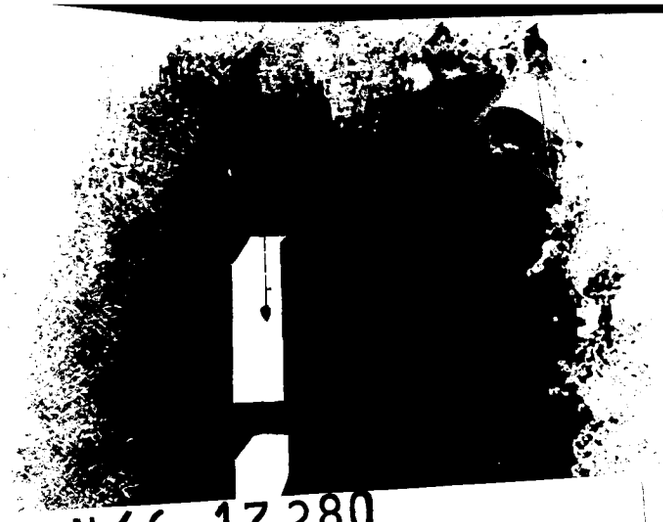


NASA CR-
Case Fi

N66-17280

(ACCESSION NUMBER) 220 (PAGES)

CR-66044 (NASA CR OR TMX OR AD NUMBER)

(THRU) N ONE (CODE)

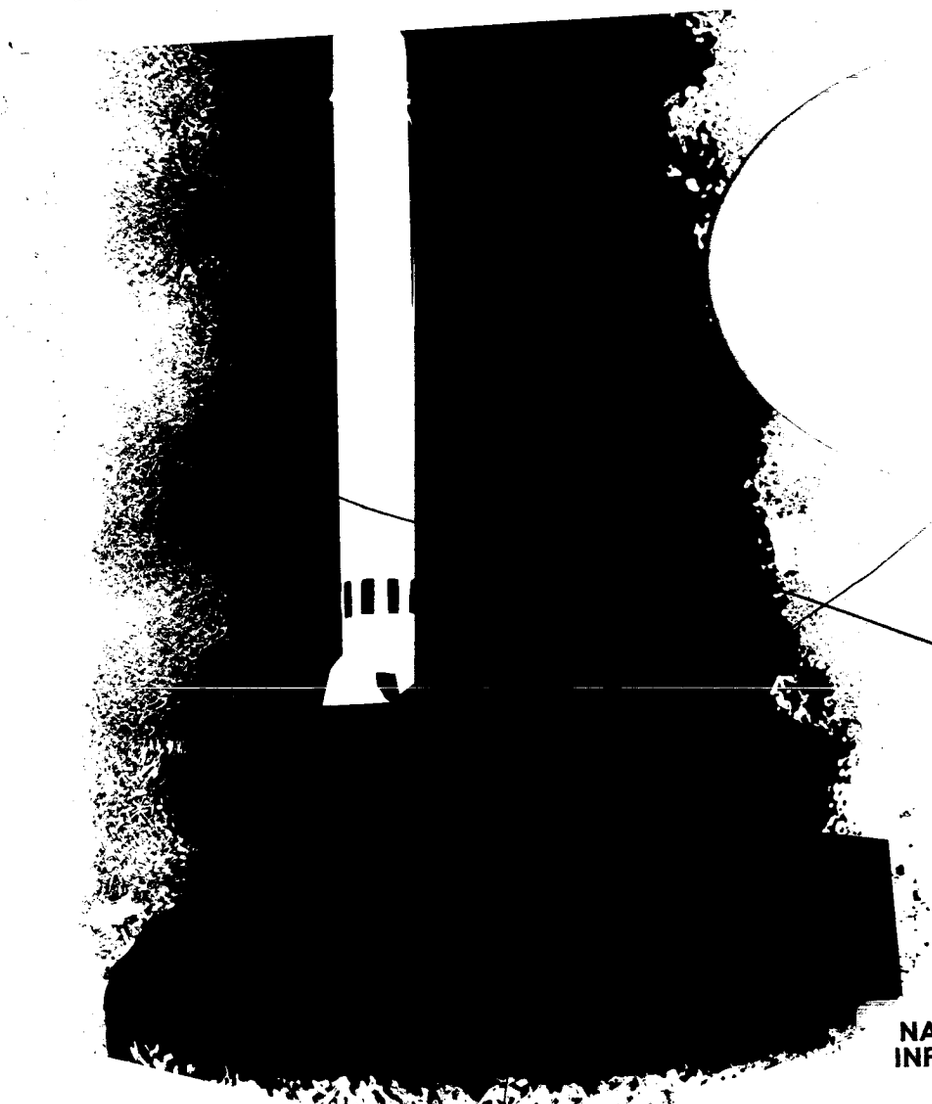
31 [redacted] (CATEGORY)

FACILITY FORM 602

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Dallas, Texas 75222

TITLE

TUNNEL MOUNTED AUTO DESTRUCT MODULE

SCOUT VEHICLE

SUBMITTED UNDER

REPORT NO.	DATED
23.205	15 July 1965
PROJECT	**CONTRACT NO.**
Scout	NAS1-3589

Task Order 17

B.V. Morris
McJarrell (EI)
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REV.	DATE	REV. BY	PAGES AFFECTED	REMARKS
A	9-15-65	DMD	Pages i, A-1 and A-4 revised.	
		BVM	Pages A-5 through A-25 issued new.	
			Pages B-1 and B-2 issued new.	
			H. C. Scott 9/16/65	

ENCLOSURE (1) TO
LTV LETTER NO.
3-15000/5L-1795

3-52715

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SECTION 1.0

SUMMARY

Under Contract NAS1-3899 Task Order 17, the contractor was authorized to furnish the services and materials necessary to design, fabricate and qualify a Tunnel Mounted Auto Destruct Module Prototype.

This report presents a summary of the design and qualification tests performed on the module.

Upon completion of this Tunnel Mounted Auto Destruct Module Prototype test program, this module was delivered to Government Bonded Storage for assignment as GFE on some future contract.

Subsequently this module prototype has been refurbished under Contract NAS1-3589 and assigned as a flight article for use on the System Evaluation Vehicle S-131R.

SECTION 1.0

CONCLUSIONS

Based on the results of the qualification test program conducted on the Tunnel Mounted Auto Destruct Module Prototype, it is concluded that this module meets all the requirements for integration into the Scout systems and is acceptable for use on the Scout first and second stages as an operational system.

SECTION 1.0

INTRODUCTION

Under Contract NAS1-3899 Task Order 17 dated 15 January 1965, the contractor was authorized to furnish the services and materials necessary to design, fabricate and qualify a Tunnel Mounted Auto Destruct Module Prototype for use on the Scout Vehicle first and second stages. Upon completion of the qualification test program, the unit was to be inspected and accepted by the Bureau of Naval Weapons representative and placed in bonded storage for assignment at a later date to another NASA contract as Government Furnished Equipment.

In general the following NASA Statement of Work was used to perform this task.

A-1. The Contractor shall provide a qualified design and prototype with the following characteristics:

1.1 The configuration of the module shall be designed under support engineering (Contract NAS1-3657) and approved by NASA.

1.2 It shall be interchangeable between first and second stages (exclusive of tunnels and tunnel support studs).

1.3 The module shall be qualified for the worst environment anticipated from all combinations of Castor I, Castor II and Algol.

1.4 The module shall not require a tunnel which is larger than the maximum size of existing tunnels in "B" section interstage region.

1.5 The module tunnel shall employ existing or qualified components wherever possible; e.g. transition "E" battery boxes.

1.6 The module tunnel shall be physically protected from contact with blast or ram air down the tunnel.

1.7 The module tunnel shall be covered with a separate tunnel section, which shall be isolated from the effect of rocket blast at separation.

1.8 The module tunnel shall have easily-installed batteries.

1.9 Consideration shall be given to minimum scrappage and ease of installation.

1.10 In addition, the Contractor shall define and design the complete interface with existing vehicle components.

1.11 The Contractor shall provide detail design of modifications required to adapt the modules to the existing Scout electrical and mechanical configuration, including layouts and isometric drawings of the complete installation.

1.12 The Algol and Castor pressure transducers shall be installed on the headcap of the rocket motors leaving ample access for installing side insertable squibs.

1.13 All components located in the modules shall be completely accessible upon removal of the module tunnel covers.

1.14 The destruct tube installations shall be relocated on the Algol and Castor motors to be consistent with the module addition.

1.15 The design shall employ the existing auto destruct pressure switch design.

1.16 All tooling shall be suitable for follow-on production.

1.17 The Contractor shall provide detailed design of changes or additions to ground support equipment (in-plant and field) required to test the modules. It is not intended that the Contractor prepare procedures for in-plant or field testing until a production incorporation point is established, but an outline of the tests and their purpose, is required.

1.18 The effort shall include the following:

1.18.1 Incorporate a stronger tunnel flap door clips for B-section and C-section per NASA drawing LX 808914A.

1.18.2 Incorporate lanyard hold down clips for B-section and C-section per NASA drawing LX 808914A.

B-1. Final report containing the following:

1.1 Definitization of requirement.

1.2 Design philosophy and approach.

1.3 Description of the work performed on this contract.

1.4 All design criteria, both mechanical and electrical.

1.5 All analyses, including but not limited to, loads analysis, thermal analysis, stress analysis, circuit analysis, reliability analysis, failure mode analysis, vibration analysis, etc.

1.6 Description and outline of test program.

1.7 All drawings and specifications.

1.8 All test plans plus test reports including those for development, evaluator, simulator, and qualification tests.

1.9 Complete mechanical and electrical interface drawings suitable for incorporating the module on Scout.

1.10 Summary of Design and Qualification limits as pertains to structural loads, temperatures, shock, vibrations, pressure, electrical loads, etc.

1.11 All other pertinent material.

The basic requirement for the Tunnel Mounted Auto Destruct Module is to remove the auto destruct components from within the vehicle transition sections to an installation located in the vehicle wiring tunnel. Removal of the auto destruct components from the transition sections eliminates the direct motor ignition blast impingement and possible shrapnel damage resulting from break-up of the separation diaphragm during vehicle staging. Damage to the auto destruct components or connecting wire bundles could possibly result in premature auto destruct of the vehicle stages.

