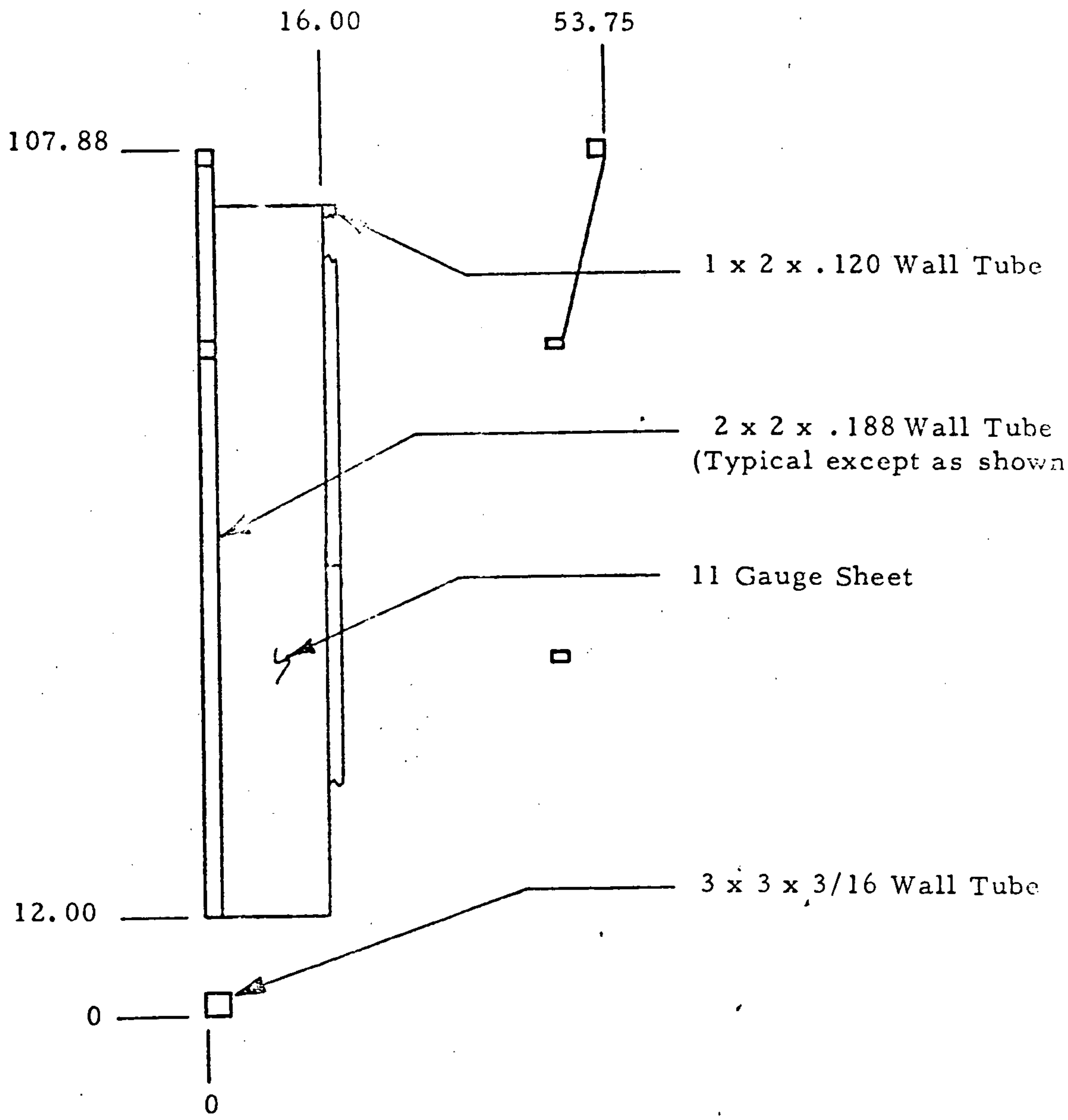
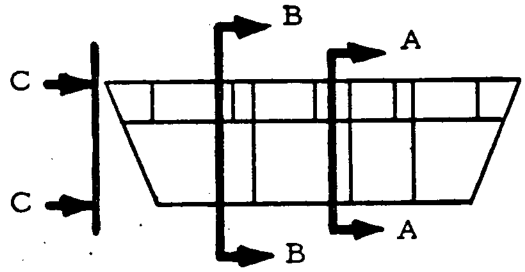


FIGURE 8

SECTION B-B (TYPICAL 5 PLACES)

SHIPPING SECTIONS 3 AND 14



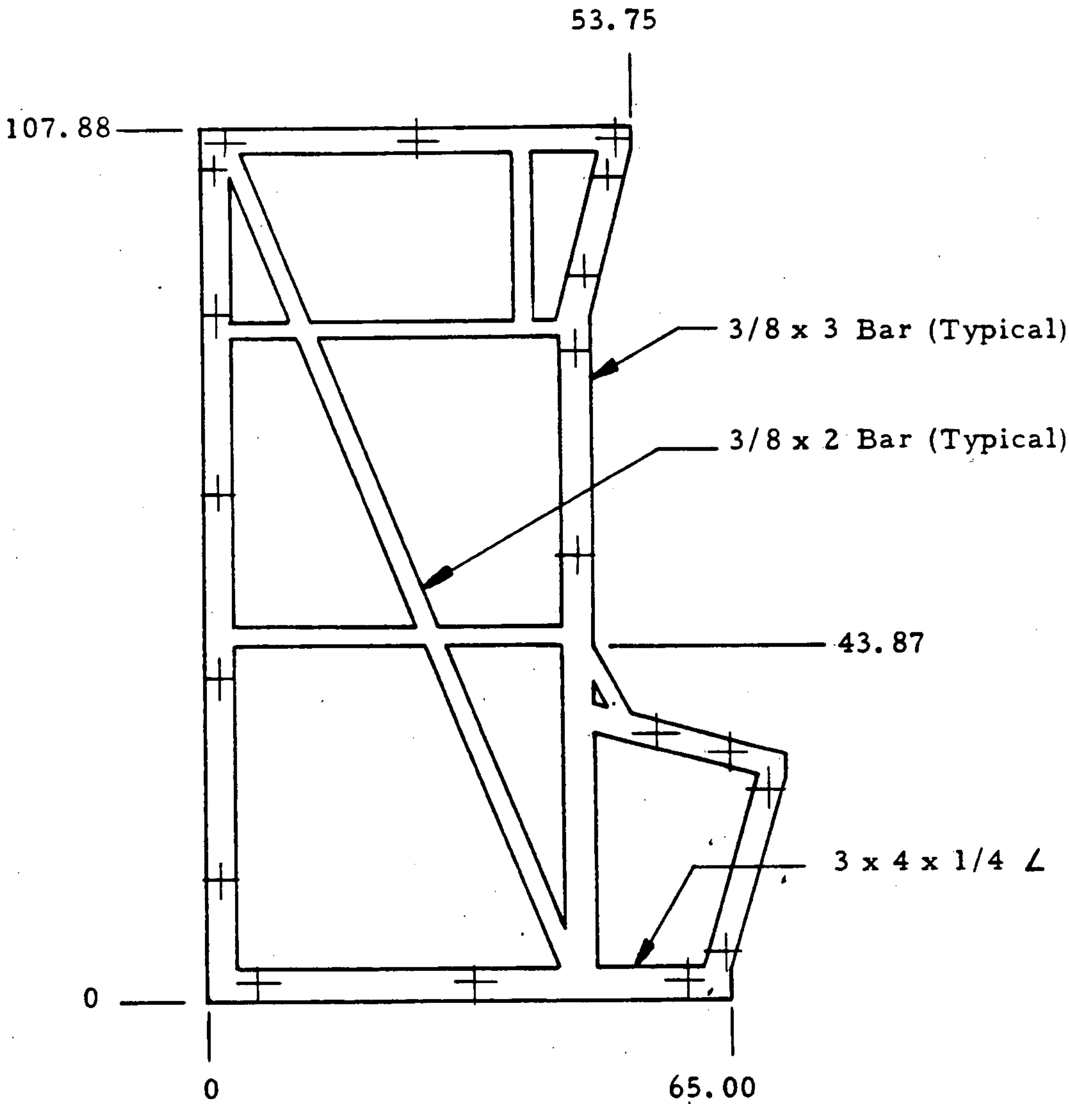


FIGURE 9

VIEW C-C END (TYPICAL) 502-5-50H

SHIPPING SECTIONS 1 THRU 6 AND 12 THRU 16

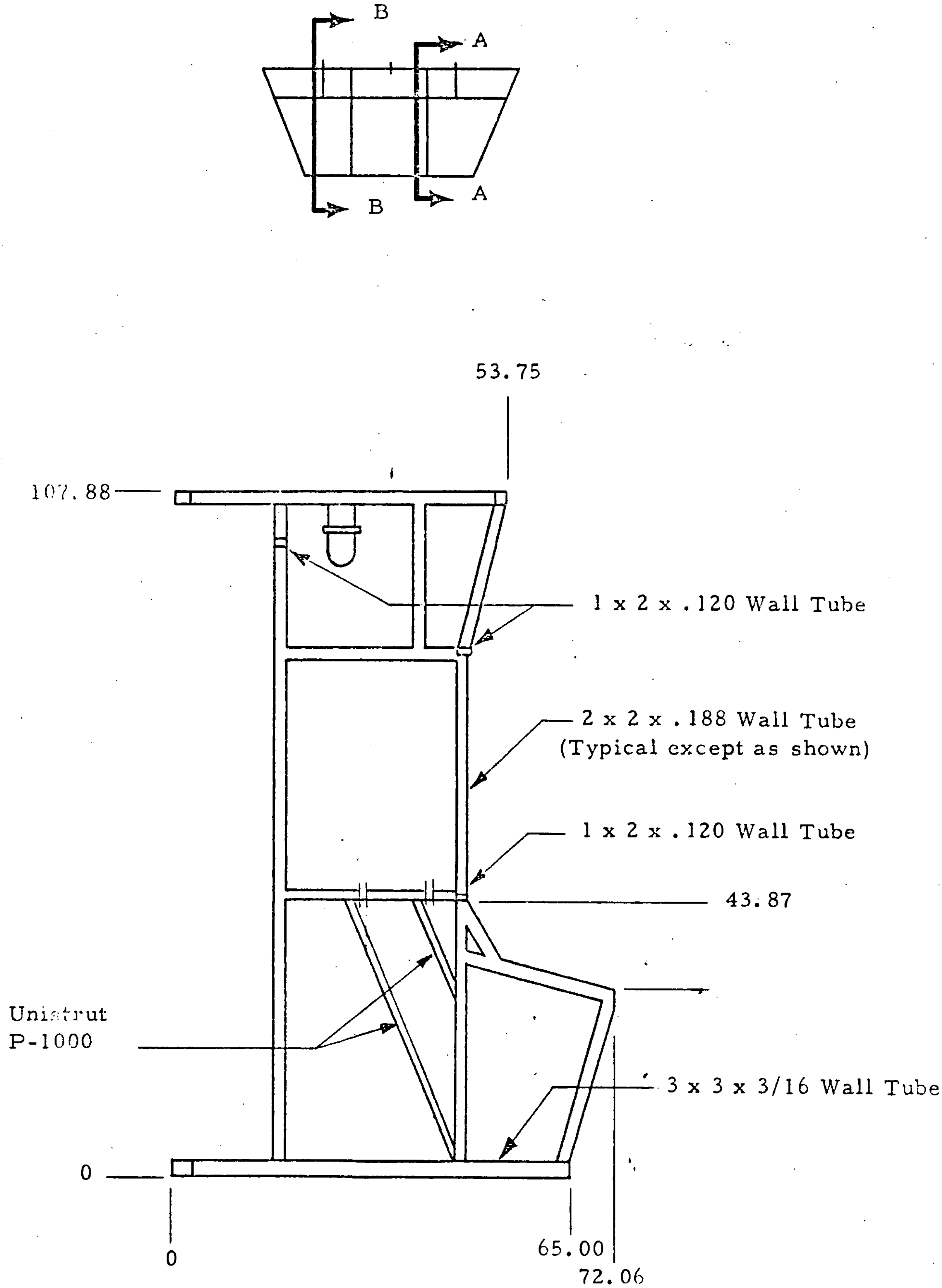
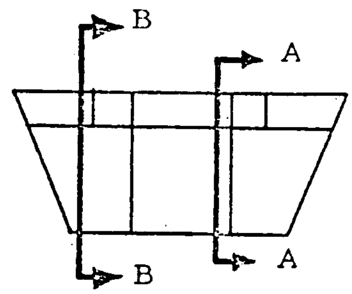


FIGURE 10

SECTION A-A (2 PLACES)

SHIPPING SECTIONS 3 AND 16



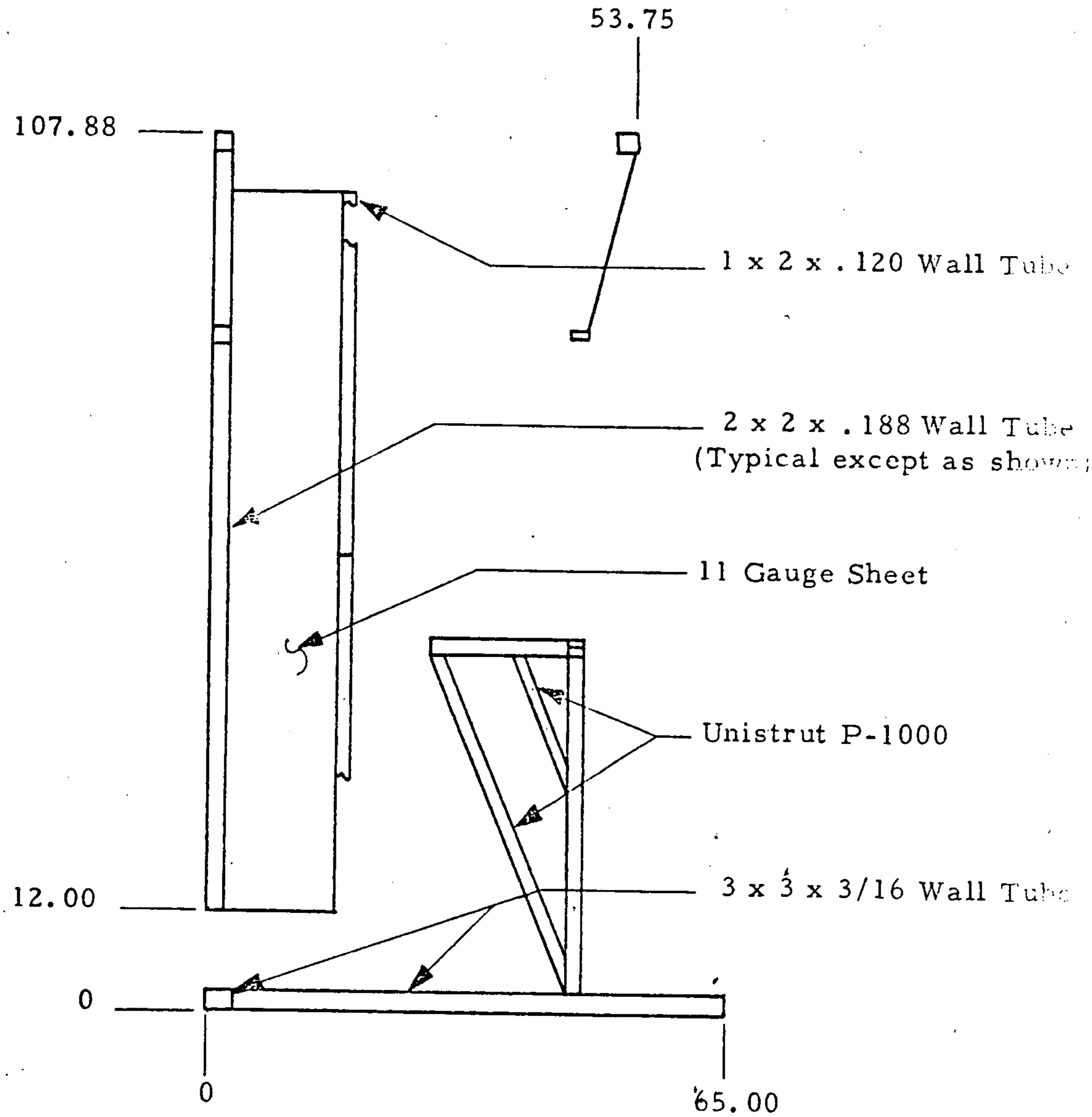
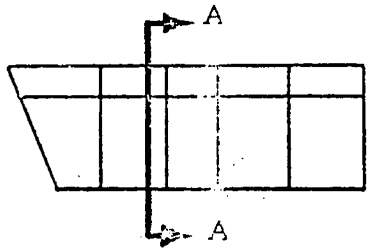


FIGURE 11

SECTION B-B

SHIPPING SECTIONS 4 AND 15



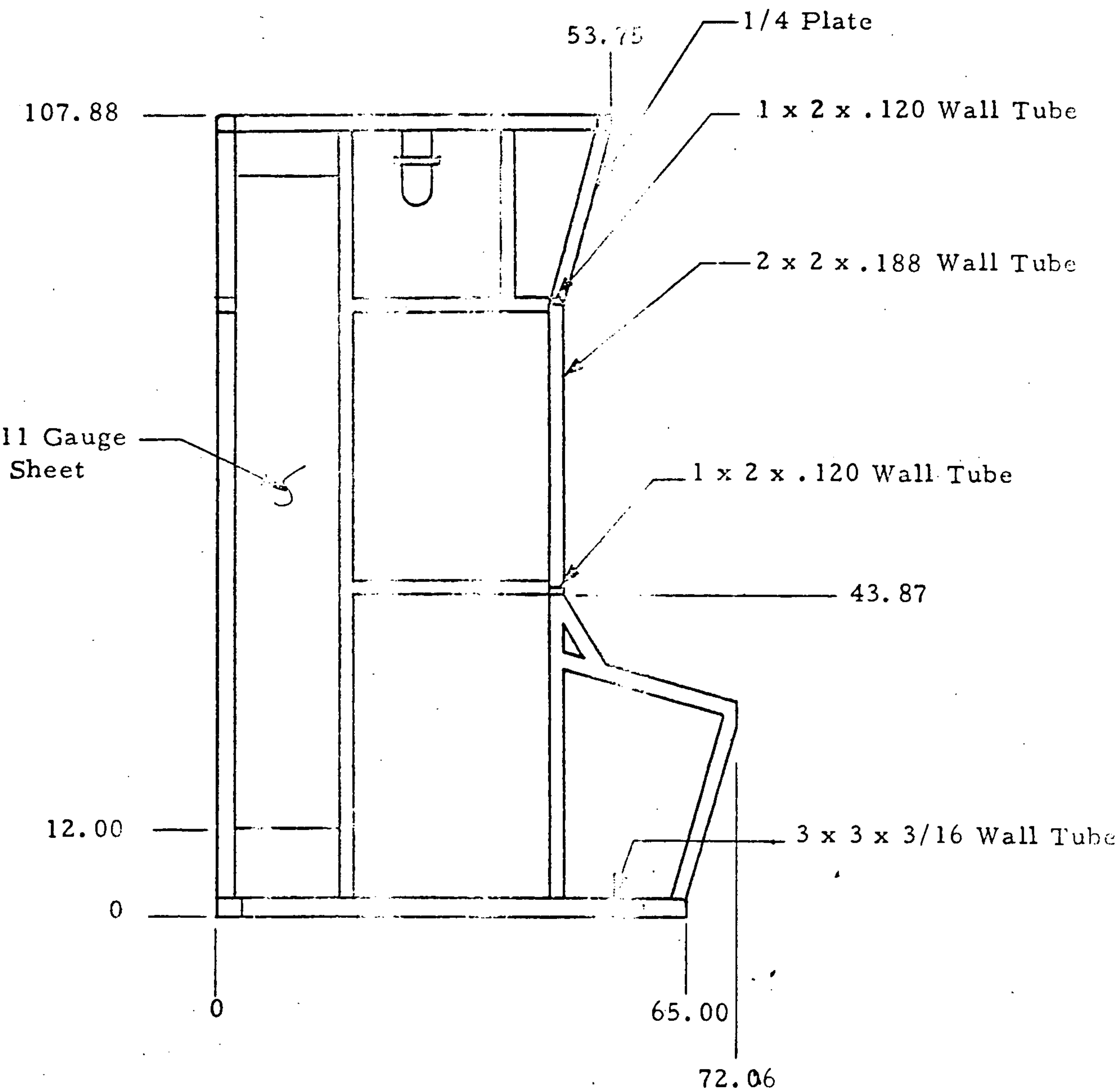
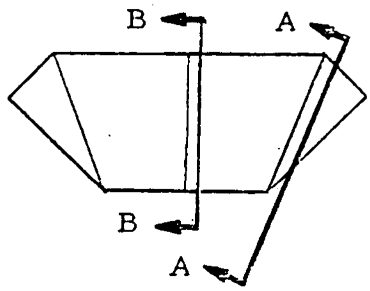


FIGURE 12

SECTION A-A (TYPICAL)

SHIPPING SECTIONS 5 AND 16



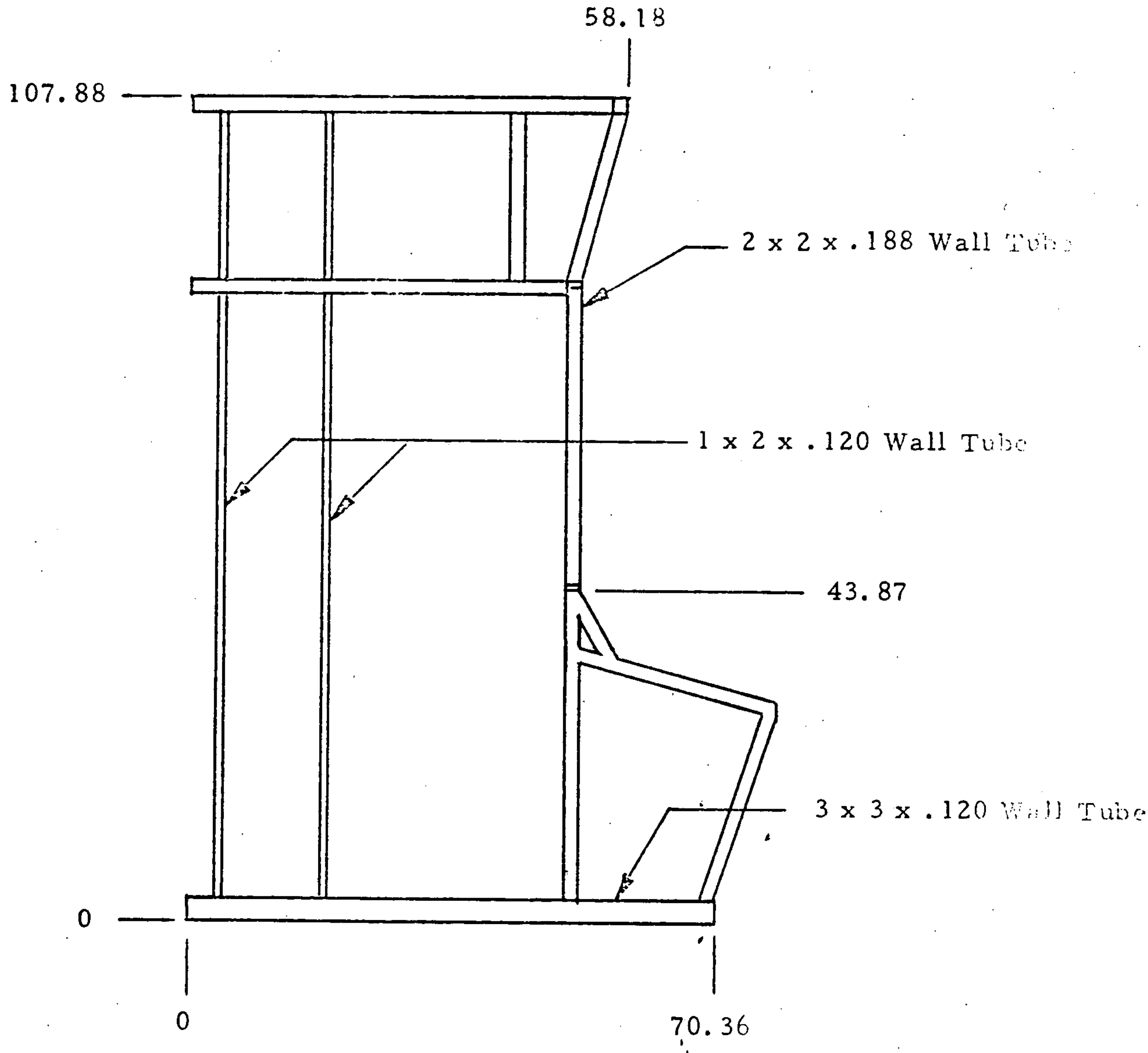
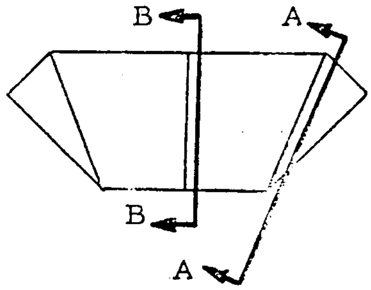


FIGURE 13

SECTION A-A (2 PLACES)

SHIPPING SECTION 6



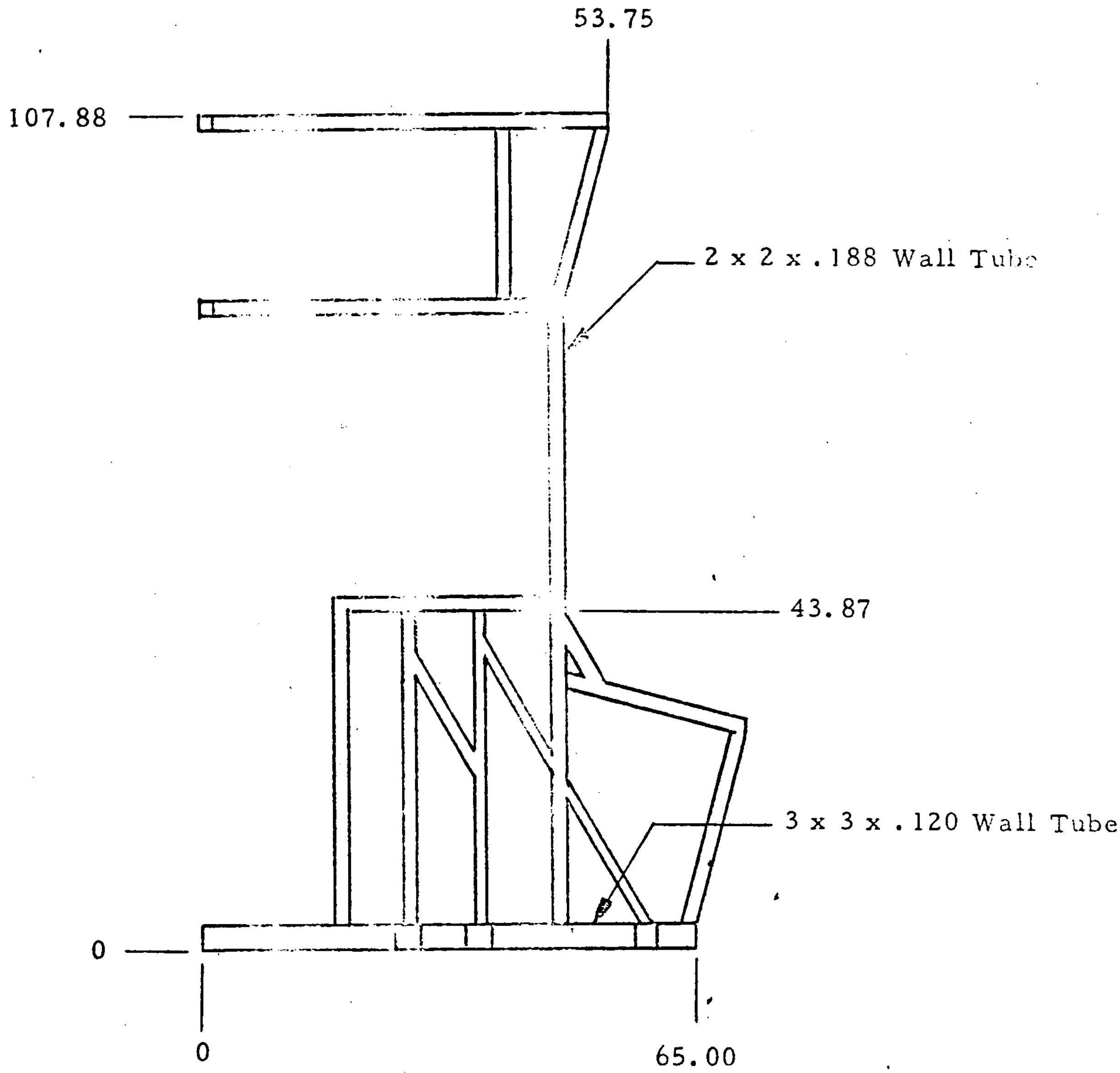
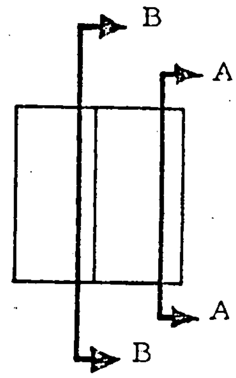


FIGURE 14

SECTION B-B

SHIPPING SECTION 6



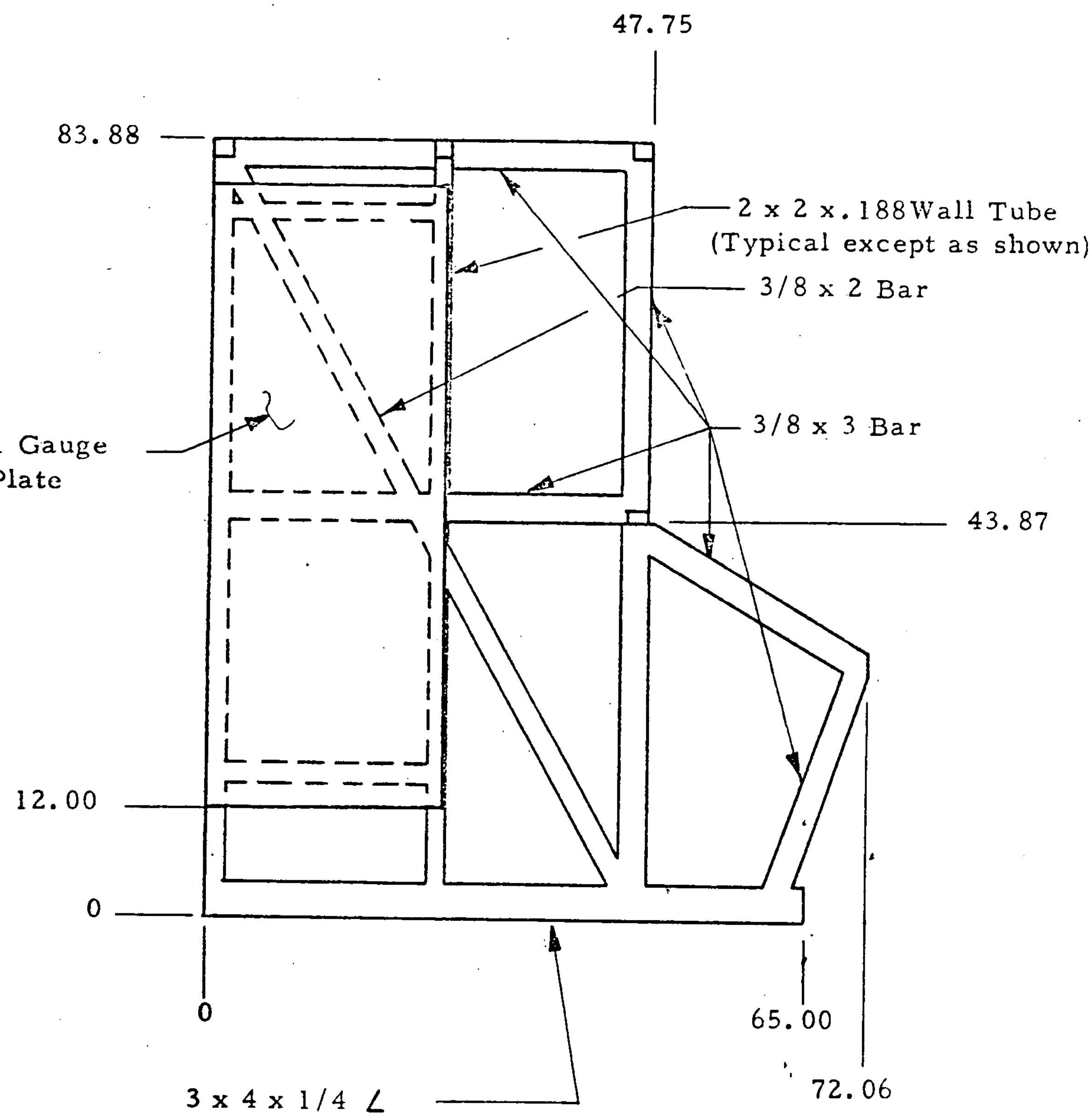
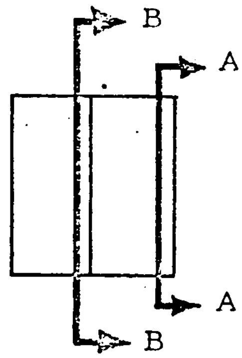


FIGURE 15

SECTION A-A (2 PLACES)

SHIPPING SECTION 8



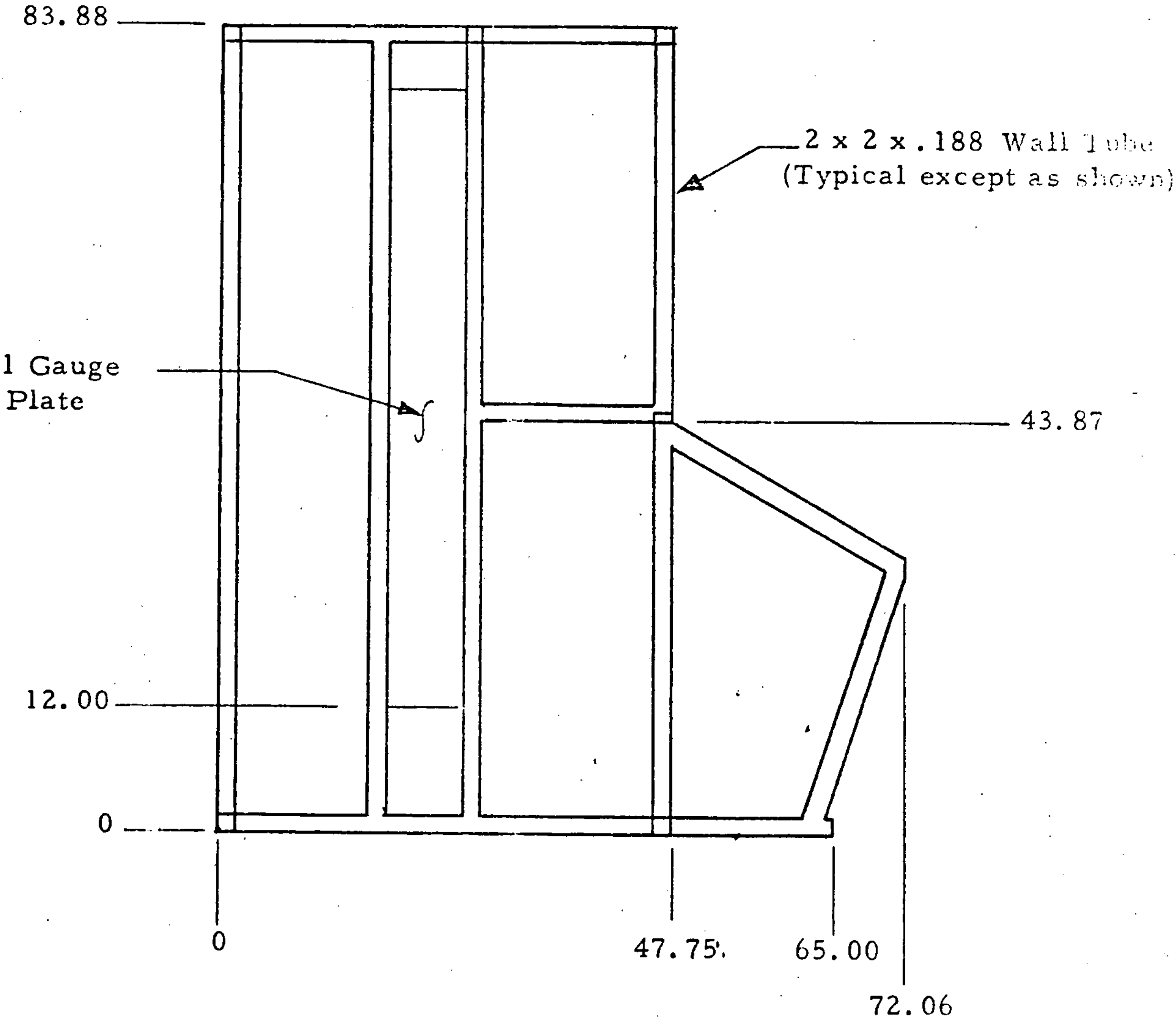
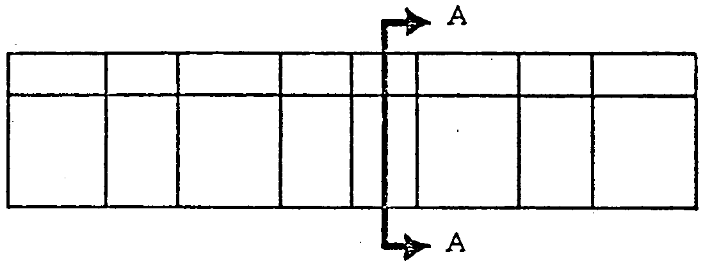


FIGURE 16

SECTION B-B (1 PLACE)

SHIPPING SECTION 8



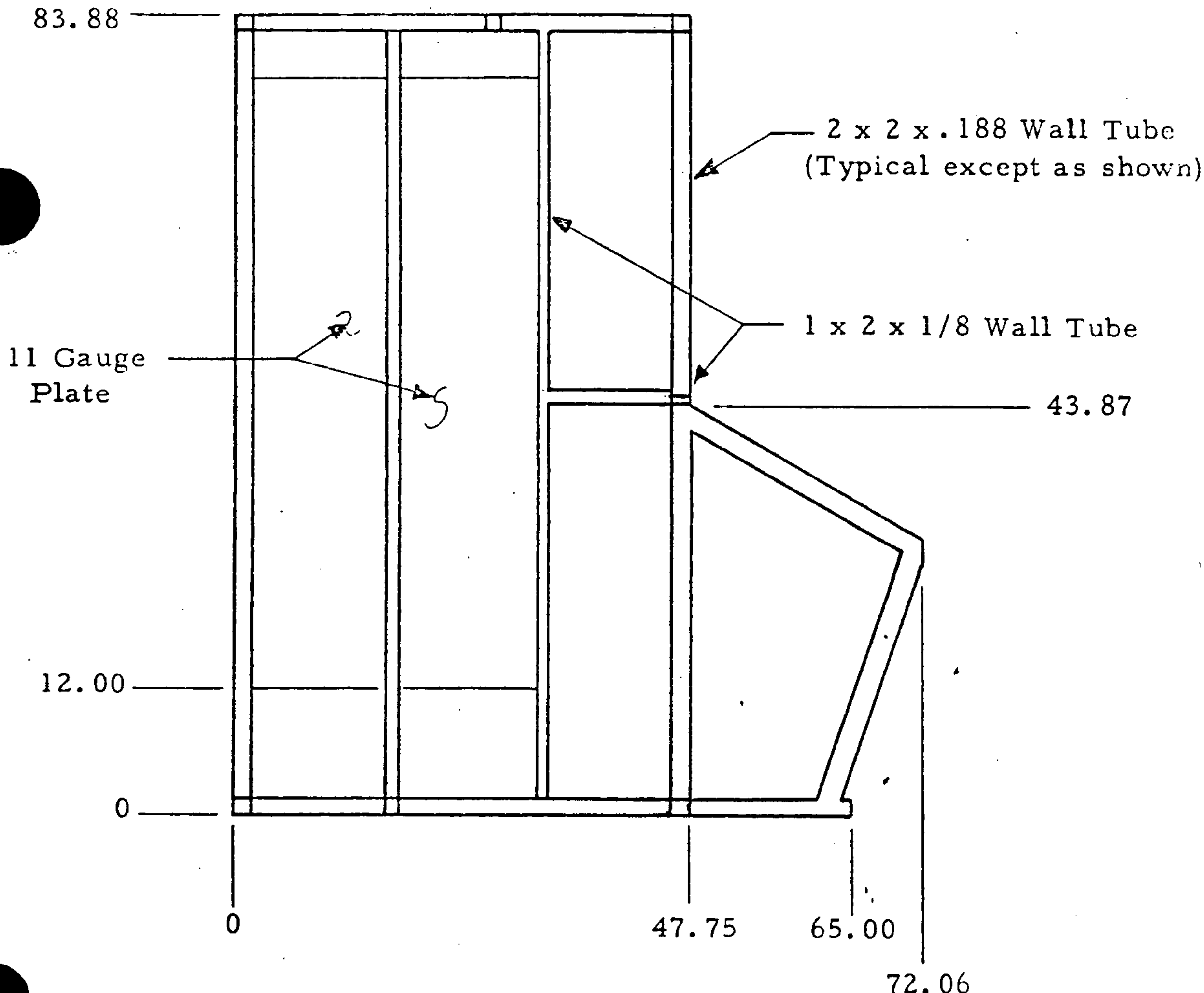
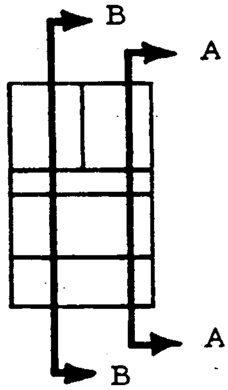


FIGURE 17

SECTION A-A (TYPICAL 7 PLACES)