The design philosophy and approach used during the design of the Tunnel Mounted Auto Destruct Module is conventional and consistent with that used on the Scout vehicle. No new concepts or methods of analysis have been used on this task.

A description of the work accomplished by the Engineering sections is presented in separate sections. These sections are 1.0 Introduction, 2.0 Stress Analysis, 3.0 Mechanical Design, 4.0 Electrical Design, and 5.0 Test Plan and Test Results.

SECTION 2

STRESS ANALYSIS

INTRODUCTION

The purpose of this section of the report is to present the stress analysis of the structural components of the tunnel mounted auto-destruct module.

DESCRIPTION

There are two auto-destruct modules per vehicle. One module is mounted externally on the first stage motor and one is mounted externally on the second stage motor.

The major structural components of the auto-destruct module consist of a 12 ply fiberglass tunnel cover supported by three small aluminum sheet metal bulkheads. The bulkheads are attached to an aluminum mounting plate. This mounting plate is attached to pads located on the first and second stage motor cases.

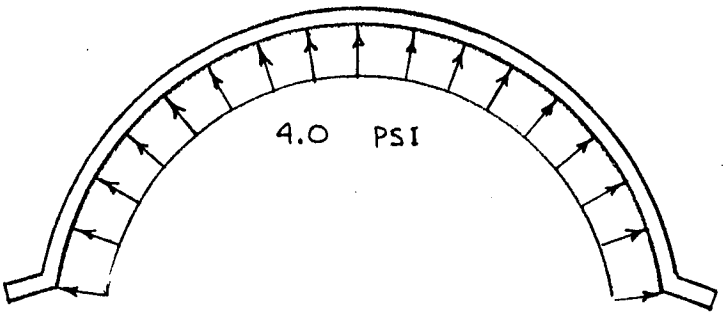
The auto-destruct module tunnel is a portion of the entire vehicle tunnel and extends from station 259.49 to station 292.64 on the second stage motor and from station 496.15 to station 529.30 on the first stage motor.

LOADS

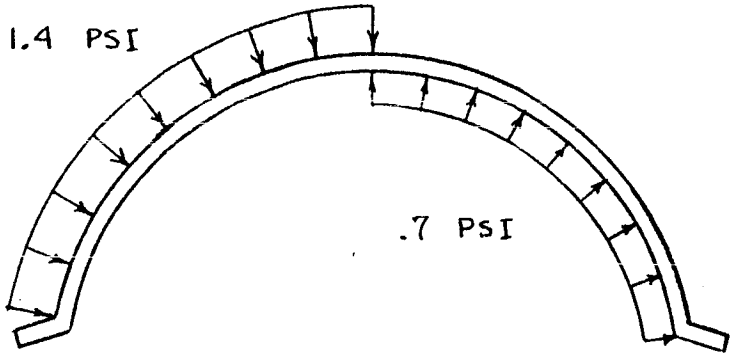
Design loading conditions for pressure loads and inertial loads are shown on pages 2.1 and 2.11 respectively.

DESIGN CRITERIA — PRESSURE LOADING

THE DESTRUCT MODULE WAS DESIGNED FOR THE FOLLOWING TWO PRESSURE CONDITIONS. REF (D)



LIMIT BURST PRESSURE



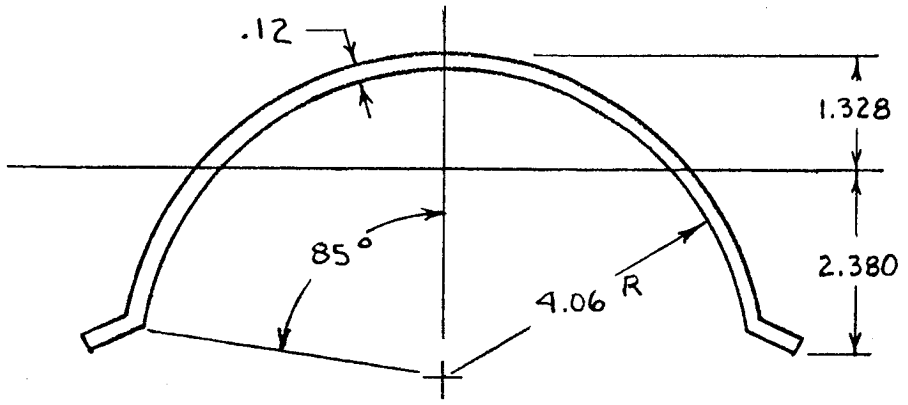
LIMIT SIDE PRESSURE

THE ABOVE LIMIT PRESSURES ARE THE MAXIMUM ANTICIPATED PRESSURES FOR ANY SECTION OF THE TUNNEL. THEY ARE MULTIPLIED BY 1.5 TO OBTAIN DESIGN ULTIMATE PRESSURES.

TUNNEL COVER – PRESSURE LOADING

SECTION PROPERTIES

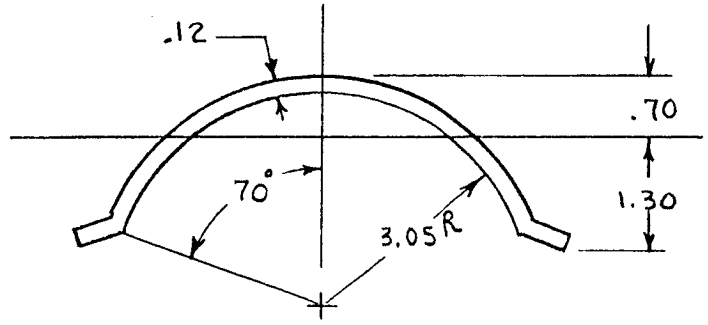
THE CROSS-SECTION OF THE MAJOR PORTION OF THE DESTRUCT MODULE TUNNEL COVER IS THAT OF SECTION A-A. THE AFT PORTION OF THE TUNNEL COVER TAPERS TO THE CROSS-SECTION SHOWN IN SECTION B-B.



$I_c = 1.825$ IN^4

SECTION A-A
(SEE PG 2.4)

GEOMETRY REF 23-002966



$I_c = .316$ IN^4

SECTION B-B
(SEE PAGE 24)

REGION OF TAPER
FIRST STAGE TUNNEL STA. 521.30 TO STA. 528.45
SECOND STAGE TUNNEL STA. 284.64 TO STA. 291.79

TUNNEL COVER - PRESSURE LOADING

LOADS ANALYSIS

BURST PRESSURE IS THE CRITICAL DESIGN LOADING FOR ALL OF THE DESTRUCT MODULE. THE BULKHEAD REACTIONS AND TUNNEL SHEAR AND MOMENT CURVES ARE SHOWN ON PAGE 2.4 FOR THE BURST PRESSURE CONDITION. THE FOLLOWING ASSUMPTIONS WERE MADE IN DETERMINING THE REACTIONS.

(1.) RUNNING LOAD IS DUE TO THE ULTIMATE BURST PRESSURE MULTIPLIED BY THE PROJECTED WIDTH OF THE TUNNEL COVER.

(2.) THE CHANGES IN CROSS-SECTION OCCUR AT SUPPORTS C AND D RATHER THAN BETWEEN THEM.

(3.) THE ACTUAL VARYING LOAD IN SPAN C-D IS USED IN DETERMINING REACTIONS BUT THE AVERAGE SECTION PROPERTIES IN THAT SPAN ARE USED.

APPLIED SIDE PRESSURE LOADING AND REACTIONS AT THE CENTER BULKHEAD ARE SHOWN BELOW. REACTIONS WERE DETERMINED BY ASSUMING THE ULTIMATE SIDE PRESSURE ACTING ON THE LENGTH OF TUNNEL SUPPORTED BY THE CENTER BULKHEAD.