SHIPPING SECTION 9



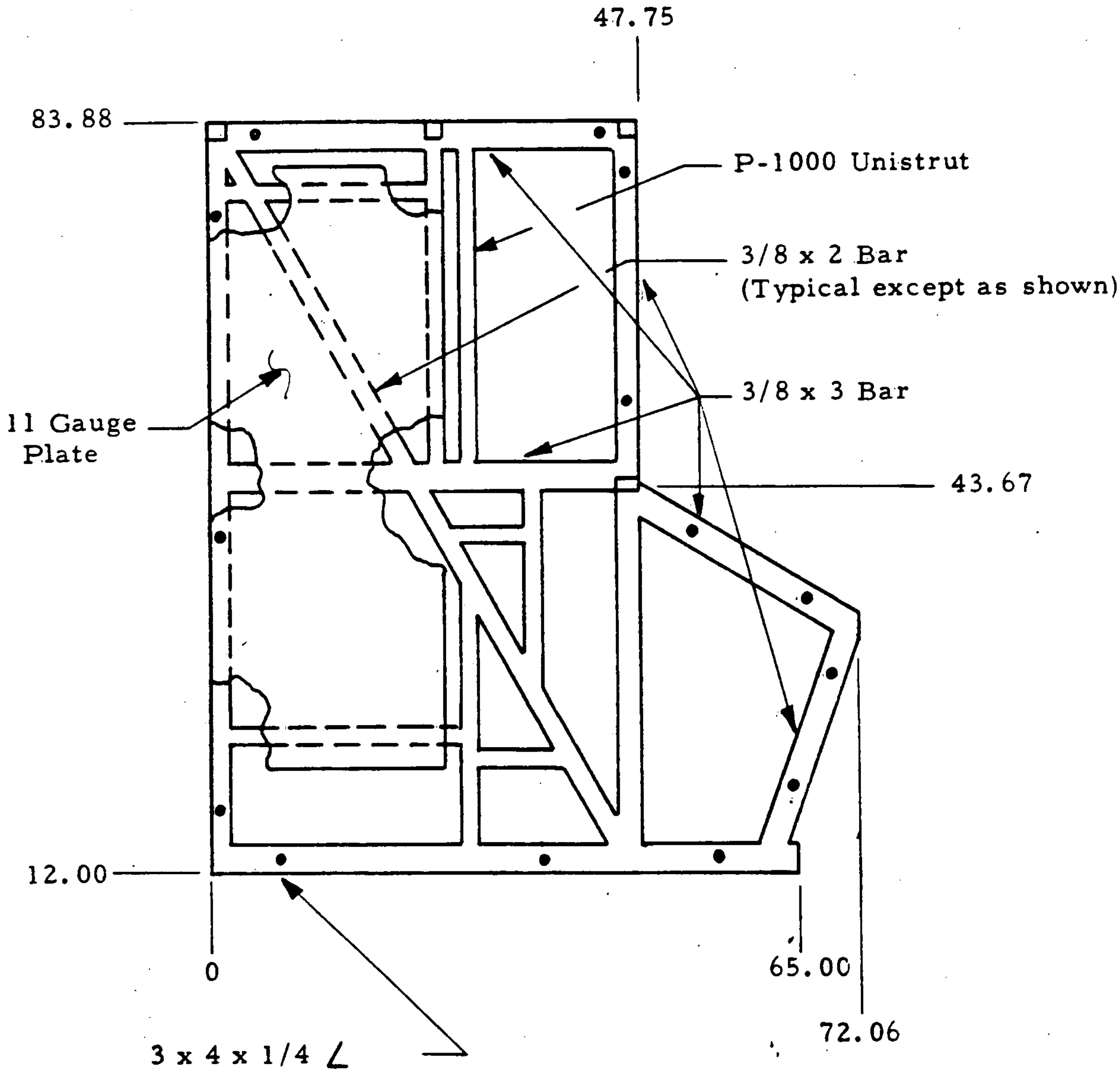


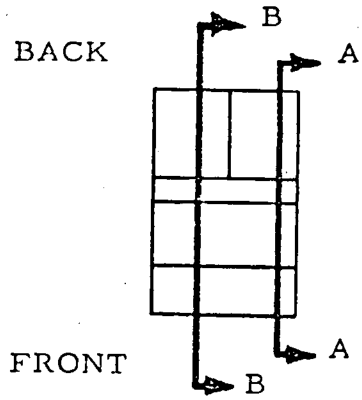
FIGURE 18

SECTION A-A (TYPICAL)

SHIPPING SECTIONS 8, 9 AND 17

502-5-5014

41



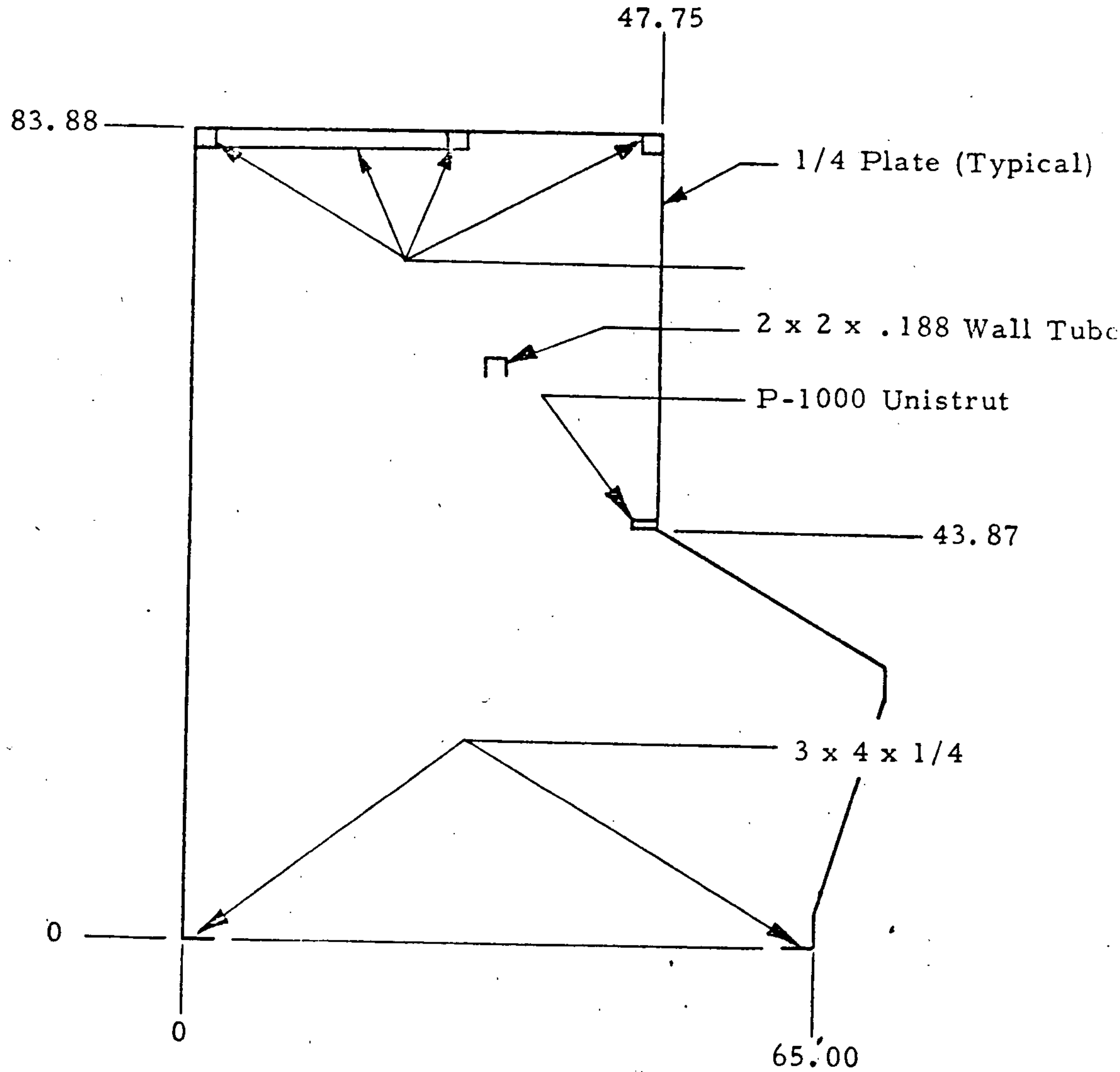


FIGURE 19

SECTION B-B (1 PLACE)

SHIPPING SECTION 17

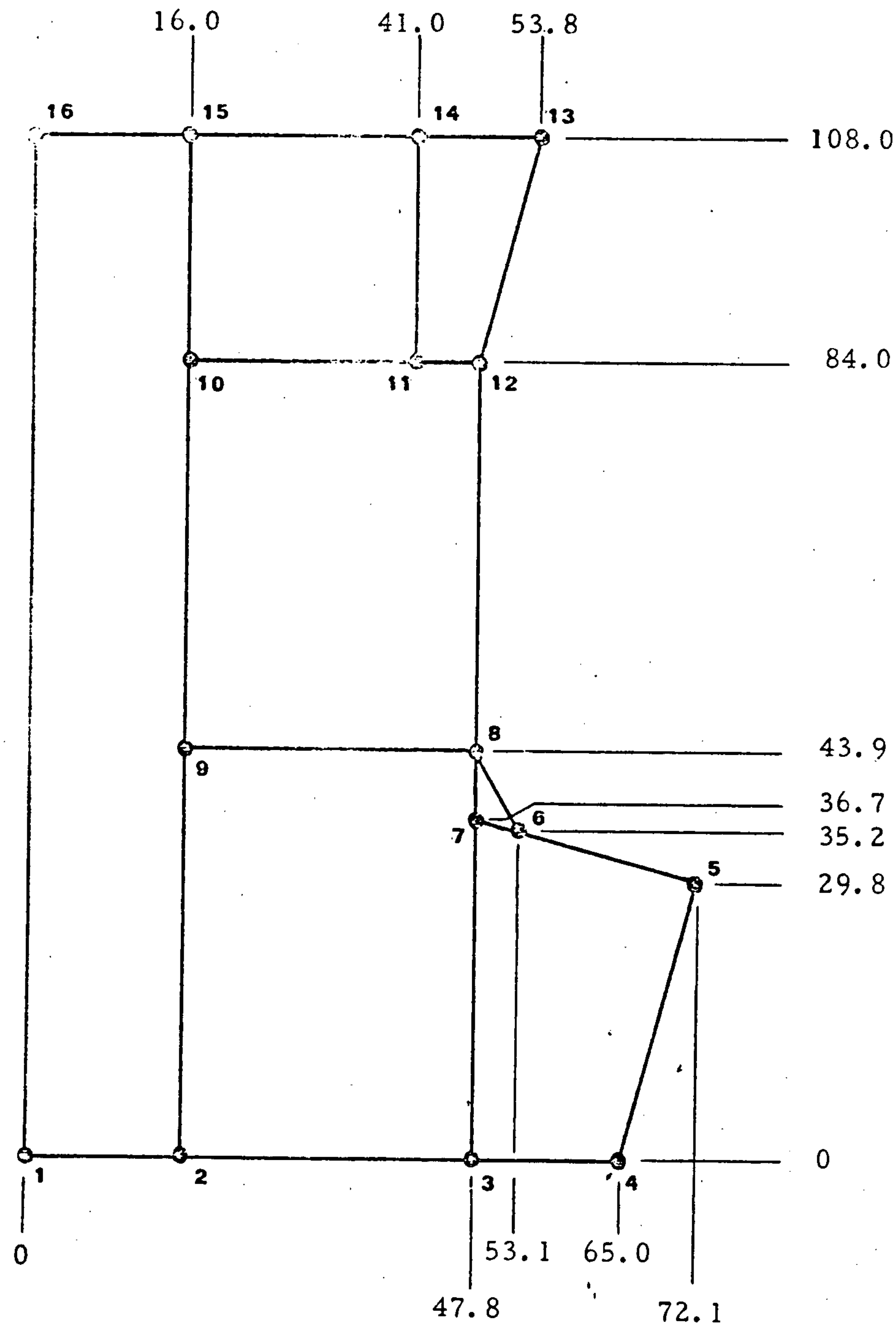


FIGURE 20

SHIPPING SECTION 3 MATH MODEL

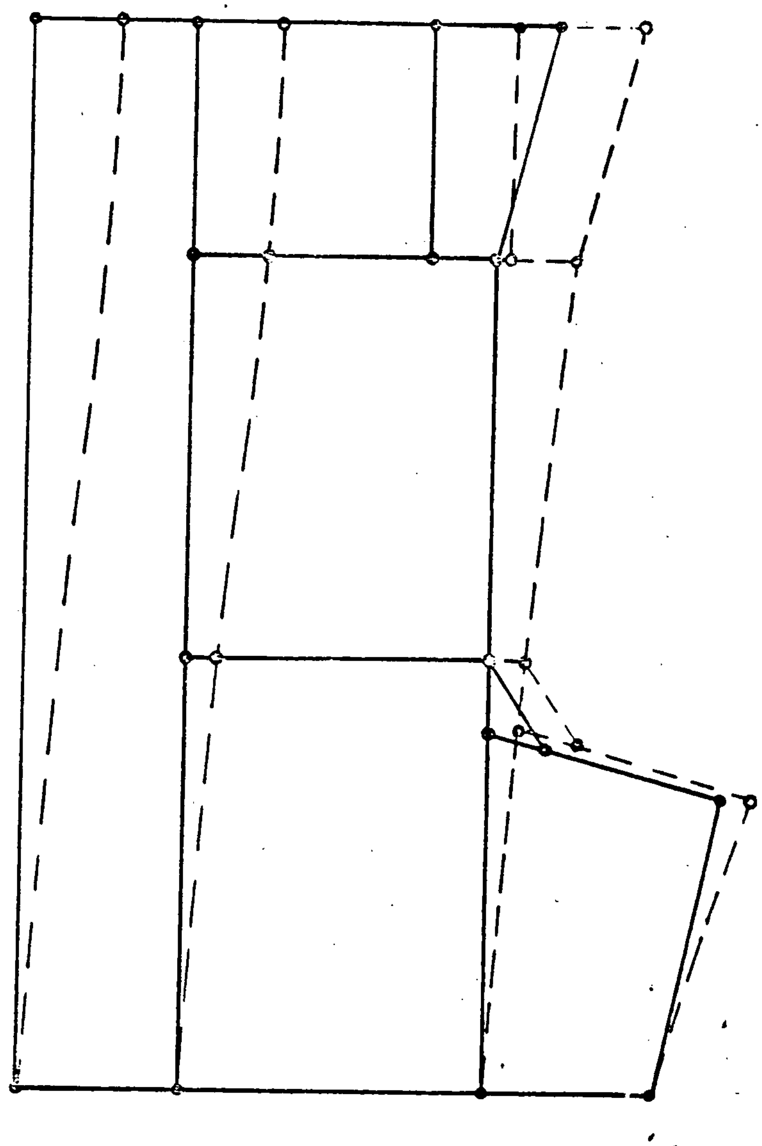


FIGURE 21

SHIPPING SECTION 3 FIRST MODE SHAPE

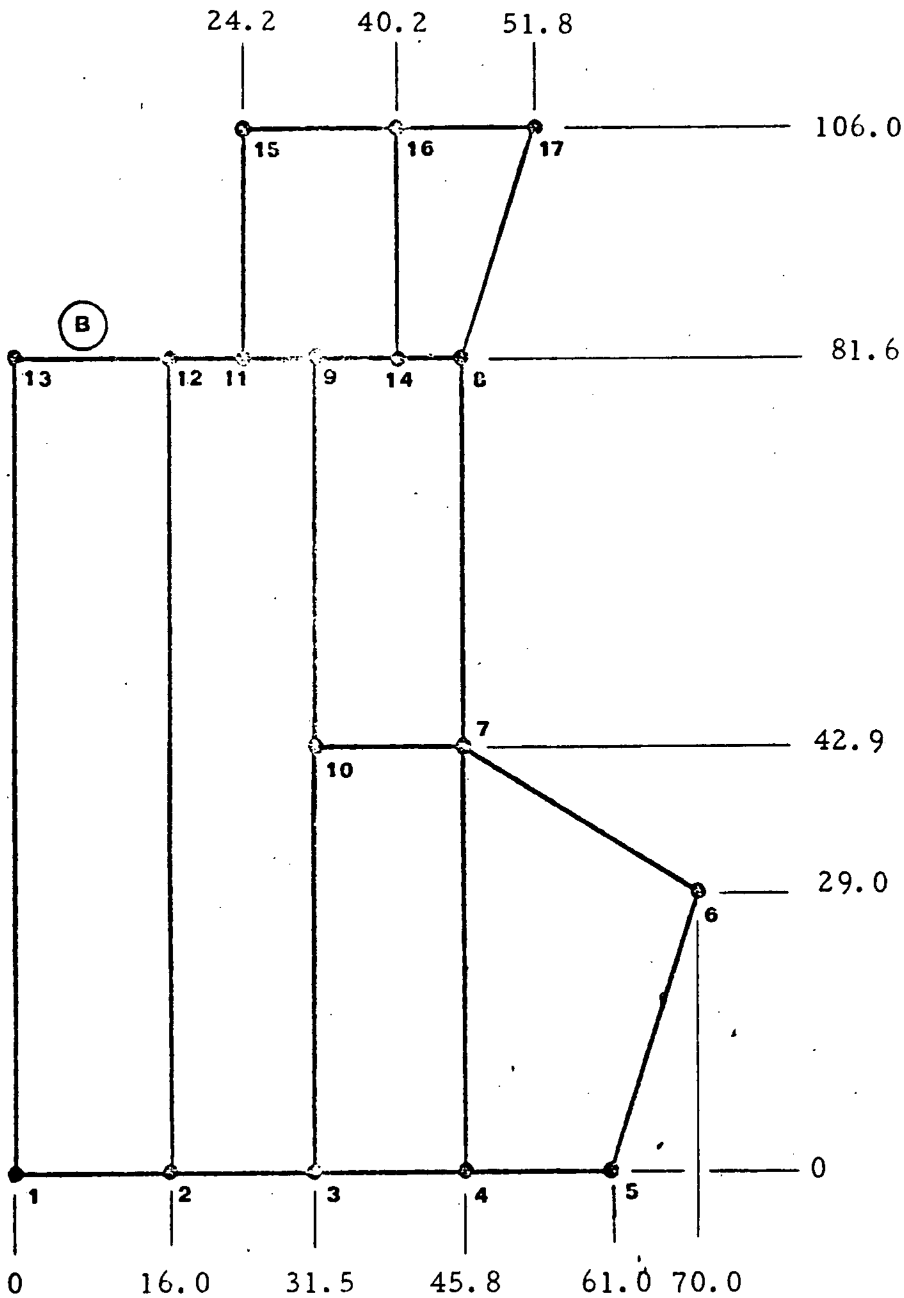


FIGURE 22

SHIPPING SECTION 9 MATH MODEL

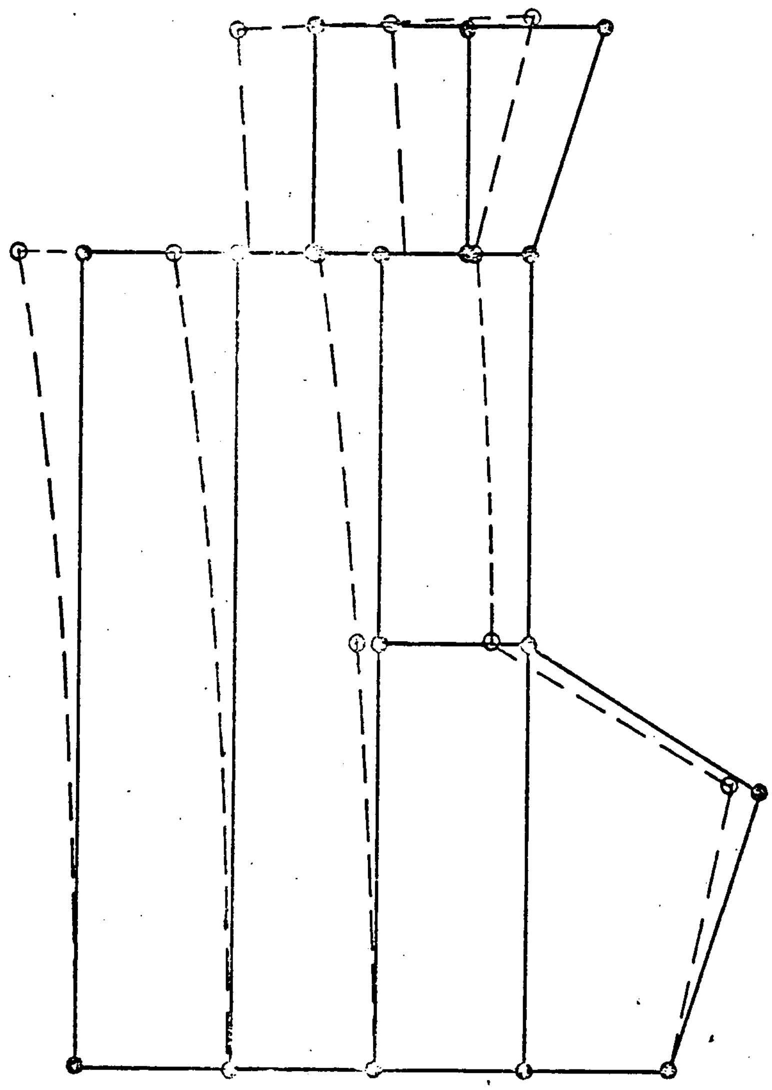


FIGURE 23

SHIPPING SECTION 9 FIRST MODE SHAPE

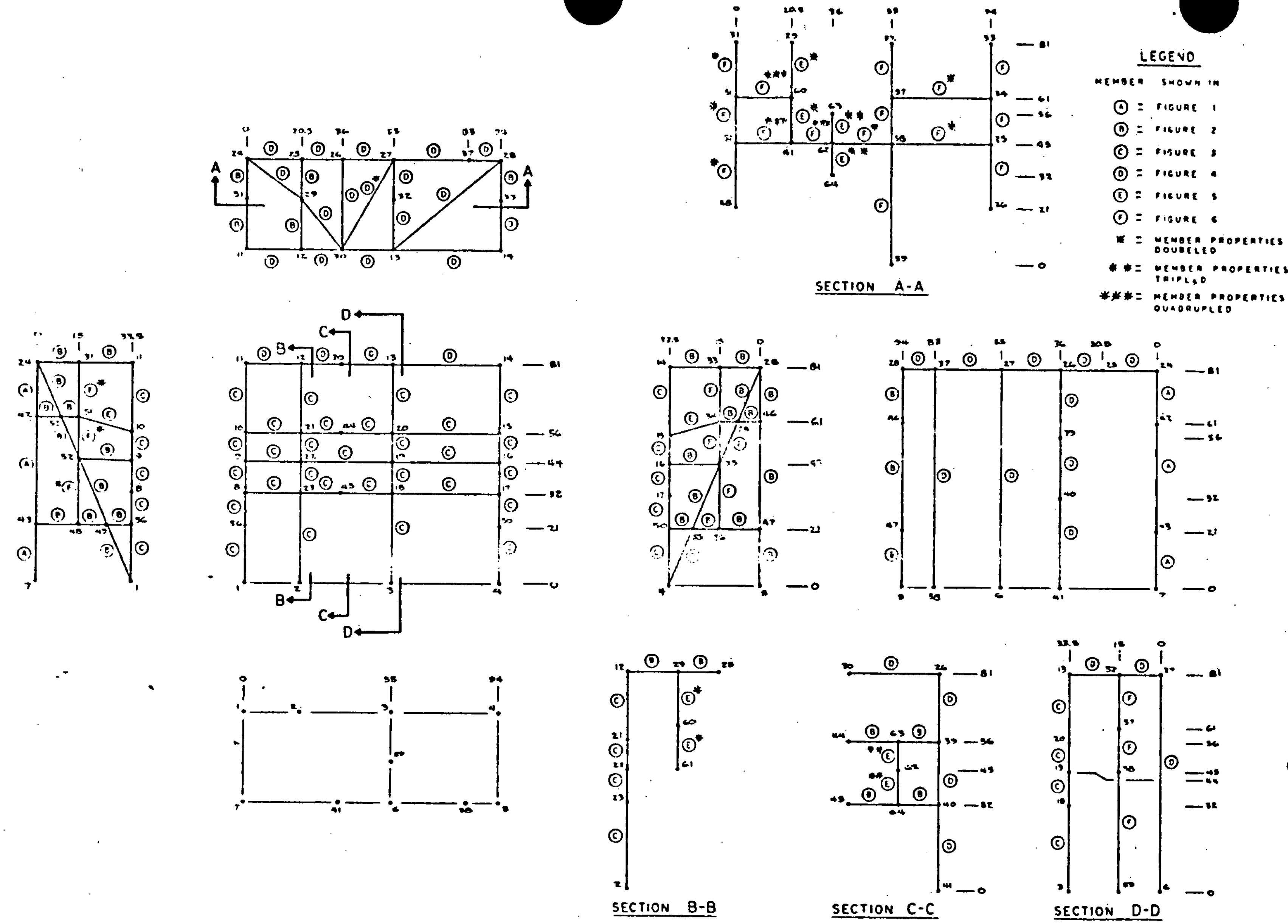
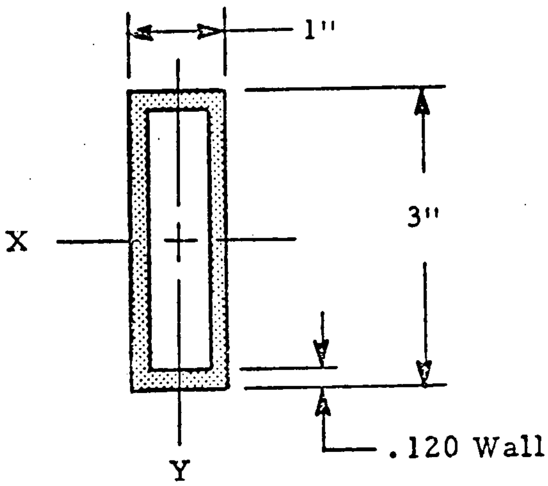


FIGURE 24

SECTION 10 MATH MODEL



A = .90 in.^{2}

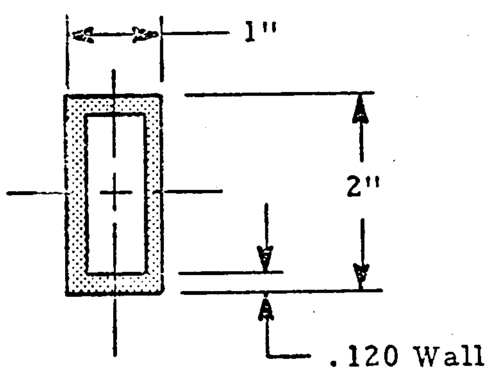
Ixx = .92 in.^{4}

Iyy = .15 in.^{4}

J = .54 in.^{4}

FIGURE 25

MEMBER PROPERTIES



A = .66 in.^{2}

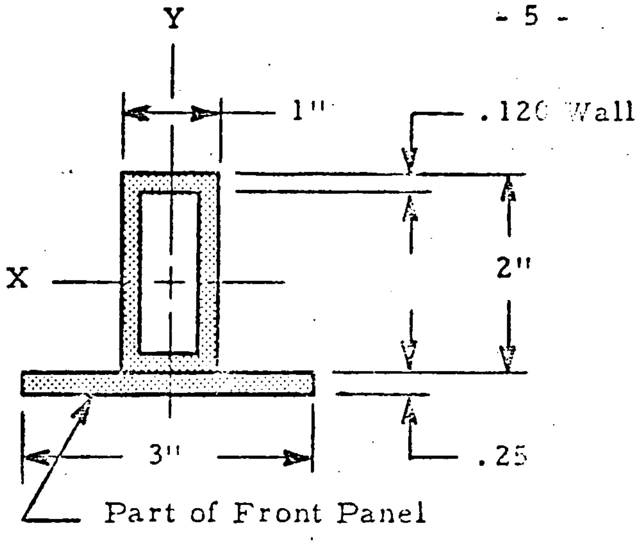
Ixx = .32 in.^{4}

Iyy = .10 in.^{4}

J = .30 in.^{4}

FIGURE 26

MEMBER PROPERTIES



$A = 1.41 \text{ in.}^2$

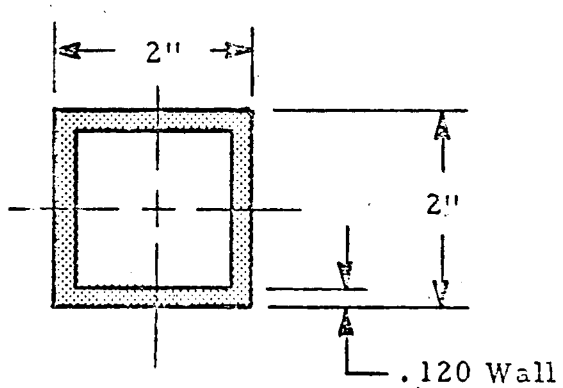
$I_{xx} = .76 \text{ in.}^4$

$I_{yy} = .67 \text{ in.}^4$

$J = .50 \text{ in.}^4$

FIGURE 27

MEMBER PROPERTIES



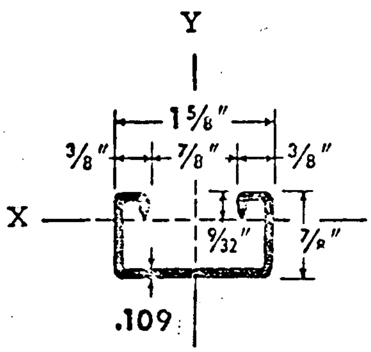
$A = 1.60 \text{ in.}^2$

$I = .67 \text{ in.}^4$

$J = 1.00 \text{ in.}^4$

FIGURE 28

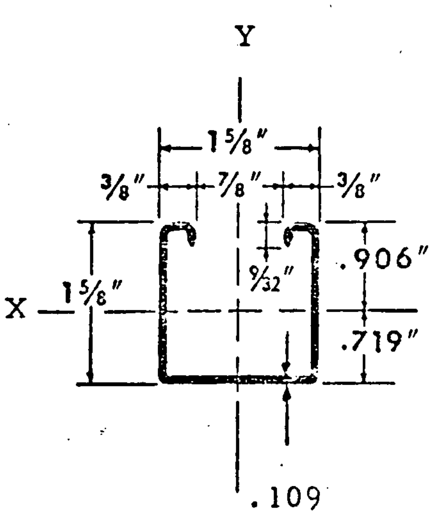
MEMBER PROPERTIES



A	=	.39 in.^{2}
Ixx	=	.04 in.^{4}
Iyy	=	.14 in.^{4}
J	=	.10 in.^{4}

FIGURE 29

MEMBER PROPERTIES

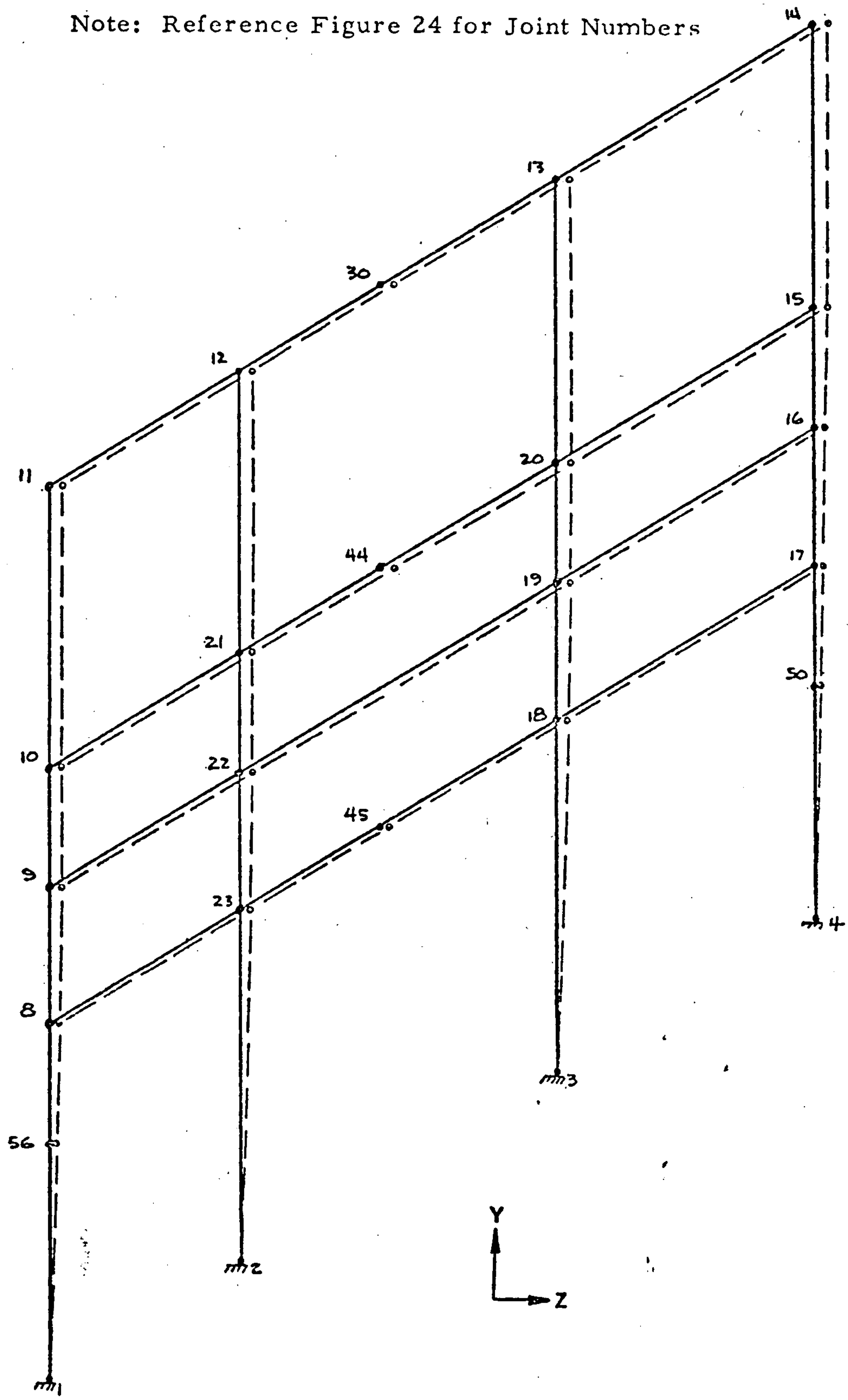


A	=	.59 in.^{2}
Ixx	=	.21 in.^{4}
Iyy	=	.25 in.^{4}
J	=	.12 in.^{4}

FIGURE 30

MEMBER PROPERTIES

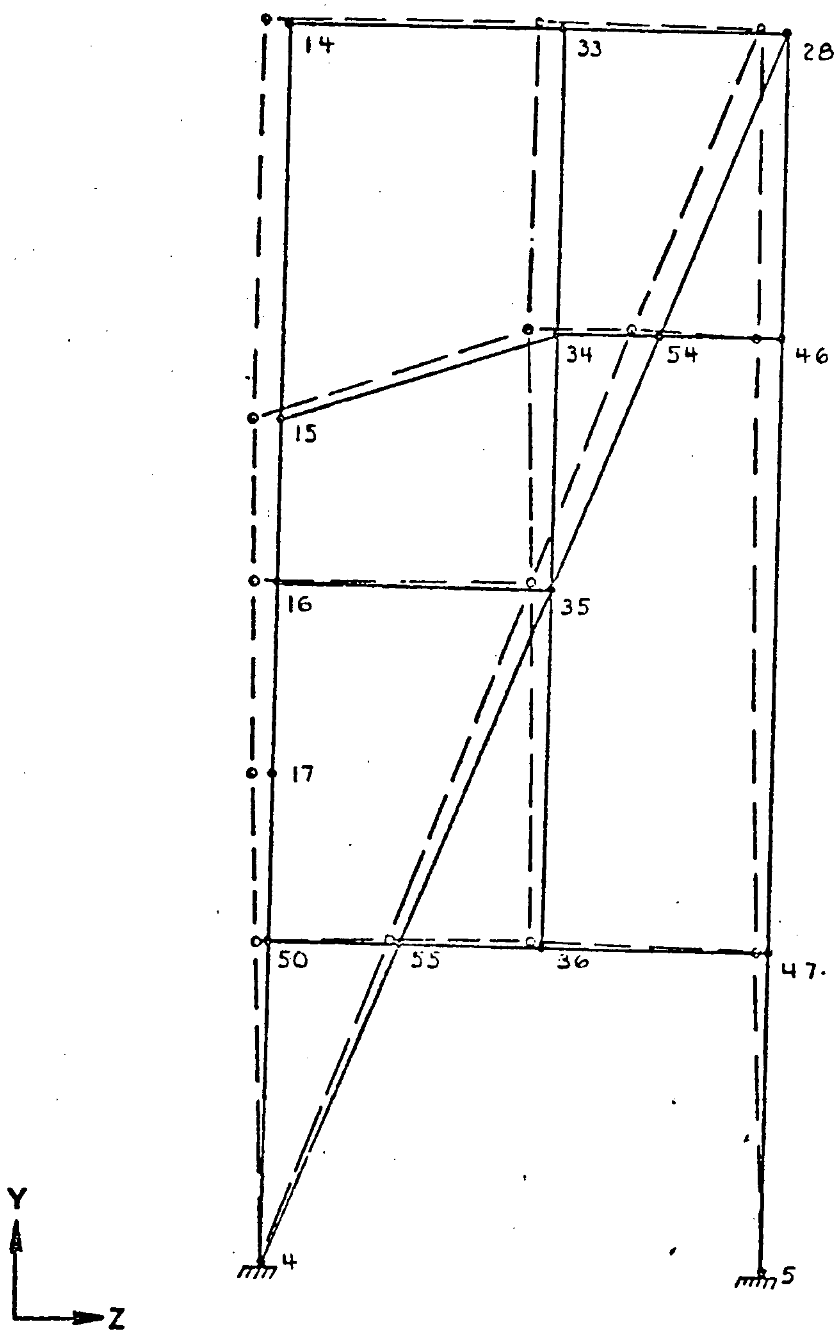
Note: Reference Figure 24 for Joint Numbers



51

FIGURE 31

SECTION 10 FIRST MODE SHAPE FRONT PANEL



Note: Reference Figure 24 for Joint Numbers

FIGURE 32

SECTION 10 FIRST MODE SHAPE SIDE PANEL

Description	Gross Weight Lbs.	Mean Length Inches	Lbs. Per Mean Lineal In.	No. of Joints	[illegible]
Shipping Sections 1 and 12	6,056	162	37.4	16	[illegible]
Shipping Sections 2 and 13	4,574	128	35.7	16	
Shipping Sections 3 and 14	6,306	152	41.5	16	[illegible]
Shipping Sections 4 and 15	4,730	128	37.0	15	[illegible]
Shipping Sections 5 and 16	6,027	166	36.3	16	[illegible]
Shipping Section 6	3,670	109	33.7	16	
Shipping Section 8	2,676	56.9	44.7	12	[illegible]
Shipping Section 9	10,659	264	40.4	17	[illegible].4
Shipping Section 17	1,700	36	47.2	24	[illegible].8

TABLE 1

WEIGHT DISTRIBUTION

Joint No.	Weight (Lbs.)
1	48.0
2	48.0
3	48.0
4	94.8
5	94.8
6	94.8
7	48.0
8	94.8
9	94.8
10	94.8
11	48.0
12	94.8
13	94.8
14	48.0
15	48.0
16	48.0

MODE 1
FREQUENCY (CPS) = 7.2321
GENERALIZED MASS = 1.0000

JOINT	DELTA X	DELTA Y	THETA Z
1	0.	0.	-3.497E-03
2	-1.801E-04	-5.830E-02	-1.916E-03
3	-1.876E-04	-6.885E-02	2.896E-03
4	0.	0.	6.678E-03
5	-3.136E-01	7.561E-02	8.351E-03
6	-3.452E-01	-3.380E-02	5.889E-03
7	-3.546E-01	-6.777E-02	7.125E-03
8	-4.014E-01	-6.748E-02	6.337E-03
9	-4.015E-01	-6.025E-02	7.052E-03
10	-8.065E-01	-6.022E-02	3.478E-03
11	-8.064E-01	-8.514E-02	5.439E-04
12	-8.063E-01	-6.652E-02	5.730E-03
13	-8.446E-01	-5.714E-02	2.490E-03
14	-8.445E-01	-8.453E-02	1.352E-03
15	-8.445E-01	-5.943E-02	-2.529E-03
16	-8.445E-01	-4.500E-03	-2.688E-03

TABLE 2

SHIPPING SECTION 3 MATH MODEL JOINT WEIGHTS
AND MODAL DISPLACEMENTS

Joint No.	Weight (Lbs.)
1	62.7
2	62.7
3	62.7
4	62.7
5	116.0
6	116.0
7	116.0
8	116.0
9	62.7
10	62.7
11	62.7
12	62.7
13	62.7
14	62.7
15	62.7
16	62.7
17	116.0

MODE 1
FREQUENCY (CPS) = 10.3593
GENERALIZED MASS = 1.0000

JOINT	DELTA X	DELTA Y	THETA Z
1	0.	0.	-5.144E-03
2	-9.473E-04	-5.641E-02	7.267E-03
3	-1.102E-03	1.587E-02	7.761E-03
4	-7.442E-04	6.148E-02	-1.350E-03
5	0.	0.	3.499E-03
6	-3.229E-01	1.018E-01	7.327E-03
7	-3.443E-01	6.755E-02	3.746E-03
8	-6.429E-01	7.186E-02	4.362E-03
9	-6.428E-01	1.085E-02	7.125E-03
10	-3.446E-01	1.160E-02	7.982E-03
11	-6.428E-01	-2.698E-02	4.171E-03
12	-6.425E-01	-6.045E-02	7.091E-03
13	-6.425E-01	-9.154E-03	-4.627E-03
14	-6.429E-01	5.143E-02	3.704E-03
15	-8.366E-01	-2.785E-02	6.536E-03
16	-8.368E-01	5.214E-02	6.245E-03
17	-8.371E-01	1.197E-01	5.693E-03

TABLE 3

SHIPPING SECTION 9 MATH MODEL JOINT WEIGHTS
AND MODAL DISPLACEMENTS

Joint		Weight in Lbs.	Joint		Weight in Lbs.
1	=	0	33	=	45
2	=	0	34	=	45
3	=	0	35	=	45
4	=	0	36	=	25
5	=	0	37	=	25
6	=	0	38	=	0
7	=	0	39	=	25
8	=	67	40	=	25
9	=	43	41	=	0
10	=	47	42	=	25
11	=	43	43	=	25
12	=	43	44	=	40
13	=	84	45	=	40
14	=	69	46	=	25
15	=	86	47	=	25
16	=	69	48	=	25
17	=	82	49	=	25
18	=	92	50	=	25
19	=	84	51	=	30
20	=	116	52	=	30
21	=	62	53	=	25
22	=	60	54	=	25
23	=	74	55	=	25
24	=	25	56	=	25
25	=	25	57	=	60
26	=	25	58	=	55
27	=	25	59	=	0
28	=	25	60	=	35
29	=	35	61	=	35
30	=	40	62	=	35
31	=	30	63	=	25
32	=	50	64	=	25

TABLE 4

SECTION 10 TABULATED LOADS

MODE 1
FREQUENCY (CPS) = 19.9742
GENERALIZED MASS = 1.0000

JOINT	DELTA X	DELTA Y	DELTA Z	THETA X	THETA Y	THETA Z
1	0.	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.
5	0.	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	0.	0.
7	0.	0.	0.	0.	0.	0.
8	0.	-1.442E-02	-3.614E-01	....	0.	0.
9	0.	-1.451E-02	-3.856E-01	....	0.	0.
10	0.	-1.468E-02	-4.209E-01	....	0.	0.
11	0.	-1.471E-02	-4.380E-01	....	0.	0.
12	0.	-3.095E-03	-4.425E-01	....	0.	0.
13	0.	-2.056E-03	-4.418E-01	....	0.	0.
14	0.	6.516E-04	-4.356E-01	....	0.	0.
15	0.	9.527E-04	-4.334E-01	....	0.	0.
16	0.	1.146E-03	-3.614E-01	....	0.	0.
17	0.	1.278E-03	-2.748E-01	....	0.	0.
18	0.	-7.979E-04	-3.605E-01	....	0.	0.
19	0.	-1.104E-03	-4.848E-01	....	0.	0.
20	0.	-1.409E-03	-5.221E-01	....	0.	0.
21	0.	-2.422E-03	-4.752E-01	....	0.	0.
22	0.	-2.026E-03	-4.405E-01	....	0.	0.
23	0.	-1.532E-03	-3.481E-01	....	0.	0.
24	0.	-5.929E-02	-4.353E-01	....	0.	0.
25	0.	-2.513E-02	-4.416E-01	....	0.	0.
26	0.	-3.434E-03	-4.431E-01	....	0.	0.
27	0.	-1.582E-03	-4.425E-01	....	0.	0.
28	0.	-6.233E-02	-4.313E-01	....	0.	0.
29	0.	-4.322E-02	-4.413E-01	....	0.	0.
30	0.	-6.282E-03	-4.425E-01	....	0.	0.
31	0.	-7.854E-02	-4.368E-01	....	0.	0.
32	0.	-8.875E-02	4.424E-01	....	0.	0.
33	0.	-7.645E-02	-4.338E-01	....	0.	0.
34	0.	-7.690E-02	-4.544E-01	....	0.	0.
35	0.	-7.723E-02	-3.604E-01	....	0.	0.
36	0.	-6.564E-02	-1.762E-01	....	0.	0.
37	0.	-1.443E-02	-4.335E-01	....	0.	0.
38	0.	0.	0.	0.	0.	0.
39	0.	-2.781E-03	-4.909E-01	....	0.	0.
40	0.	-1.828E-03	-3.516E-01	....	0.	0.
41	0.	0.	0.	0.	0.	0.
42	0.	-4.804E-02	-4.358E-01	....	0.	0.
43	0.	-1.863E-02	-1.923E-01	....	0.	0.
44	0.	-1.022E-02	-4.917E-01	....	0.	0.
45	0.	-2.983E-04	-3.527E-01	....	0.	0.
46	0.	-4.767E-02	-4.210E-01	....	0.	0.
47	0.	-1.826E-02	-1.751E-01	....	0.	0.
48	0.	-7.680E-02	-1.947E-01	....	0.	0.
49	0.	-4.491E-02	-1.955E-01	....	0.	0.
50	0.	1.400E-03	-1.752E-01	....	0.	0.
51	0.	-7.880E-02	-4.366E-01	....	0.	0.
52	0.	-7.949E-02	-3.835E-01	....	0.	0.
53	0.	-7.968E-02	-4.357E-01	....	0.	0.
54	0.	-1.005E-01	-4.544E-01	....	0.	0.
55	0.	-4.012E-02	-1.757E-01	....	0.	0.
56	0.	4.127E-03	-1.960E-01	....	0.	0.
57	0.	-1.042E-02	-4.317E-01	....	0.	0.
58	0.	-1.147E-02	-2.834E-01	....	0.	0.
59	0.	0.	0.	0.	0.	0.
60	0.	-4.423E-02	-4.428E-01	....	0.	0.
61	0.	-4.413E-02	-3.873E-01	....	0.	0.
62	0.	-2.639E-02	-3.814E-01	....	0.	0.
63	0.	-2.628E-02	-4.910E-01	....	0.	0.
64	0.	-2.620E-02	-3.522E-01	....	0.	0.