$R = 4.06''$, $\theta = 85°$ } REF. PG 2.2

$L = \frac{9.40 + 9.89}{2} = 9.645''$ REF PG 2.4

$A = R\theta L = 4.06\left(\frac{85\pi}{180}\right)9.645 = 58\ IN^2$

$W_C = \rho A = 2.1(58) = 122$ LBS

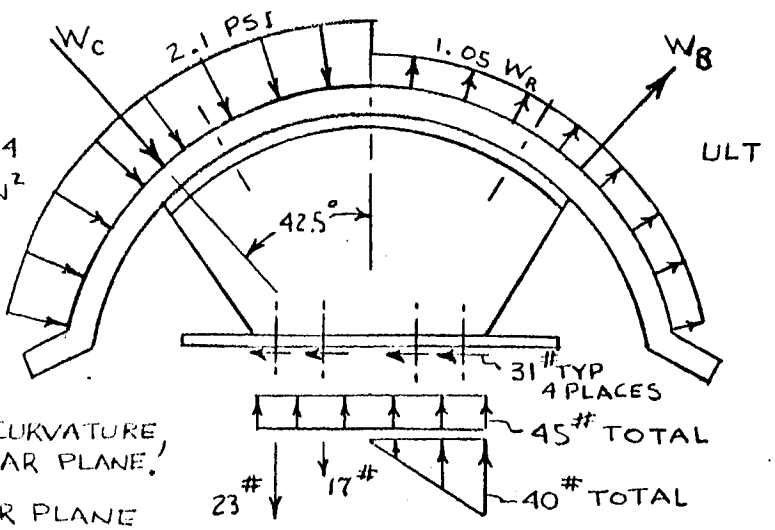
$W_B = 1.05(58) = 61$ LBS

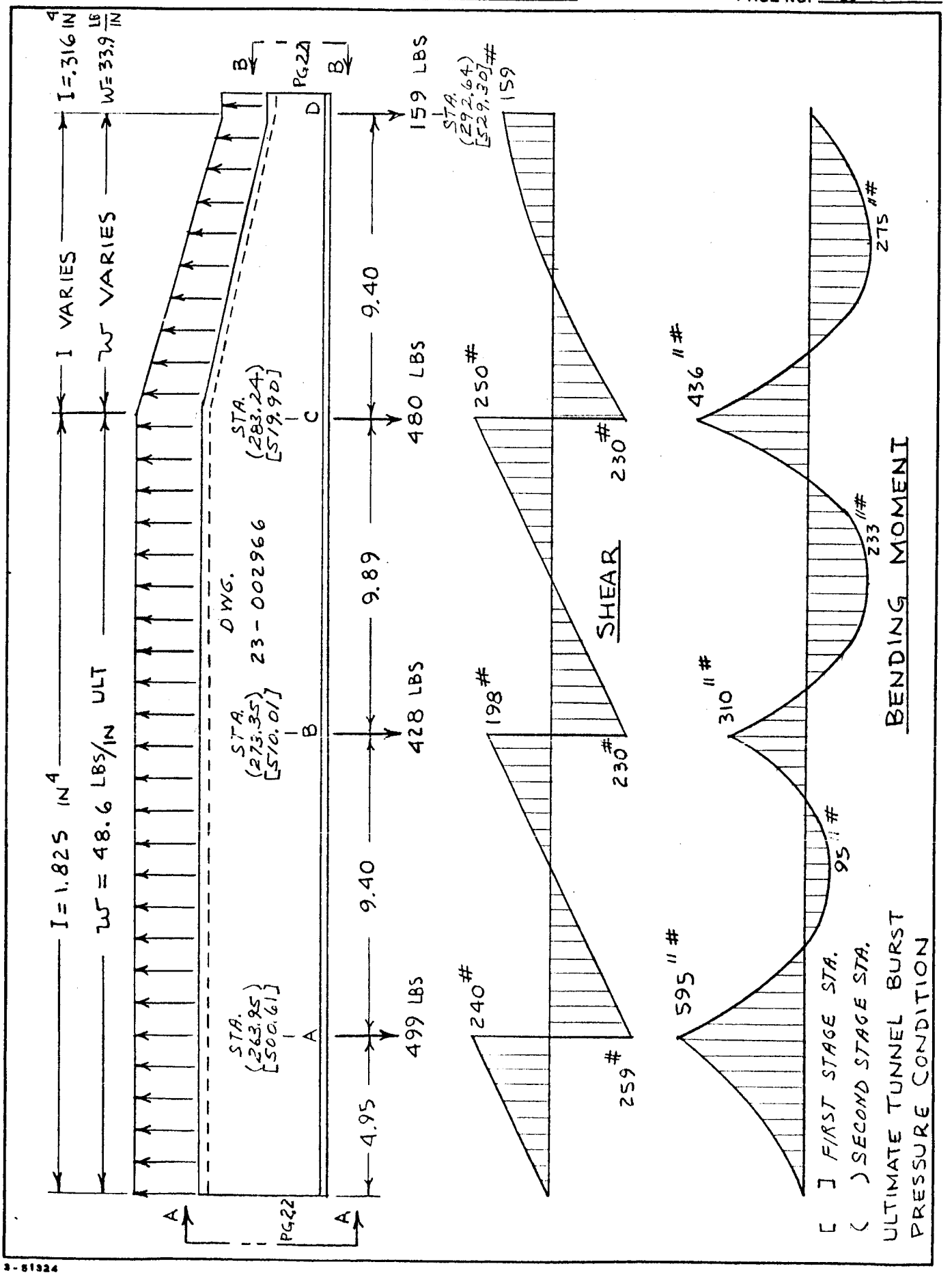
$V = (W_C + W_B)\sin 42.5° = 124$ LBS

$P = (W_C - W_B)\cos 42.5° = 45$ LBS

M = 0 AT TUNNEL CENTER OF CURVATURE, 1.23 INCHES BELOW SHEAR PLANE.

$M = 1.23\ (124) = 152\ IN.LBS$ @ SHEAR PLANE




I = .316 IN⁴
W = 33.9 LB/IN
I VARIES
W VARIES
I = 1.825 IN⁴
W = 48.6 LBS/IN ULT
DWG. 23-002966
PG 22
PG 22
STA. (263.25) [500.61]
STA. (273.35) [510.01]
STA. (283.24) [519.90]
STA. (292.64) [529.30]
159 LBS
480 LBS
428 LBS
499 LBS
9.40
9.89
9.40
4.95
SHEAR
BENDING MOMENT
250#
230#
198#
230#
240#
259#
159
436 11#
275 11#
233 11#
310 11#
95 11#
595 11#
[ ] FIRST STAGE STA.
( ) SECOND STAGE STA.
ULTIMATE TUNNEL BURST
PRESSURE CONDITION

TUNNEL COVER — PRESSURE LOADING

STRESS ANALYSIS

TUNNEL BENDING (STA. 263.95 & 500.61)

$$f_b = \frac{MC}{I} = \frac{595 \text{ IN-LBS} \times 2.38 \text{ IN}}{1.825 \text{ IN}^4}$$

REF PG 2.4 FOR MOMENT
PG 2.2 FOR SECTION PROPERTIES

$f_b = 776$ PSI ULT

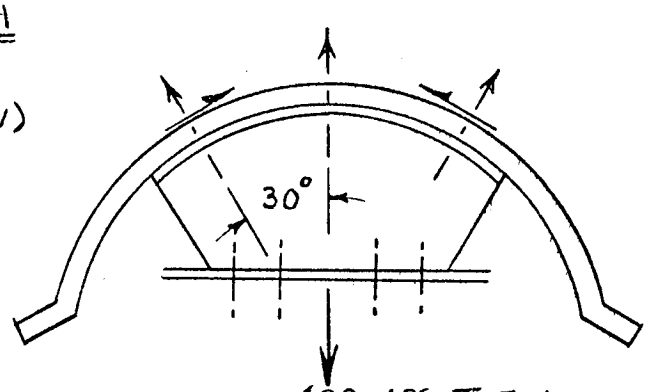
MATERIAL = FIBERGLASS ; $F_{t_u} = 18{,}000$ PSI @ 500°F REF. (E)

$$MS = \frac{18{,}000}{776} - 1 = \underline{\text{HIGH}}$$

FASTENERS (STA. 263.95 & 500.61)

AN 525-10-10 SCREWS
ASSUME EACH OF THREE SCREWS IS LOADED EQUALLY.

$$\frac{499}{3} = 166 \text{ LBS/SCREW}$$



REF PG 2.4

CENTER SCREW — $P_t = 166$ LBS , $P_s = 0$

SIDE SCREWS — $P_t = 166 \cos 30° = 144$ LBS

$P_s = 166 \sin 30° = 83$ LBS

HIGHER TENSILE LOAD IS APPLIED TO THE SCREWS IN TORQUING THEM ON INSTALLATION. T = 15-20 IN-LBS

$$P = \frac{T}{KD} = \frac{20}{.2(.19)} = 526 \text{ LBS MAX LIMIT}$$

K = TORQUE CONSTANT
D = BOLT DIAMETER

ULT $P = 1.5\,(526) = 790$ LBS

$$f_t = \frac{P}{A} = \frac{790}{.0199} = 39{,}700 \text{ PSI ULT}$$

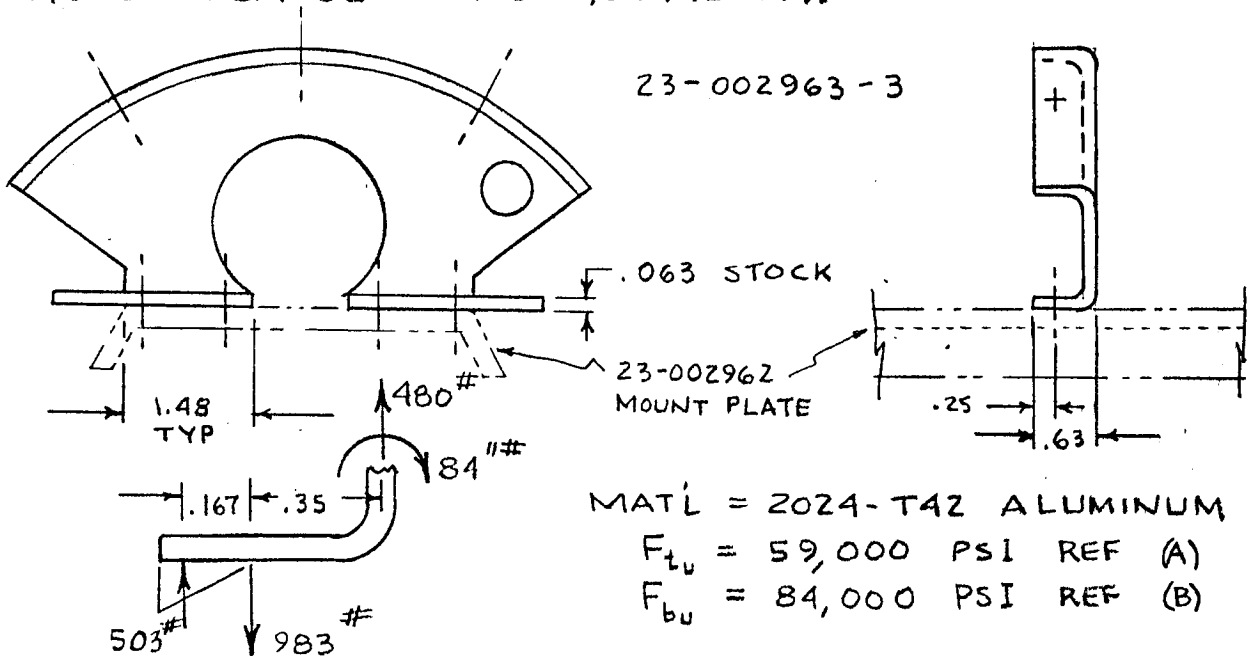
$F_{t_u} = 125{,}000$ PSI FOR AN525 ∴ $M.S. = \frac{125{,}000}{39{,}700} - 1 = \underline{\text{HIGH}}$

THE SIDE PRESSURE LOADING SHOWN ON PAGE 2.3 IS LOW IN COMPARISON TO BURST PRESSURE SO NO STRESS ANALYSIS OF SIDE PRESSURE ON THE TUNNEL COVER IS PRESENTED.

BULKHEADS - PRESSURE LOADING

STRESS ANALYSIS

CRITICAL LOADINGS FOR THE TUNNEL BULKHEADS ARE THE TENSILE LOADS CAUSED BY BURST PRESSURE IN THE TUNNEL. (SEE PAGE 2.4) THE BULKHEAD AT (A) CARRIES THE HIGHEST LOAD BUT THE ONE AT (C) IS MORE CRITICAL BECAUSE OF ITS GEOMETRY.



MAT'L = 2024-T42 ALUMINUM
F_{t_u} = 59,000 PSI REF (A)
F_{b_u} = 84,000 PSI REF (B)

ASSUME ONE-HALF OF MOMENT DUE TO ECCENTRIC LOADING REACTED BY HEEL AND TOE ACTION AND THE OTHER HALF IN BENDING OF THE BULKHEAD WEB.

$$f_t = \frac{P}{bt} = \frac{480}{2.96(.063)} = 2580 \text{ PSI} \qquad R_t = \frac{2580}{59,000} = .044$$

$$f_b = \frac{6M}{bt^2} = \frac{6(84)}{2.96(.063)^2} = 45,580 \text{ PSI} \qquad R_b = \frac{45,580}{84,000} = .543$$

$$M.S. = \frac{1}{R_t + R_b} - 1 = \frac{1}{.044 + .543} - 1 = \underline{\underline{.70}}$$

FASTENERS - NAS 1054-5

$$P_t = \left(\frac{983}{4}\right)\frac{499}{480} = 256 \text{ LBS @ (A)} \qquad P_{t_u} = 1160 \text{ LBS REF (C)}$$

$$M.S. = \frac{1160}{256} - 1 = \underline{\underline{\text{HIGH}}}$$

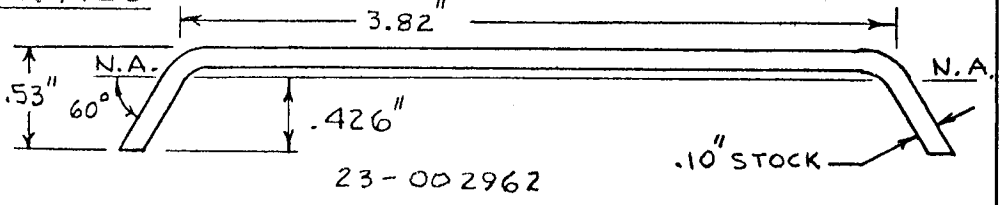
MOUNT PLATE - PRESSURE LOADING

SECTION PROPERTIES & LOADS ANALYSIS

SECTION PROPERTIES

$A = .481 \text{ IN}^2$

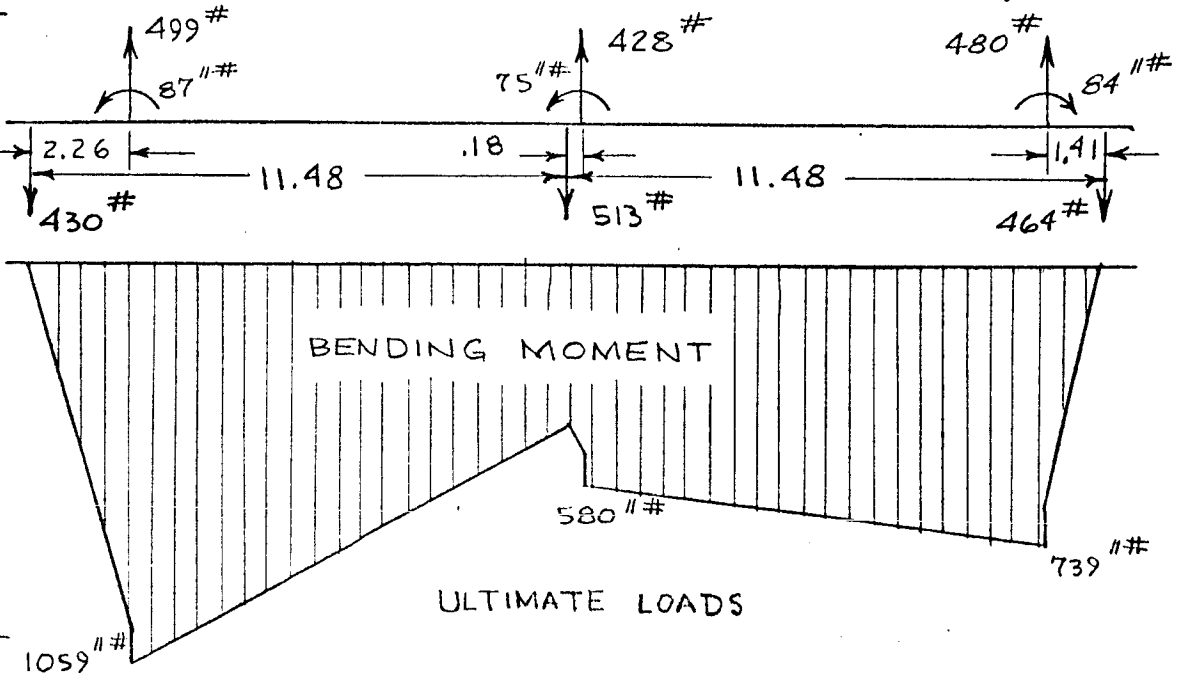
$I_{NA} = .00738 \text{ IN}^4$



LOADS ANALYSIS

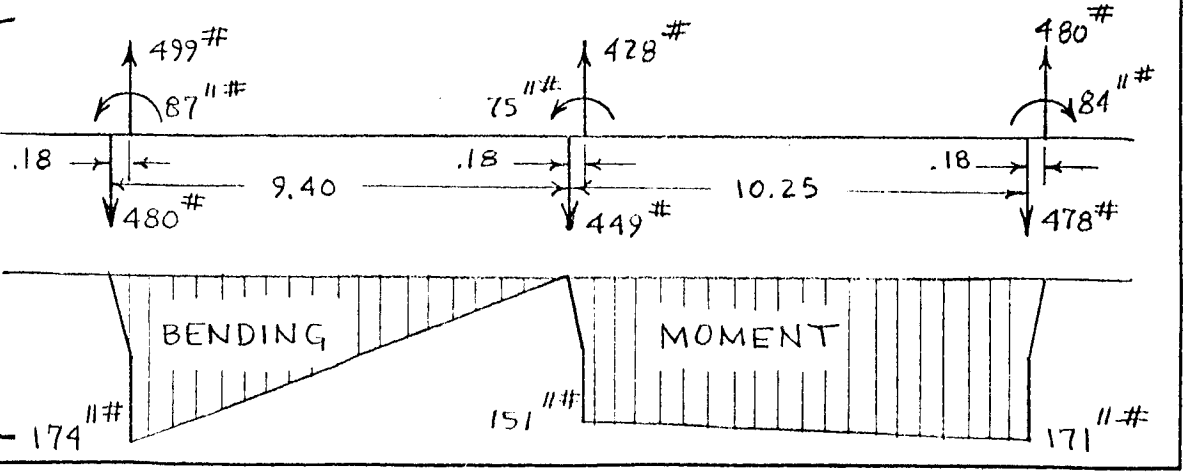
REF PG 2.4 FOR APPLIED LOADS.
CONCENTRATED MOMENTS ARE DUE TO HEEL AND TOE ACTION FROM BULKHEADS. (SEE PG 2.6 FOR EXAMPLE)

CASTOR I



ULTIMATE LOADS

CASTOR II & ALGOL



MOUNT PLATE - PRESSURE LOADING

STRESS ANALYSIS

MOUNT PLATE BENDING

MAT'L = 7075-T6 23-002962
F_{tu} = 73,000 PSI } REF: (A)
F_{cy} = 65,000 PSI

MAXIMUM BENDING MOMENT = 1059 IN-LBS ULT REF: PG 2.7
SECTION PROPERTIES REF PG 2.7

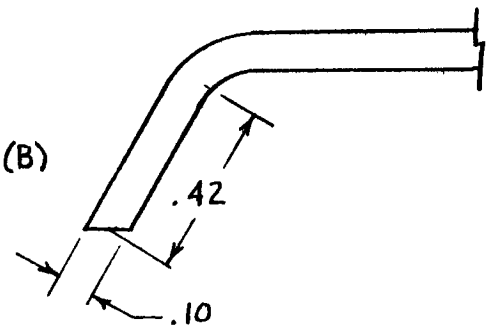
$$f_b = \frac{MC}{I} = \frac{1059\ (.426)}{.00738} = 61,000 \text{ PSI COMPRESSION}$$

CRIPPLING

$$b/t = \frac{.42}{.10} = 4.2$$

F_{cc} = 65,000 PSI REF: (B)

$$MS = \frac{65,000}{61,000} - 1 = .06$$



ATTACH BOLTS

NAS 1104 P_{tu} = 4520 LBS

MAX P_t IS DUE TO INSTALLATION TORQUE

T = 50-60 IN-LBS REF 23-002973

$$P_t = \frac{T}{KD} = 1.5\ \frac{60}{.2(.25)} = 1800 \text{ LBS ULT}$$

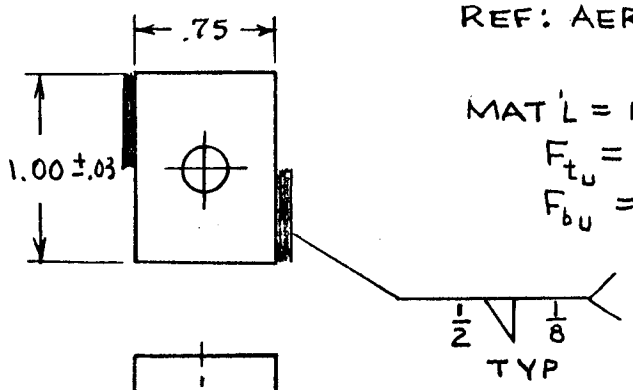
$$M.S. = \frac{4520}{1800} - 1 = \text{HIGH}$$

MOTOR MOUNT PADS - PRESSURE LOADING

STRESS ANALYSIS

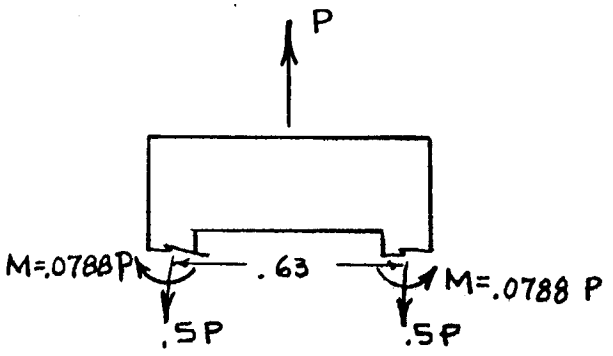
THE MOUNT PADS ON BOTH ALGOL AND CASTOR ARE CRITICAL IN BENDING OF THE FLANGES DUE TO TENSION LOADS.