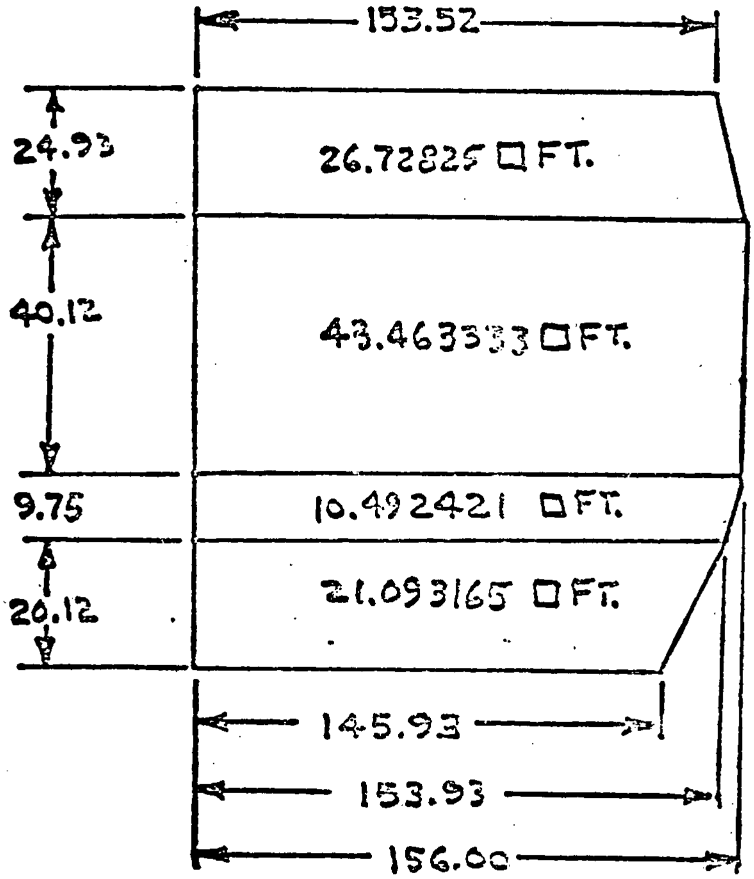
TABLE 5

SECTION 10 MODAL DISPLACEMENTS

APPENDIX I

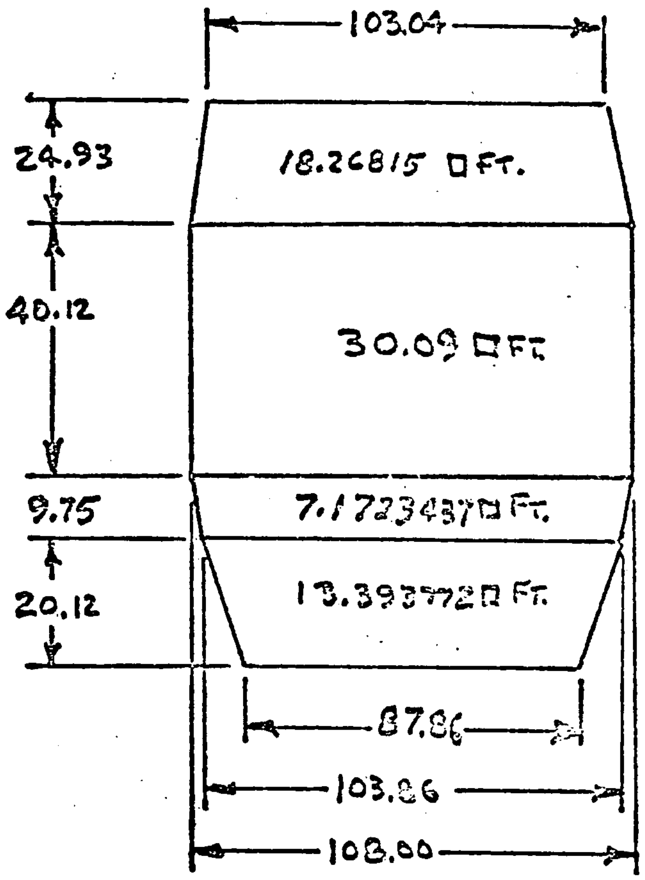
TABULATED WEIGHTS SUPPLIED BY CIRCLE AW

SHIPPING SECTION 1



AREA OF FRONT PANEL = 101.84174 □FT.
WEIGHT OF .25 THICK STEEL = 10.20#/□FT.
GROSS WEIGHT OF FRONT PANEL = 1038.7857#
NET WEIGHT OF FRONT PANEL = 719.6488
SHEET 3 WEIGHT = 659.005
SHEET 4 WEIGHT = 4677.9677
TOTAL WEIGHT OF SHIPPING SECTION 1 = 6056.6215#

SHIPPING SECTION 2



AREA OF FRONT PANEL = 68.924264

WEIGHT OF .25 THICK STEEL = 10.20#/□FT

GROSS WEIGHT OF FRONT PANEL = 703.0275#

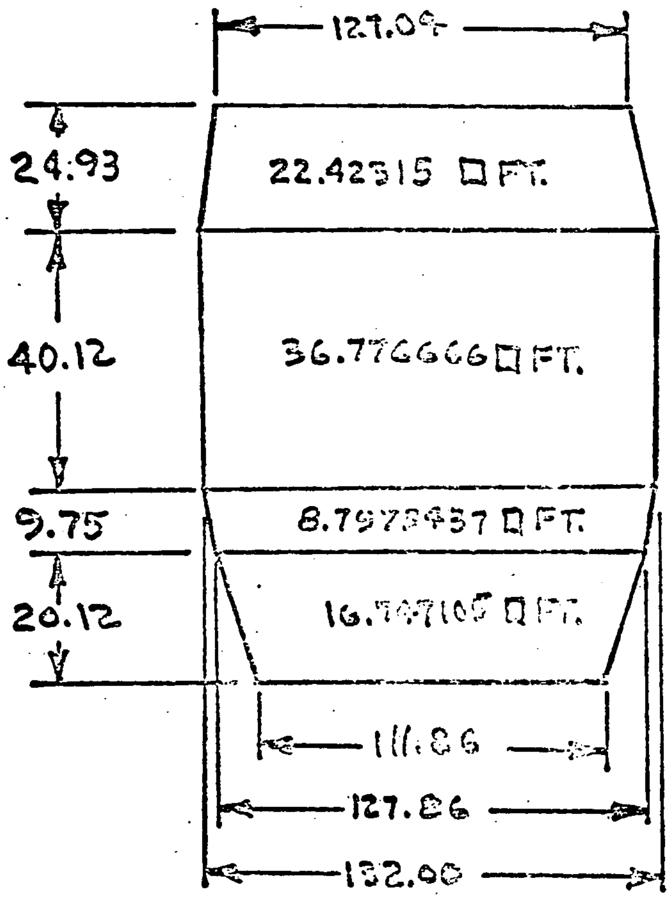
NET WEIGHT OF FRONT PANEL = 454.04629#

SHEET 3 WEIGHT = 643.54#

SHEET 4 WEIGHT = 3476.3759#

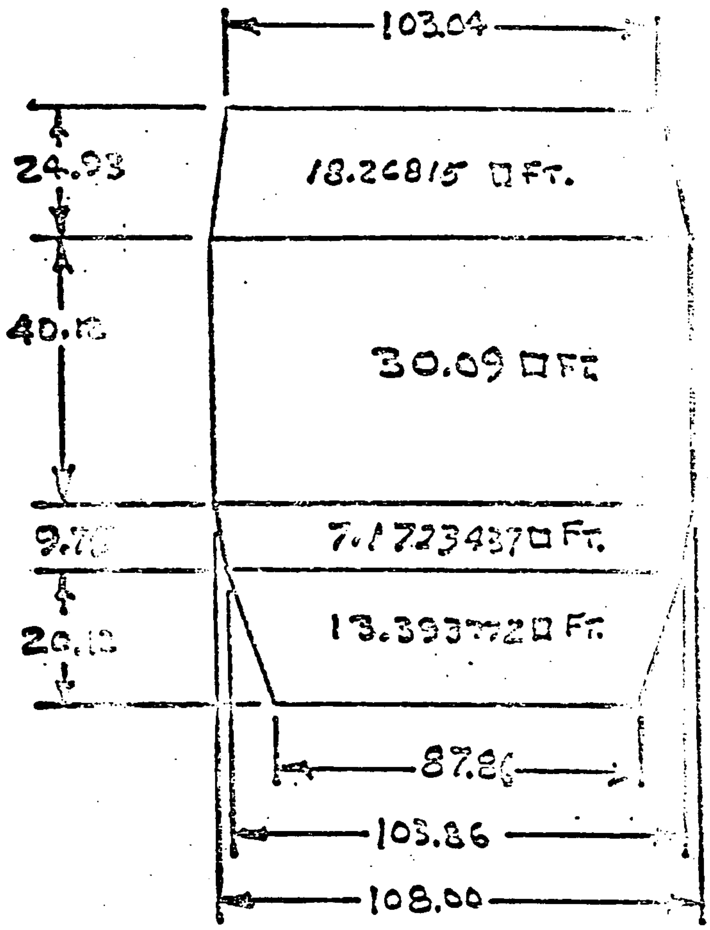
TOTAL WEIGHT OF SHIPPING SECT. 2 = 4573.962#

SHIPPING SECTION 3



AREA OF FRONT PANEL = 84.744264 □FT.
WEIGHT OF .25 THICK STEEL = 10.20 #/□FT.
GROSS WEIGHT OF FRONT PANEL = 864.39149#
NET WEIGHT OF FRONT PANEL = 551.35917#
SHEET 5 WEIGHT = 635.71#
SHEET 6 WEIGHT = 3894.9791#
TOTAL WEIGHT OF SHIPPING SECTION 3 = 5082.0482#

SHIPPING SECTION 4.



AREA OF FRONT PANEL = 68.924264

WEIGHT OF .25 THICK STEEL = 10.20 #/□FT.

GROSS WEIGHT OF FRONT PANEL = 703.0275 #

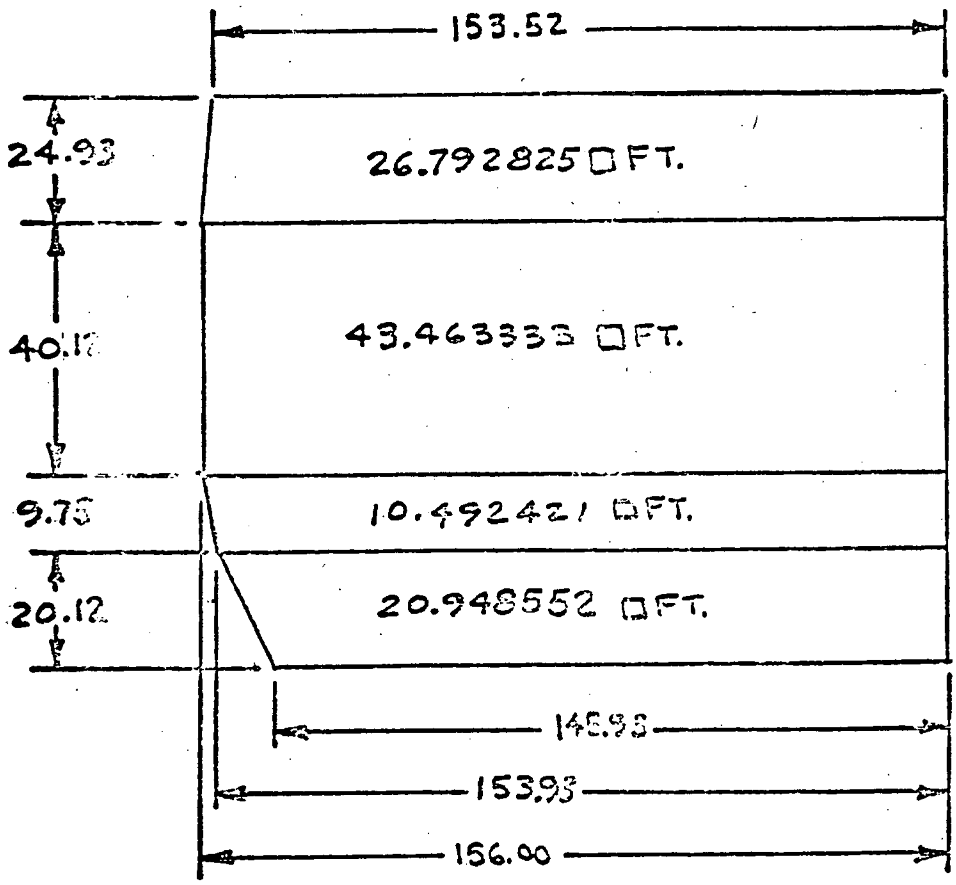
NET WEIGHT OF FRONT PANEL = 442.66133 #

SHEET 3 WEIGHT = 578.82 #

SHEET 4 WEIGHT = 3709.2544

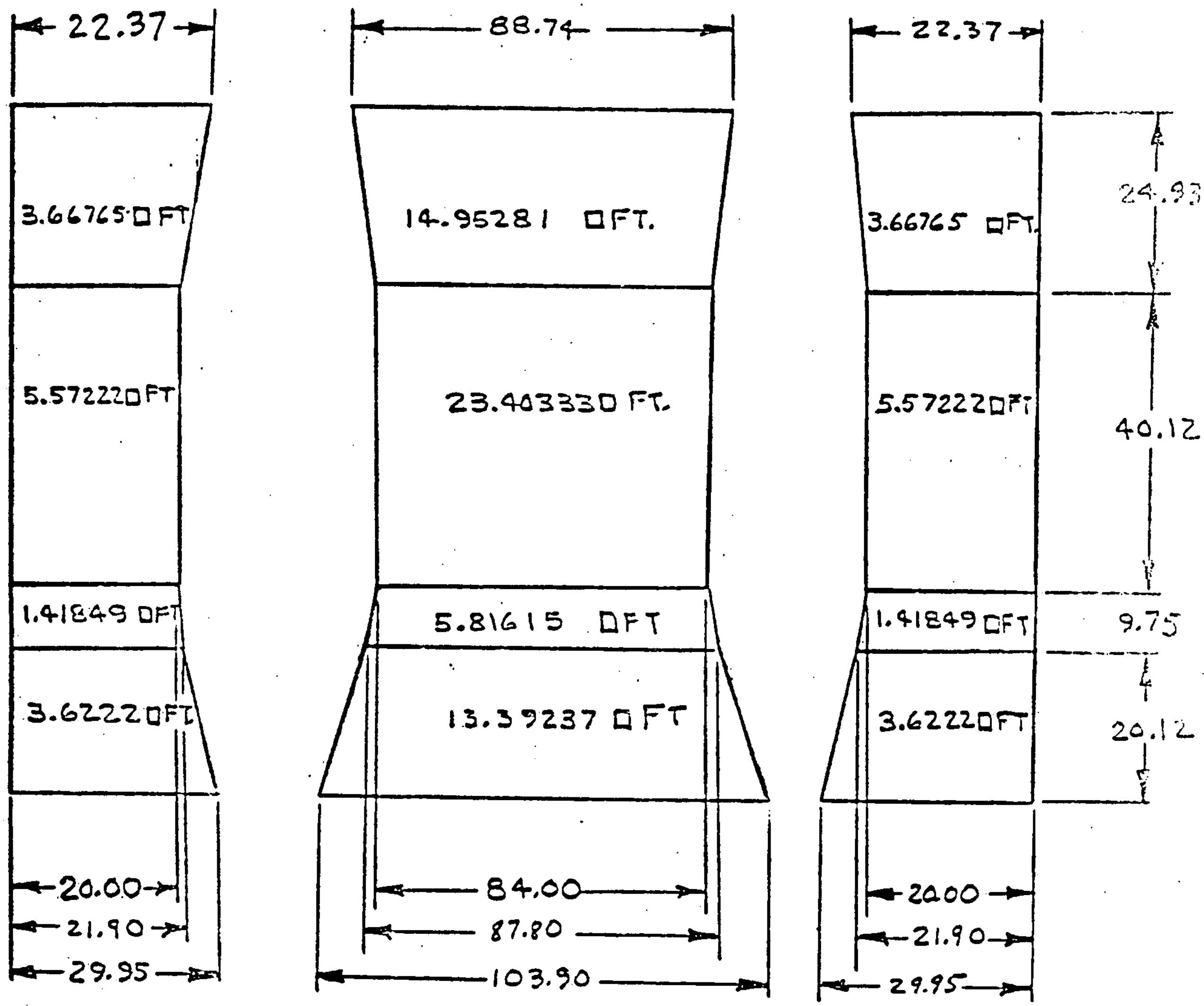
TOTAL WEIGHT OF SHIPPING SECT. 4 = 4730.7357

SHIPPING SECTION 5



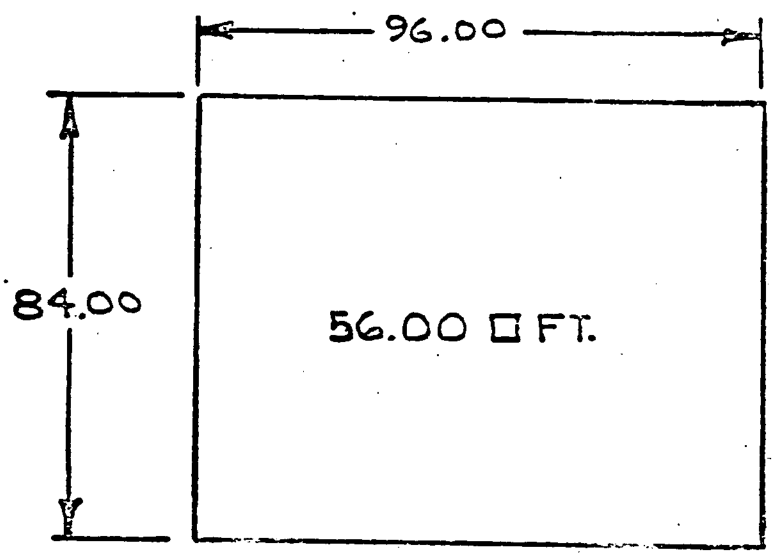
TOTAL AREA OF INSTRUMENT PANEL = 101.69713
WEIGHT OF INSTRUMENT PANEL = 1037.3107
NET WEIGHT OF INSTRUMENT PANEL = 698.7615
WEIGHT OF INSTRUMENTS = 828.80
WEIGHT OF STRUCTURE = 4499.3753
TOTAL WEIGHT OF SHIPPING SECTION 5 = 6026.9368

SHIPPING SECTION 6



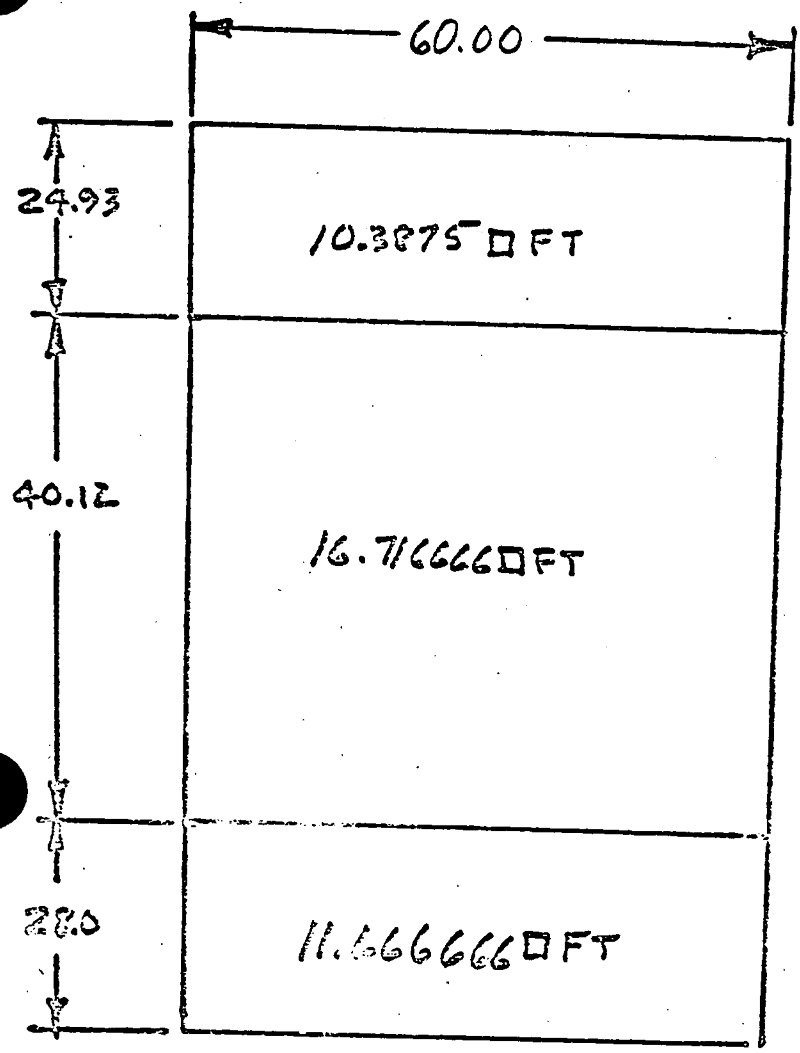
TOTAL AREA OF INSTRUMENT PANEL = 86.12578 □FT.
WEIGHT OF INSTRUMENT PANEL = 878.4829 LBS.
WEIGHT OF INSTRUMENT CUTOUTS = 175.14128 LBS.
NET WEIGHT OF INSTRUMENT PANEL = 703.34162 LBS.
WEIGHT OF INSTRUMENTS (SHEET 3) = 459.62 LBS
WEIGHT OF STRUCTURE (SHEET 4) = 2507.1608 LBS
TOTAL WEIGHT OF SHIPPING SECTION 6 = 3670.1224 LBS.

SHIPPING SECTION 7



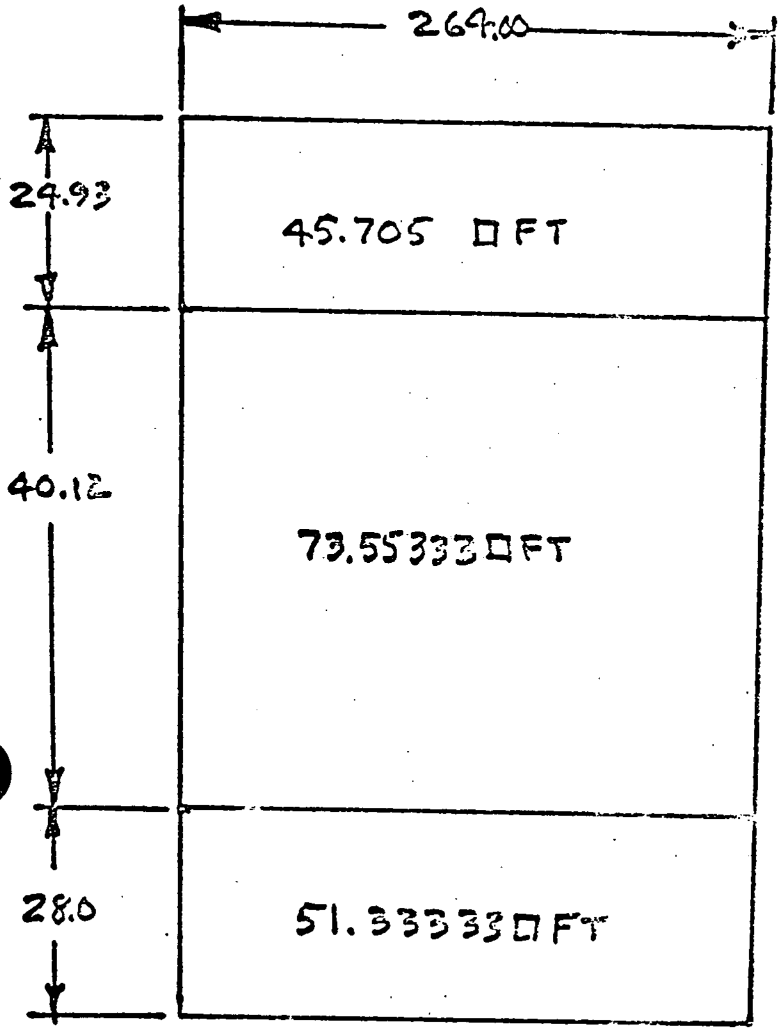
TOTAL AREA OF INSTRUMENT PANEL	= 56.00 □ FT.
WEIGHT OF INSTRUMENT PANEL	= 571.20 LBS.
WEIGHT OF INSTRUMENT CUTOUTS	= 135.59502 LBS.
NET WEIGHT OF INSTRUMENT PANEL	= 435.6049 LBS.
WEIGHT OF INSTRUMENTS	= 424.72 LBS.
WEIGHT OF STRUCTURE	= 1610.238 LBS.
TOTAL WEIGHT OF SHIPPING SECT.	= ~~2370.5629~~ LBS. 2470.5629 LBS

SHIPPING SECTION 8



AREA OF FRONT PANEL = 38.770832 □ FT.
WEIGHT OF .25 THICK STEEL = 10.20 #/□ FT.
GROSS WEIGHT OF FRONT PANEL = 395.46247#
NET WEIGHT OF FRONT PANEL = 283.03709#
PLUS SHEET 3 = 357.4#
" SHEET 4 = 2035.9167#
SHIPPING SECT. 8 TOTAL WT. = 2676.35#

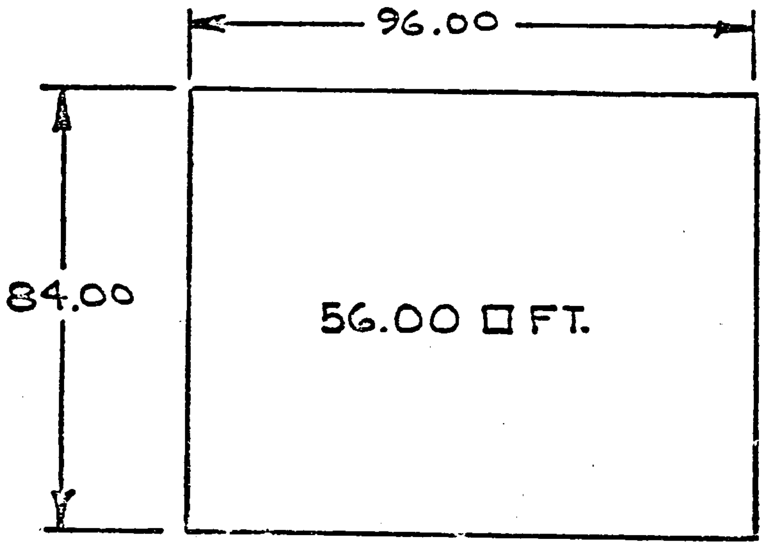
SHIPPING SECTION 9



AREA OF FRONT PANEL = 170.59166 □FT.
WEIGHT OF .25 THICK STEEL = 10.20 #/□FT.
GROSS WEIGHT OF FRONT PANEL = 1740.0349#
NET WEIGHT OF FRONT PANEL = 1320.032#
PLUS SHEET 3 = 978.07
PLUS SHEET 4 = 8360.6589

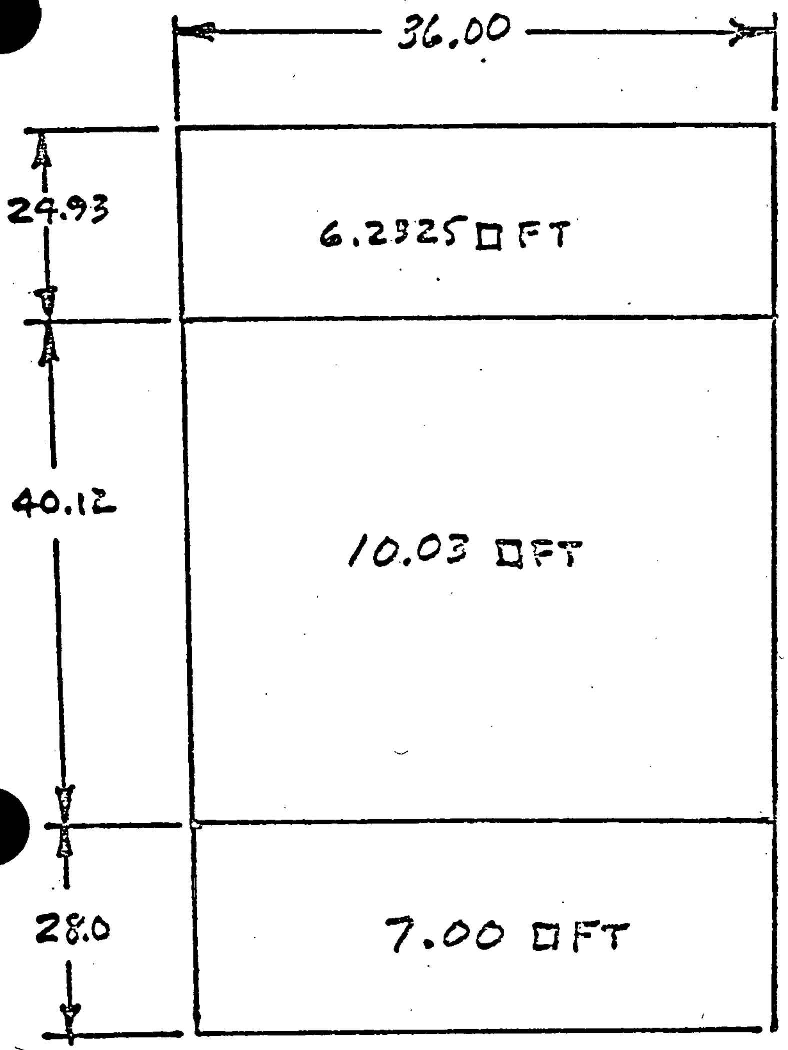
TOTAL WT. OF SHIPPING SECT. 9 = 10658.76#

SHIPPING SECTION 10



TOTAL AREA OF INSTRUMENT PANEL	= 56.00 □ FT.
WEIGHT OF INSTRUMENT PANEL	= 571.20 LBS.
WEIGHT OF INSTRUMENT CUTOUTS	= 163.91524 LBS.
NET WEIGHT OF INSTRUMENT PANEL	= 407.28476 LBS.
WEIGHT OF INSTRUMENTS	= 671.48 LBS.
WEIGHT OF STRUCTURE	= 1618.5688 LBS.
TOTAL WEIGHT OF SHIPPING SECT.	= 2697.3335 LBS.

SHIPPING SECTION 17



AREA OF FRONT PANEL = 23.2625 □FT.
WEIGHT OF .25 THICK STEEL = 10.20 #/□FT.
GROSS WEIGHT OF FRONT PANEL = 237.2775#
NET WEIGHT OF FRONT PANEL = 165.20902#
SHEET 3 = 214.92#
SHEET 4 = 1319.3982#
SHIPPING SECTION 17 TOTAL WT. 1699.53#

TEST REPORT

WYLE LABORATORIES /Norco, California . 737-0871 , 689-2104 . TWX 910-332-1204 . Cable WYLAB

REPORT NO. 54498
OUR JOB NO. ND 54498
YOUR P.O. NO. 7651
CONTRACT ----

60 - Page Report

JELCO, INC.
P. O. Box 2248
Pomona, California 91766

DATE 31 March 1976

SEISMIC TESTING

ON

ONE CONTROL PANEL

PART NUMBER 2/3 CR-62

FOR

JELCO, INC.

SUPERCEDES SØ23-SO2-S-120

REGISTERED PROFESSIONAL ENGINEER GEORGE D. SHIPWAY No. 12157 MECHANICAL STATE OF CALIFORNIA

SØ23-502-5-501-0 SCE#0376

STATE OF CALIFORNIA } ss.
COUNTY OF RIVERSIDE }

Roy C. Sadlier, being duly sworn, deposes and says: That the information contained in this report is the result of complete and carefully conducted tests and is to the best of his knowledge true and correct in all respects.

Roy C. Sadlier

SUBSCRIBED and sworn to before me this 31st day of March, 19 76

Catherine C. Kelty

Notary Public in and for the County of Riverside, State of California

My Commission expires February, 19 79

OFFICIAL SEAL CATHERINE C. KELTY NOTARY PUBLIC - CALIFORNIA RIVERSIDE COUNTY

70

W-867A

DEPARTMENT DYNAMICS

DEPT. MGR. J. J. Anderson

TEST ENGINEER W. Franz — Wayne Franz

Registered Professional Engineer G. D. Shipway — George D. Shipway

DCAS-QAR VERIFICATION

QUALITY CONTROL A. Heeseman

1.0 REFERENCES

1.1 Jelco, Inc. Purchase Order 7651.

1.2 Bechtel Specification Number S023-502-5, Appendix 4F.

1.3 Bechtel Drawing Number 53018-C, entitled "Control Panel Layout Chemical and Volume Control, Reactor Coolant and Reactivity Systems Shipping Section 3".

1.4 Bechtel Drawing Number 53022-C, titled "Control Panel Layout Chemical Control Shipping Section 7".

1.5 Wyle Laboratories Test Procedure No. 3570, Revision A

2.0 GENERAL

Although Reference 1.1 above is applicable to the testing of two control panel specimens, namely, shipping section No. 7, and shipping section No. 3, only the testing of the former is described in this document. An addendum shall be issued to cover the testing performed on the latter. These steps are necessary due to an anticipated time lapse in the testing of the latter; however, the procedures described herein shall be identically applicable to shipping section No. 3, except for the mounting methods.

3.0 PROCEDURES

3.1 Receiving Inspection

Prior to testing, the specimen, shipping section No. 7, was subjected to a visual examination for evidence of shipping damage. Specimen identification information was recorded on a receiving inspection data sheet included in the body of this report.

3.2 Test Fixture and Specimen Orientations

The specimen base was welded to a one-inch thick steel interface plate which, in turn, was welded to the test machine table. Two inch long welds (1/4-inch fillets) were employed on the outer periphery of the specimen at eight-inch spacing increments to simulate the in-service mounting method. No welds were placed along the open end.

With the specimen in its normal upright position, its lateral axis was initially aligned parallel to the horizontal test machine driver axis. For the second test orientation the specimen was rotated ninety degrees about its vertical centerline such that its longitudinal axis was aligned with the horizontal driver. The specimen remained in its normal upright position throughout testing. Axis definitions are presented in Figure 1. The actual setups are shown in the attached photographs.

3.3 Instrumentation

3.3.1 Accelerometers

Twenty accelerometers were attached to the specimen near the mounting points for each instrument in the panel assembly. The orientations, and in some cases, the locations of the accelerometers were changed to suit each individual test run. The locations and orientations of each are shown in Figure 1 and Table I. These accelerometer data were recorded for each test run on a galvanometer recorder system.

3.3.2 Strain Gages

Four strain gages were mounted near the base of the specimen, two on the open end structure, and two on the inside rear center vertical support strut. A sketch of these locations is presented in Figure 2. All the gages were oriented vertically to measure cantilever type bending strains. Strains for all the test setups were also continuously recorded via a galvanometer recorder system.

3.4 Functional Test

No electrical functional tests were conducted. The panel was simply assembled with dummy weights fabricated by Wyle Laboratories. The weights, composed of wood and steel, were designed to simulate the weight, center of gravity, and mounting method for each instrument at its proper location. The dummies are depicted in the attached photographs.

3.5 Seismic Testing

3.5.1 Resonance Search

The specimen was subjected to sinusoidal sweep testing in the frequency range of from 1 to 35 to 1 Hz.

A logarithmic frequency sweep rate of one-half octave per minute was employed at an input level of 0.2g peak.

This type test was performed uniaxially in the three principal axes, one at a time.

3.5.2 Random and Superimposed Sine Beat

Following iterative "bare table" motion calibrations the specimen was subjected to biaxially applied random motions with biaxial sine beat motions superimposed at specific frequencies.

The biaxial random motions were amplitude controlled with a series of adjustable attenuation filters tuned to discrete frequencies in one-third octave increments from 1.25 to 35 Hz. Ten oscillation-per-beat sine beats were superimposed on the random excitation at frequencies of 1.6, 2.0, and 2.5 Hz.

Twenty oscillations-per-beat sine beats were employed at 1.25 Hz. One, three, and five beats per frequency were used for the 1.25 to 2.5 Hz test conditions, respectively, with a two-second interbeat delay.

Each test run consisted of thirty seconds of random excitation with the aforementioned appropriate sine beat excitations superimposed. A separate test run was made for each of two sine beat phasing conditions; i.e., the horizontal and vertical test machine drivers in phase and the two drivers 180° out of phase. The horizontal/vertical random waveform excitations were phase incoherent throughout the testing sequence.

3.5.2 (continued)

The test response spectra were determined with the use of a shock spectra analyser, tuned in one-twelfth octave frequency increments from 1 to 100 Hz. The data were formatted in plots of peak acceleration versus frequency.

3.5.3 Test Sequence

The detailed sequence following in the conduction of the test is given below.

3.5.3.1 Calibrated the biaxial seismic input motion so that an analysis of the random signal and the four sine beats enveloped the required response spectra.

3.5.3.2 Installed the specimen into the test setup as previously described.

3.5.3.3 Installed the instrumentation which is called out in Paragraph 3.3 and verified that it was being recorded on an oscillograph.

3.5.3.4 Conducted a sine sweep resonance search in the lateral axis as detailed in Paragraph 3.5.1.

3.5.3.5 Conducted a sine sweep resonance search in the vertical axis.

3.5.3.6 Input the 30 seconds of biaxial seismic motion as detailed in Paragraph 3.5.2, with the 1.25 Hz sine beat superimposed; first with horizontal and vertical drivers in phase and then repeated the test with the drivers out of phase.

3.5.3.7 Repeated Paragraph 3.5.3.6 only input the sine beats at 1.6 Hz.

3.5.3.8 Repeated Paragraph 3.5.3.6 only input the sine beats at 2.0 Hz.

3.5.3.9 Repeated Paragraph 3.5.3.6 only input the sine beats at 2.5 Hz. Reoriented the specimen so that its longitudinal axis was parallel to the horizontal axis of excitation. Reoriented the appropriate accelerometers to coincide with the horizontal excitation axis.

3.5.3.10 Conducted a sine sweep as detailed in Paragraph 3.5.1 in the horizontal axis.

3.5.3.11 Repeated Paragraphs 3.5.3.6 through 3.5.3.9

4.0 RESULTS

4.1 Receiving Inspection

Inspection of the specimen revealed no visible damage due to shipping. Receiving inspection data and specimen identification are shown on a following data sheet.

4.2 Test Fixtures

No visible evidence of fixture or mounting method anomalies occurred.

4.3 Functional Tests

No visible anomalies occurred in the dummy weights or their mounting methods.

4.4 Seismic Tests

4.4.1 Resonance Searches

Resonance behavior was observed at 17.5 Hz during the lateral axis test only. All the accelerometers displayed this behavior except number five, mounted inside on a low strut. The highest responses occurred at the top open end and at the number seven and eight accelerometer locations on the instrument mounting panel. The response values are tabulated in Table II (Page 9) for these conditions.

4.4.2 Random with Sine Beats

4.4.2.1 Test Response Spectra (TRS)

The required response spectra (RRS) were enveloped by the TRS, for each sine beat condition, as shown in the attached plots. Peak table input acceleration values (ZPA) varied from 1.1 to 2.6 for the horizontal test axis; the maximum occurring at

4.4.2.1 (continued)

the 1.25 Hz in phase sine be[illegible] condition (Z-Y axes). For th[illegible] vertical axis, the ZPA varie[illegible] from about 1.3 to 2.0g; the maximum occurring in the Z-Y [illegible]xis at the 1.6 Hz out of pha[illegible] sine beat condition.

4.4.2.2 Instrument Location Accelera[illegible]ions

The maximum output of each [illegible]ponse accelerometer for the 2 Hz out of phase sine beat [illegible]mic test condition in the Z-[illegible] axes plane is also shown i[illegible]ble II, Page 9.

These data consist of the [illegible]al peak accelerations at eac[illegible] accelerometer location, as [illegible]cribed in Table I, Page 3, f[illegible] input peak acceleration ([illegible]orizontal ZPA) value of 1.4g[illegible] Thus, the requirement which [illegible]ates that no device input accelera- tion shall exceed 3.0g is m[illegible].

The 2.5 Hz sine beat conditi[illegible] in the Z-Y axes was chosen for [illegible] this tabulation since only o[illegible] cabinet resonance was detected, namely, 17.5 Hz in the Z di[illegible]tion; therefore, the highest fre- quency Z-Y axes sine beat wa[illegible] chosen to be nearest the reson[illegible] point such that the respon[illegible] recorded would be the highest [illegible] amplification.

4.4.2.3 Strain Gages

No significant strains were measured throughout testing. Th[illegible] maximum strain recorded was [illegible] the order of 100 microinches per inch.

TABLE I

ACCELEROMETER LOCATIONS AND DIRECTIONS

Accelerometer Location (See Figure 1)	Accelerometer Number and Direction				
	Resonance Search			Seismic Random	
	Z Axis	Y Axis	X Axis	Z-Y Axis	X-Y Axis
A	3Z	3Y	3X	3Z	3X
B	6Z	6Y	6X	6Z	6X
C	7Z	7Y	7X	7Z	7X
D	8Z	8Y	8X	8Z	8X
E	9Z	9Z	9X	9Z	9Z
F	10Z	10Y	10X	10Z	10X
G	11Z	-	11X	11Z	11X
H	12Z	-	12X	12Z	12X
I	13Z	13Z	13X	13Z	13Z
J	14Z	14Y	14X	14Z	14X
K	15Z	15Y	15X	15Z	15X
L	16Z	16Y	16X	16Z	16X
M	17Z	17Z	-	17Z	17Z
N	18Z	18Y	-	18Z	-
O	19Z	19Y	19X	19Z	19X
P	20Z	20Y	20X	20Y	20X
Q	21Z	21Y	21X	21Y	21Y
R	22Z	22Y	22X	22Y	22Y
S	5Z	4Y	4X	4Y	4Y
T	-	5Y	5X	-	5Y
U	4Z	11Y	17X	5Y	18Y
V	-	12Y	18X	-	-

TABLE II

RESPONSE ACCELEROMETER DATA

Accelerometer Number	Z Axis Resonance Response in Peak g's (17.5Hz, 0.2g input)	Z-Y Axes Seismic* Response in Peak g's
3	1.6	0.96
4	1.3	1.54
5	0.2	1.54
6	1.4	1.54
7	2.0	1.74
8	1.8	1.74
9	1.4	Malfunctioned
10	1.3	1.40
11	1.2	1.40
12	Malfunctioned	1.40
13	1.2	Malfunctioned
14	1.0	1.16
15	1.1	1.54
16	1.0	1.54
17	1.0	1.74
18	0.7	1.54
19	1.0	1.74
20	1.5	1.54
21	1.6	1.54
22	1.6	1.54

* 2.5 Hz sine beat, out of phase, 1.4g horizontal TRS ZPA, 1.3g vertical TRS ZPA, seismic test conditions.

DATA SHEET

Customer JELCO Job No. 54498

Date 3-19-76

Specimen CONTROL PANEL (SHIPPING UNIT #7)

RECEIVING INSPECTION

No. of Specimens Received: ONE

Record identification information exactly as it appears on the tag or specimen:

Manufacturer: JELCO

Part Number: 2/8 CR-62

How does identification information appear: (name plate, tag, painted, imprinted, etc.)

CUSTOMER'S DRAWINGS

Serial Numbers:* N/A

Examination: Visual, for evidence of damage, poor workmanship, or other defects, and completeness of identification.

Inspection Results: There was no visible evidence of damage to the specimens unless noted below.

* If additional space is required for serial numbers, use an additional page, or reference first functional test data sheet (if applicable).

79

Inspected By [signature]

Sheet No. of

Approved [signature] Date: 3/29/76

W-614

Q.C. Form Approval [initials]

WYLE LABORATORIES

DATA SHEET

Report No. 54498

Page No. 11

CUSTOMER JELCO

Test Title: SEISMIC RANDOM WITH SINE BEATS

Specimen CONTROL PANEL

Part No. SEE REC INSP

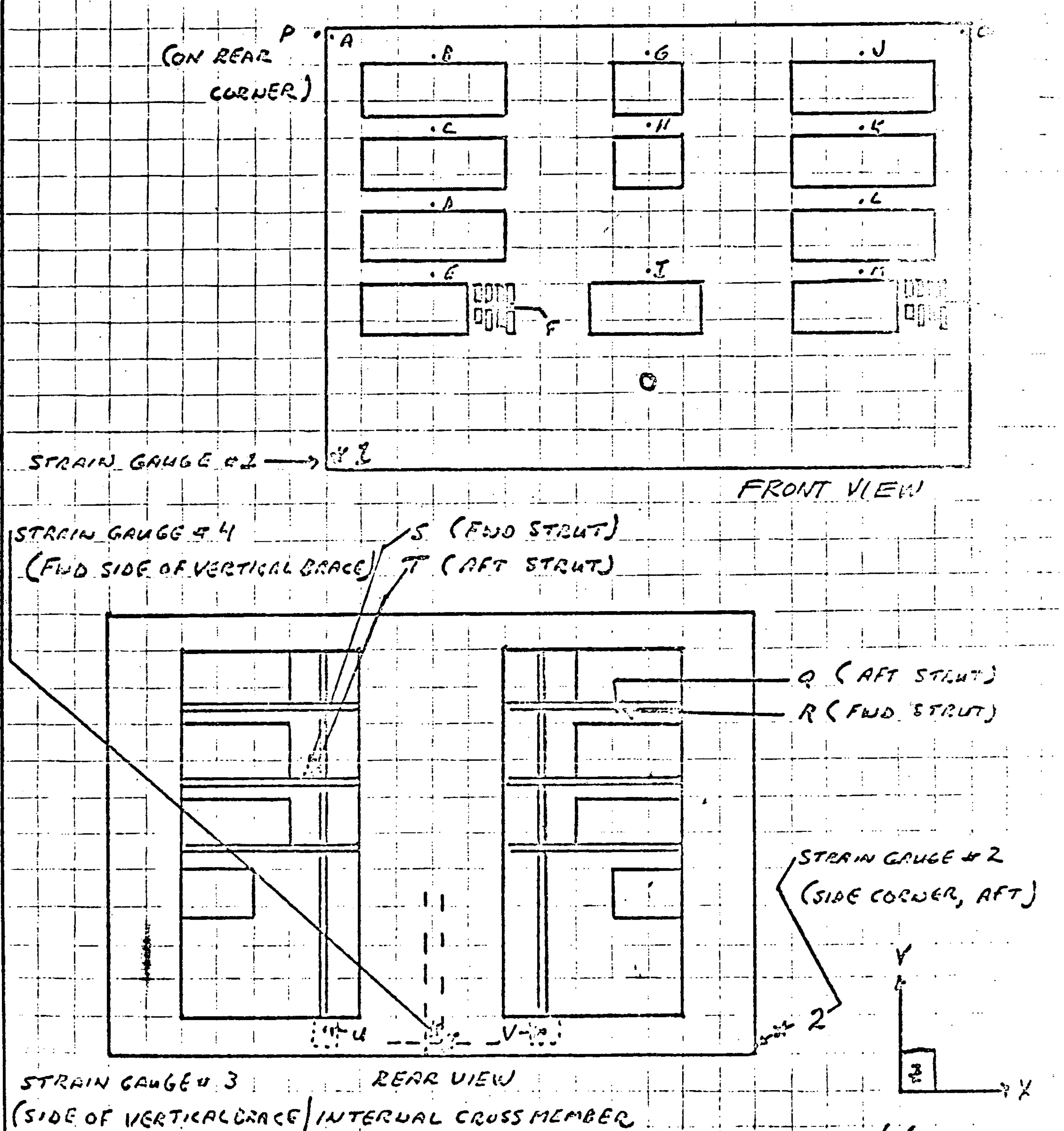
Job No. 54498

S/N SEE REC INSP

Date 5-24-75

FIGURE 1

ACCELEROMETER LOCATIONS (ALSO TABLE I) AND AXES



W 814 B

QC Form Approval

SHEET ____ OF ____

DATA SHEET

CUSTOMER JELCO
Test Title: SEISMIC RANDOM WITH SINE BEATS
Specimen CONTROL PANEL
Job No. 54498
S/N ——
Part No. SEE REC. INSP.
Date 3/24/76

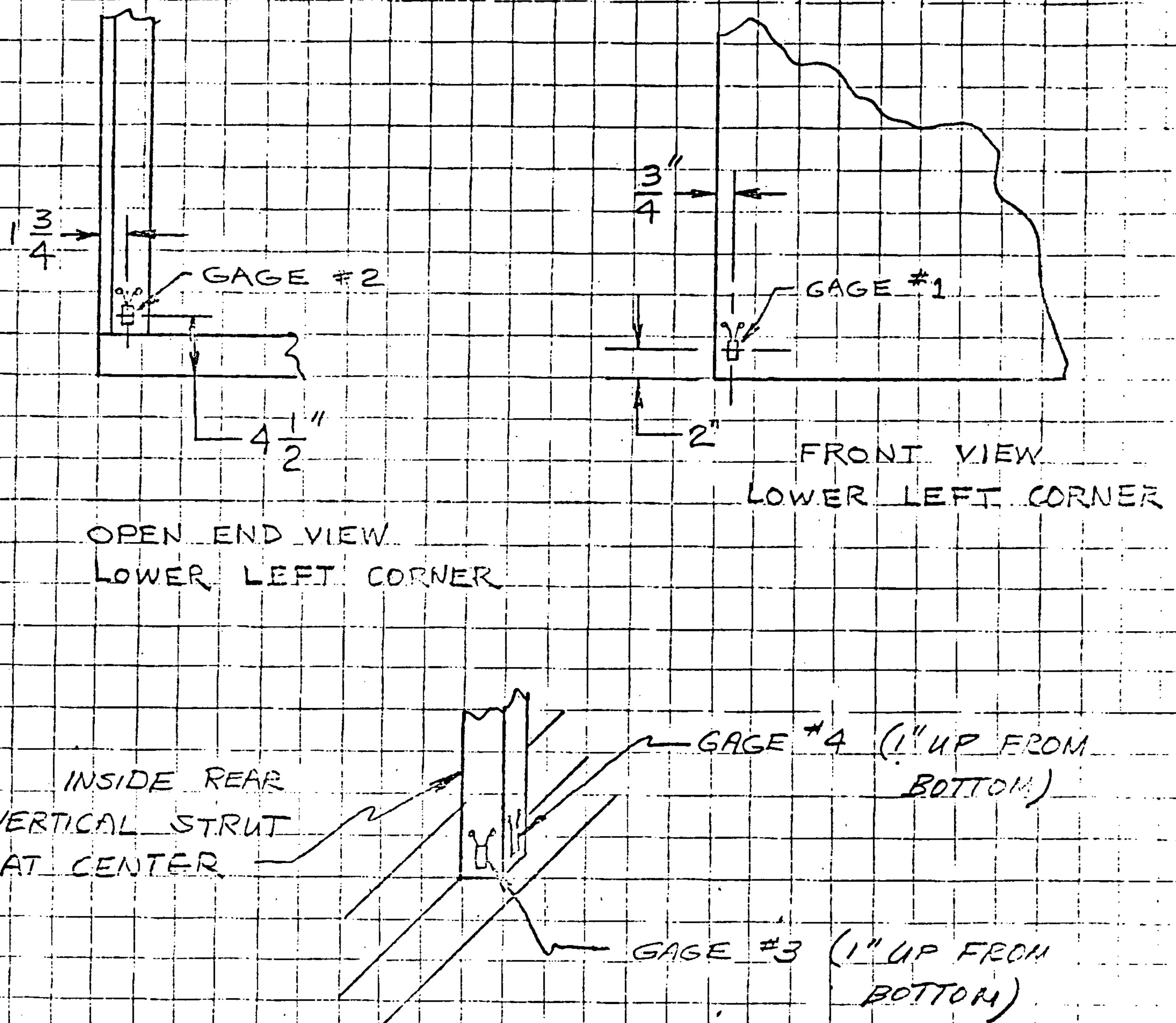


FIGURE 2
STRAIN GAGE LOCATION DETAILS

wf

WYLE LABORATORIES

Report No. 54498

Customer JELCO Job No. 54498

Page No. 13

Channel Identification: T/R 1 Trk. No. 1 Accel. No. 1

Transducer S/N 1143 Control (X). Response ( )

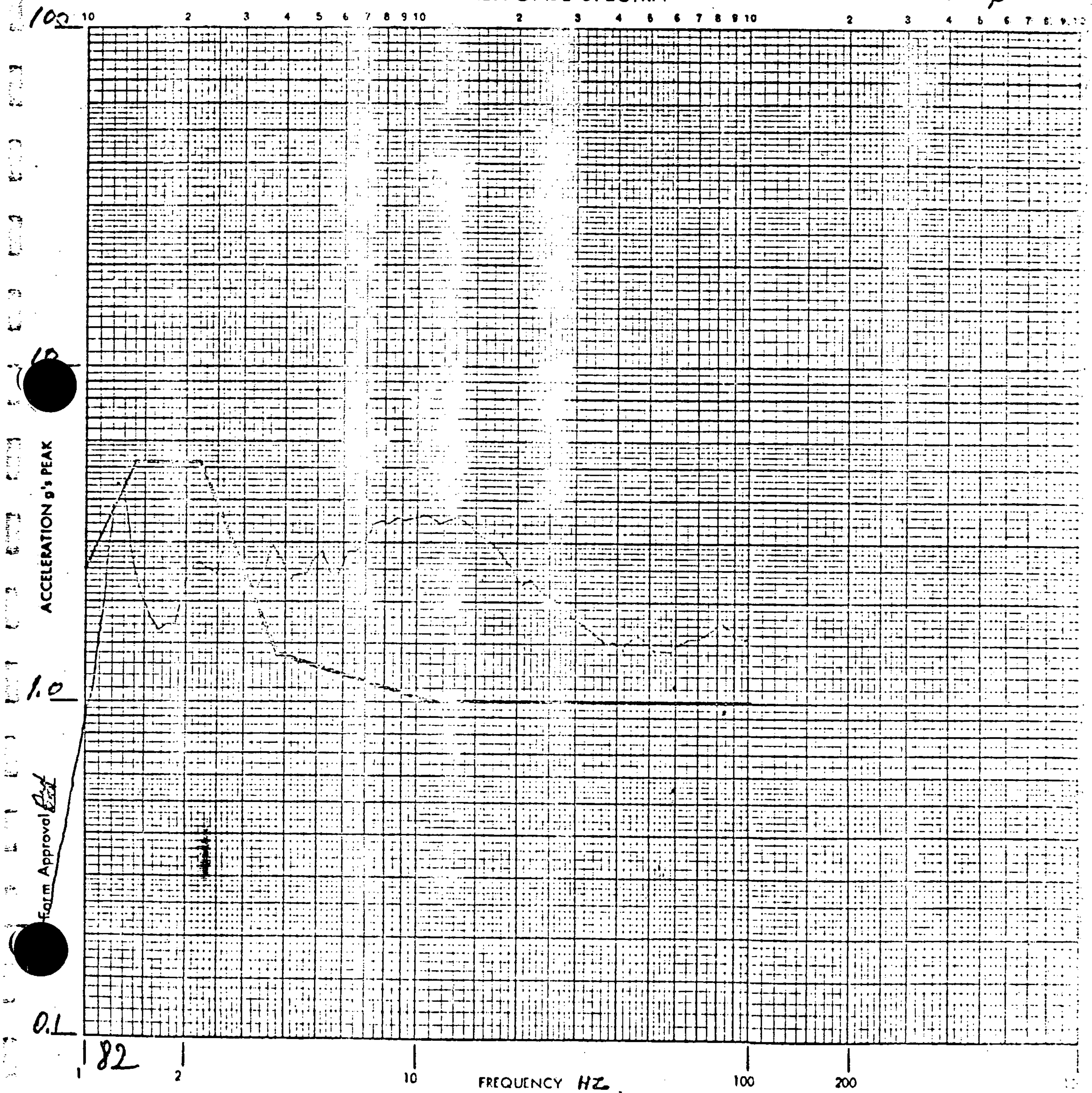
Full Scale 100 G Cal Voltage 500 MVPK/ 1.0 G

Mode PRIMARY Specimen CONTROL PANEL

Operator MEEHAN P/N 2/3CR-62 (UNIT 7)

Date 3/24/76 Polarity + Q 5% Axis of Test X-Y

HORIZONTAL RESPONSE SPECTRA 1.25 HZ IN ϕ



WYLE LABORATORIES

Report No. 54498

Customer JELCO Job No. 54498

Page No. 14

Channel Identification: T/R 1 Trk. No. 2 Accel. No. 2

Transducer S/N 1168 Control (X), Response ( )

Full Scale 100 G Cal Voltage 500 MVPK/ 1.0 G

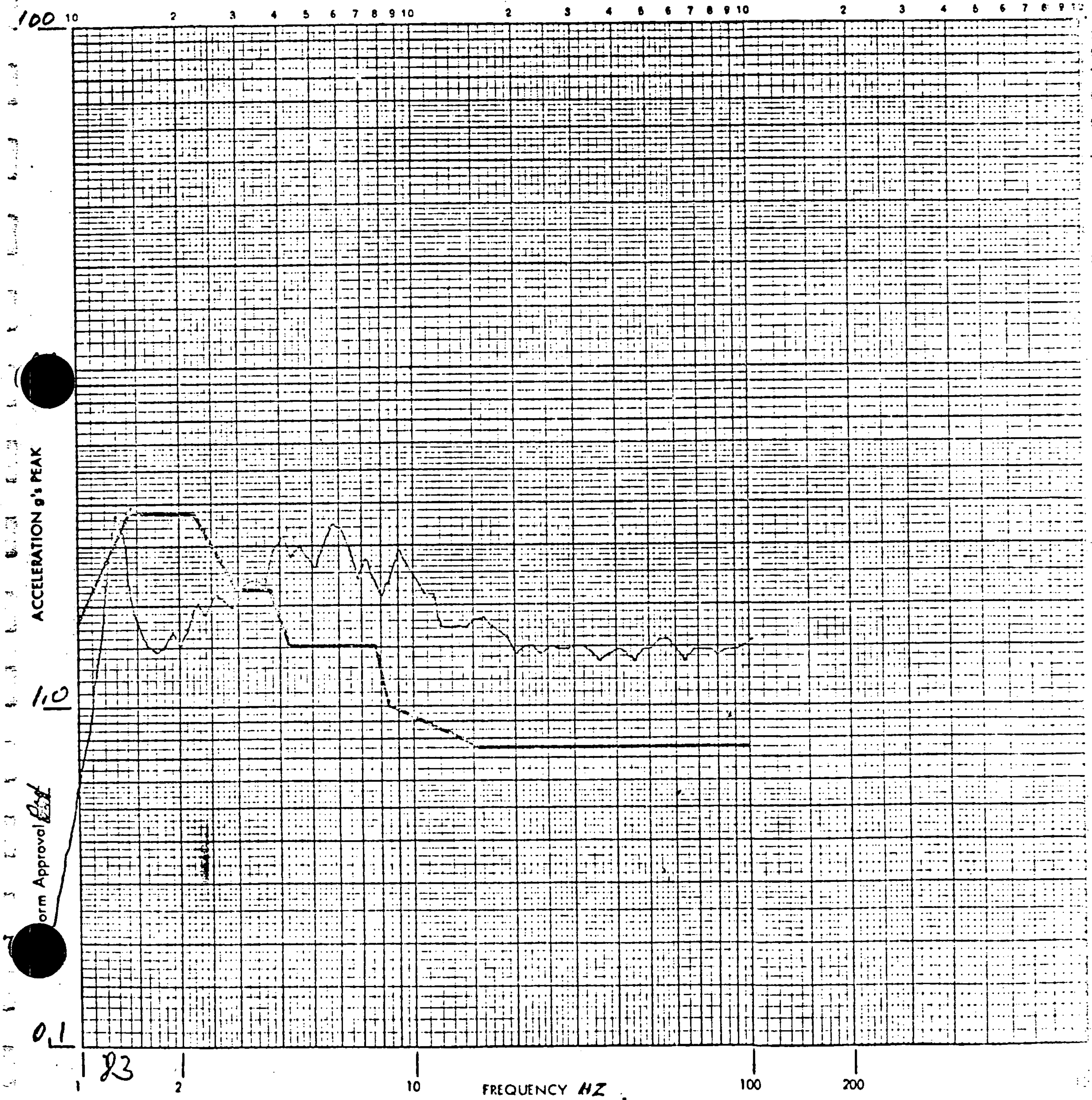
Mode PRIMARY Specimen CONTROL PANEL

Operator MEEHAN P/N 2/3CR-62 (UNIT 7)

Date 3/24/76 Polarity + Q 5% Axis of Test X-Y

125 HZ IN ϕ

VERTICAL RESPONSE SPECTRA



WYLE LABORATORIES

Report No. 54498

Customer JELCO Job No. 54498 Page No. 15

Channel Identification: T/R 1 Trk. No. 1 Accel. No. 1

Transducer S/N 1143 Control (X), Response ( )

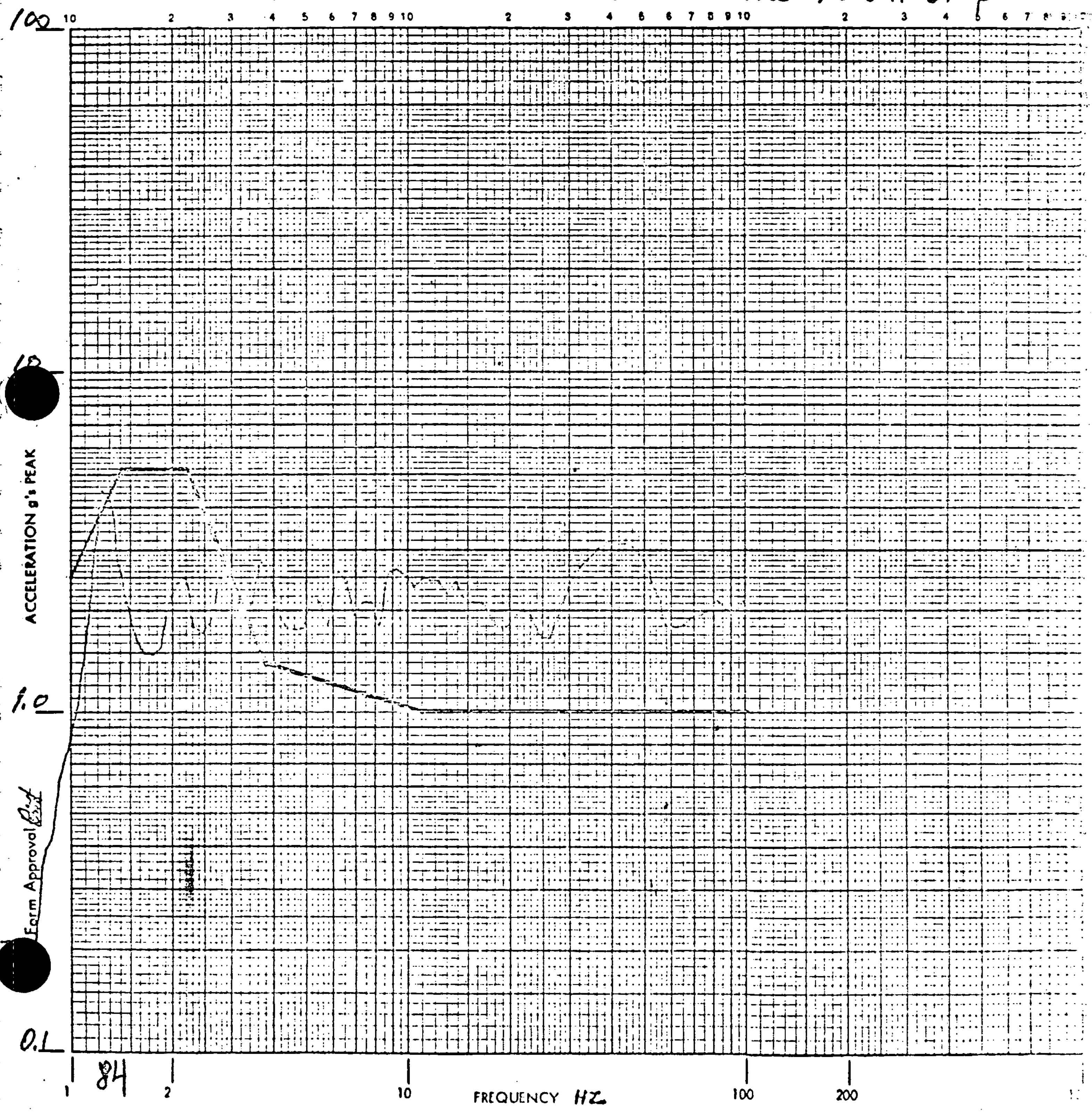
Full Scale 100 G Cal Voltage 500 MVPK/ 1.0 G

Mode PRIMARY Specimen CONTROL PANEL

Operator MEEHAN P/N 2/3CR-62 (UNIT 7)

Date 3/24/76 Polarity + Q 5% Axis of Test X-Y

HORIZONTAL RESPONSE SPECTRA 1.25 HZ OUT OF Φ



Customer JELCO Job No. 54498

Channel Identification: T/R 1 Trk. No. 2 Accel. No. 2

Transducer S/N 1168 Control (X), Response ( )

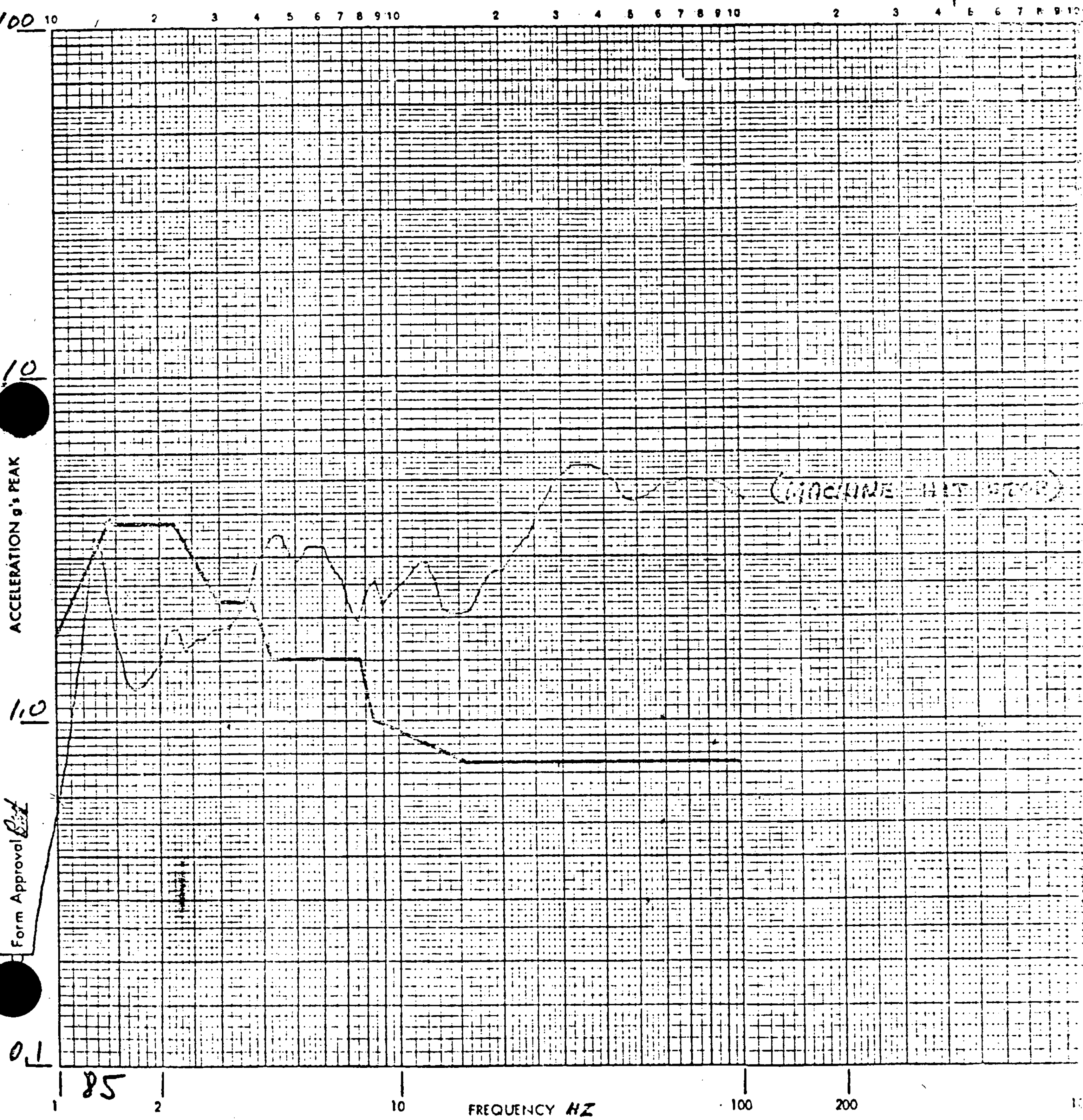
Full Scale 100 G Cal Voltage 500 MVPK/ 1.0 G

Mode PRIMARY Specimen CONTROL PANEL

Operator MEEHAN P/N 2/3CR-62 (UNIT ?)

Date 3/24/76 Polarity + Q 5% Axis of Test X-Y

VERTICAL RESPONSE SPECTRA 1.25HZ OUT OF ∅



WYLE LABORATORIES

Report No. 5...

Customer JELCO Job No. 54498

Page No.

Channel Identification: T/R 1 Trk. No. 1

Accel. No.

Transducer S/N 1143 Control (X).

Response

Full Scale 100 G Cal Voltage 500 MVPK/ 1.0 G

Mode PRIMARY

Specimen CON...

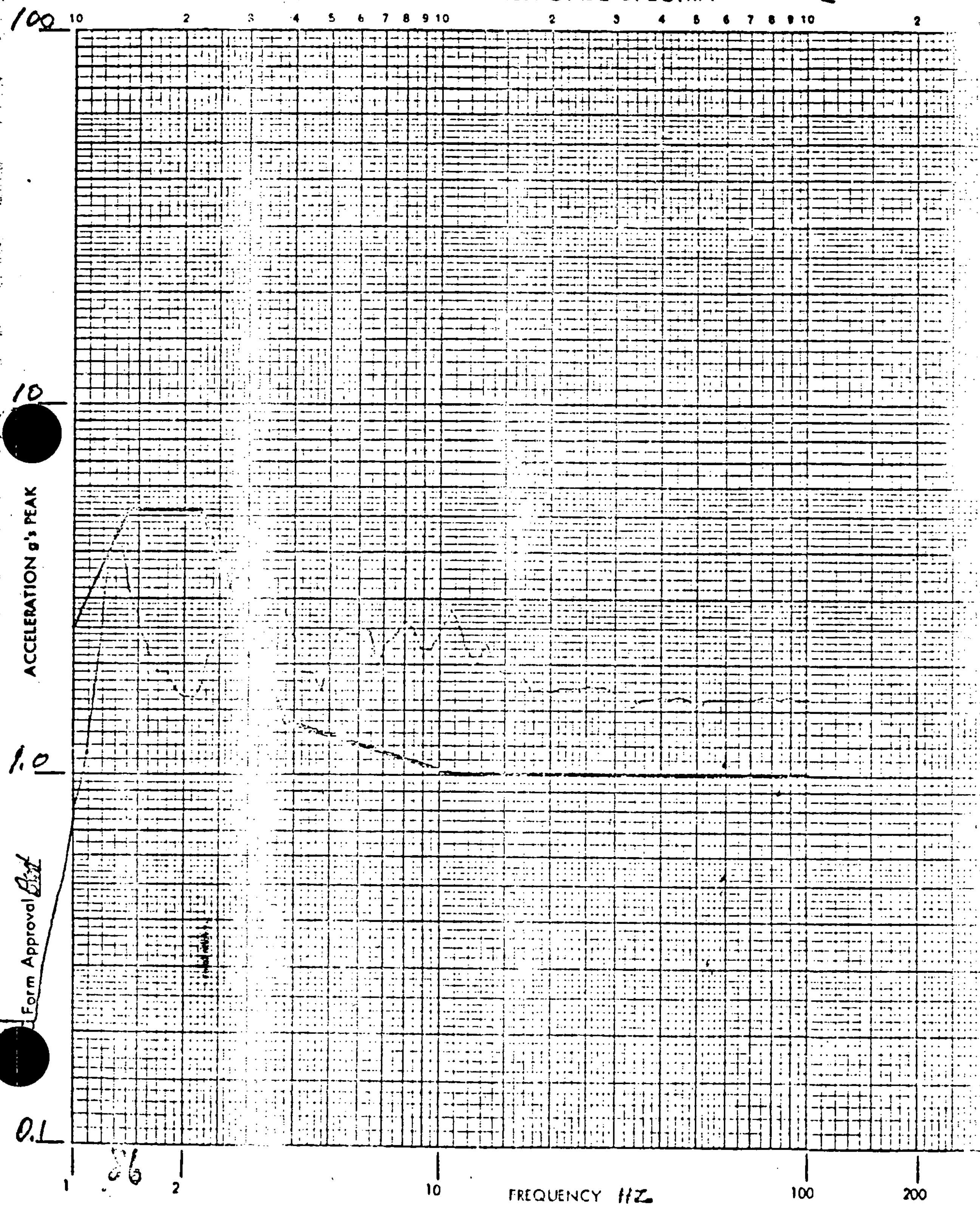
Operator MEEHAN

P/N 2/...

Date 3/26/76 Polarity + Q 5%

Axis of Test X

HORIZONTAL RESPONSE SPECTRA 2ND 1.25



Form Approval

WYLE LABORATORIES

Report No. 54498

Customer JELCO Job No. 54498 Page No. 18

Channel Identification: T/R 1 Trk. No. 2 Accel. No. 2

Transducer S/N 1168 Control (X), Response ( )

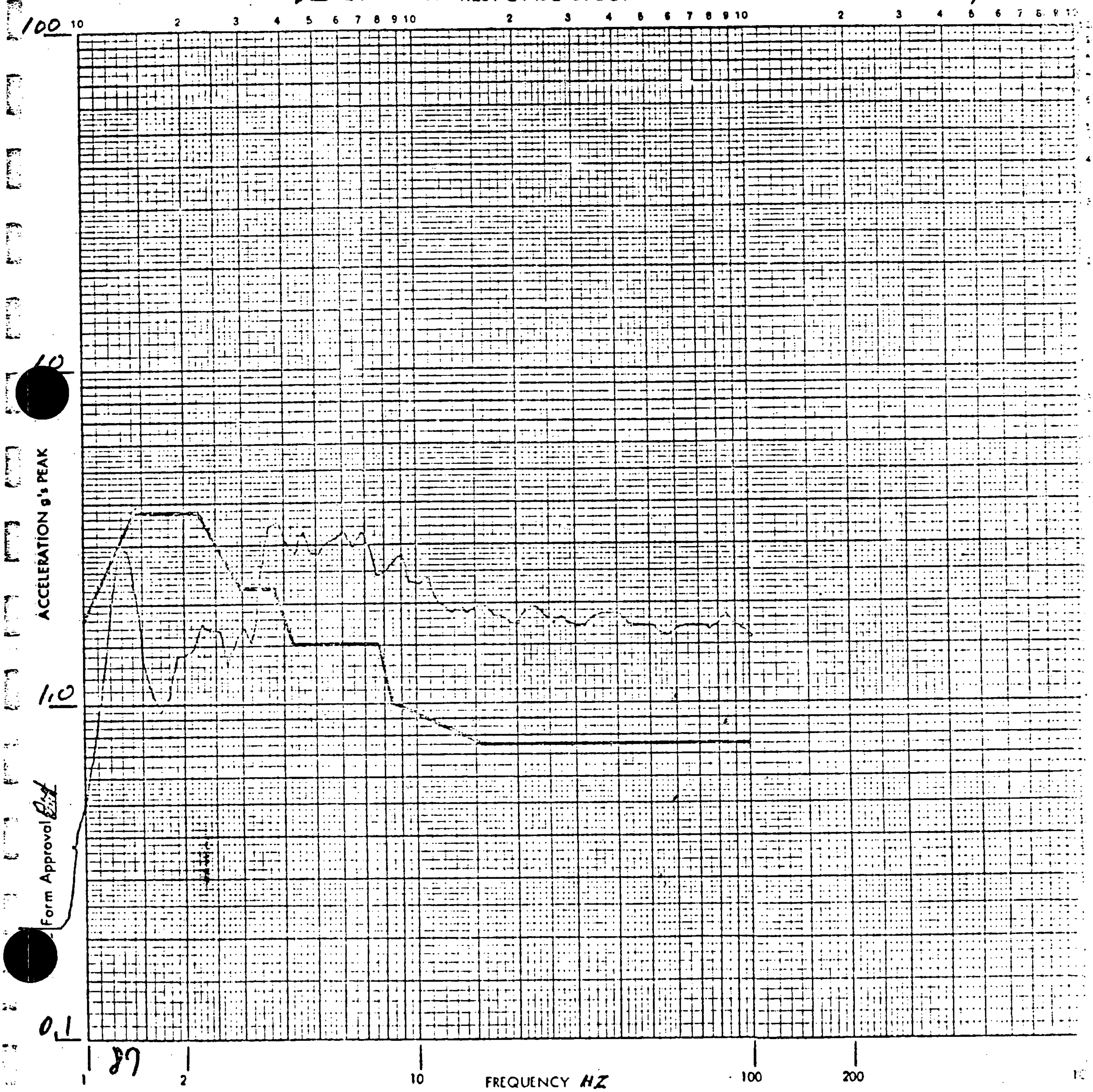
Full Scale 100 G Cal Voltage 500 MVPK/ 1.0 G

Mode PRIMARY Specimen CONTROL PANE[illegible]

Operator MEEHAN P/N 2/3CR-62 (UNIT [illegible])

Date 3/24/76 Polarity + Q 5% Axis of Test X-Y

VERTICAL RESPONSE SPECTRA ZWO 1.25 HZ OUT Ø



WYLE LABORATORIES

Report No. 5

Customer JELCO Job No. 54498 Page No.

Channel Identification: T/R 1 Trk. No. 1 Accel. No.