ALGOL



REF: AEROJET DWG 360344

MAT'L = NORMALIZED 4130 STEEL
F_{t_u} = 90,000 PSI REF (A)
F_{b_u} = 130,000 PSI REF (B)



MINIMUM DIMENSIONS

$$f_b = \frac{6M}{bt^2} = \frac{6\,(.0788\,P)}{.485\,(.09)^2} = 120.4\,P \quad *$$

$$f_t = \frac{P}{A} = \frac{.5\,P}{.485(.09)} = 11.46\,P \quad *$$

@ FAILURE $R_b + R_t = 1$ OR $\frac{120.4\,P}{130,000} + \frac{11.46\,P}{90,000} = 1$

CRITICAL P = 950 LBS

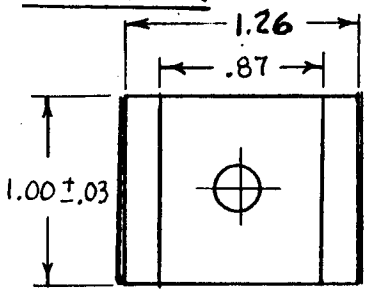
MAX P = 480 LBS REF PG 2.7 $MS = \frac{950}{480} - 1 = \underline{.98}$

* SINCE ONLY ONE-HALF OF THE FLANGE LENGTH IS WELDED TO THE MOTOR, ONLY ONE-HALF IS ASSUMED EFFECTIVE.

MOTOR MOUNT PADS – PRESSURE LOADING

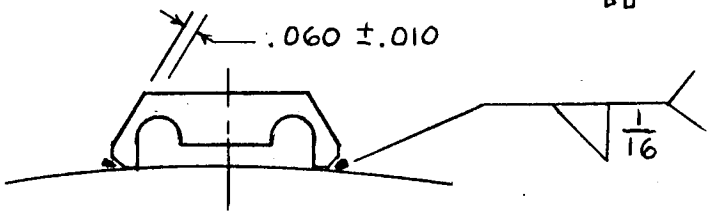
STRESS ANALYSIS

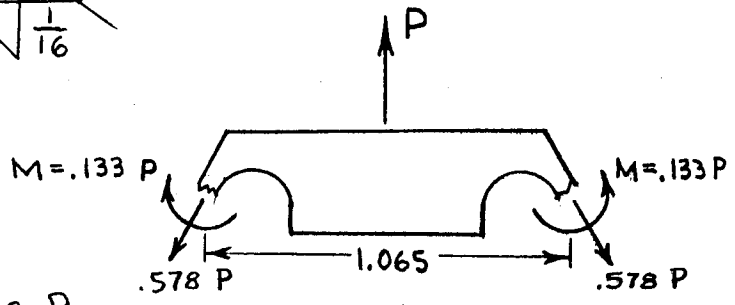
CASTOR



REF: THIOKOL DWG JR35086

MAT'L = HEAT TREATED 4130 STEEL
F_{ty} = 150,000 PSI MIN REF DWG
F_{tu} = 167,400 PSI REF (A)
F_{bu} = 235,000 PSI REF (B)





MINIMUM DIMENSIONS

$$f_b = \frac{6M}{bt^2} = \frac{6\,(.133\,P)}{.97\,(.05)^2} = 330\,P$$

$$f_t = \frac{P}{A} = \frac{.578\,P}{.97\,(.05)} = 11.85\,P$$

@ FAILURE $R_b + R_t = 1$ OR $\frac{330P}{235,000} + \frac{11.85P}{167,400} = 1$

CRITICAL P = 678 LBS

MAX P = 513 LBS REF PG 2.7

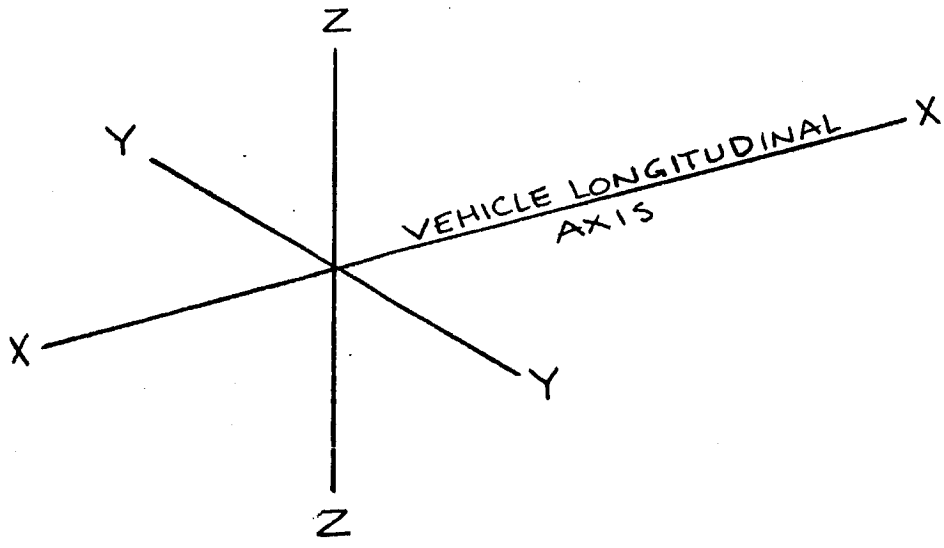
$$MS = \frac{678}{513} - 1 = \underline{\underline{.32}}$$

DESIGN CRITERIA - INERTIA LOADING

THE FOLLOWING EQUIPMENT SUPPORT STRUCTURE CRITERIA FOR USE ON SCOUT IS CONSIDERED APPLICABLE FOR THE DESTRUCT MODULE.

(1) STRUCTURE SHALL NOT YIELD UNDER $g_x = 200$.

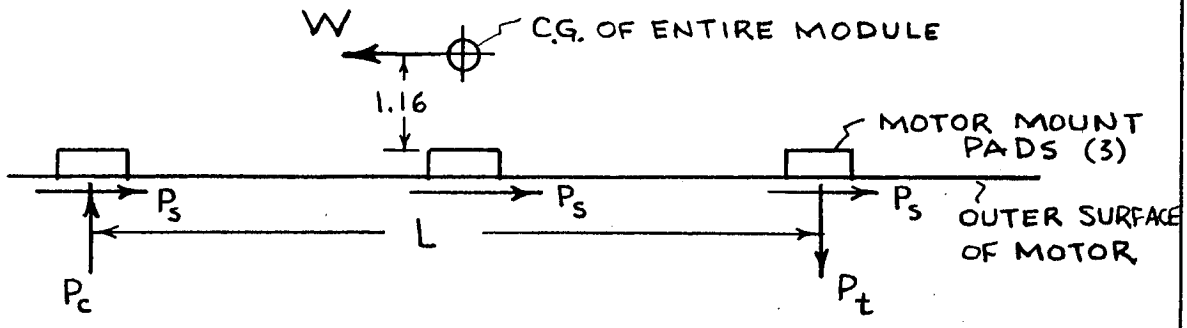
(2) STRUCTURE SHALL NOT DEFLECT MORE THAN .020 INCHES UNDER ANY COMBINATION OF $g_x = 50$, $g_Y = 15$ AND $g_z = 15$.



REFERENCE AXES FOR "g" LOADING

MODULE ATTACHMENTS – INERTIA LOADING

CHECK ATTACH BOLTS AND MOTOR MOUNT PADS FOR LOADS CAUSED BY $g_x = 200$ APPLIED TO THE ENTIRE DESTRUCT MODULE.



ALGOL & CASTOR II

MODULE WEIGHT = 12.61 LBS REF 23-002973

L = 19.65 INCHES REF 23-002962

W = 12.61 × 200 = 2522 LBS

$$P_s = \frac{2522}{3} = 841 \text{ LBS} \qquad P_t = \frac{1.16 \times 2522}{19.65} = 149 \text{ LBS}$$

CASTOR I

MODULE WEIGHT = 12.71 LBS REF 23-002973

L = 22.96 INCHES REF 23-002962

W = 12.71 × 200 = 2542 LBS

$$P_s = \frac{2542}{3} = 847 \text{ LBS} \qquad P_t = \frac{1.16 \times 2542}{22.96} = 129 \text{ LBS}$$

MODULE ATTACHMENTS – INERTIA LOADING

ATTACH BOLTS

NAS 1104 $P_{t_u} = 4520$ LBS & $F_{t_u} = 160{,}000$ PSI MIN

BOLT DIAMETER = $\frac{.2487}{.2481}$ $F_{t_Y} = 142{,}000$ PSI REF (A)

$F_{s_u} = 100{,}000$ PSI REF (A) $P_{t_Y} = \left(\frac{142}{160}\right) 4520 = 4010$ LBS

$P_{s_u} = F_{s_u} A_s = 100{,}000 \text{ PSI} \left(\frac{\pi}{4} \times .2481^2\right) = 4840$ LBS

$$MS = \frac{1}{R_t + R_s^2} = \frac{1}{\left(\frac{149}{4010}\right) + \left(\frac{841}{4840}\right)^2} - 1 = \underline{\text{HIGH}}$$

MOTOR MOUNT PADS

MODULE INERTIA LOADS ARE TRANSFERRED TO THE MOTOR BY SHEAR OF THE WELDS. SEE PAGES 2.9 & 2.10 FOR WELD DIMENSIONS.