Transducer S/N 1143 Control (X), Response ( )

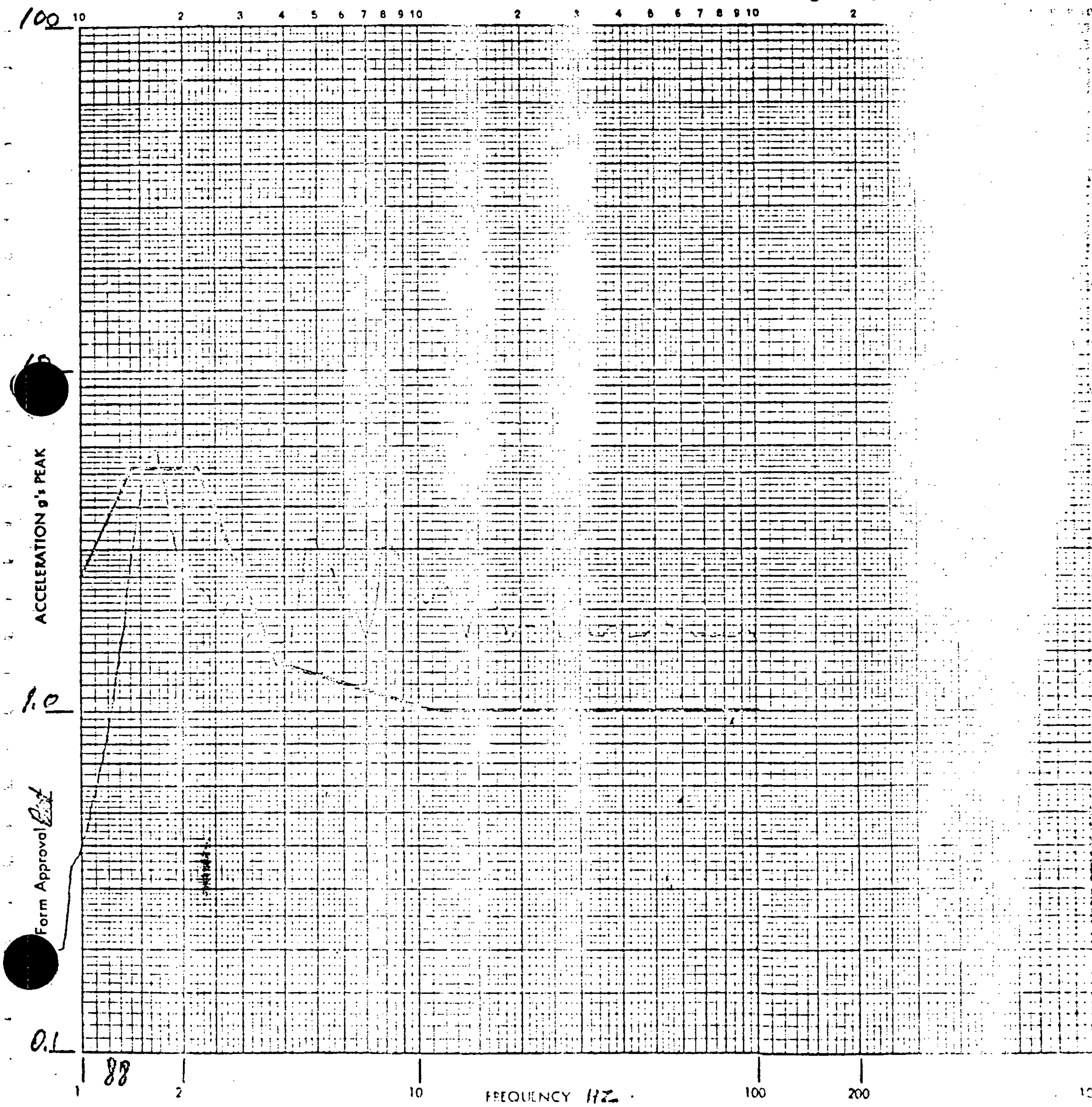
Full Scale 100 G Cal Voltage 500 MVPK/ 1.0

Mode PRIMARY Specimen CONT

Operator MEEHAN P/N 2/

Date 3/24/76 Polarity + Q 5% Axis of Test X-

HORIZONTAL RESPONSE SPECTRA 1.6 HZ OV



Form Approval

WYLE LABORATORIES

Report No. ______

Customer JELCO Job No. 54498

Page No. ______

Channel Identification: T/R 1 Trk. No. 2

Accel. No. ______

Transducer S/N 1168 Control (X), Response ( )

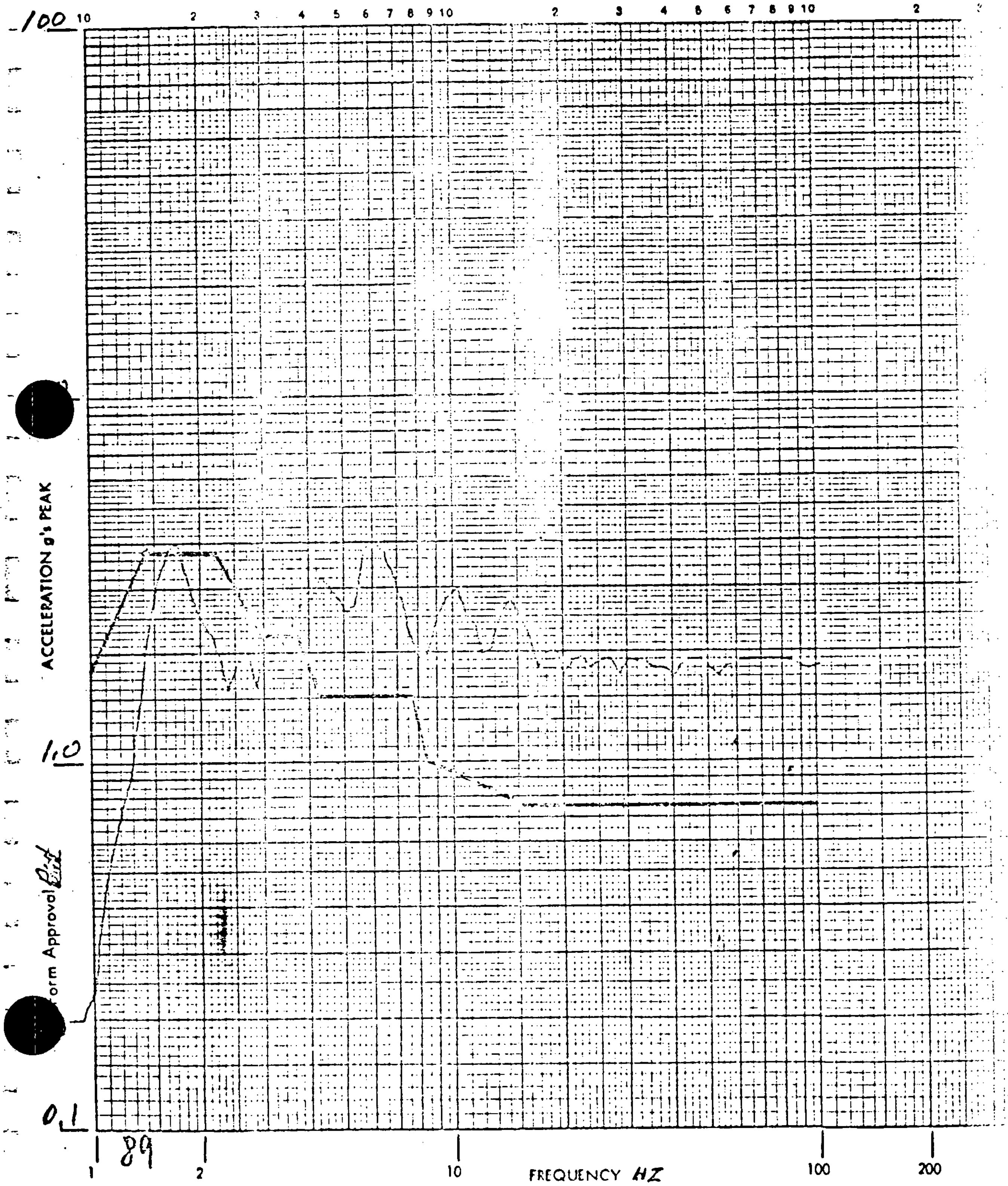
Full Scale 100 G Cal Voltage 500 MVPK/ 1.0

Mode PRIMARY Specimen CONT

Operator MEEHAN P/N 2/3

Date 3/24/76 Polarity + Q 5% Axis of Test X-Y

VERTICAL RESPONSE SPECTRA 1.6

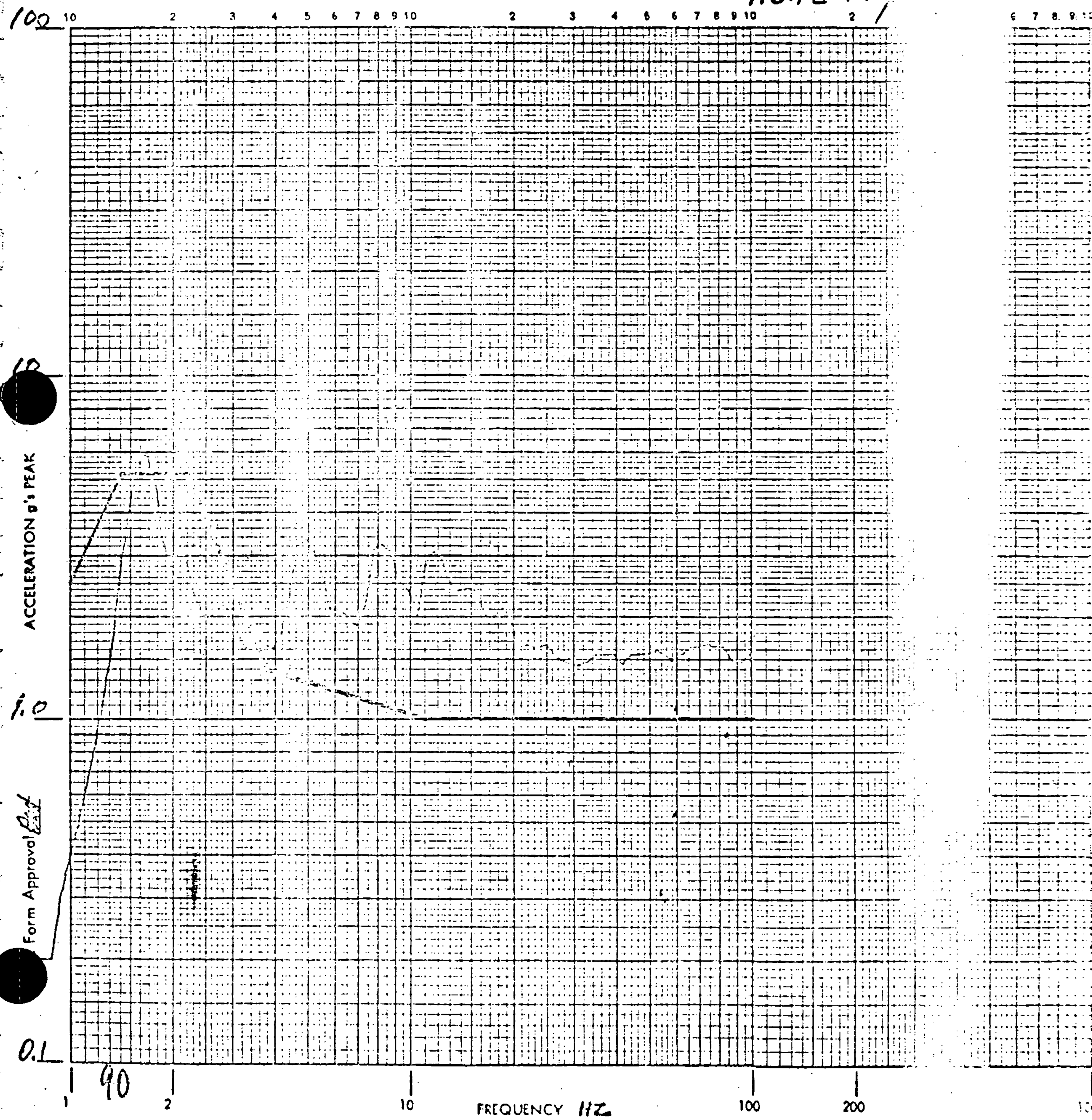


Form Approval

WYLE LABORATORIES

Report No. ... 98
Customer JELCO Job No. 54498 Page No. 21
Channel Identification: T/R 1 Trk. No. 1 Accel. No.
Transducer S/N 1143 Control (X), Response ( )
Full Scale 100 G Cal Voltage 500 MVPK/ 1.0 G
Mode PRIMARY Specimen CON... PANEL
Operator MEEHAN P/N 2/30... (UNIT ...)
Date 3/24/76 Polarity + Q 5% Axis of Test X -

HORIZONTAL RESPONSE SPECTRA 1.6HZ IN ...



WYLE LABORATORIES

Report No. 54498

Customer JELCO Job No. 54498

Page No. 22

Channel Identification: T/R 1 Trk. No. 2 Accel. No. 2

Transducer S/N 1108 Control (X), Response ( )

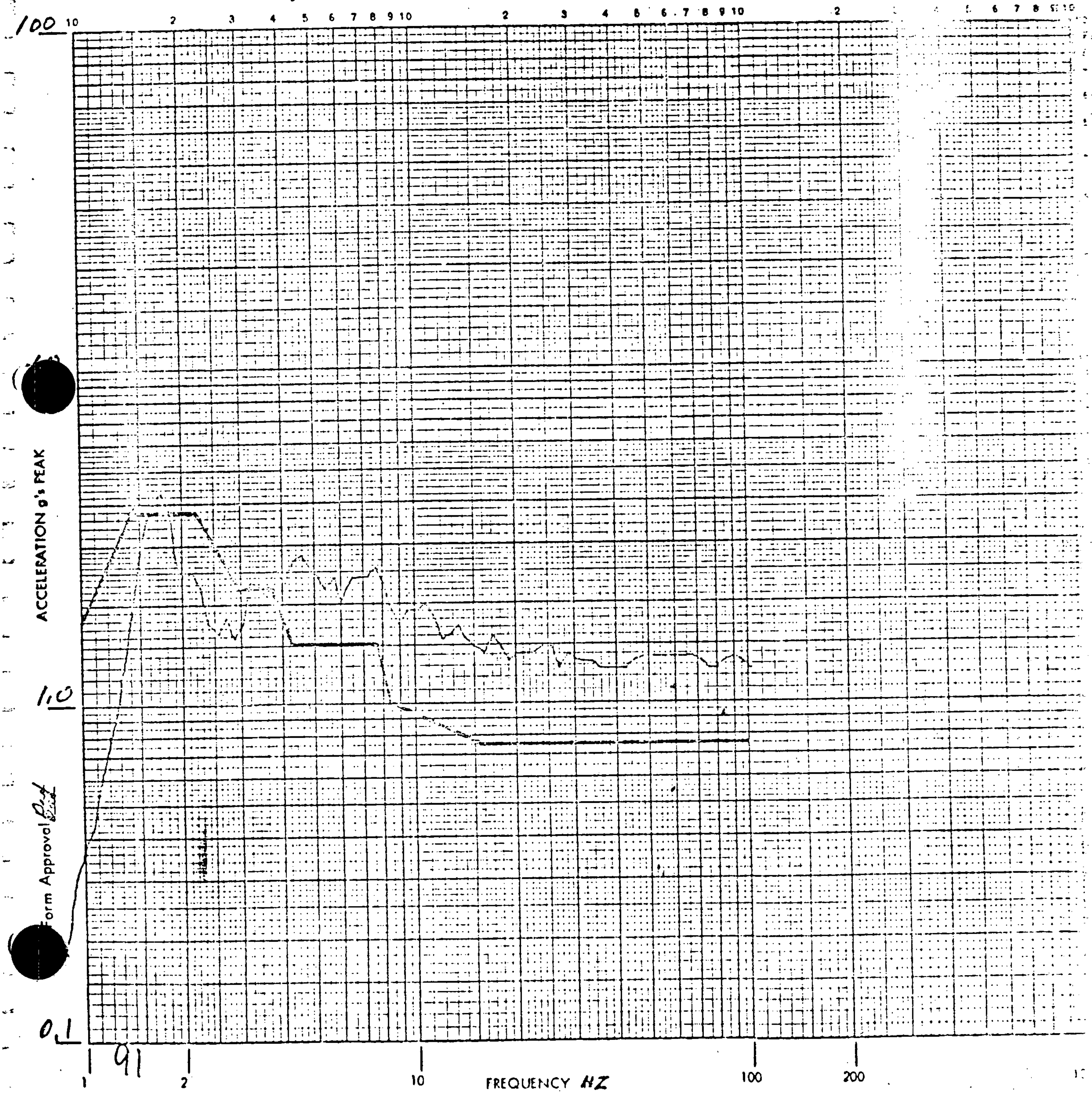
Full Scale 100 G Cal Voltage 500 MVPK/ 1.0 G

Mode PRIMARY Specimen CONTROL PANEL

Operator MEEHAN P/N 2/30 -62 (UNIT)

Date 3/24/76 Polarity + Q 5% Axis of Test X-Y

VERTICAL RESPONSE SPECTRA 1.6 HZ IN



Form Approval

91

WYLE LABORATORIES

Report No. ...28

Page No. ...3

Customer JELCO Job No. 54498

Channel Identification: T/R 1 Trk. No. 1 Accel. No.

Transducer S/N 1143 Control (X). Response ( )

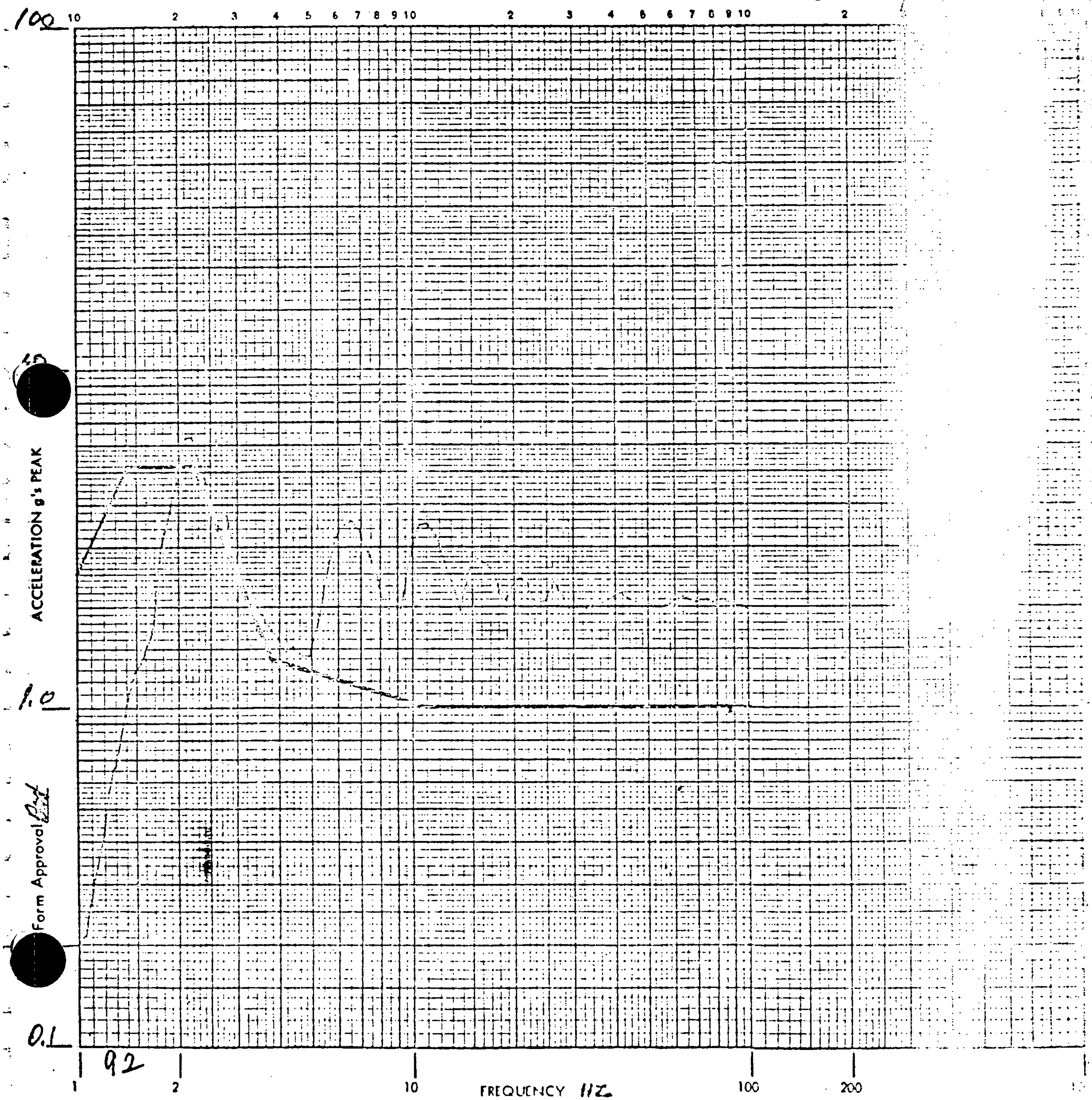
Full Scale 100 G Cal Voltage 500 MVPK/ 1.0 G

Mode PRIMARY Specimen CONT...

Operator MEEHAN P/N 2/...

Date 3/24/76 Polarity + Q 5% Axis of Test X-...

HORIZONTAL RESPONSE SPECTRA 2.0 HZ IN...



WYLE LABORATORIES

Report No. 4498

Customer JELCO Job No. 54498 Page No. 24

Channel Identification: T/R 1 Trk. No. 2 Accel. No.

Transducer S/N 1168 Control (X), Response ( )

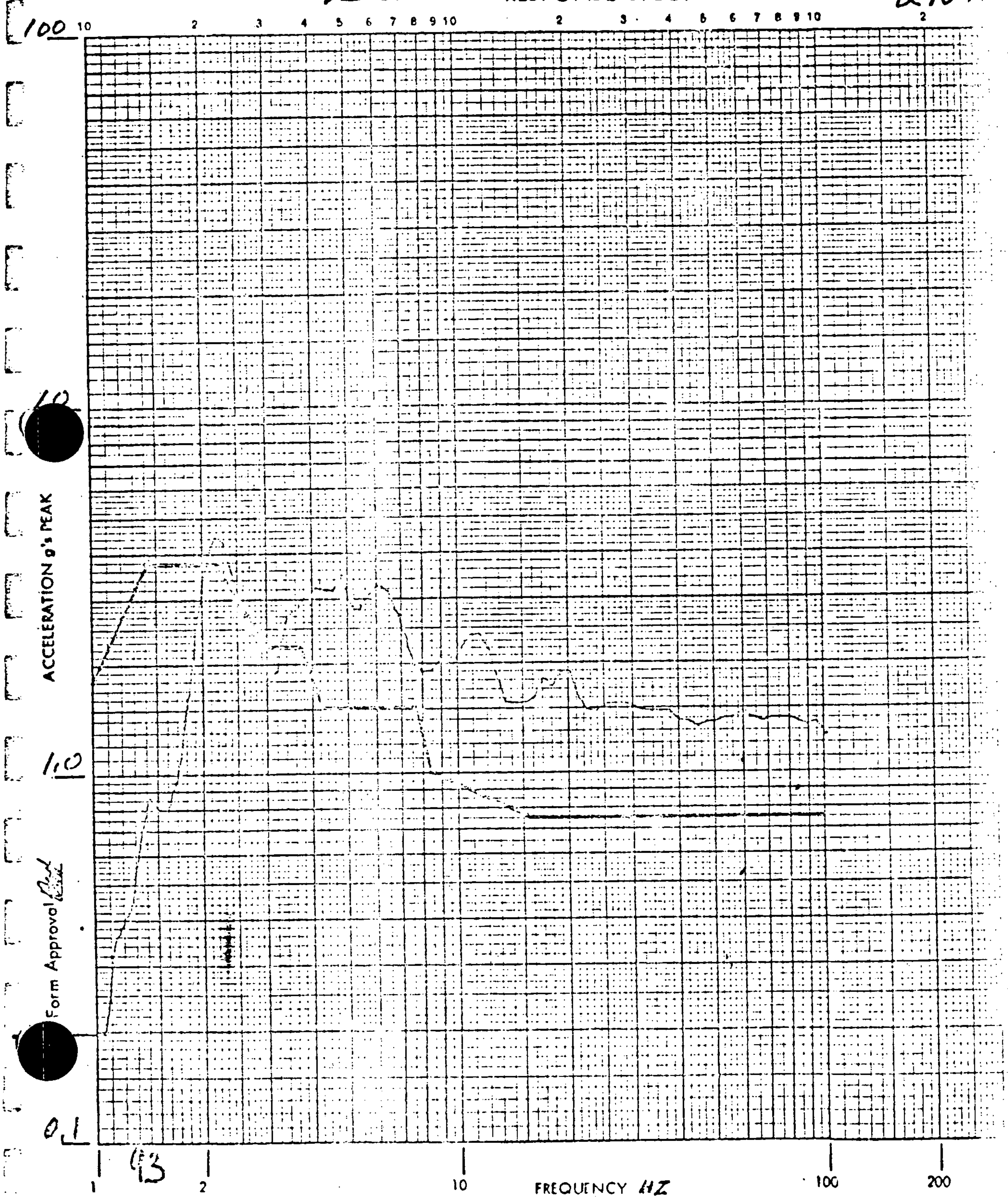
Full Scale 100 G Cal Voltage 500 MVPK/ 1.0 G

Mode PRIMARY Specimen CONT... NEL

Operator MEEHAN P/N 2/3...

Date 3/24/76 Polarity + Q 5% Axis of Test

VERTICAL RESPONSE SPECTRA 2.0



Form Approval

WYLE LABORATORIES

Report No. 54498

Customer JELCO Job No. 54498 Page No. 25

Channel Identification: T/R 1 Trk. No. 1 Accel. No. 1

Transducer S/N 1143 Control (X), Response ( )

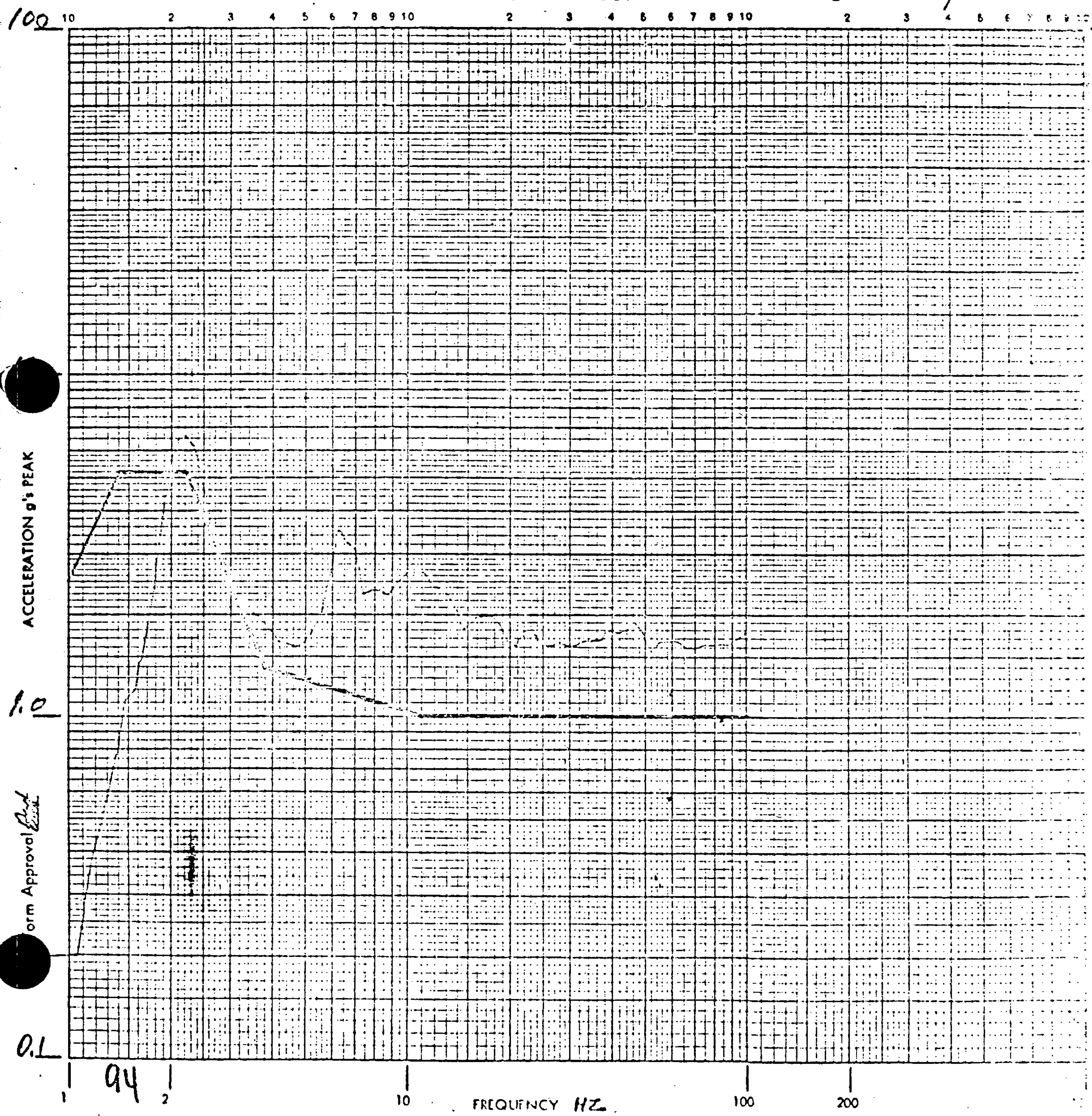
Full Scale 100 G Cal Voltage 500 MVPK/ 1.0 G

Mode PRIMARY Specimen CONTROL PANEL

Operator MEEHAN P/N 2/3CR-62 (UNIT

Date 3/24/76 Polarity + Q 5% Axis of Test X-Y

HORIZONTAL RESPONSE SPECTRA 2.0 HZ OUT ϕ



Form Approval

WYLE LABORATORIES

Report No. 54498

Customer JELCO Job No. 54498

Page No. 26

Channel Identification: T/R 1 Trk. No. 2 Accel. No. 2

Transducer S/N 1168 Control (X), Response ( )

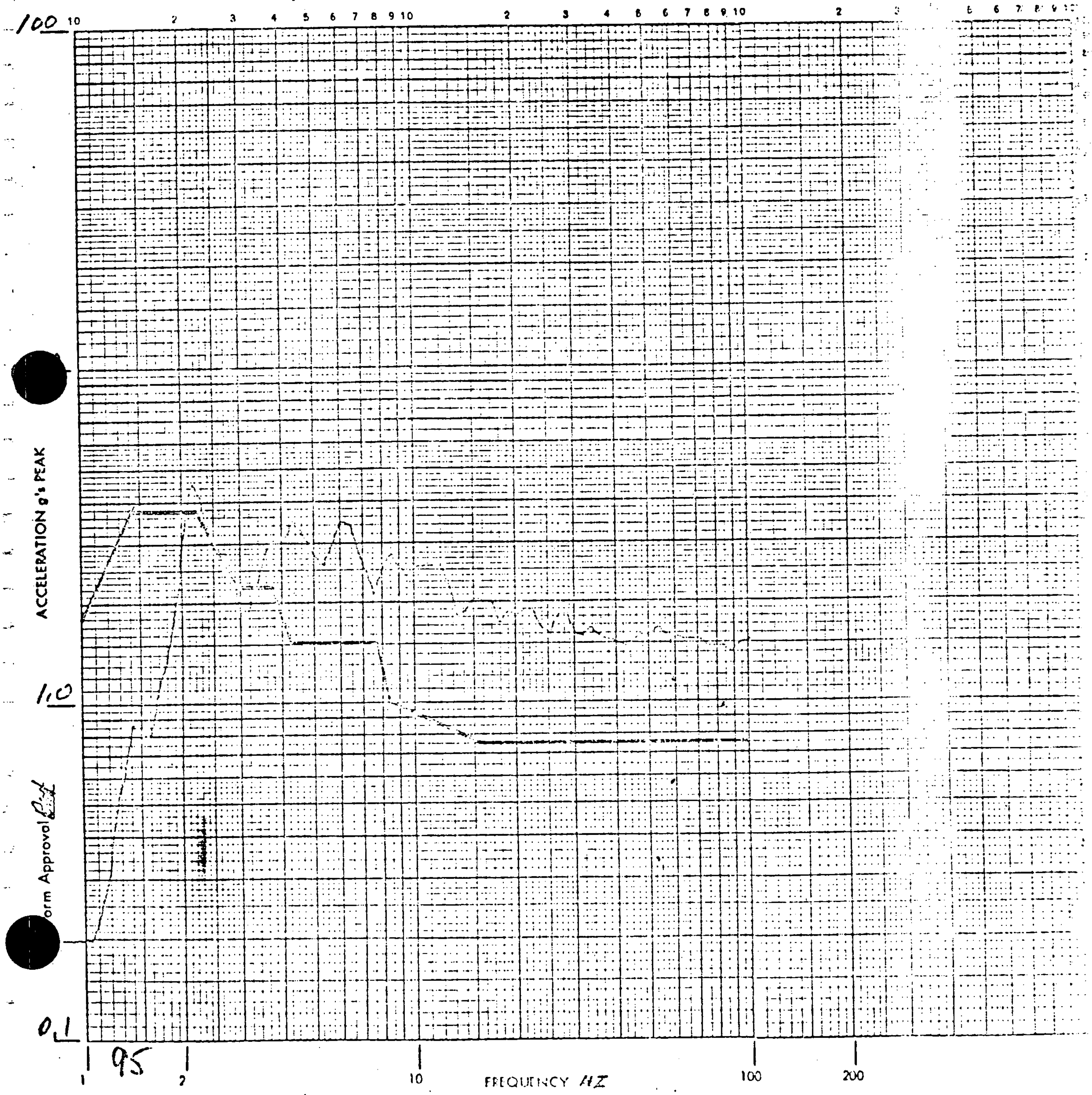
Full Scale 100 G Cal Voltage 500 MVPK/ 1.0 G

Mode PRIMARY Specimen CONTROL PANEL

Operator MEEHAN P/N 2/3...-62 (UNIT)

Date 3/24/76 Polarity + Q 5% Axis of Test X

VERTICAL RESPONSE SPECTRA 2.0 HZ OK



WYLE LABORATORIES

Report No. 54498

Customer JELCO Job No. 54498

Page No. 27

Channel Identification: T/R 1 Trk. No. 1 Accel. No. 1

Transducer S/N 1143 Control (X) Response ( )

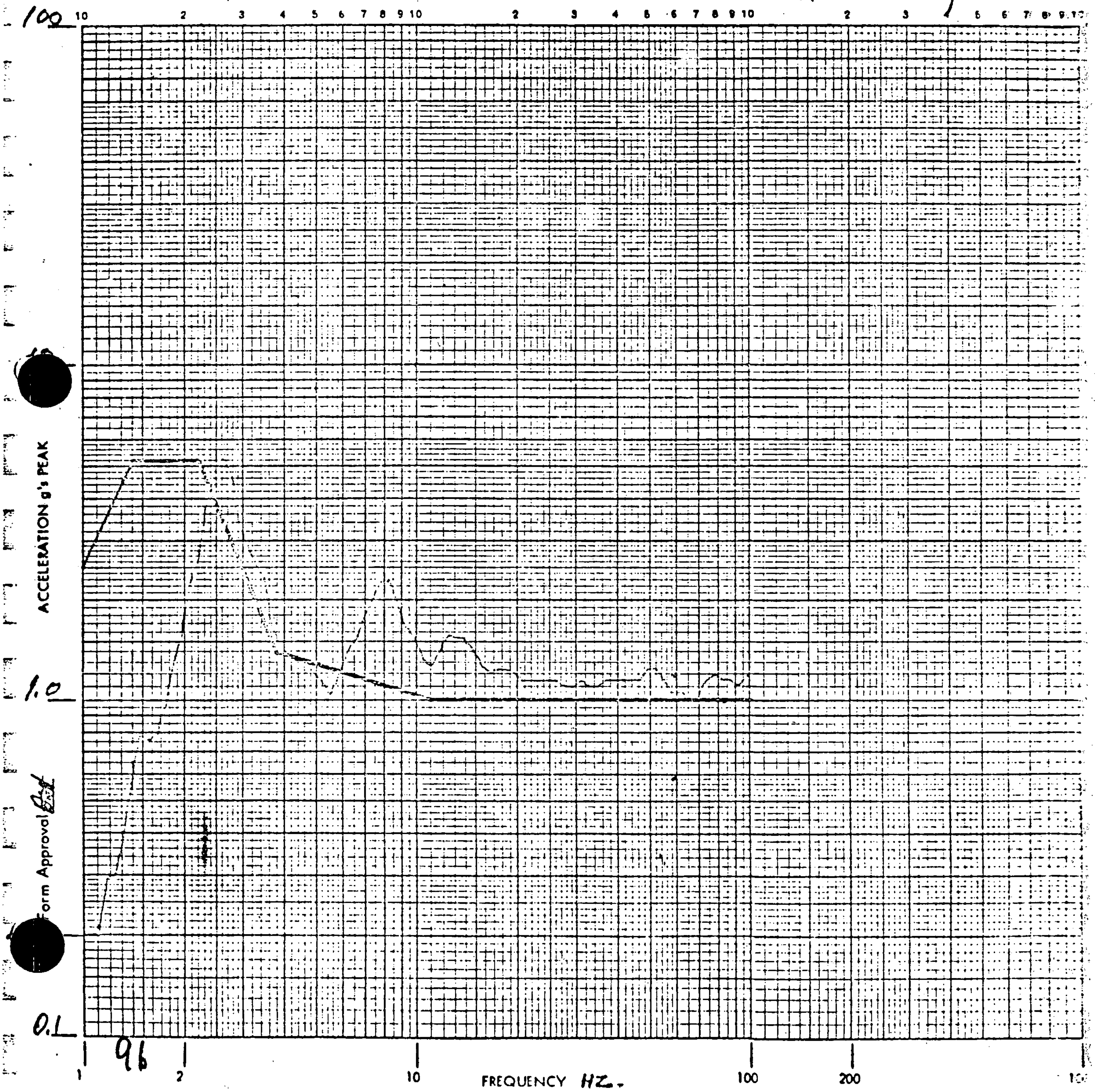
Full Scale 100 G Cal Voltage 500 MVPK/ 1.0 G

Mode PRIMARY Specimen CONTROL PANEL

Operator NEEHAN P/N 2/SCR-62 (UNIT 7

Date 3/24/76 Polarity + Q 5% Axis of Test X-Y

HORIZONTAL RESPONSE SPECTRA 2.5HZ OUT ϕ



Form Approval

WYLE LABORATORIES

Report No. 54498

Page No. 28

Customer JELCO Job No. 54498

Channel Identification: T/R 1 Trk. No. 2 Accel. No. 2

Transducer S/N 1168 Control (X), Response ( )

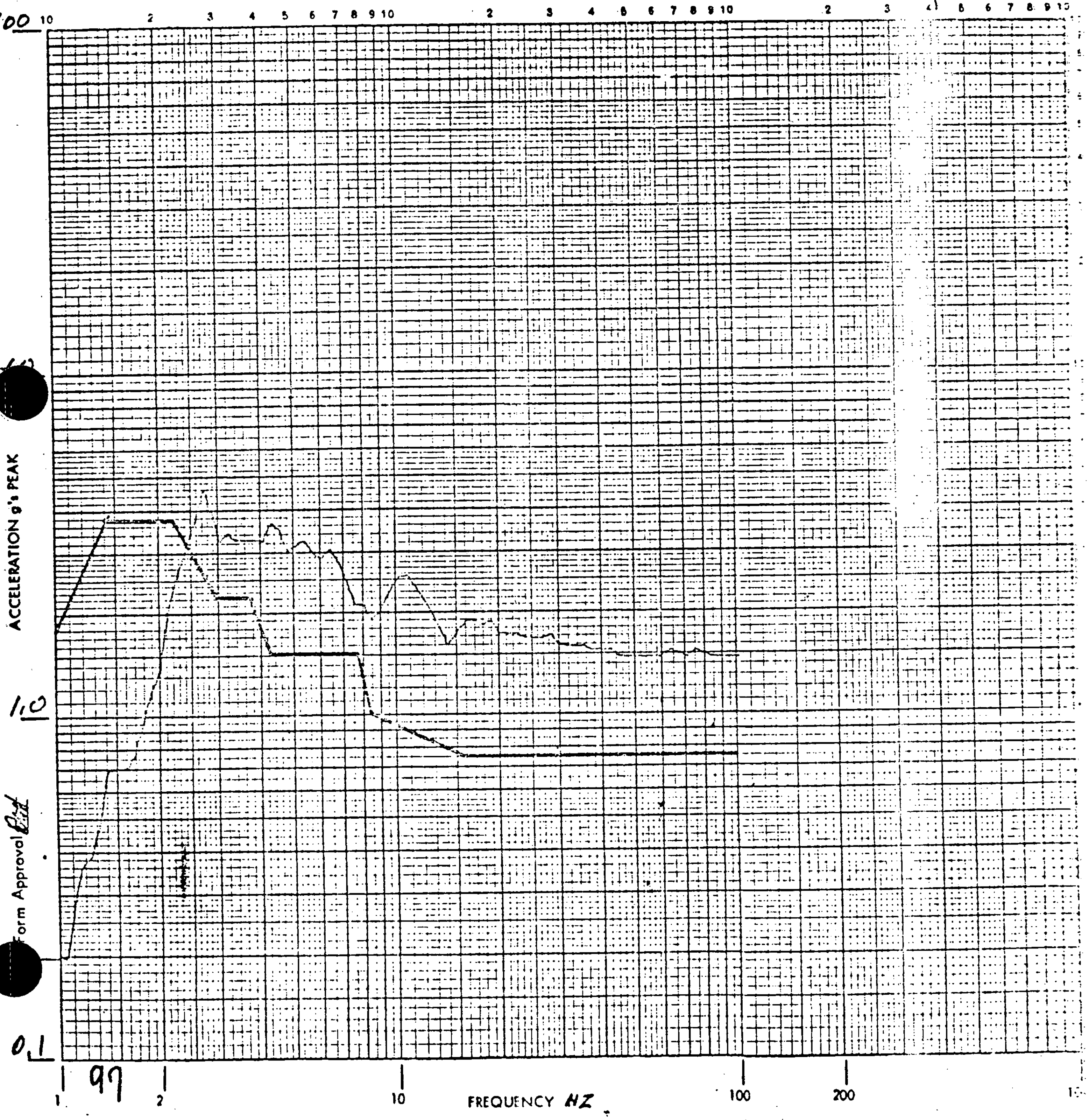
Full Scale 100 G Cal Voltage 500 MVPK/ 1.0 G

Mode PRIMARY Specimen CONTROL PANEL

Operator MEEHAN P/N 2/3C[illegible]-62 (UNIT 7)

Date 3/24/76 Polarity + Q 5% Axis of Test X-Y

VERTICAL RESPONSE SPECTRA 2.5 HZ OFF



WYLE LABORATORIES

Report No. 54498

Customer JELCO Job No. 54498 Page No. 29

Channel Identification: T/R 1 Trk. No. 1 Accel. No. 1

Transducer S/N 1143 Control (X). Response ( )

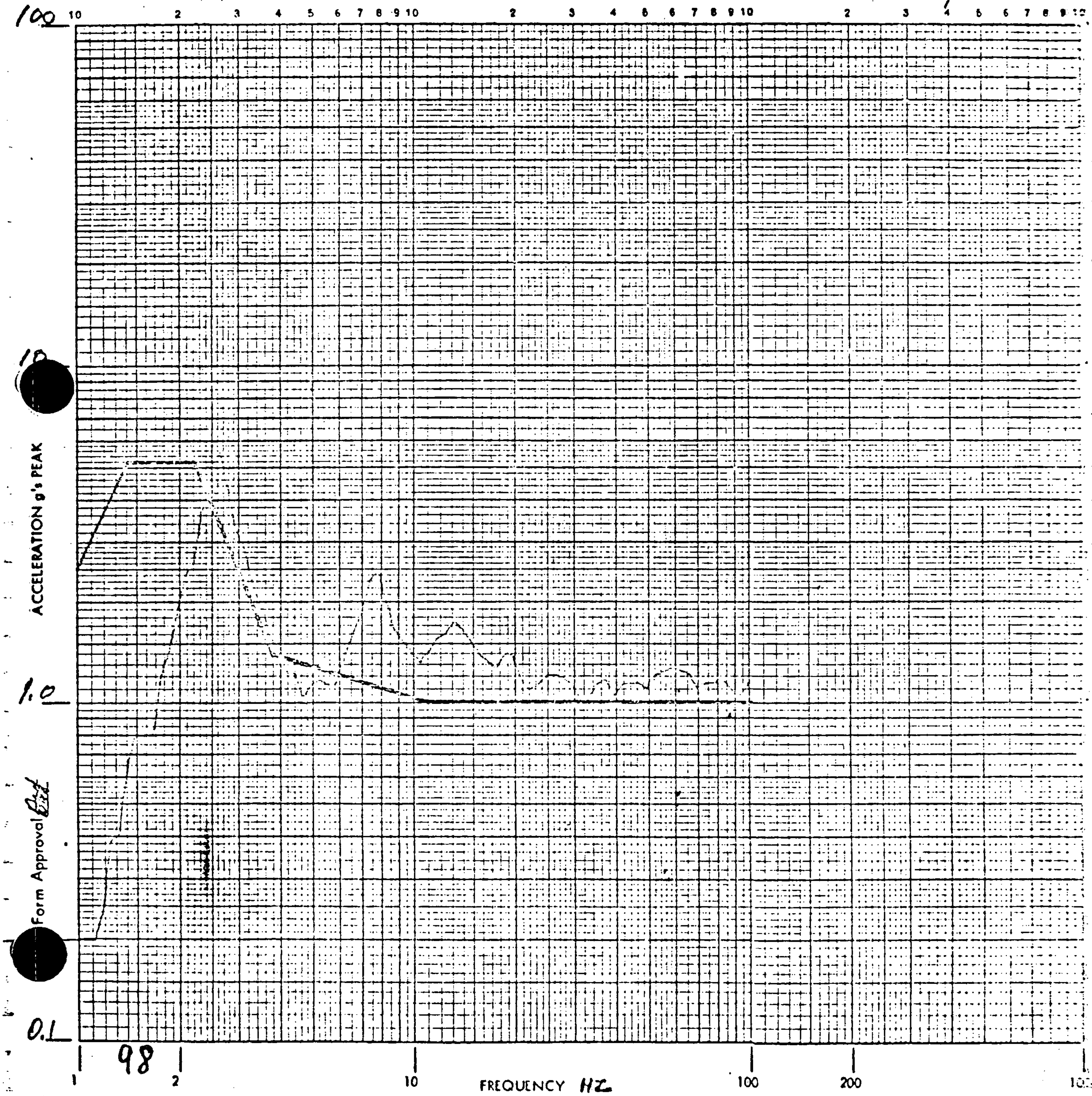
Full Scale 100 G Cal Voltage 500 MVPK/ 1.0 G

Mode PRIMARY Specimen CONTROL PANEL

Operator MEEHAN P/N 2/3CR-62 (UNIT 7)

Date 3/24/76 Polarity + Q 5% Axis of Test X-Y

HORIZONTAL RESPONSE SPECTRA 2.5HZ IN Φ



WYLE LABORATORIES

Report No. ____

Customer JELCO Job No. 54498

Page No. ____

Channel Identification: T/R 1 Trk. No. 2

Accel. No. ____

Transducer S/N 1168 Control (X),

Response (

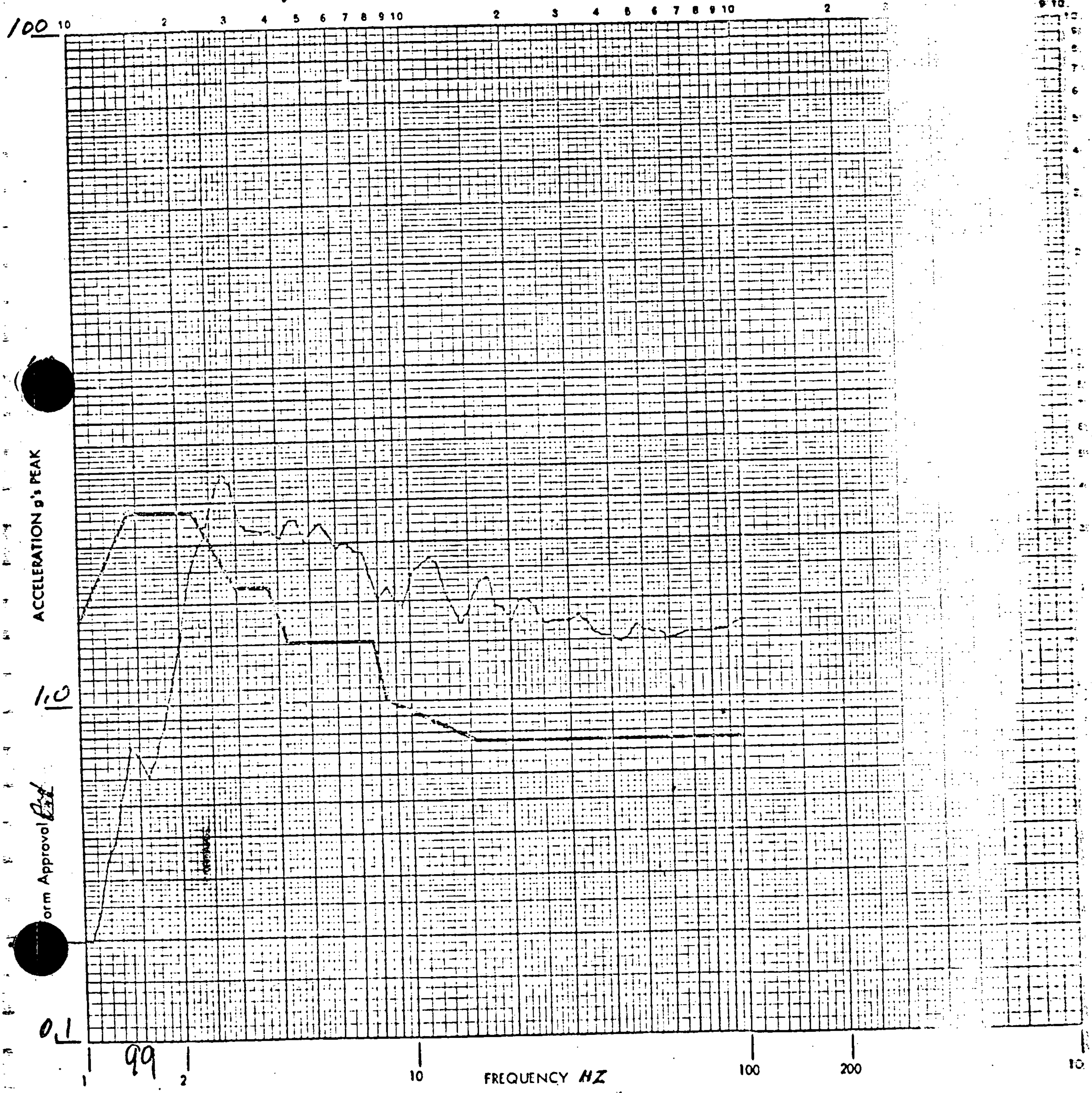
Full Scale 100 G Cal Voltage 500 MVPK/ 1.0 G

Mode PRIMARY Specimen CONT ... IEL

Operator MEEHAN P/N 2/3... ...UNIT 7)

Date 3/24/76 Polarity + Q 5% Axis of Test X-...

VERTICAL RESPONSE SPECTRA 2.5HZ



Form Approval

99

WYLE LABORATORIES

Report No. 54498

Customer JELCO Job No. 54498

Page No. 31

Channel Identification: T/R 1 Trk. No. 1 Accel. No. 1

Transducer S/N 1143 Control (X), Response ( )

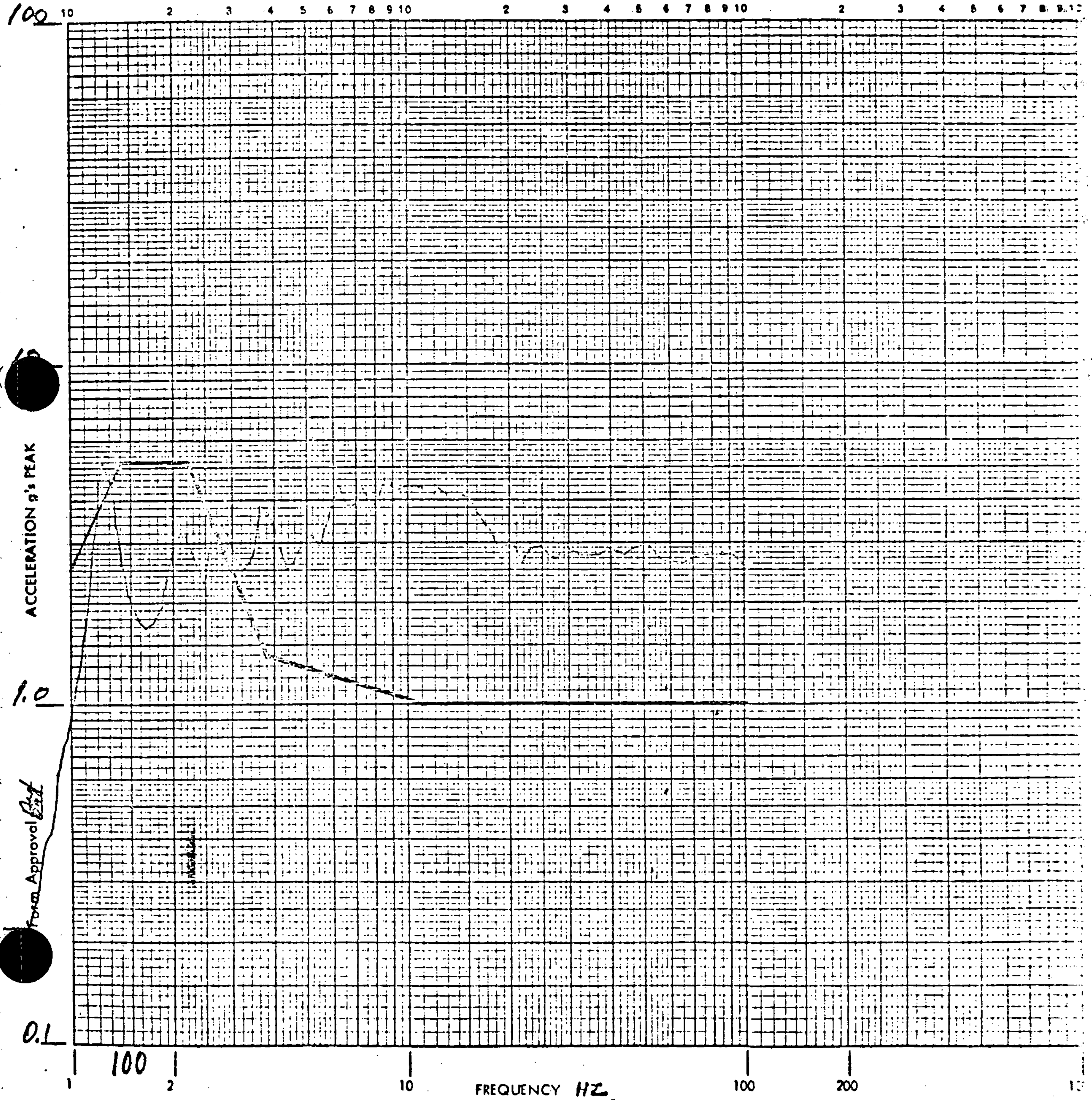
Full Scale 100 G Cal Voltage 500 MVPK/ 1.0 G

Mode PRIMARY Specimen CONTROL PANEL

Operator MEEHAN P/N 2/3CR-62 (UNIT 7)

Date 3-23-76 Polarity + Q 5% Axis of Test Z-Y

HORIZONTAL RESPONSE SPECTRA 1.25 HZ IN Ø



WYLE LABORATORIES Report No. 54498

Customer JELCO Job No. 54498 Page No. 32

Channel Identification: T/R 1 Trk. No. 2 Accel. No. 2

Transducer S/N 1168 Control (X), Response ( )

Full Scale 100 G Cal Voltage 500 MVPK/ 1.0 G

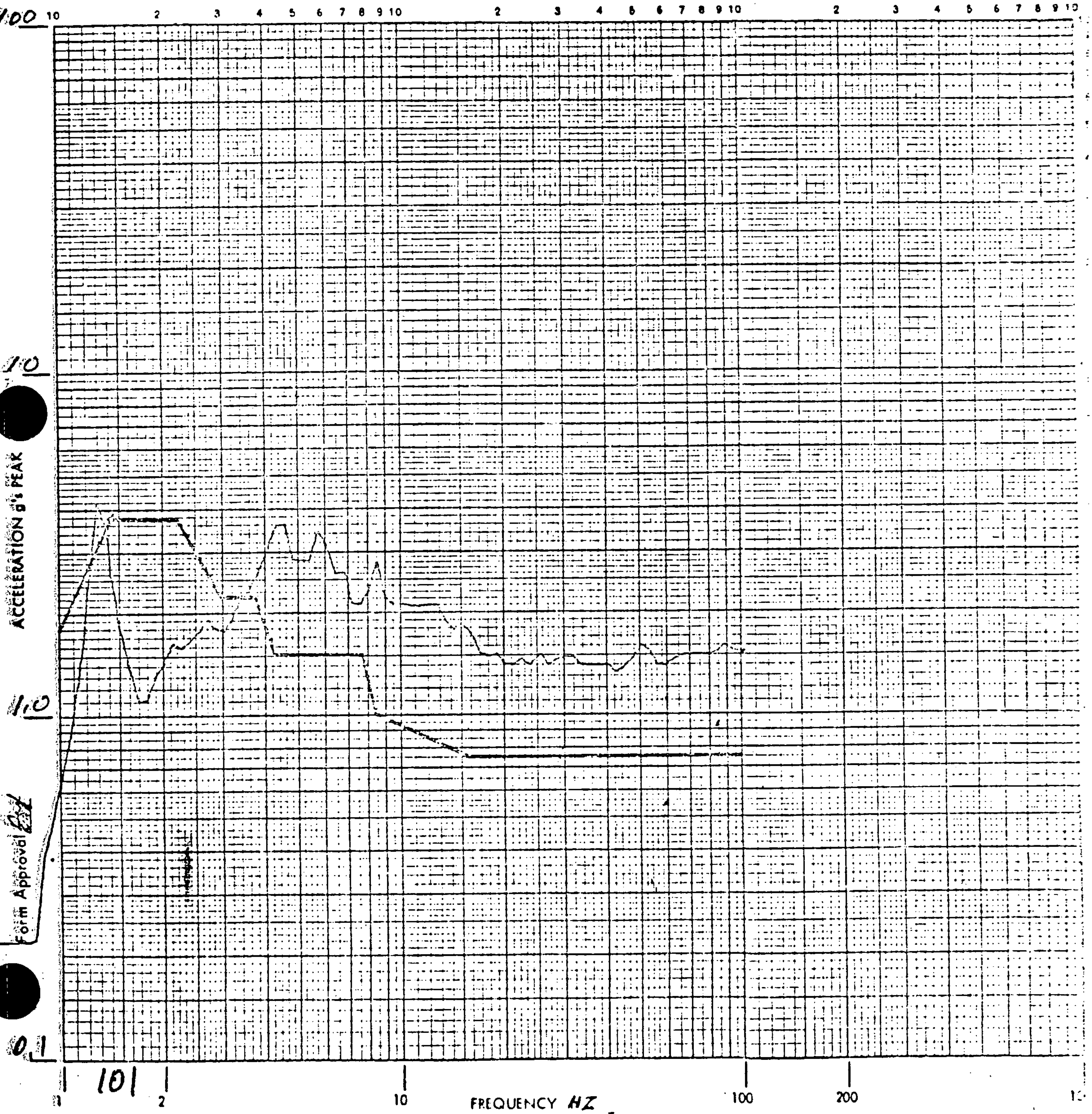
Mode PRIMARY Specimen CONTROL PANEL

Operator MEEHAN P/N 2/3CR-62 (UNIT 7)

Date 3-23-76 Polarity + Q 5% Axis of Test Z-Y

1.25 HZ IN Ø

VERTICAL RESPONSE SPECTRA



WYLE LABORATORIES

Report No. 54498

Customer JELCO Job No. 54498 Page No. 33

Channel Identification: T/R 1 Trk. No. 1 Accel. No. 1

Transducer S/N 1143 Control (X), Response ( )

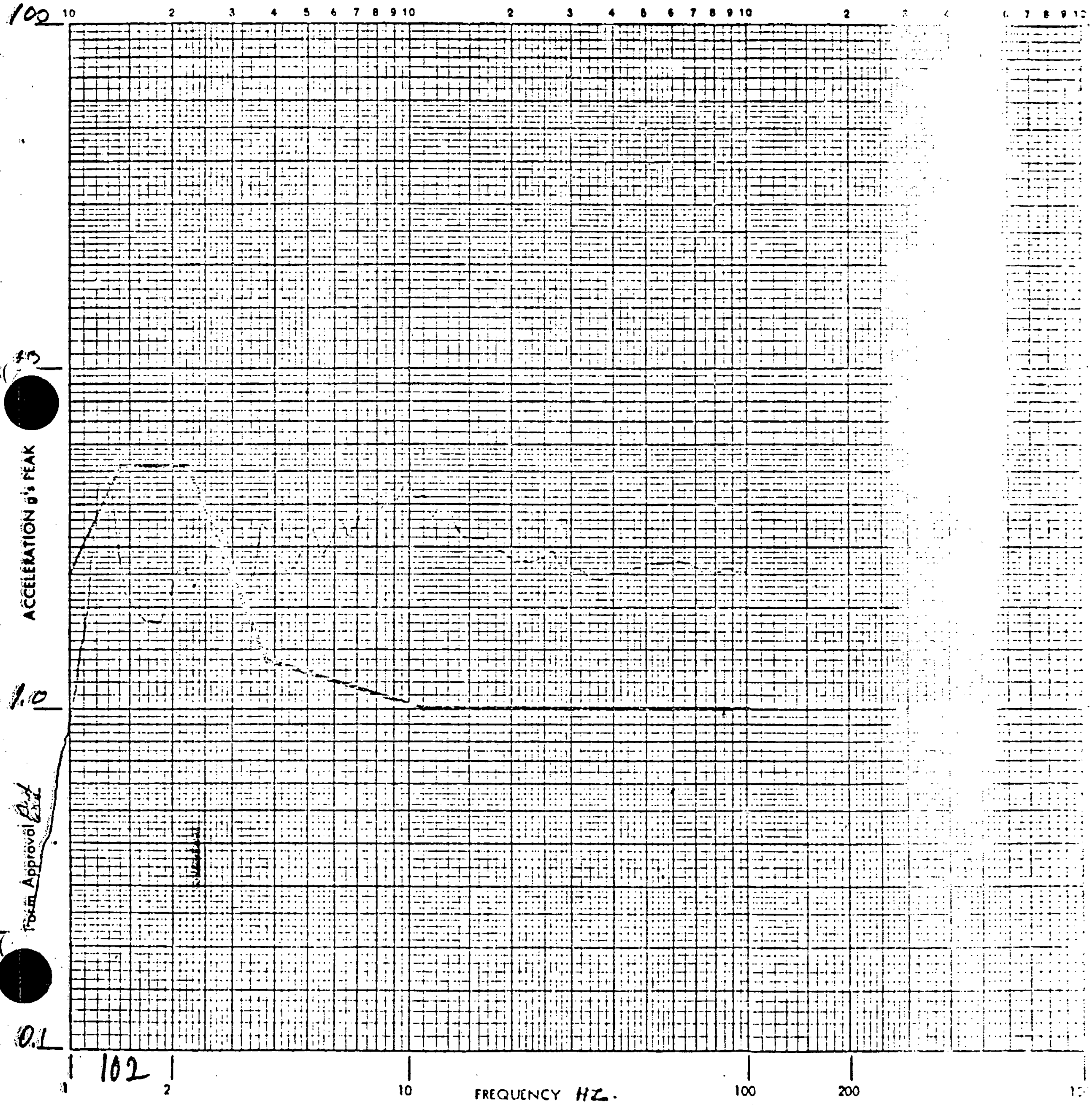
Full Scale 100 G Cal Voltage 500 MVPK/ 1.0 G

Mode PRIMARY Specimen CONT [illegible] ANEL

Operator MEEHAN P/N 2/3[illegible] (UNIT 7)

Date 3/23/76 Polarity + Q 5% Axis of Test Z-Y

HORIZONTAL RESPONSE SPECTRA 1.25 HZ [illegible]



Form Approval

WYLE LABORATORIES

Report No. 54498

Customer JELCO Job No. 54498 Page No. 34

Channel Identification: T/R 1 Trk. No. 2 Accel. No. 2

Transducer S/N 1168 Control Response ( )

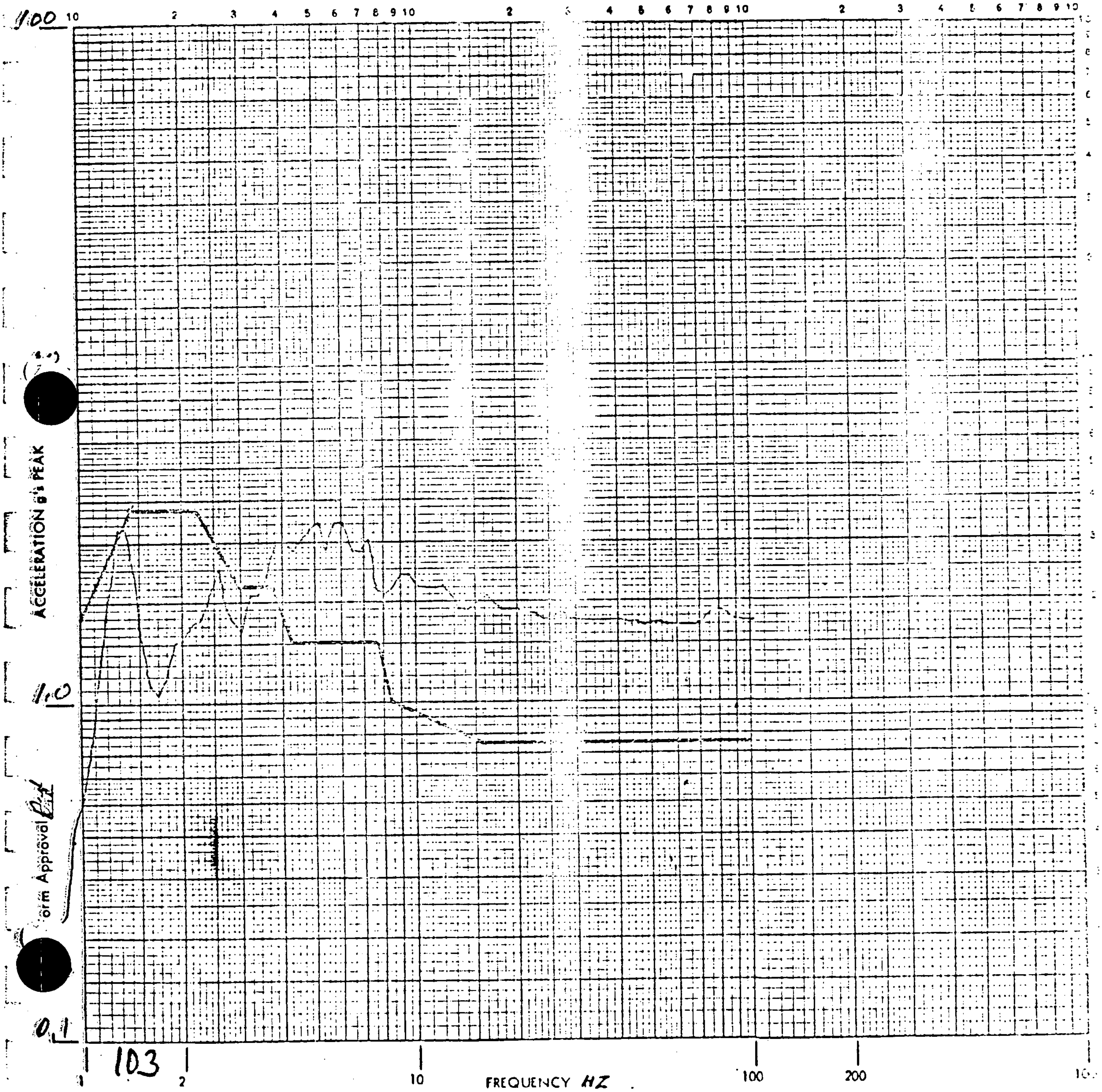
Full Scale 100 G Cal Voltage 500 MVPK/ 1.0 G

Mode PRIMARY Specimen CONTROL PANEL

Operator MEEHAN P/N 2/3CE-62 (UNIT 7)

Date 3/23/76 Polarity + Q 5 Axis of Test Z-Y

VERTICAL RESPONSE SPECTRA 1.25 Hz CUT 4



WYLE LABORATORIES

Report No.

Customer JELCO Job No. 54498

Page No.

Channel Identification: T/R 1 Trk. No. 1

Accel. No.

Transducer S/N 1143 Control (X)

Response ( )

Full Scale 100 G Cal Voltage 500 MVPK/ 1.0 G

Mode PRIMARY

Specimen CONT... ...EL

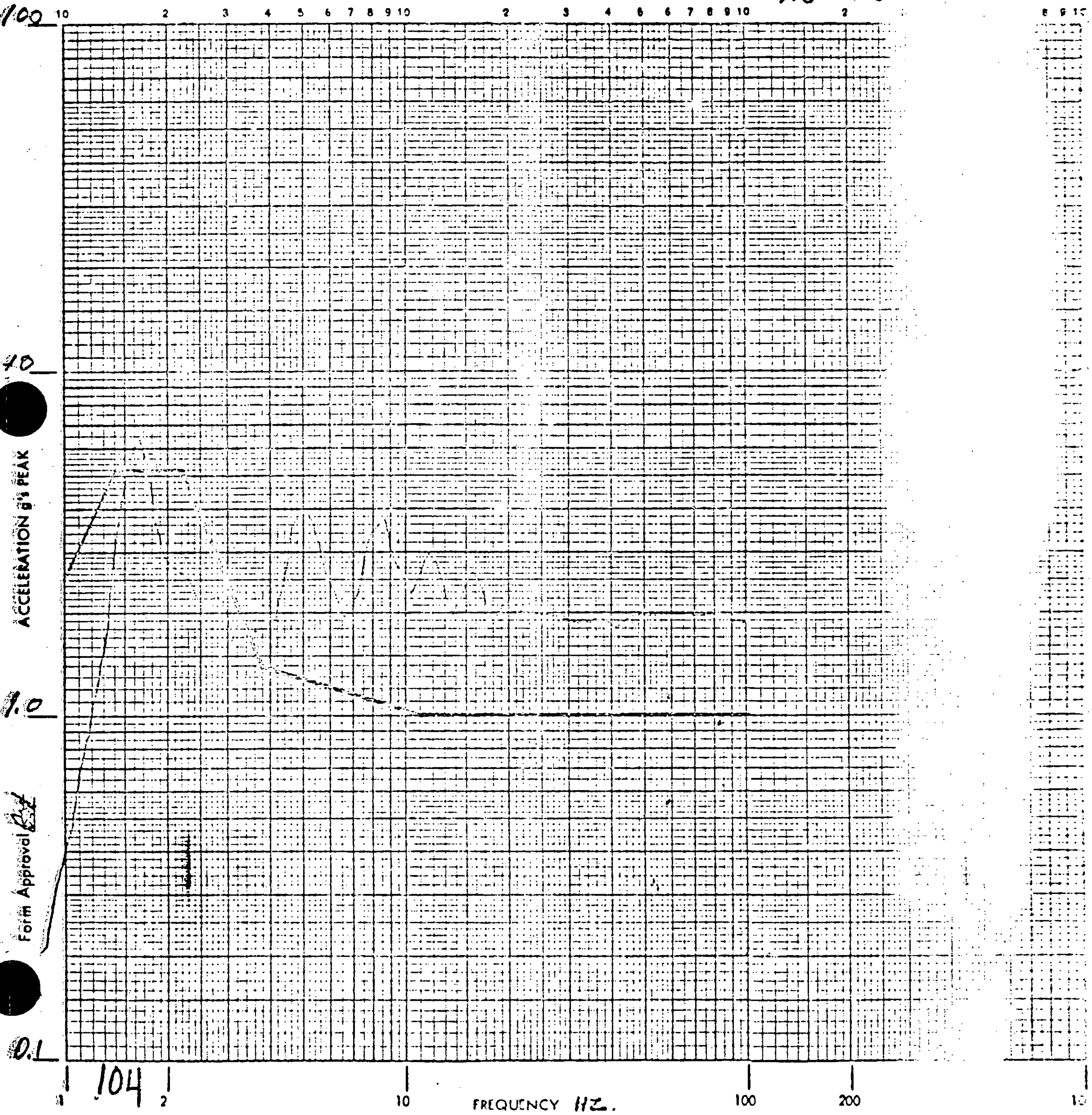
Operator MEEHAN

P/N 2/...

Date 3/23 Polarity + Q 5%

Axis of Test Z-Y

HORIZONTAL RESPONSE SPECTRA 1.6 HZ ...



104

Form Approval

WYLE LABORATORIES

Report No. ______ 196

Customer JELCO Job No. 54498 Page No. 36

Channel Identification: T/R 1 Trk. No. 2 Accel. No.

Transducer S/N 1168 Control (X), Response ( )

Full Scale 100 G Cal Voltage 500 MVPK/ 1.0 G

Mode PRIMARY Specimen CONT ... EL

P/N 2/30 ... NIT 7)

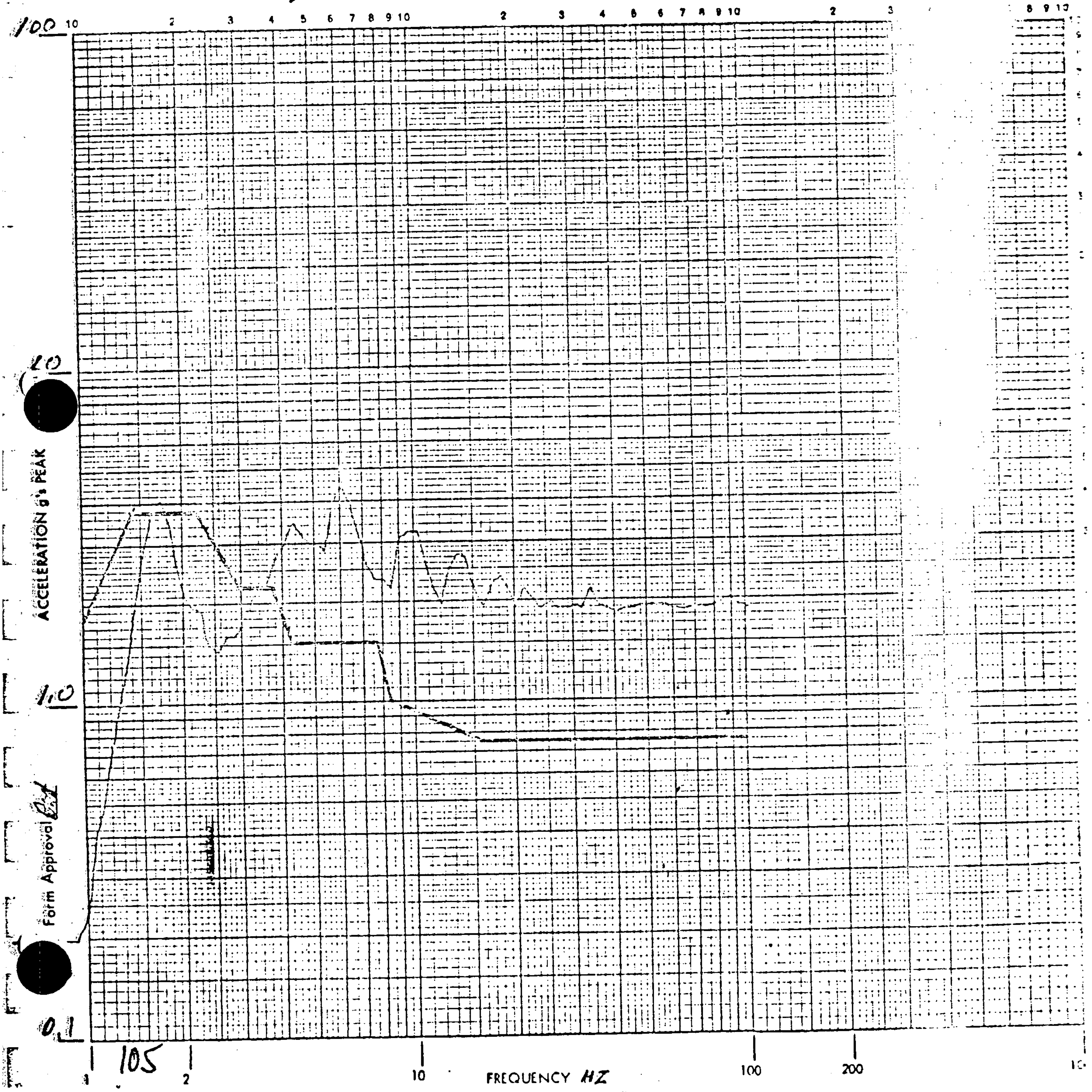
Operator MEEHAN

Date 3/23/76 Polarity + Q 5%

Axis of Test Z-Y

1.6 HZ OUT

VERTICAL RESPONSE SPECTRA



Form Approval

Report No. ______

Customer JELCO Job No. 54498 Page No. 37

Channel Identification: T/R 1 Trk. No. 1 Accel. No. 1

Transducer S/N 1143 Control (X), Response ( )

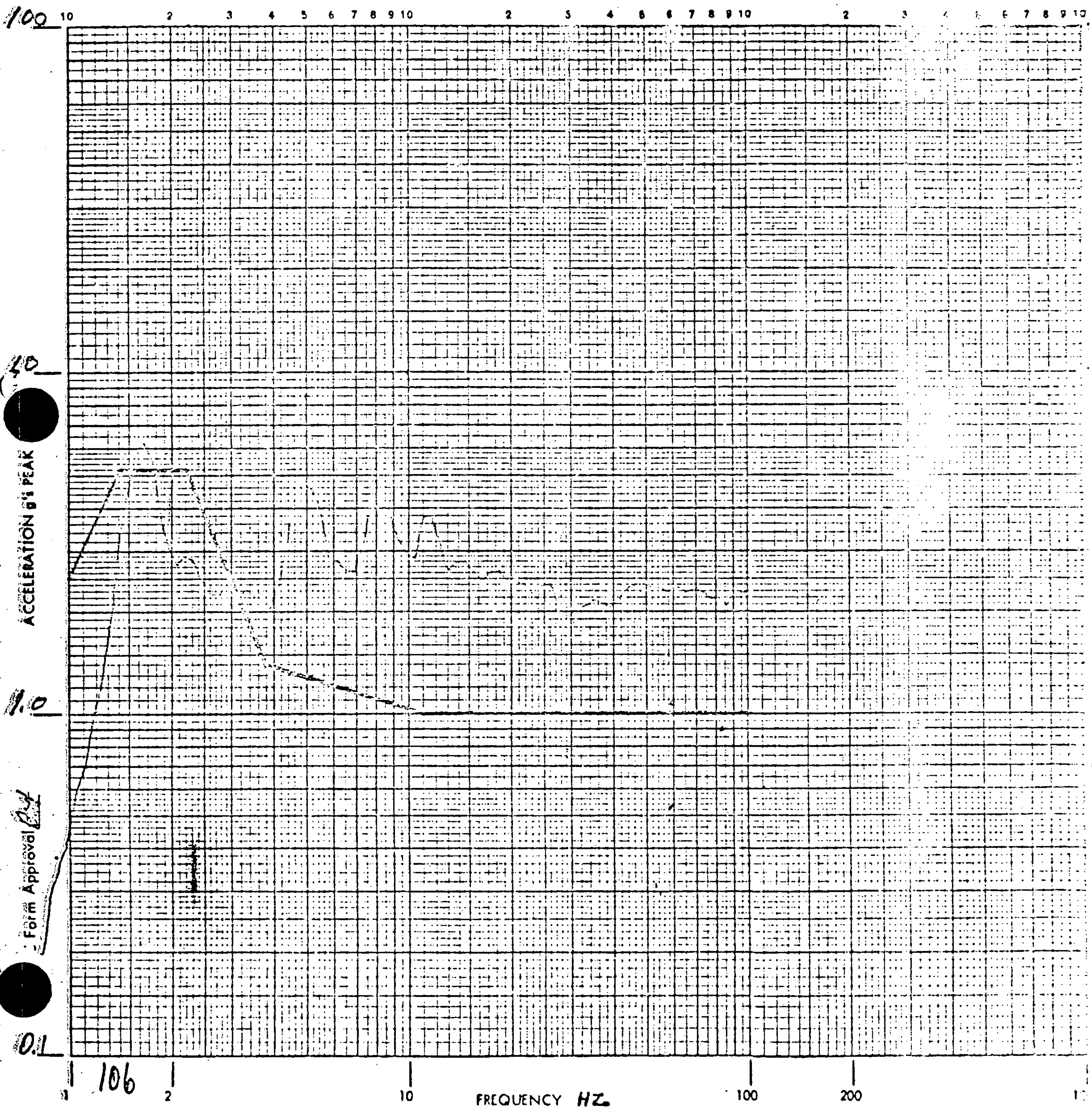
Full Scale 100 G Cal Voltage 500 MVPK/ 1.0 G

Mode PRIMARY Specimen CONTROL PANEL

Operator MEEHAN P/N 2/3CP-63 (UNIT 7)

Date 3/23/76 Polarity + Q 5% Axis of Test Z-Y

HORIZONTAL RESPONSE SPECTRA 1.6 Hz IN ⌀



Form Approval

Customer JELCO Job No. 54498 Page No. 38

Channel Identification: T/R 1 Trk. No. 2 Accel. No. —

Transducer S/N 1168 Control (X), Response (

Full Scale 100 G Cal Voltage 500 MVPK/ 1.0 G

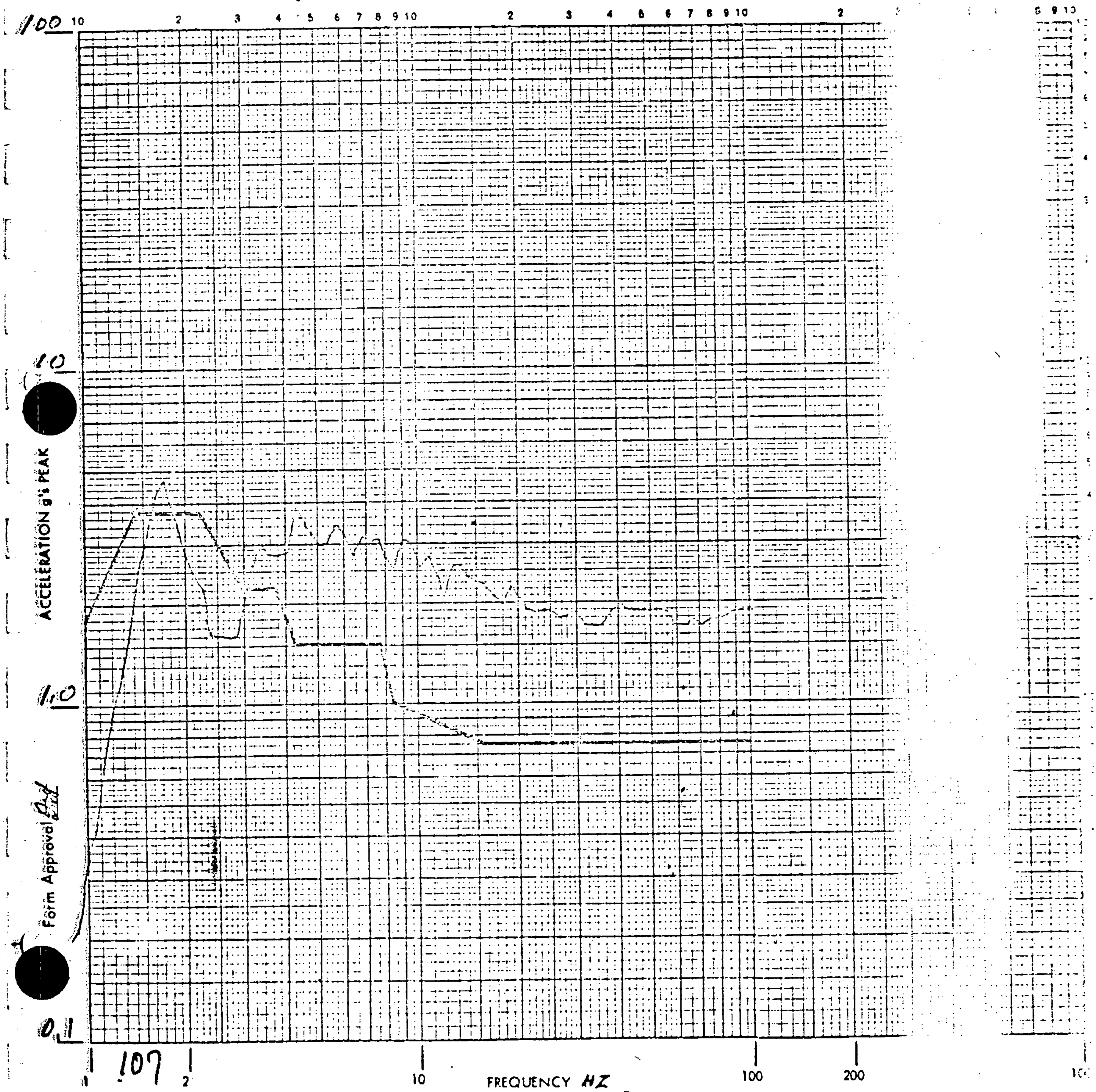
Mode PRIMARY Specimen CON... ...IEL

Operator MEEHAN P/N 2/3 ...IT 7)

Date 3/23/76 Polarity + Q 5% Axis of Test Z-Y

1.6 HZ IN Z

VERTICAL RESPONSE SPECTRA



WYLE LABORATORIES

Customer JELCO Job No. 54498 Report No.

Page No.

Channel Identification: T/R 1 Trk. No. 1 Accel. No.

Transducer S/N 1143 Control ( ), Response (

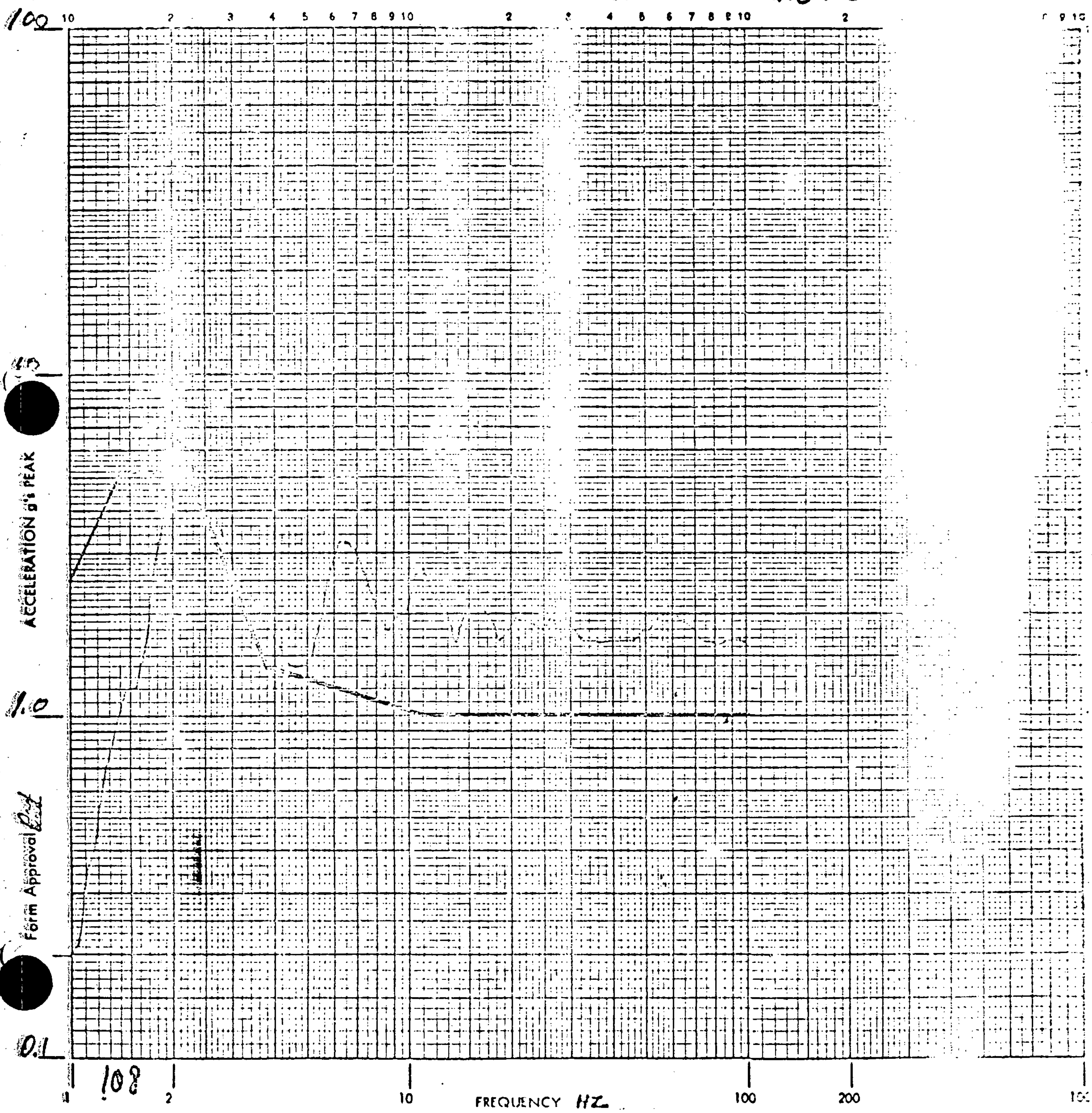
Full Scale 100 G Cal Voltage 500 MVPK/ 1.0 G

Mode PRIMARY Specimen CON[illegible]EL

Operator MEEHAN P/N 2/[illegible]

Date 3/23/76 Polarity + Q 5[illegible] Axis of Test Z-[illegible]

HORIZONTAL RESPONSE SPECTRA 2.0 HZ



Form Approval

WYLE LABORATORIES

Customer JELCO Job No. 54498 Page No. ____

Channel Identification: T/R 1 Trk. No. 2 Accel. No. ____

Transducer S/N 1168 Control (X), Response ( )

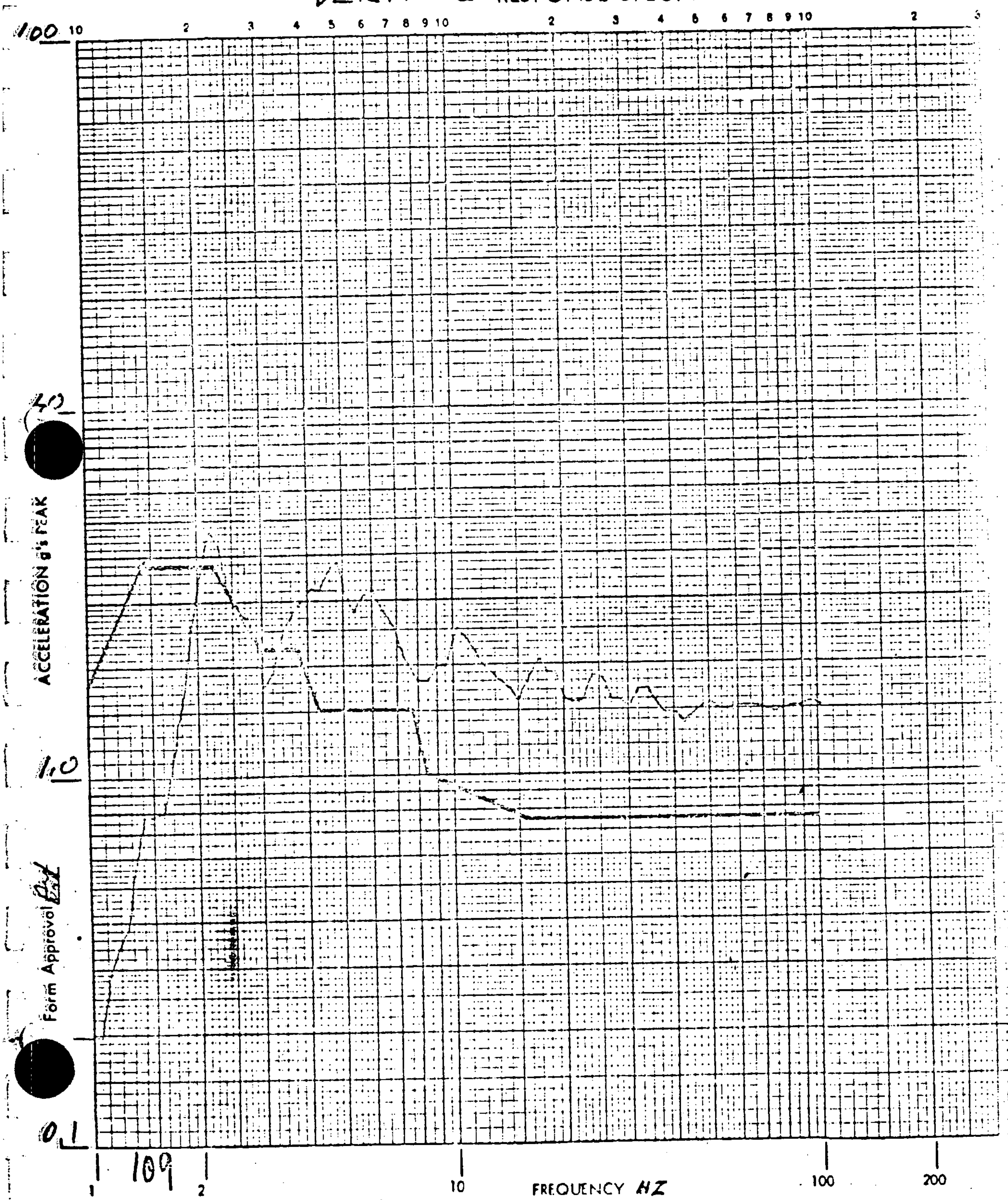
Full Scale 100 G Cal Voltage 500 MVPK/ 1.0 ____ G

Mode PRIMARY Specimen CONT. ...VEL (UNIT 7)

Operator MEEHAN P/N 2/3...