CONSERVATIVELY ASSUME THAT WELD SHEAR STRENGTH IS THE LOWEST VALUE GIVEN IN REF (A)

$F_{s_u} = 32{,}000$ PSI

$A_s = \ell h \sin 45°$



ALGOL – $A_s = 1.00 (.125) .707 = .0885$ IN^2

CASTOR – $A_s = 2.00 (.0625) .707 = .0885$ IN^2

$P_{s_u} = F_{s_u} A_s = 32{,}000 \text{ PSI} \times .0885 \text{ IN}^2 = 2830$ LBS

$P_s = 841 \rightarrow 149 = 853$ LBS $\quad MS = \frac{2830}{853} - 1 = \underline{\text{HIGH}}$

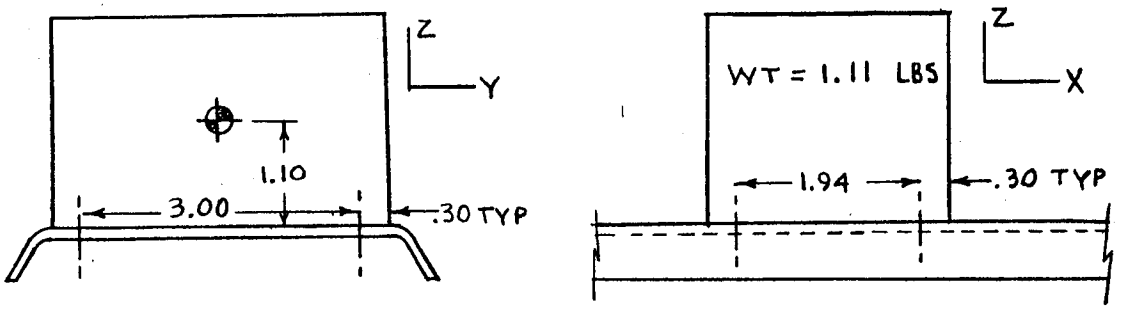
NOTE THAT ONE OF THE THREE ATTACHMENTS COULD TAKE ALL THE 200g INERTIA LOAD IF TOLERANCES ALLOWED IT.

BOLT – $MS = \frac{4840}{3(847)} - 1 = \underline{.90}$ WELD – $MS = \frac{2830}{3(847)} - 1 = \underline{.11}$

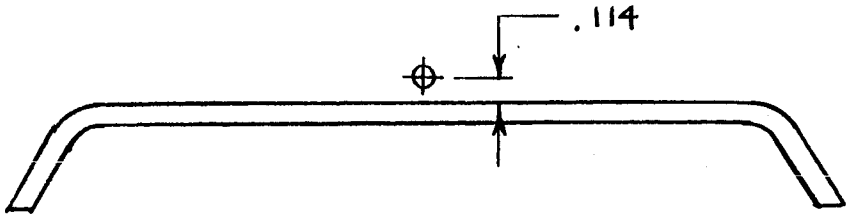
COMPONENTS - INERTIA LOADING

LOADS ANALYSIS

THE 23-002632 BATTERY INSTALLATIONS PRODUCE THE CRITICAL CONDITION FOR BOTH STRESS AND DEFLECTION OF THE MOUNT PLATE.



FLEXURAL CENTER OF THE MOUNT PLATE CROSS-SECTION WAS DETERMINED TO BE AS SHOWN IN THE SKETCH BELOW BY THE METHOD OF REFERENCE (F)



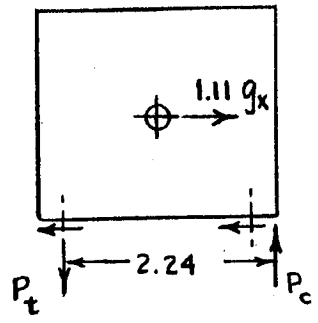
MOMENT ARM FOR LOADS IN X AND Y DIRECTIONS IS EQUAL TO:

$$a = 1.10 - .114 = .986 \text{ INCHES}$$

COMPONENTS - INERTIA LOADING

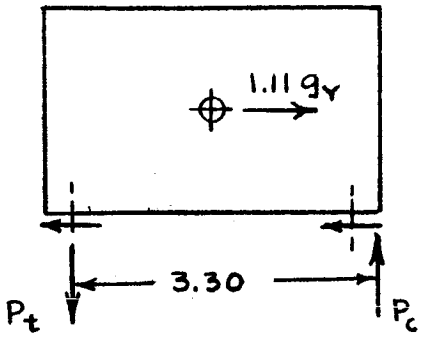
LOADS ANALYSIS

X-DIRECTION LOADS



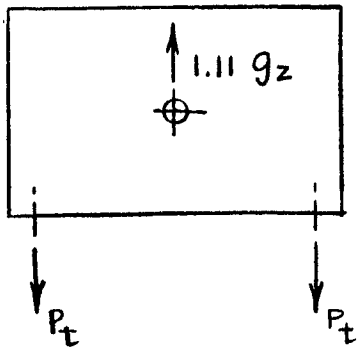
$$P_t = P_c = \frac{.986 \text{ IN } (1.11 g_x \text{ LBS})}{2 \ (2.24 \text{ IN})} = .244 \ g_x$$

Y-DIRECTION LOADS



$$P_t = P_c = \frac{.986 \text{ IN } (1.11 g_Y \text{ LBS})}{2 \ (3.30 \text{ IN})} = .166 \ g_Y$$

Z-DIRECTION LOADS



$$P_t = \frac{1.11 g_z}{4} = .278 \ g_z$$

MOUNT PLATE – INERTIA LOADING

STRESS ANALYSIS

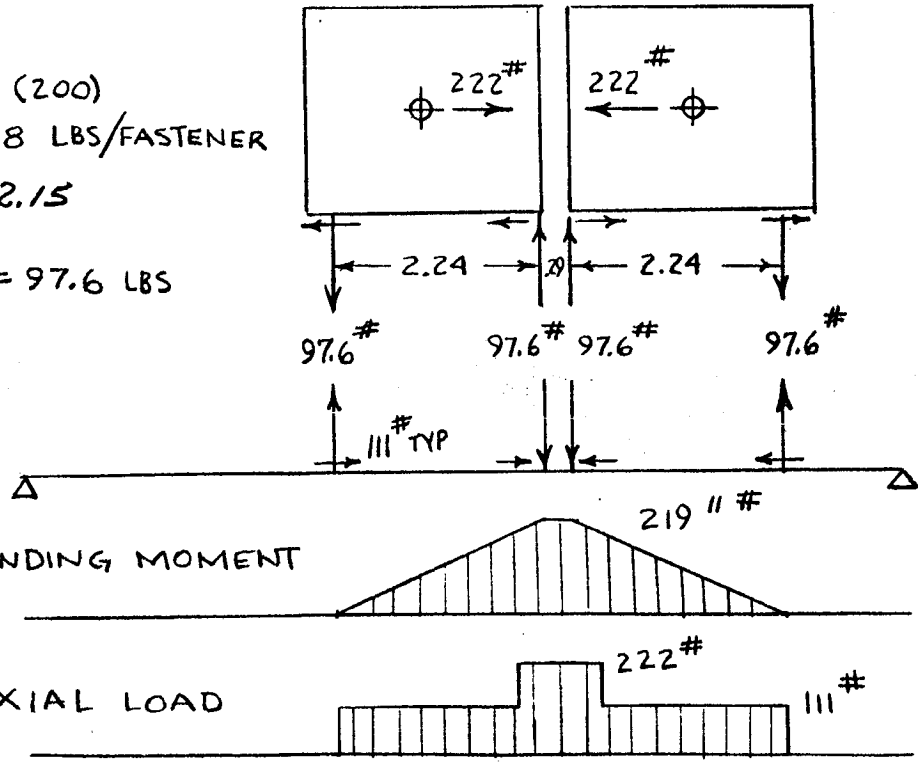
THE PART OF THE MOUNT PLATE UNDER THE TWO BATTERIES IS ASSUMED TO BE A BEAM WITH SIMPLE SUPPORT AT THE ADJACENT BULKHEADS. RIGIDITY OF THE BATTERIES IS ASSUMED TO ENABLE THE MOUNT PLATE TO ACT AS A BEAM WITH RIGID CROSS-SECTION, THAT IS, THERE IS NO DEFLECTION OF THE MOUNT PLATE WEB RELATIVE TO THE FLANGES.

THE BATTERIES ARE ASSUMED TO FEEL THE 200 g LOADING IN OPPOSING DIRECTIONS SINCE THIS GIVES THE HIGHEST BENDING MOMENT IN THE MOUNT PLATE.

$P_t = P_c = .244\,(200)$
$= 48.8$ LBS/FASTENER

REF PG 2.15

$2 \times 48.8 = 97.6$ LBS



$$f = \frac{MC}{I} \pm \frac{P}{A}$$

REF PG 2.7 FOR SECT. PROP.
REF PG 2.8 FOR MATL. PROP.

$$\text{MAX } f_t = \frac{219\,(.426)}{.00738} - \frac{222}{.481} = 12{,}158 \text{ PSI}$$

$$\text{MAX } f_c = \frac{219\,(.104)}{.00738} + \frac{222}{.481} = 3552 \text{ PSI}$$

$$\text{M.S.} = \frac{65{,}000}{12{,}158} - 1 = \underline{\text{HIGH}}$$

MOUNT PLATE - INERTIA LOADING

DEFLECTION ANALYSIS

THE MOUNT PLATE SPAN UNDER THE BATTERIES WHICH WAS ANALYZED FOR STRESS ON PAGE 2.16 IS ALSO CRITICAL FOR DEFLECTION. REFERENCE PAGES 2.11 AND 2.15 FOR DESIGN CRITERIA AND LOADS.

LOADS IN THE X AND Z DIRECTIONS, WHICH CAUSE SIMPLE BENDING OF THE MOUNT PLATE, WERE COMBINED AND THE RESULTING DEFLECTION WAS DETERMINED BY GRAPHICAL INTEGRATION ON PAGE 2.19

LOADS IN THE Y-DIRECTION CAUSE A TWISTING MOMENT ON THE MOUNT PLATE WHICH IS REACTED AT THE BULKHEADS. FOR A MEMBER OF THIS TYPE CROSS-SECTION A TWISTING MOMENT IS RESISTED PARTIALLY BY THE TORSIONAL RIGIDITY OF THE WHOLE SECTION AND PARTIALLY BY THE BENDING RIGIDITY OF THE FLANGES. THE TORSIONAL RIGIDITY WAS CONSERVATIVELY NEGLECTED FOR THIS CASE AND THE FLANGES WERE ASSUMED TO RESIST THE Y-DIRECTION LOAD BY SIMPLE BENDING. DETERMINATION OF THE FLANGE DEFLECTION BY GRAPHICAL INTEGRATION IS SHOWN ON PAGE 2.20.