Date 3/23/76 Polarity + Q 5% Axis of Test Z-Y

VERTICAL RESPONSE SPECTRA 2.0 HE



Form Approval

WYLE LABORATORIES

Report No. ______

Customer JELCO Job No. 54498

Page No. 41

Channel Identification: T/R 1 Trk. No. 1

Accel. No. ______

Transducer S/N 1143 Control (X), Response ( )

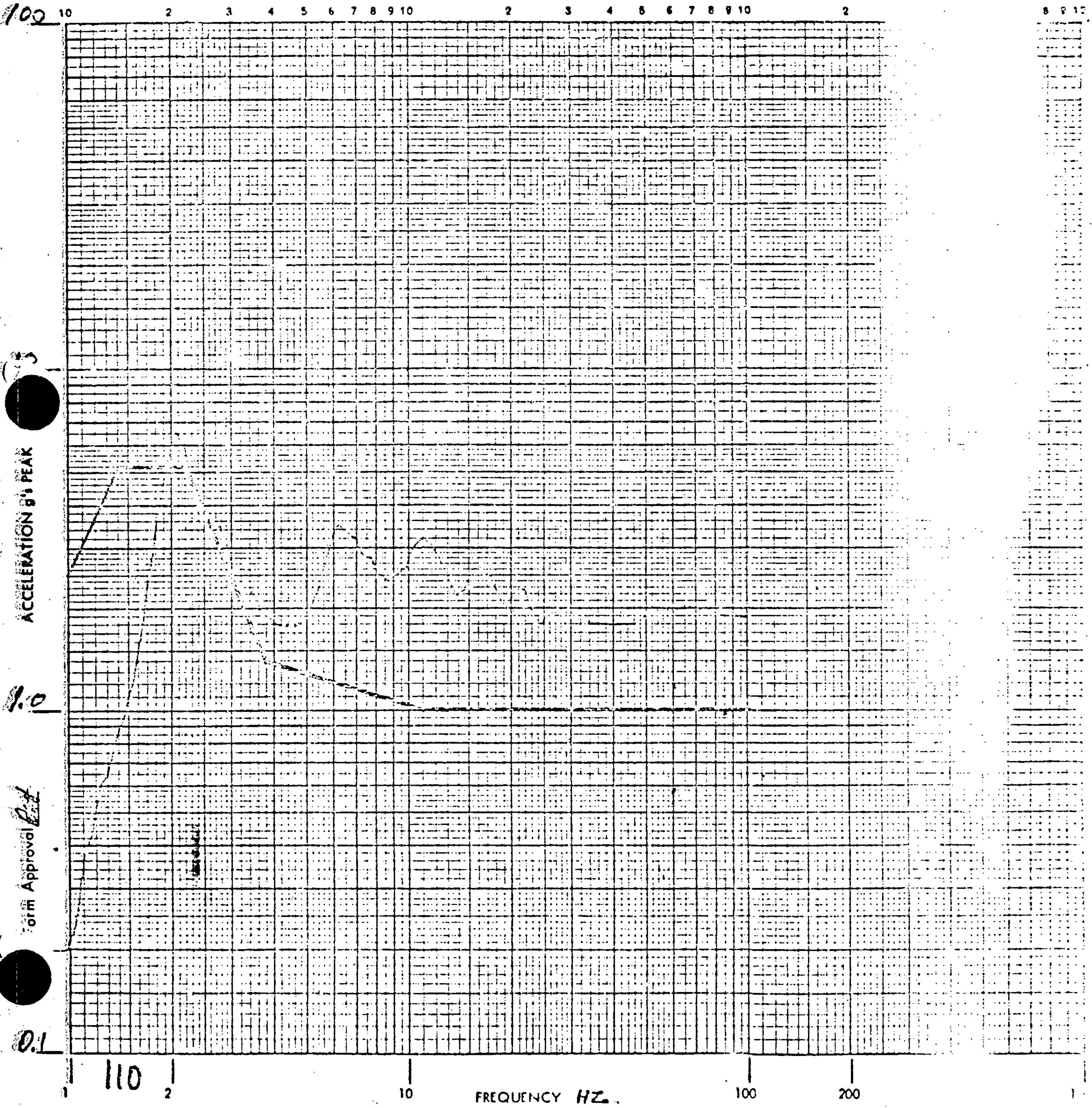
Full Scale 100 G Cal Voltage 500 MVPK/ 1.0 G

Mode PRIMARY Specimen CONVEL

Operator MEEHAN P/N 2/3 ...

Date 3-27-76 Polarity + Q 5% Axis of Test Z-Y

HORIZONTAL RESPONSE SPECTRA 2.0 HZ



Form Approval

Customer JELCO Job No. 54498 Page No. 42

Channel Identification: T/R 1 Trk. No. 2 Accel. No. 2

Transducer S/N 1160 Control (X), Response ( )

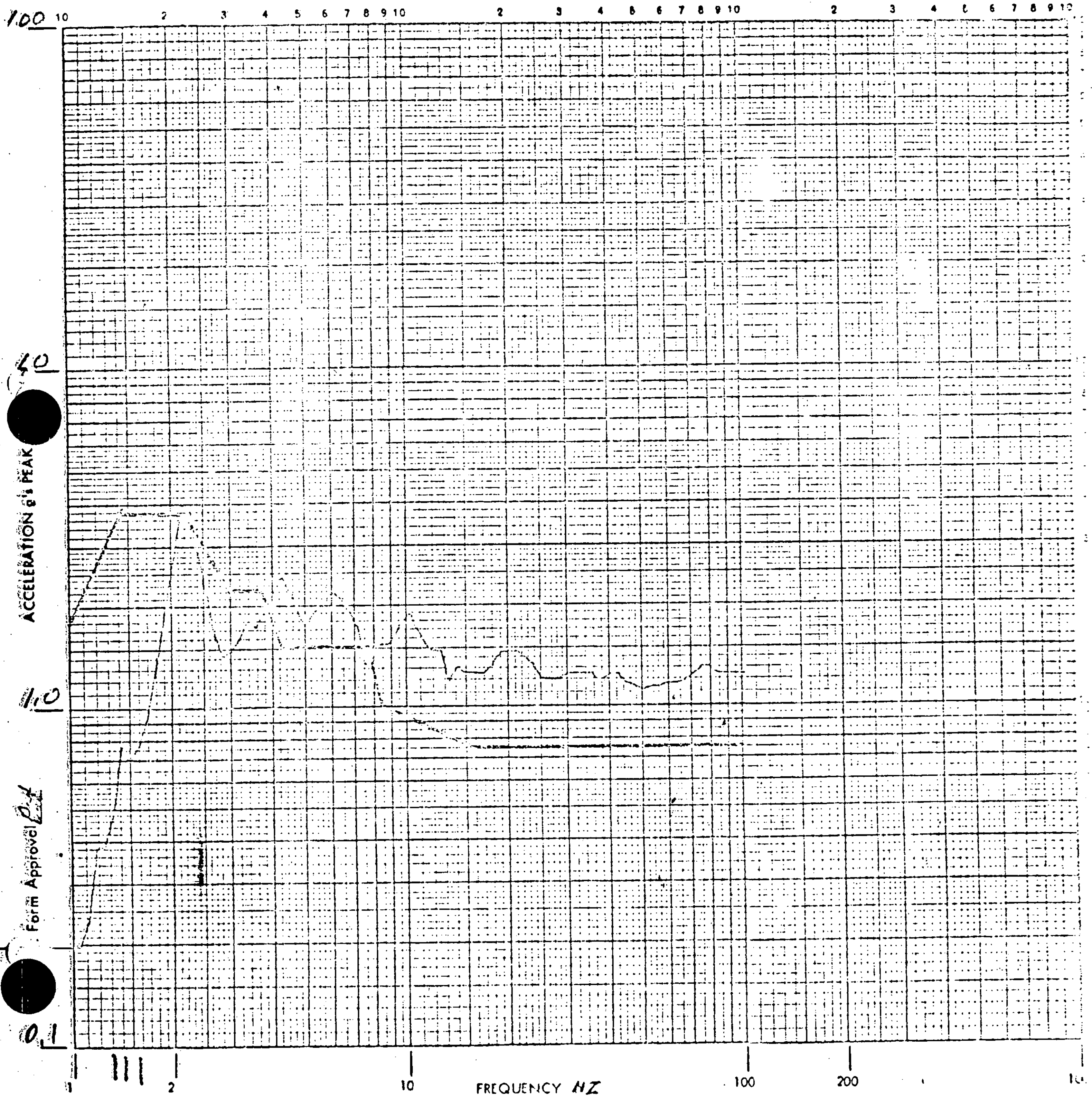
Full Scale 100 G Cal Voltage 500 MVPK/ 1.0 G

Mode PRIMARY Specimen CONTROL PANEL

Operator MEEHAN P/N 2/30[illegible]-62 (UNIT 7)

Date 3/27/76 Polarity + Q 5% Axis of Test 3-Y

VERTICAL RESPONSE SPECTRA 2.0 HZ ok'd



WYLE LABORATORIES Report No. 544[illegible]

Customer JELCO Job No. 54498 Page No. 43

Channel Identification: T/R 1 Trk. No. 1 Accel. No. 1

Transducer S/N 1143 Control (X), Response ( )

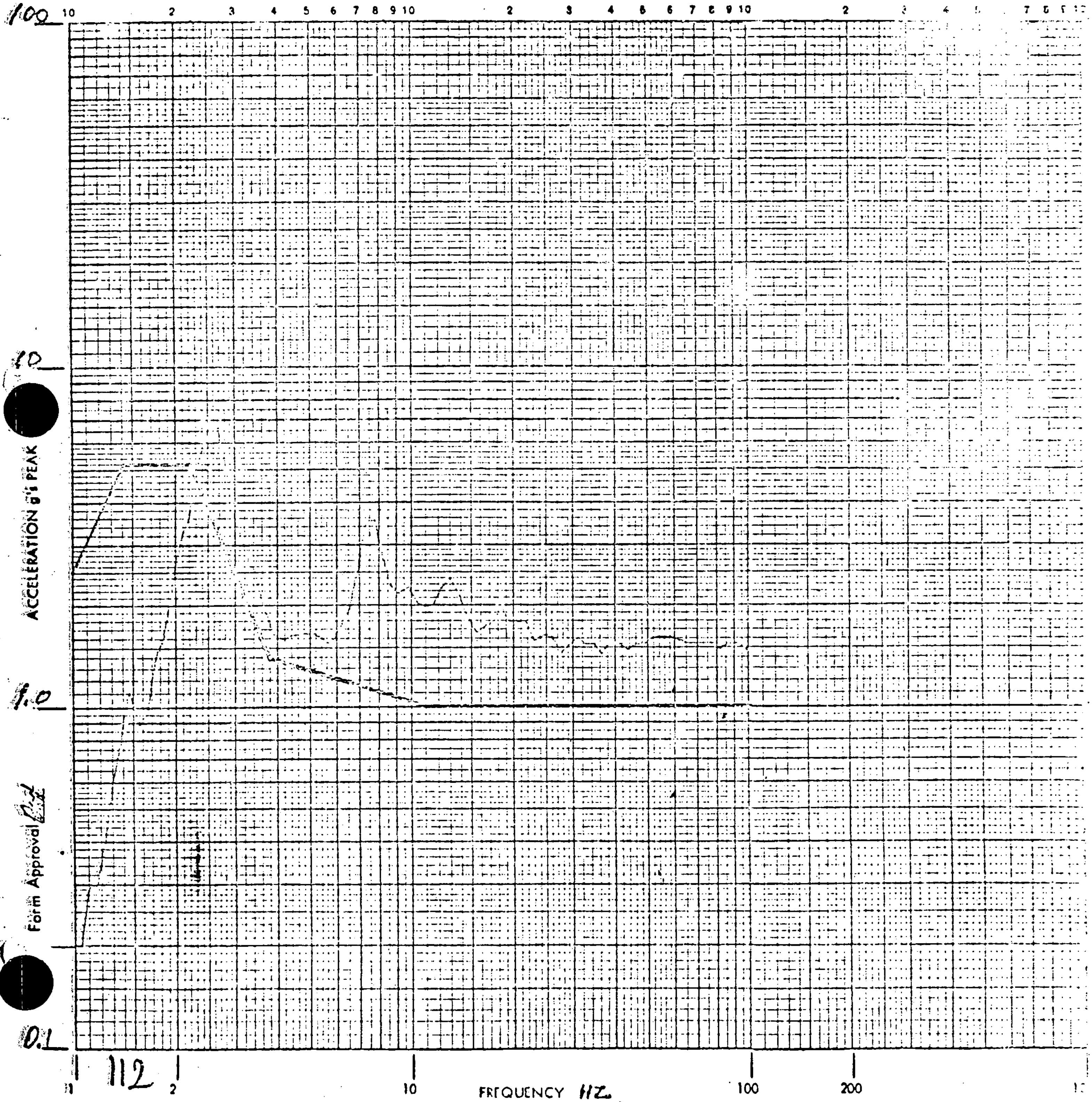
Full Scale 100 G Cal Voltage 500 MVPK/ 1.0 G

Mode PRIMARY Specimen CONT[illegible]NEL

Operator MEEHAN P/N 2/3[illegible]

Date 3/23/76 Polarity + Q 5% Axis of Test Z-Y

HORIZONTAL RESPONSE SPECTRA 2.5 Hz CUT[illegible]



Form Approval

Customer JELCO Job No. 54498 Page No. 44

Channel Identification: T/R 1 Trk. No. 2 Accel. No. 2

Transducer S/N 1168 Control (X), Response ( )

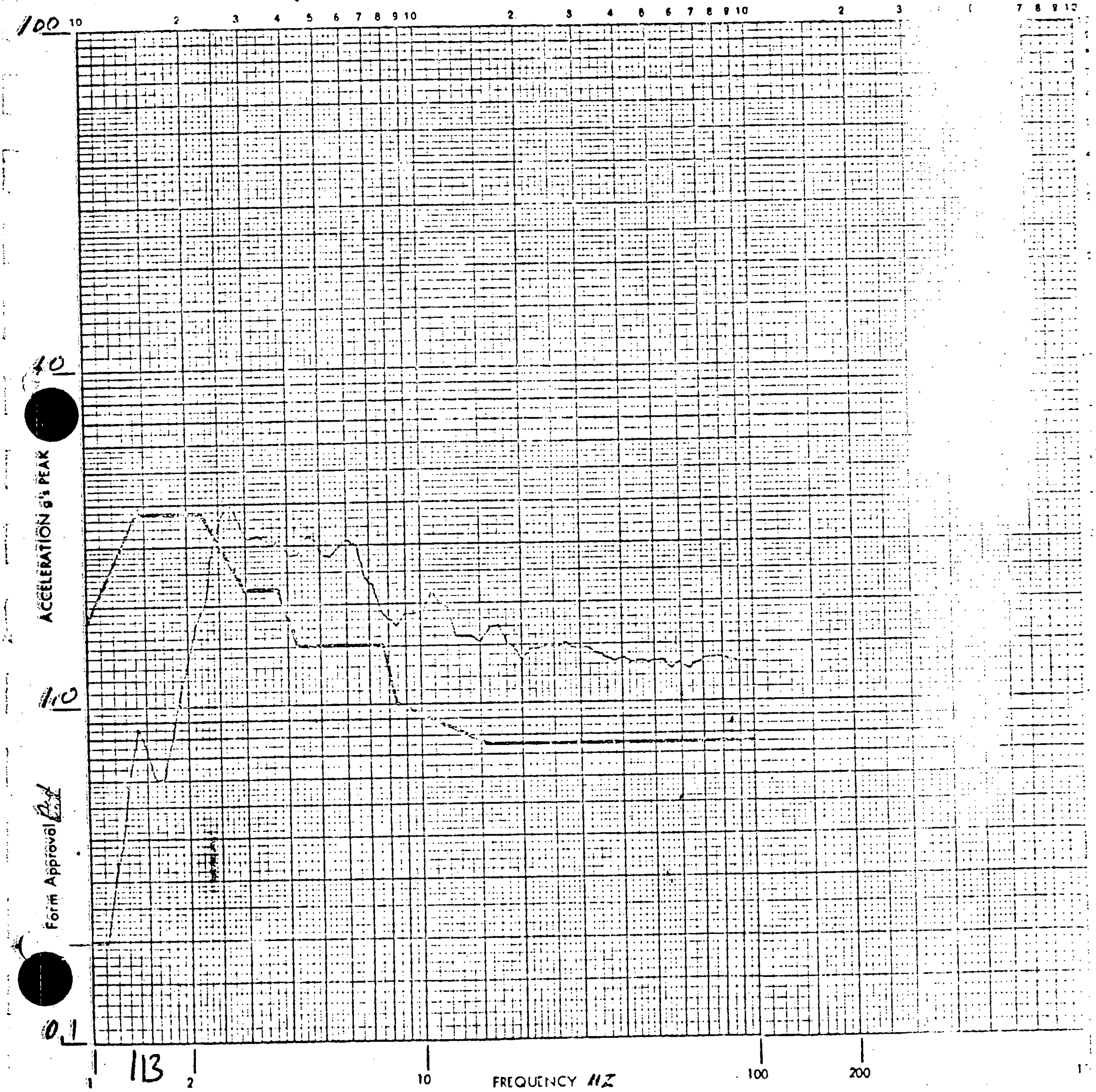
Full Scale 100 G Cal Voltage 500 MVPK/ 1.0 G

Mode PRIMARY Specimen CONTR... ...EL

Operator MEEHAN P/N 2/30... (UNIT ?)

Date 3/23/76 Polarity + Q 5% Axis of Test Z-Y

VERTICAL RESPONSE SPECTRA 2.5 HE ...



WYLE LABORATORIES

Report No. 54498

Customer JELCO Job No. 54498 Page No. 45

Channel Identification: T/R 1 Trk. No. 1 Accel. No. 1

Transducer S/N 1143 Control (X). Response ( )

Full Scale 100 G Cal Voltage 500 MVPK/ 1.0 G

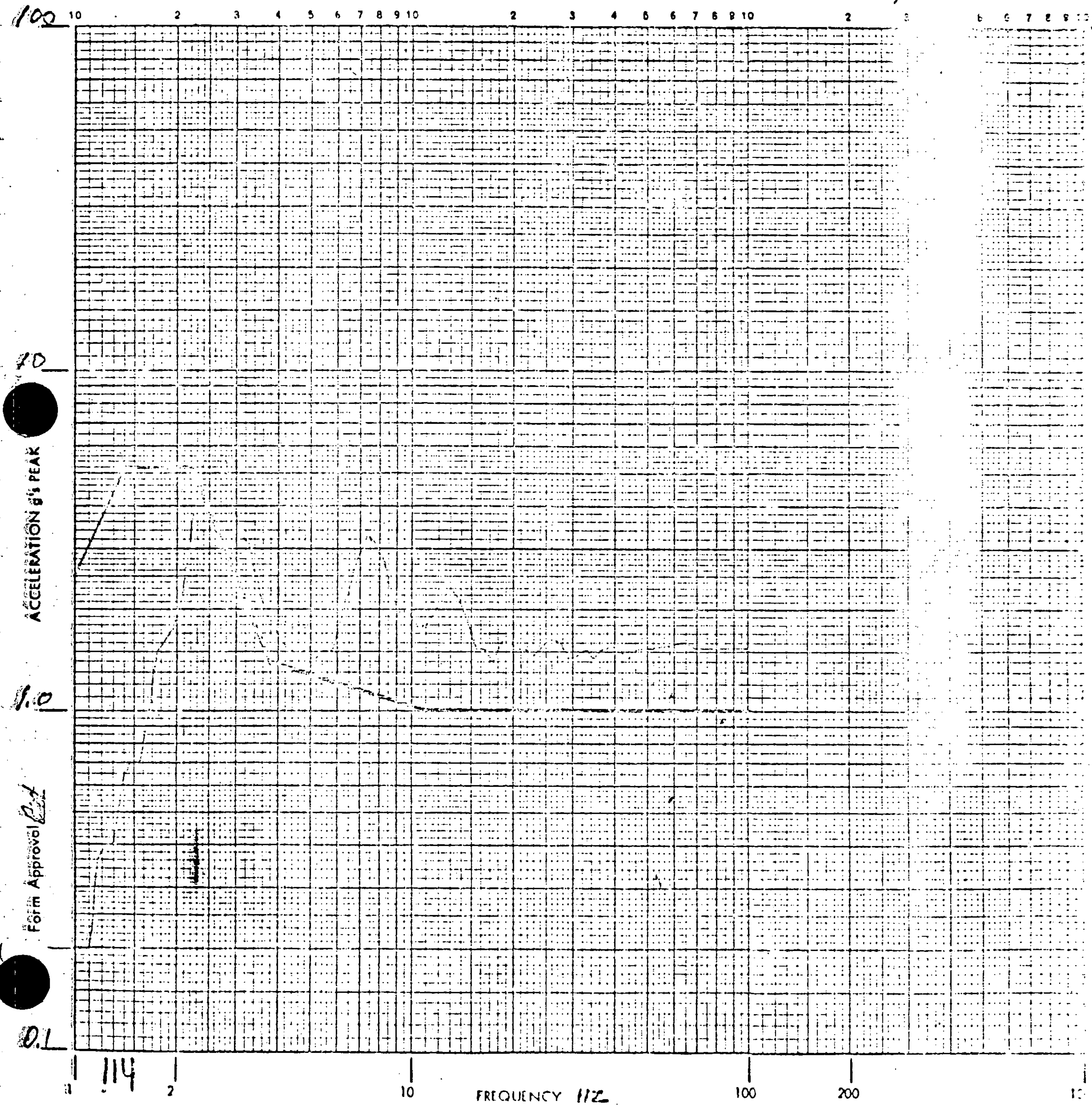
Mode PRIMARY Specimen CONT[illegible] PANEL

Operator MEEHAN P/N 2/3C[illegible] (UNIT 7)

Date 3-23-76 Polarity + Q 5%

Axis of Test Z-Y

HORIZONTAL RESPONSE SPECTRA 2.5 Hz 10 G



Form Approval

114

WYLE LABORATORIES — Report No. 54498

Customer JELCO Job No. 54498 Page No. 46

Channel Identification: T/R 1 Trk. No. 2 Accel. No. 2

Transducer S/N 1168 Control (X), Response ( )

Full Scale 100 G Cal Voltage 500 MVPK/ 1.0 G

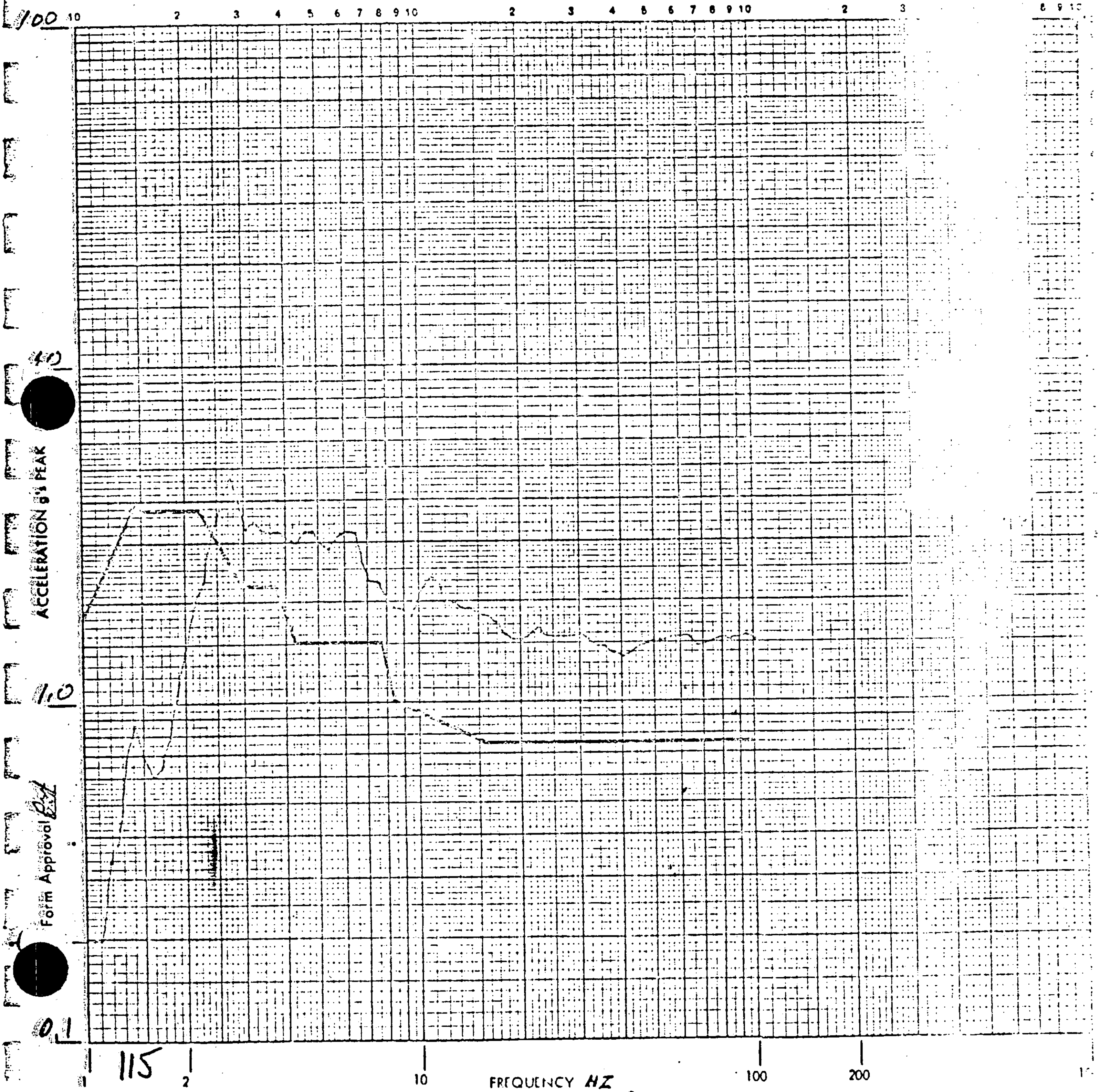
Mode PRIMARY Specimen CONTROL PANEL

Operator MEEHAN P/N 2/30... (UNIT 7)

Date 3-23-76 Polarity + Q 5% Axis of Test Z-Y

2.5 Hz

VERTICAL RESPONSE SPECTRA



SPECIMEN: CONTROL PANEL

CUSTOMER: JELCO

PART NO.: SEE REC INSP

S/N: SEE REC INSP

JOB NO.: 5449

DATE: 3-23-76

TEST BY: [signature]

WITNESS:

WYLE LABORATORIES

TEST: SEISMIC RANDOM WITH SINE BEATS

EQUIPMENT	MANUFACTURER	MODEL NO.	RANGE	WYLE NO.	CALIBRATION		ACCY.
					LAST	DUE	
EXCITER	TEAM CORP	W 3000	12" DIA 30,000 FORCE LBS	—	—	—	N/A
EXCITER	TEAM CORP	W 1800	10" DIA 18,000 FORCE LBS	—	—	—	N/A
EXCITER	TEAM CORP	W 1800	10" DIA 18,000 FORCE LBS	—	—	—	N/A
SERVO CONTROLLER	McFADDEN	152 A	—	—	PRIOR TO	USE	N/A
SERVO CONTROLLER	McFADDEN	152 A	—	—	PRIOR TO	USE	N/A
SERVO CONTROLLER	McFADDEN	152 A	—	—	PRIOR TO	USE	N/A
AMPLIFIER	McFADDEN	152 A	—	—	PRIOR TO	USE	N/A
AMPLIFIER	McFADDEN	152 A	—	—	PRIOR TO	USE	N/A
AMPLIFIER	McFADDEN	152 A	—	—	PRIOR TO	USE	N/A
SHOCK SPECTRUM ANALYZER	SPECTRAL DYNAMICS	13231	120 CHANNEL	7530	SYSTEM	CALIBRATION	MFG. SPEC.
SPECTRUM SHAPER	BRUEL KJAER	123	12.5 TO 40 KHZ	31337	PRIOR TO	USE	N/A
SPECTRUM SHAPER	BRUEL KJAER	123	12.5 TO 40 KHZ	31570	PRIOR TO	USE	N/A
EQUALIZER SHAPER	TRACOR	822	1.25 TO 10 HZ	31534	PRIOR TO	USE	N/A
EQUALIZER SHAPER	TRACOR	822	1.25 TO 10 HZ	31574	PRIOR TO	USE	N/A
X-Y RECORDER	HEWLETT PACKARD	7005	X = 20 "/SEC Y = 20 "/SEC	[illegible]	PRIOR TO	USE	MFG. SPEC.
OSCILLOSCOPE	HEWLETT PACKARD	122 AR	DUAL TRACE	6326	12-15-75	6-15-76	±5%
ELECTRONIC VOLTMETER	BRUEL KJAER	2416	0.01 TO 1000 VOLTS	[illegible]	1-20-76	5-23-76	±1% AVE

111

SPECIMEN CONTROL PANEL

CUSTOMER JELCO

PART NO. SEE REC INSP

S/N SEE REC INSP

JOB NO. 5449

DATE 3-23-76

TEST BY [signature]

WITNESS

WYLE LABORATORIES

TEST: SEISMIC RANDOM WITH SINE BEATS

EQUIPMENT	MANUFACTURER	MODEL NO.	RANGE	WYLE NO.	CALIBRATION LAST	CALIBRATION DUE	ACCY.
ACCELEROMETER	UNHOLTZ DICKIE	75D21	0-1000 G	7532	1-12-76	4-12-76	± 2%
ACCELEROMETER	UNHOLTZ DICKIE	75D21	0-1000 G	7398	2-3-76	5-3-76	± 2%
ACCELEROMETER	UNHOLTZ DICKIE	75D21	0-1000 G	7143	3-22-76	6-22-76	± 2%
ACCELEROMETER	UNHOLTZ DICKIE	75D21	0-1000 G	7320	2-17-76	5-17-76	± 2%
ACCELEROMETER	UNHOLTZ DICKIE	75D21	0-1000 G	7144	2-3-76	5-3-76	± 2%
ACCELEROMETER	UNHOLTZ DICKIE	75D21	0-1000 G	7523	1-12-76	4-12-76	± 2%
ACCELEROMETER	UNHOLTZ DICKIE	75D21	0-1000 G	7300	2-17-76	5-17-76	± 2%
ACCELEROMETER	UNHOLTZ DICKIE	75D21	0-1000 G	7361	3-22-76	6-22-76	± 2%
ACCELEROMETER	UNHOLTZ DICKIE	75D21	0-1000 G	7399	3-22-76	6-22-76	± 2%
ACCELEROMETER	UNHOLTZ DICKIE	75D21	0-1000 G	7302	3-22-76	6-22-76	± 2%
ACCELEROMETER	UNHOLTZ DICKIE	75D21	0-1000 G	7373	3-22-76	6-22-76	± 2%
ACCELEROMETER	UNHOLTZ DICKIE	75D21	0-1000 G	7362	3-22-76	6-22-76	± 2%
ACCELEROMETER	ENDEVCO	2246M15	0-1000 G	31030	3-22-76	6-22-76	± 2%
ACCELEROMETER	ENDEVCO	2246M15	0-1000 G	31025	3-22-76	6-22-76	± 2%
ACCELEROMETER	ENDEVCO	2246M15	[illegible] G	[illegible]	3-22-76	6-22-76	± 2%
ACCELEROMETER	ENDEVCO	2272	[illegible] G	31276	3-22-76	6-22-76	± 2%
ACCELEROMETER	ENDEVCO	2213C	0-1000 G	30601	[illegible]	5-17-76	± 2%

W 614 C Q.C. Approval [initials]

Report No. 54498 Page No. 48

SHEET OF

118

SPECIMEN CONTROL PANEL

CUSTOMER JELCO

PART NO. SEE REC INSP

S/N SEE REC INSP

JOB NO. 5449

DATE 5-23-76

TEST BY [signature]

WITNESS

WYLE LABORATORIES

TEST: SEISMIC RANDOM WITH SINE BEATS

EQUIPMENT	MANUFACTURER	MODEL NO.	RANGE	WYLE NO.	CALIBRATION LAST	CALIBRATION DUE	ACCY.
ACCELEROMETER	ENDEVCO	2213C	0-1000 G	30727	2-17-76	5-17-76	±2%
ACCELEROMETER	ENDEVCO	2213	0-1000 G	6478	3-22-76	6-22-76	±2%
ACCELEROMETER	ENDEVCO	2213	0-1000 G	6475	2-18-76	5-18-76	±2%
ACCELEROMETER	ENDEVCO	2213C	0-1000 G	31016	2-17-76	5-17-76	±2%
ACCELEROMETER	ENDEVCO	2213C	0-1000 G	2397	2-17-76	5-17-76	±2%
CHARGE AMPLIFIER	UNHOLTZ DICKIE	D22	0-1000 G	7341	1-13-76	7-11-76	±2%
CHARGE AMPLIFIER	UNHOLTZ DICKIE	D22	0-1000 G	7342	1-13-76	7-11-76	±2%
CHARGE AMPLIFIER	UNHOLTZ DICKIE	D22	0-1000 G	7343	1-13-76	7-11-76	±2%
CHARGE AMPLIFIER	UNHOLTZ DICKIE	D22	0-1000 G	7344	1-13-76	7-11-76	±2%
CHARGE AMPLIFIER	UNHOLTZ DICKIE	D22	0-1000 G	7338	1-27-76	7-25-76	±2%
CHARGE AMPLIFIER	UNHOLTZ DICKIE	D22	0-1000 G	7346	1-13-76	7-11-76	±2%
CHARGE AMPLIFIER	UNHOLTZ DICKIE	D22	0-1000 G	7335	1-13-76	7-11-76	±2%
CHARGE AMPLIFIER	UNHOLTZ DICKIE	D22	0-1000 G	7336	1-13-76	7-11-76	±2%
CHARGE AMPLIFIER	UNHOLTZ DICKIE	D22	0-1000 G	7337	1-13-76	7-11-76	±2%
CHARGE AMPLIFIER	UNHOLTZ DICKIE	D22	0-1000 G	7340	1-13-76	7-11-76	±2%
CHARGE AMPLIFIER	UNHOLTZ DICKIE	11	0-1000 G	31404	3-16-76	9-19-76	±2%
CHARGE AMPLIFIER	UNHOLTZ DICKIE	D22	0-1000 G	7339	1-13-76	7-11-76	±2%

W614C Q.C. Approval [initials]

Report No. 54493

Page No. 49

SPECIMEN CONTROL PANEL

CUSTOMER JELCO

PART NO. SEE REC INSP

S/N SEE REC INSP

JOB NO. 5449[illegible]

DATE 3-23-76

TEST BY [signature]

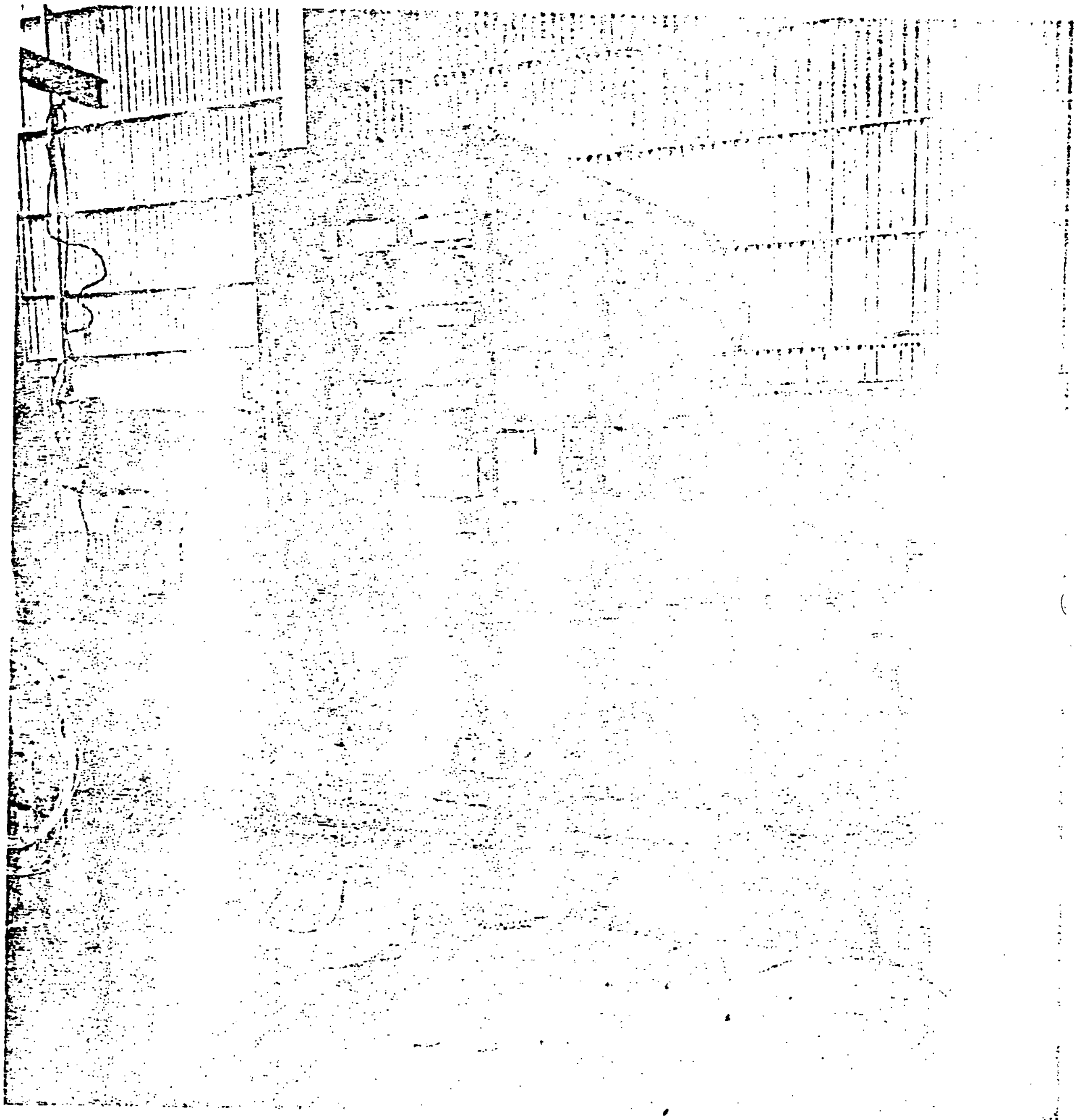
WITNESS

WYLE LABORATORIES

TEST: SEISMIC RANDOM WITH SINE BEATS

EQUIPMENT	MANUFACTURER	MODEL NO.	RANGE	WYLE NO.	CALIBRATION LAST	CALIBRATION DUE	ACCY.
CHARGE AMPLIFIER	UNHOLTZ DICKIE	11	0-1000 G	31465	3-16-76	9-19-76	± 2%
CHARGE AMPLIFIER	UNHOLTZ DICKIE	11	0-1000 G	31453	3-16-76	9-19-76	± 2%
CHARGE AMPLIFIER	UNHOLTZ DICKIE	11	0-1000 G	31492	3-16-76	9-19-76	± 2%
CHARGE AMPLIFIER	UNHOLTZ DICKIE	11	0-1000 G	31407	3-16-76	9-19-76	± 2%
CHARGE AMPLIFIER	UNHOLTZ DICKIE	11	0-1000 G	31490	1-13-76	7-11-76	± 2%
CHARGE AMPLIFIER	UNHOLTZ DICKIE	11	0-1000 G	31493	3-15-76	9-9-76	± 2%
CHARGE AMPLIFIER	UNHOLTZ DICKIE	11	0-1000 G	31406	3-15-76	9-9-76	± 2%
CHARGE AMPLIFIER	UNHOLTZ DICKIE	11	0-1000 G	31491	3-15-76	9-9-76	± 2%
CHARGE AMPLIFIER	UNHOLTZ DICKIE	11	0-1000 G	31481	3-15-76	9-9-76	± 2%
CHARGE AMPLIFIER	UNHOLTZ DICKIE	11	0-1000 G	31488	3-15-76	9-9-76	± 2%
SINE BEAT GENERATOR	MCFADDEN	209A	.5 TO 50 HZ	N/A	PRIOR TO TEST		MFG SPEC
TAPE RECORDER	SANBORN	3924B	14 CHANNEL	31265	PRIOR TO TEST		MFG SPEC
TAPE RECORDER	SANBORN	3924B	14 CHANNEL	31266	PRIOR TO TEST		MFG SPEC
OSCILLOGRAPH	HONEYWELL	[illegible]	[illegible]	[illegible]	[illegible]	6-6-76	± 2%
OSCILLOGRAPH	HONEYWELL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]-76	[illegible]
[illegible]	[illegible]	5[illegible]	[illegible]	[illegible]	[illegible]	[illegible]-2-76	± 2 FREQ
[illegible]ITOR	SPECTRAL DYN.	SD105A	[illegible]	[illegible]	PRIOR TO TEST		N/A