ALL BEAMS WERE CONSERVATIVELY ASSUMED TO HAVE SIMPLY SUPPORTED ENDS. LOADS AND MOMENT DIAGRAMS WHICH WERE USED IN THE GRAPHICAL INTEGRATION ARE SHOWN ON PAGE 2.18

TOTAL MAX δ = .009 + .009 = .018 IN. REF PGS 2.19 & 2.20

ALLOWABLE δ = .020 IN. REF PG 2.11



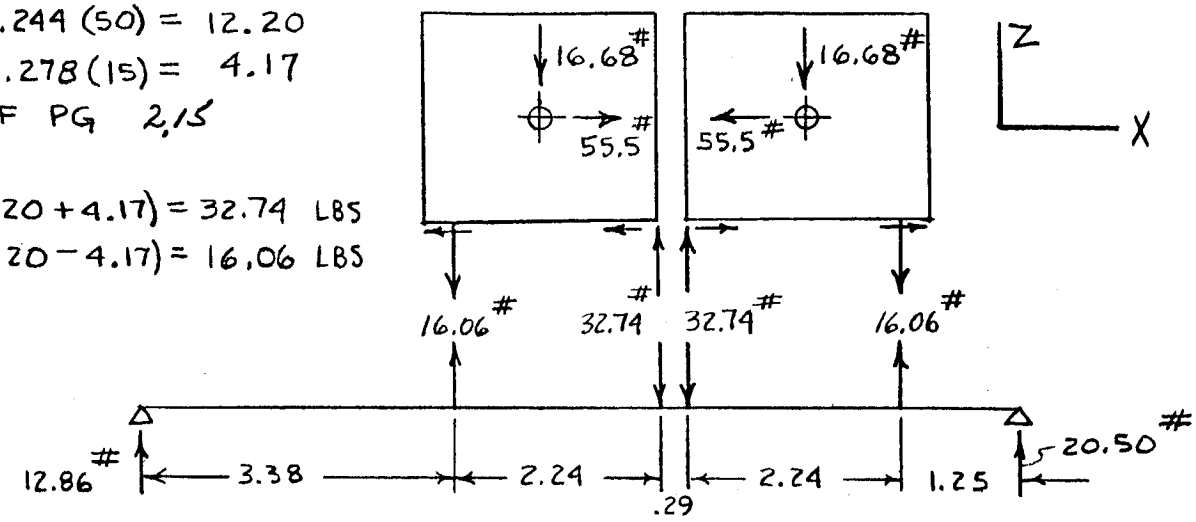
$$MS = \frac{.020}{.018} - 1 = .11$$

MOUNT PLATE - INERTIA LOADING

DEFLECTION ANALYSIS

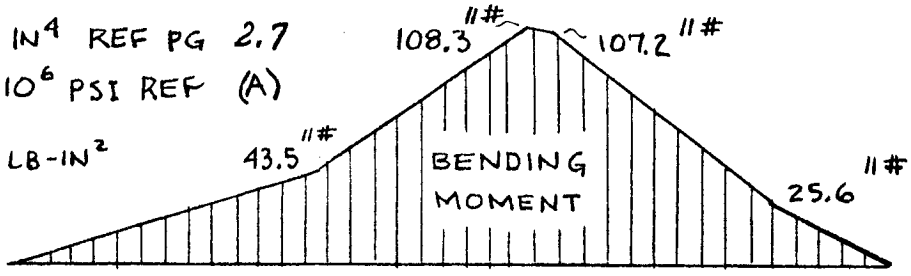
$P_X = .244\,(50) = 12.20$
$P_Z = .278\,(15) = 4.17$
REF PG 2.15

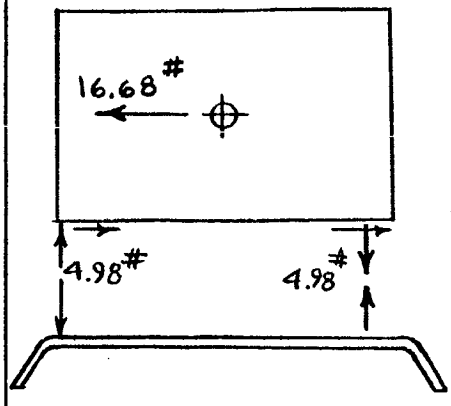
$2\,(12.20 + 4.17) = 32.74$ LBS
$2\,(12.20 - 4.17) = 16.06$ LBS



$I = .00738\ IN^4$ REF PG 2.7
$E = 10.3 \times 10^6$ PSI REF (A)

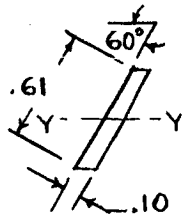
$EI = 76{,}000\ LB\text{-}IN^2$





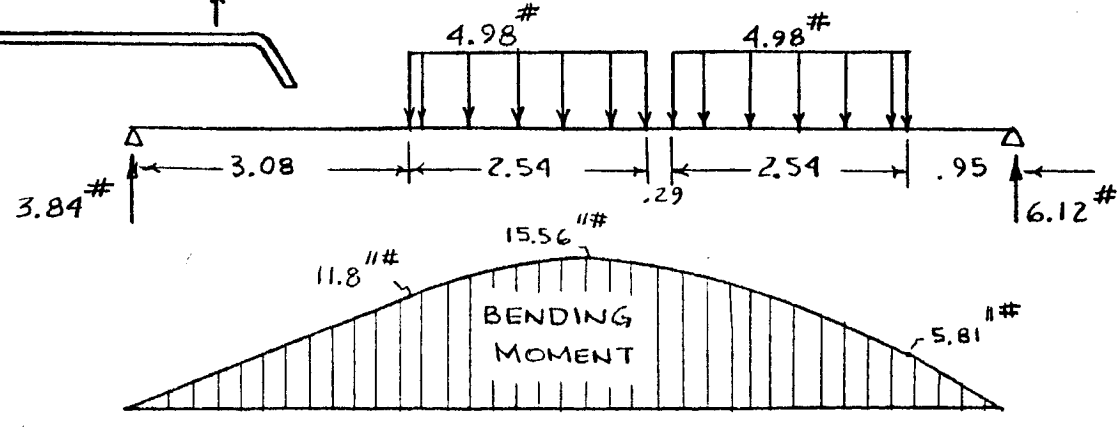
$P_Y = .166\,(15) = 2.49$ LBS/FASTENER REF PG 2.15