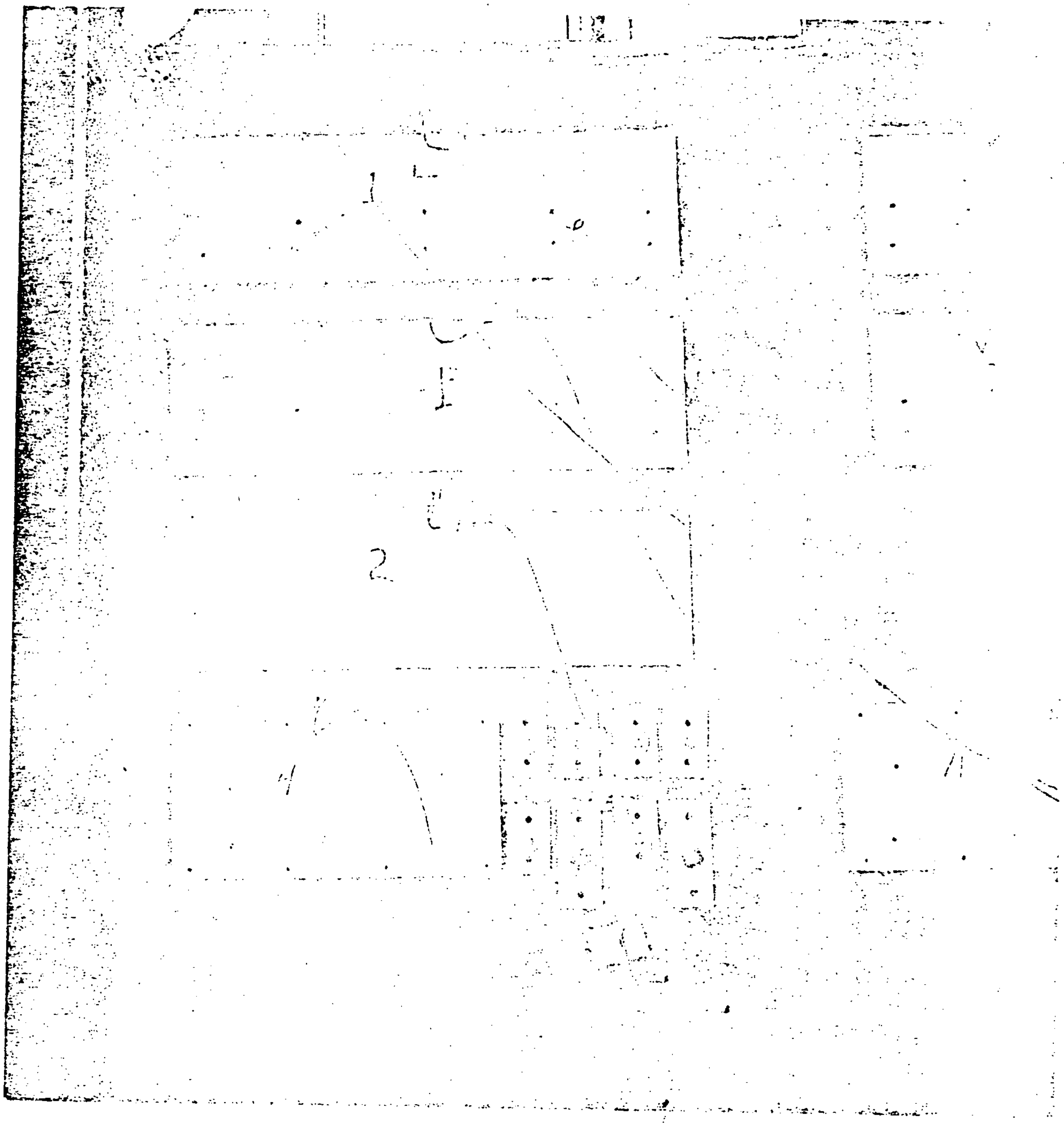
W 614 C Q.C. Approval [initials]



PHOTOGRAPH 1

TYPICAL SEISMIC TEST SETUP
Z - Y AXES

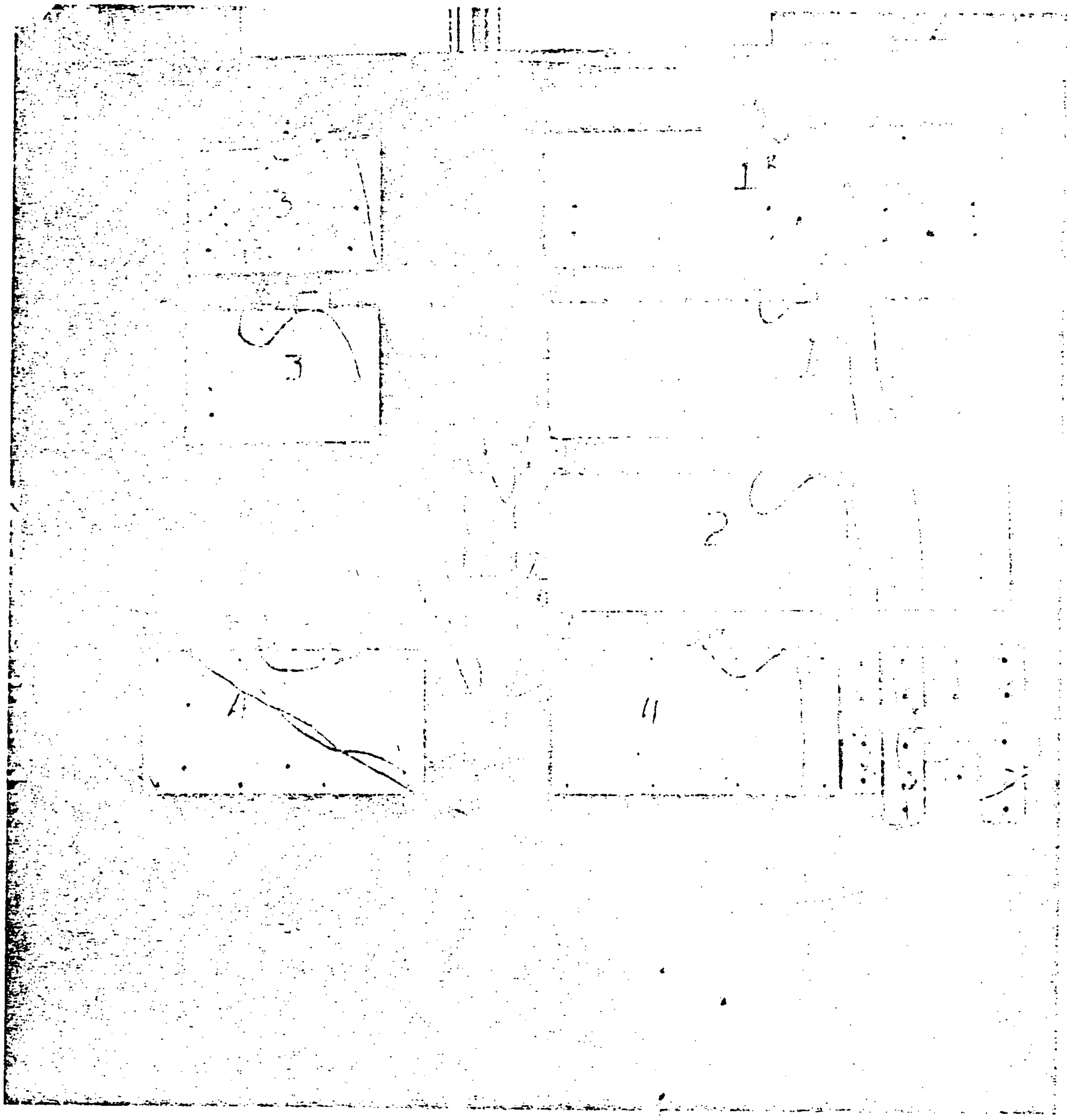
120



PHOTOGRAPH 2

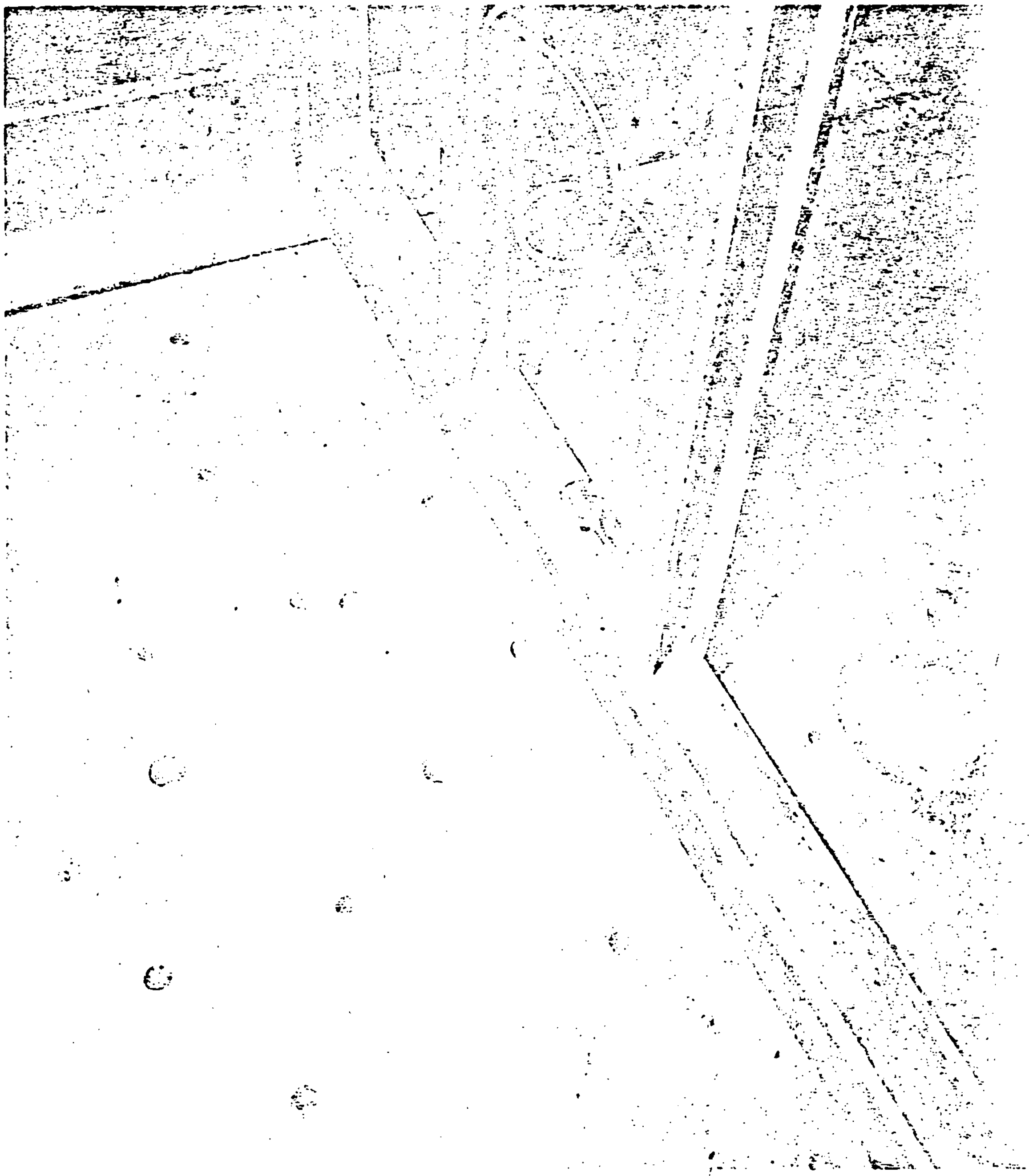
TYPICAL ACCELEROMETER LOCATIONS

121



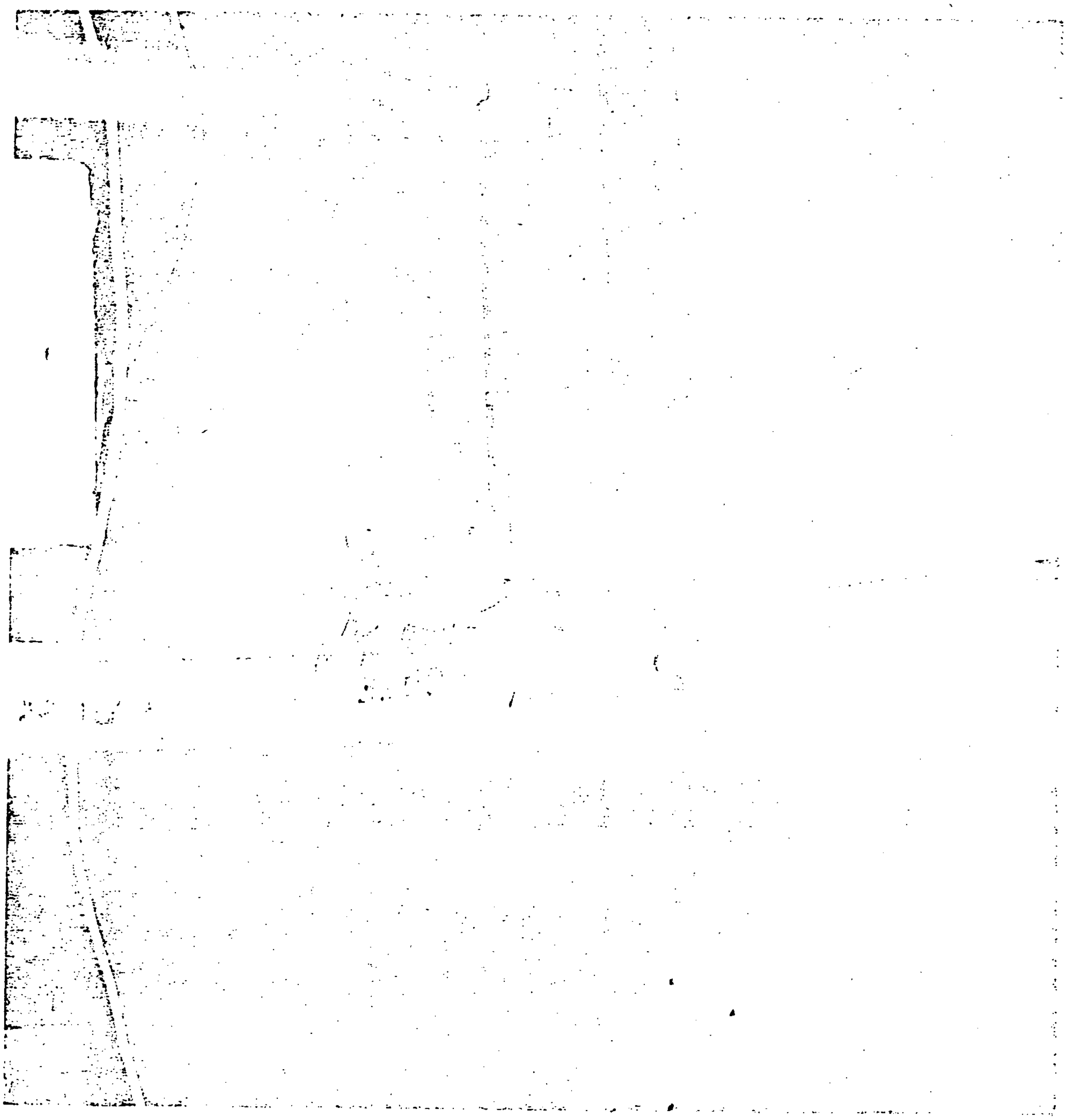
PHOTOGRAPH 3

TYPICAL ACCELEROMETER LOCATIONS



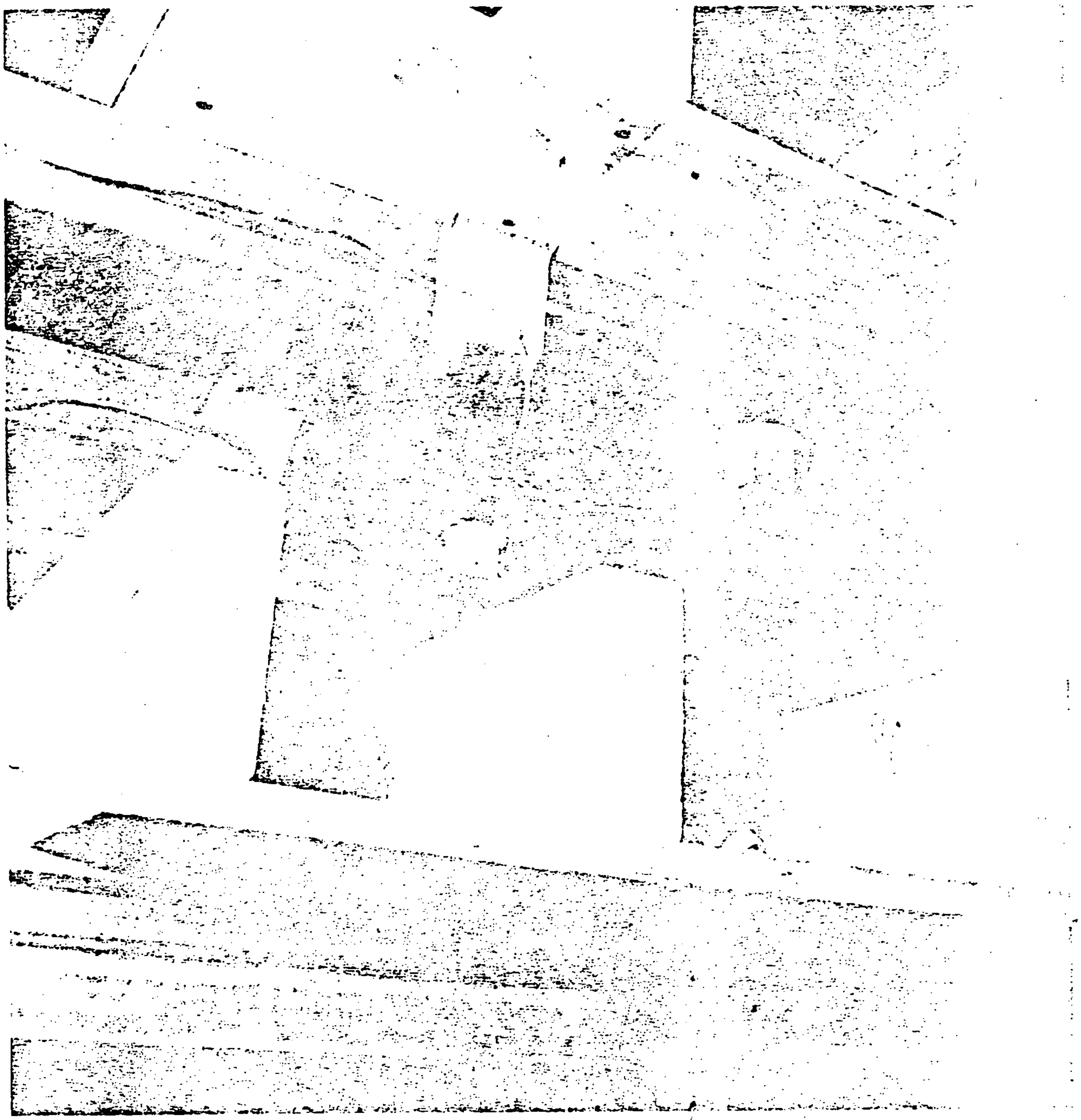
PHOTOGRAPH 4

TYPICAL ACCELEROMETER LOCATIONS



PHOTOGRAPH 5

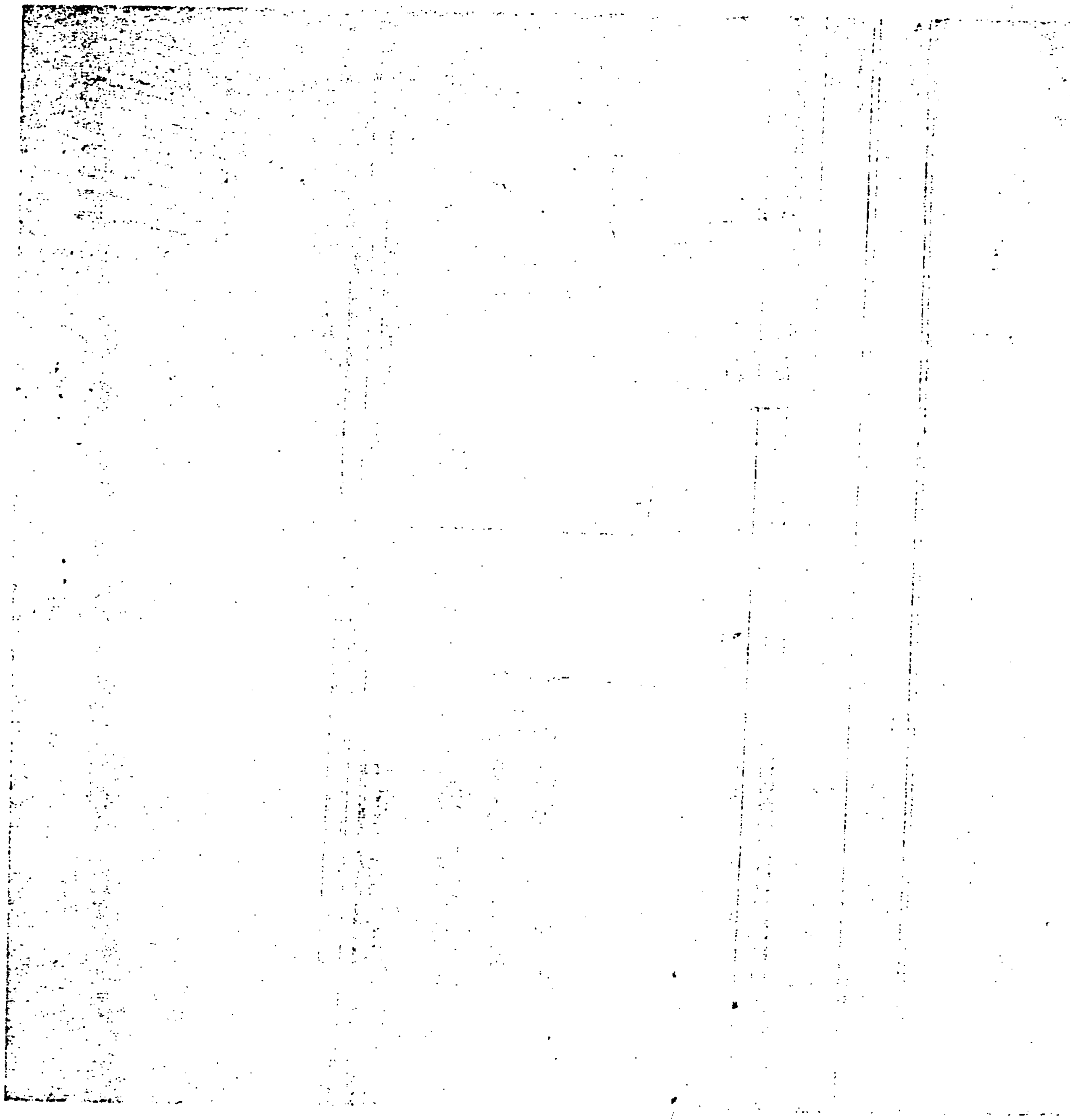
TYPICAL ACCELEROMETER LOCATIONS



PHOTOGRAPH 6

TYPICAL ACCELEROMETER LOCATIONS

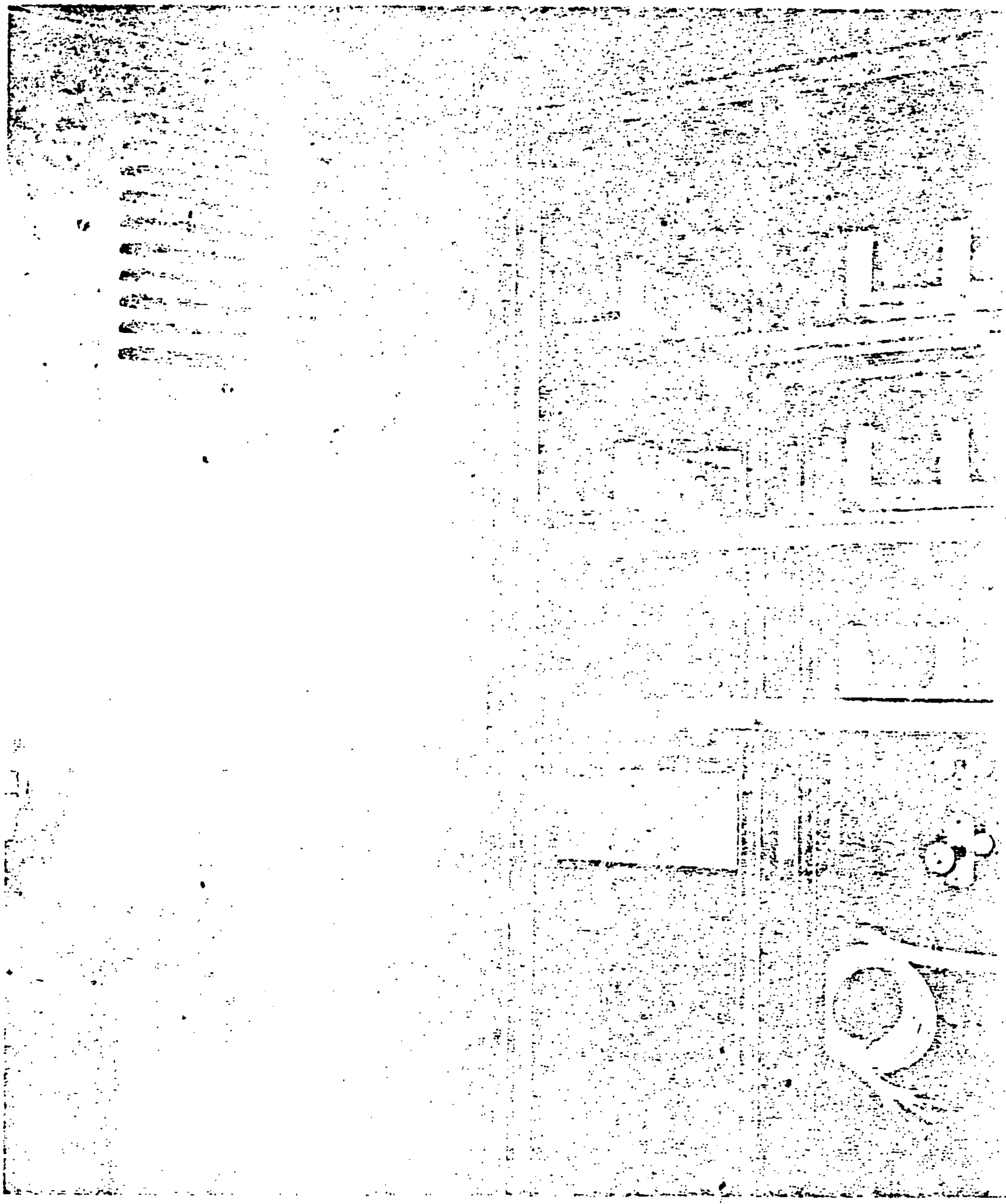
125



PHOTOGRAPH 7

[illegible]LATIONS

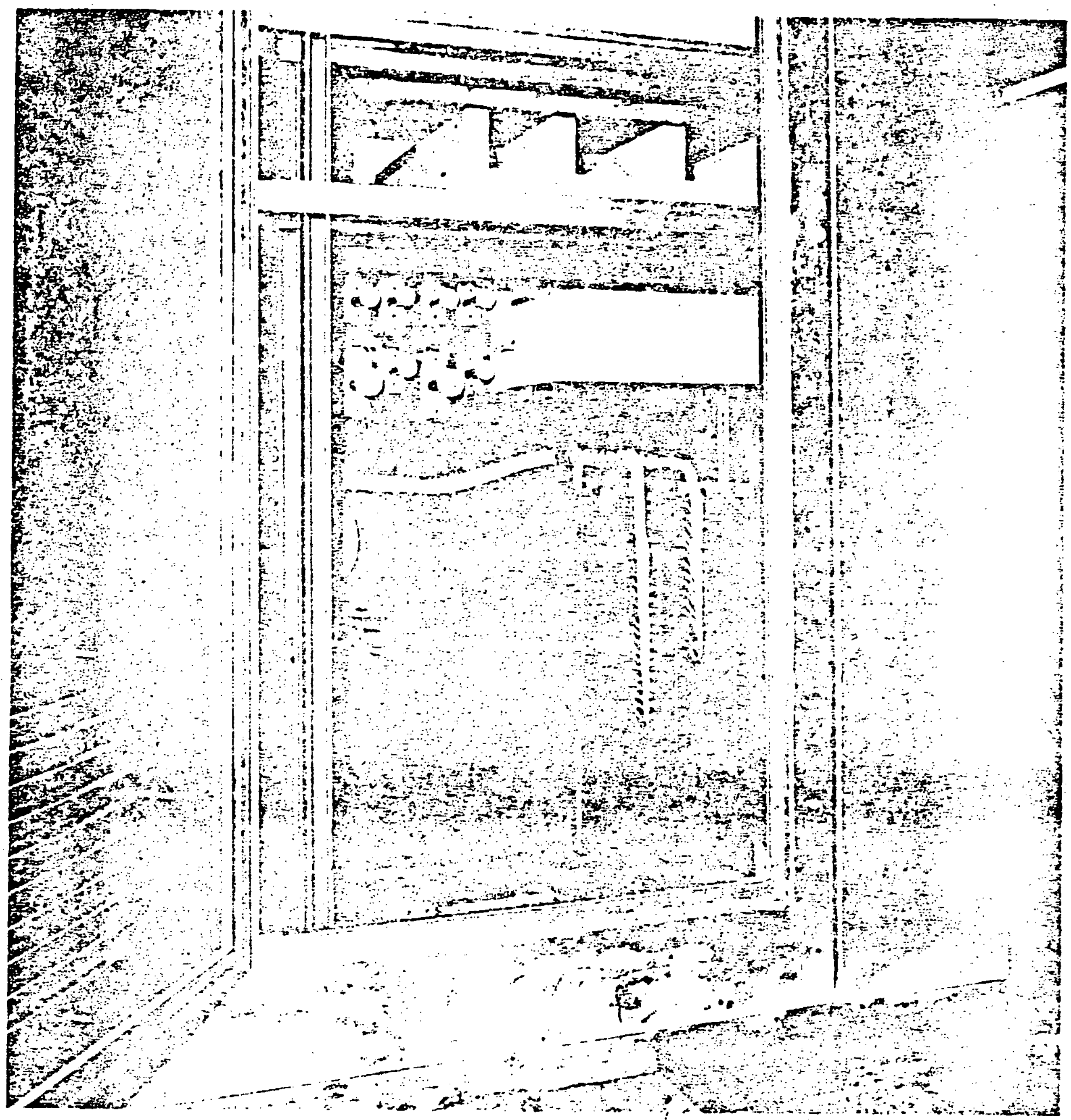
126



PHOTOGRAPH 8

DIRECT WEIGHT INSTALLATIONS

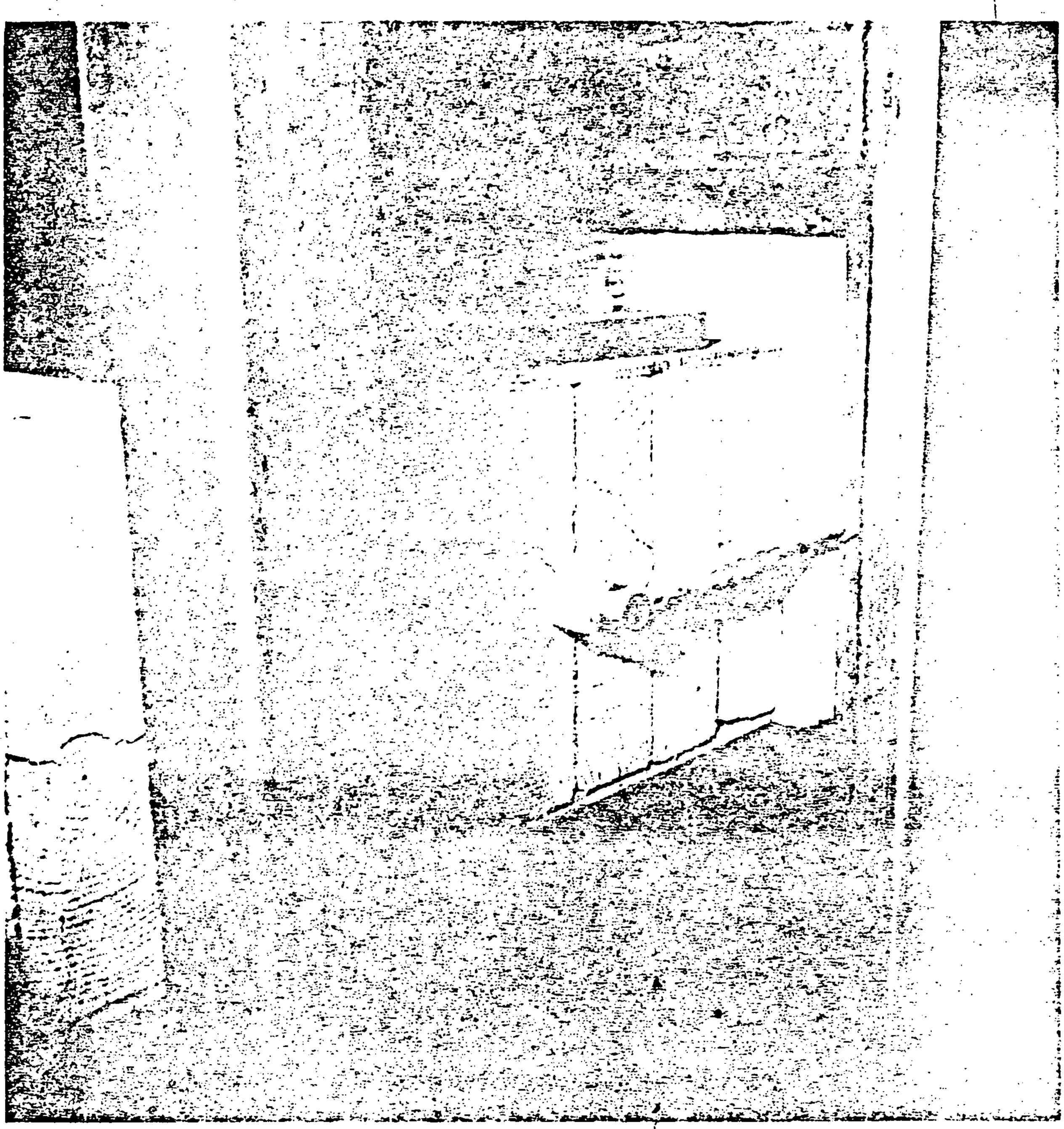
127



PHOTOGRAPH 9

DUMMY WEIGHT INSTALLATIONS

128



PHOTOGRAPH 10

DUMMY WEIGHT INSTALLATION DETAIL

TEST REPORT

WYLE LABORATORIES /Norco, California . 737-0871 , 689-2104 . TWX 910-332-1204 . Cable WYLAB

REPORT NO. 54498

OUR JOB NO. ND 54498

YOUR P. O. NO. 7651

CONTRACT ---

5 - Page Addendum

JELCO, Inc.
P. O. Box 2248
Pomona, California 91766

DATE 29 June 1976

ADDENDUM I

1.0 REFERENCES

1.1 Jelco, Inc. Purchase Order No. 7651, dated 15 March 1976.

1.2 Wyle Laboratories Test Report No. 7651, dated 31 March 1976.

2.0 PURPOSE

The purpose of this addendum is to incorporate four pages of test data sheets inadvertently omitted from Reference 1.2. These data sheets furnish test information for resonance search and seismic random with sine beat tests on Shipping Section No. 7.

REGISTERED PROFESSIONAL ENGINEER
GEORGE D. SHIPWAY
No. 12157
MECHANICAL
STATE OF CALIFORNIA

STATE OF CALIFORNIA } ss.
COUNTY OF RIVERSIDE

Ray C. Myrick, being duly sworn, deposes and says: That the information contained in this report is the result of complete and carefully conducted tests and is to the best of his knowledge true and correct in all respects.

SUBSCRIBED and sworn to before me this 29th day of June, 19 76

Notary Public in and for the County of Riverside, State of California

My Commission expires 14 July, 19 79

OFFICIAL SEAL
CATHERINE C. KELTY
NOTARY PUBLIC - CALIFORNIA

130

DEPARTMENT ELECTRONICS

DEPT. MGR. James J. Anderson

TEST ENGINEER W. K. Franz

Registered Professional Engineer George D. Shipway

DCAS-QAR VERIFICATION

QUALITY CONTROL

131

YLE LABO[redacted]ORIES

DYNAMICS SEC[redacted]
VIBRATION TEST DATA [redacted]HEET

RESONANCE SEARCH

Job No. [redacted] 5447
Sheet [redacted] of
I D No.

Date	Time	Axis	Temp (°F)	SINUSOIDAL Freq. (HZ)	Disp. ("DA)	Accel. (± G)	Test Time (Min.)	Comments	Name
76	LISTED	X-Y-Z	AMB	1-35-1	.	0.2	*		
								* ONE CYCLE 1-35-1 HZ AT A SWEEP RATE OF APPROX. ONE HALF OCTAVE PER MINUTE	
23	1150 1153	Z	AMB	1-4	-	0.2	3 MIN 26 SEC	START SWEEP, MANUAL CONTROL SHUT DOWN, CHANGE TO AUTOMATIC	[illegible]
23	1155 1206	Z	AMB	4-35-4	-	0.2	11 MIN 40 SEC	RESUME SWEEP AUTOMATIC SERVO SHUT DOWN, CHANGE TO MANUAL	[illegible]
23	1207 1210	Z	AMB	4-1	-	0.2	3 MIN 26 SEC	RESUME SWEEP MANUAL CONTROL COMPLETED SWEEP	[illegible]
23	1413 1416	Y	AMB	1-4	-	0.2	3 MIN 26 SEC	START SWEEP, MANUAL CONTROL SHUT DOWN, CHANGE TO AUTOMATIC	[illegible]
23	1418 1429	Y	AMB	4-35-4	-	0.2	11 MIN 40 SEC	RESUME SWEEP, AUTOMATIC SERVO SHUT DOWN, CHANGE TO MANUAL	[illegible]
23	1430 1433	Y	AMB	4-1	.	0.2	3 MIN 26 SEC	RESUME SWEEP, MANUAL CONTROL COMPLETED SWEEP	[illegible]

Page No. 2

Signed: [illegible]

YLE LAB ORIES

DYNAMICS SEC
VIBRATION TEST DATA SHEET
RESONANCE SEARCH

132

Job No. 5449
Sheet ____ of ____
I D No. ____

ate	Time	Axis	Temp (°F)	SINUSOIDAL Freq. (HZ)	Disp. ("DA.)	Accel. (± G)	Test Time (Min.)	Comments	Nar
73	NOTED	X-Y-Z	AMB	1-35-1	-	0.2	*		
								* ONE CYCLE 1-35-1 HZ AT A SWEEP RATE	
								OF APPROX. ONE HALF OCTAVE PER MINUTE	
24	1315	X	AMB	1-4	-	0.2		START SWEEP, MANUAL CONTROL	
	1318						3 MIN 35 SEC	SHUT DOWN, CHANGE TO AUTOMATIC JM	
24	1320	X	AMB	4-35-4	-	0.2		RESUME SWEEP, AUTOMATIC SERVO	
	1331						11 MIN 05 SEC	SHUT DOWN, CHANGE TO MANUAL JM	
24	1332	X	AMB	4-1	-	0.2		RESUME SWEEP, MANUAL CONTROL	
	1335						3 MIN 55 SEC	COMPLETED SWEEP JM	

Page No. 3

Signed: [illegible]

DATA SHEET

Page No. 4

CUSTOMER JELCO
Test Title: SEISMIC RANDOM WITH SINE BEATS
Specimen CONTROL
Job No. 54478
S/N SEE REC INSP
Part No. SEE REC INSP
Date 3-23-76

DATE	TIME	AXIS	TEST	COMMENTS
1976	NOTED	Z-Y	NOTED	RANDOM LOOP WAS 30 SECONDS
3-23	1527	Z-Y	1.25 HZ	IN Ø
3-23	1533	Z-Y	1.25 HZ	OUT Ø
3-23	1539	Z-Y	1.6 HZ	OUT Ø
3-23	1557	Z-Y	1.6 HZ	IN Ø
3-23	1611	Z-Y	2.0 HZ	IN Ø
3-23	1615	Z-Y	2.0 HZ	OUT Ø
3-23	1622	Z-Y	2.5 HZ	OUT Ø
3-23	1627	Z-Y	2.5 HZ	IN Ø

133

QC Form Approval

SHEET____ OF____

Page No. 5

CUSTOMER JELCO
Test Title: SEISMIC RANDOM WITH SINE BEATS

Specimen CONTROL PANEL
Job No. 54498
S/N SEE REC INSP
Part No. SEE REC INSP
Date 3-24-76

DATE	TIME	AXIS	TEST	COMMENTS
1976	NOTED	X-Y	NOTED	RANDOM LOOP WAS 30 SECONDS
3-24	1403	X-Y	1.25 HZ	IN Ø [illegible]
3-24	1411	X-Y	1.25 HZ	OUT Ø [illegible]
3-24	1416	X-Y	1.25 HZ	OUT Ø [illegible]
3-24	1422	X-Y	1.6 HZ	OUT Ø [illegible]
3-24	1426	X-Y	1.6 HZ	IN Ø [illegible]
3-24	1431	X-Y	2.0 HZ	IN Ø
3-24	1435	X-Y	2.0 HZ	OUT Ø
3-24	1440	X-Y	2.5 HZ	OUT Ø
3-24	1445	X-Y	2.5 HZ	IN Ø

134

QC Form Approval

SHEET ____ OF ____