$2 \times 2.49 = 4.98$ LBS



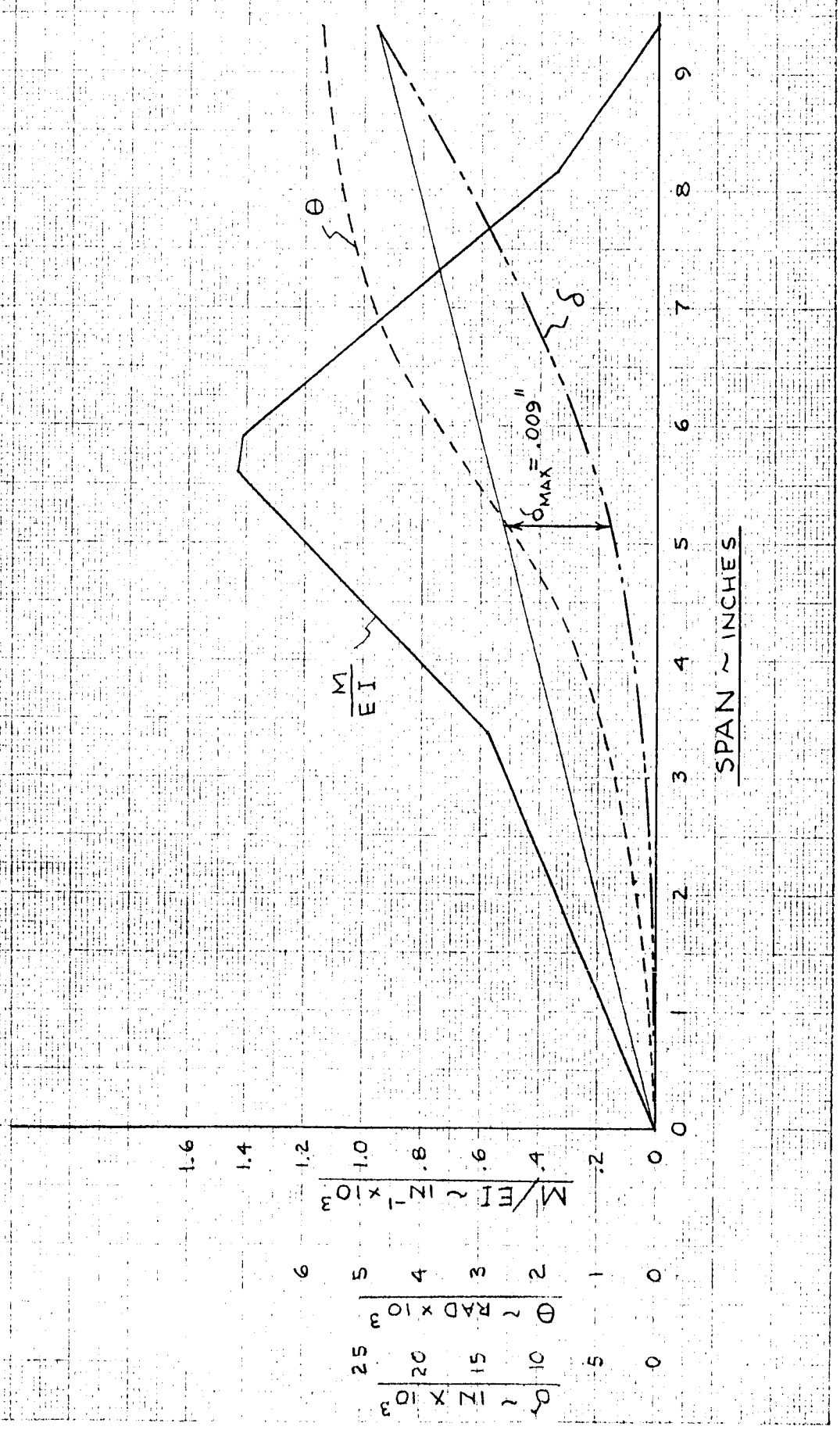
$I_Y = .00143\ IN^4$

$EI = 14{,}710\ LB\text{-}IN^2$



MOUNT PLATE DEFLECTION UNDER BATTERIES

DUE TO LOADS IN X AND Z DIRECTIONS



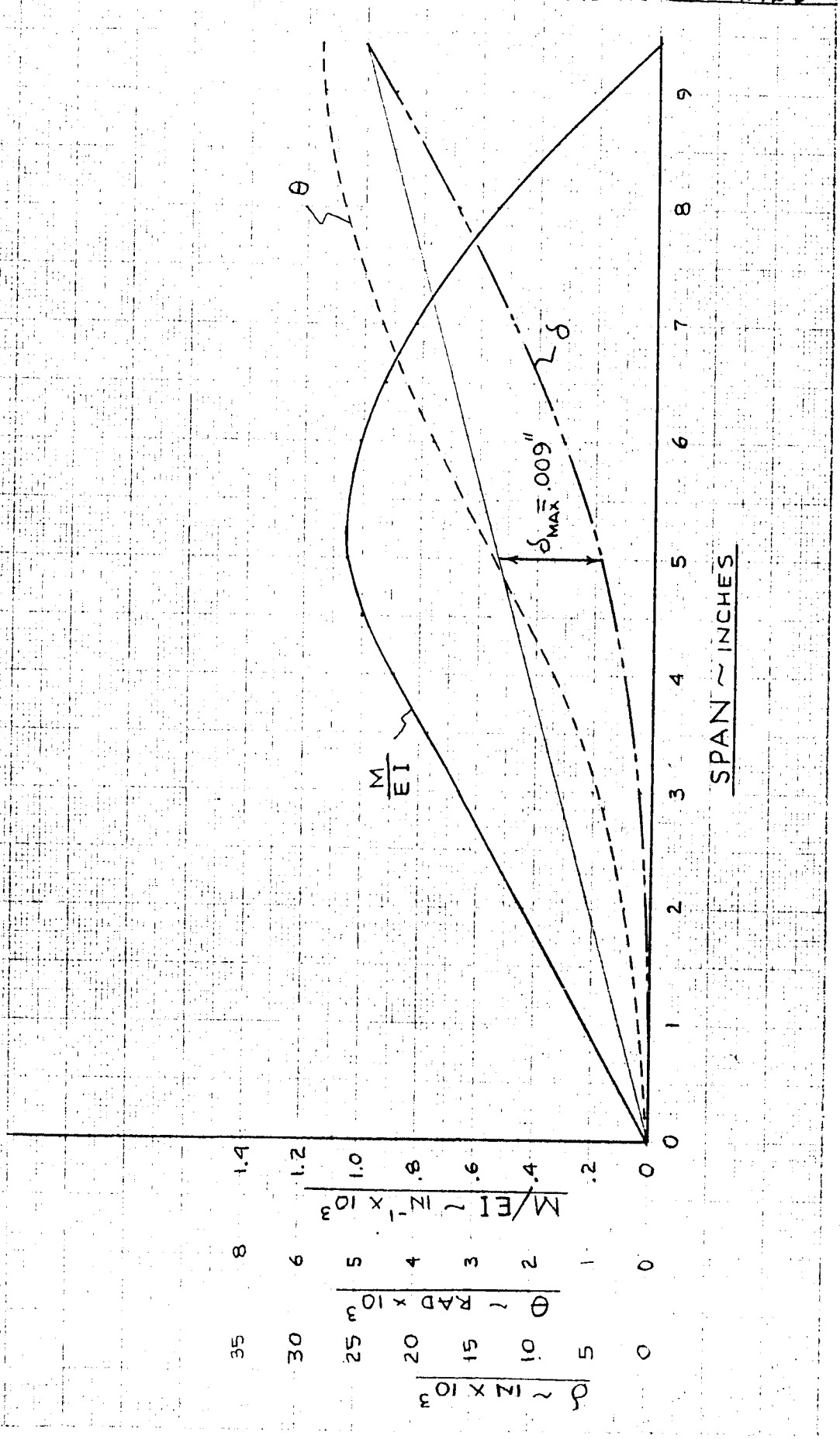
BY C.R. BUSH
DATE 4-7-65

MODEL SCOUT

REPORT NO 23.205
PAGE NO 2.20

MOUNT PLATE DEFLECTION UNDER BATTERIES

DUE TO LOADS IN Y DIRECTION



REFERENCES

(A) Mil-Hdbk-5, "Metallic Materials and Elements for Flight Vehicle Structures," dated March 1961.

(B) LTV Structural Design Manual

(C) LTV Report No. 10049, "A Summary of Structural Data for Mechanical Fasteners Commonly Used at Chance Vought Aircraft," dated 22 Dec. 1955.

(D) LTV Report No. AST/EIR-12430, "NASA Scout Stress Analysis Report," dated 2 Dec. 1964.

(E) LTV DIR No. 53420-58-23, "Design Data on Glass Reinforced Plastic Laminates," dated 22 August 1958.

(F) "Formulas for Stress and Strain," by R. J. Roark, Third Edition, dated 1954.

SECTION 3.0

MECHANICAL DESIGN

DEFINITION OF REQUIREMENT

Destruct System components shall be relocated from their present locations in Lower B and Lower C Sections to eliminate the possibility of blast damage during stage separation.

Components to be moved are:

a) Destruct Safe/Arm Initiators and associated destruct tubing.

b) Auto destruct Batteries.

c) Auto destruct Lanyard Switches.

d) Auto destruct Pressure Switches.

e) Electrical wiring for above components.

The relocated components shall be assembled together into modules attached externally to the forward end of Algol and Castor motors forming a part of the Guidance Tunnel.

A Module Installation drawing 23-002973 is presented on pages 3.5 and 3.6.

SECTION 3.0

DESTRUCT MODULE SUMMARY

I. Prototype Module Assembly -

a) Drawing 23-002973 was prepared to define the module assembly and installation on both Algol and Castor motors.

b) The following drawings were prepared for this assembly:

23-002942 - "Wiring Diagram"

23-002962 - "Bracket Assembly"

23-002963 - "Bulkheads"

23-002964 - "Pressure Switch Modification"

23-002965 - "Bracket - S/A Unit"

23-002966 - "Tunnel Cover"

23-002967 - "Adapter - Pressure Switch"

23-002968 - "Lanyard Switch"

23-002969 - "Cover - Arming"

23-003125 - "Bundle Assembly"

c) In addition, the following existing drawings were changed by E.O. to add Module Assembly requirements:

23-000423 - "Plug Assembly - S/A Unit"

23-002632 - "Battery - Assembly"

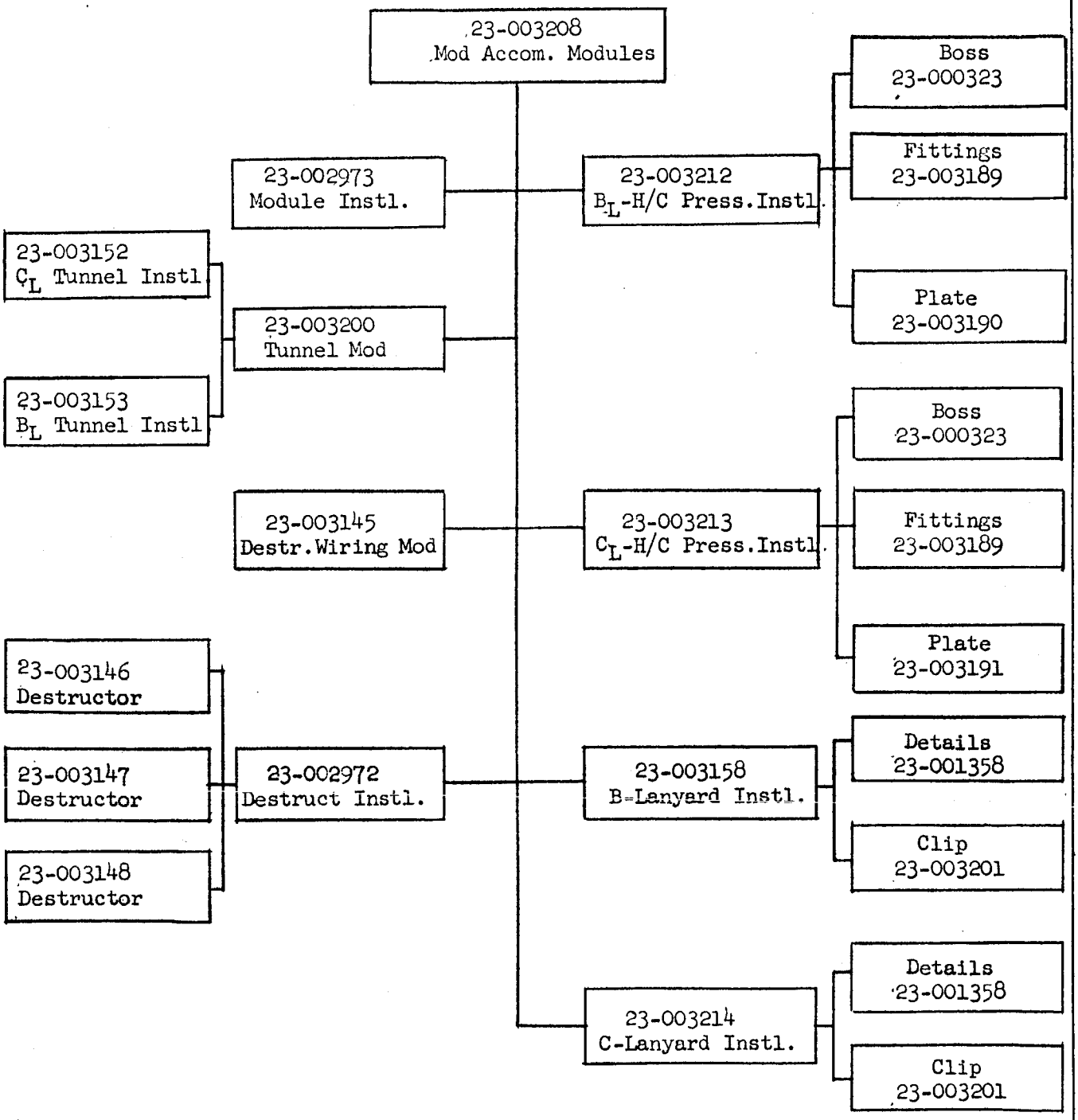
II. Test Configuration Drawing -

a) Drawing 23-003187 was prepared to describe the assembly to be tested.

b) In addition to the 23-002973-1 Module Installation, the Test assembly consists of the Lower B Guidance Tunnel, the Lower B Headcap Pressure System, adjacent wire bundles, and short sections of destruct tubes.

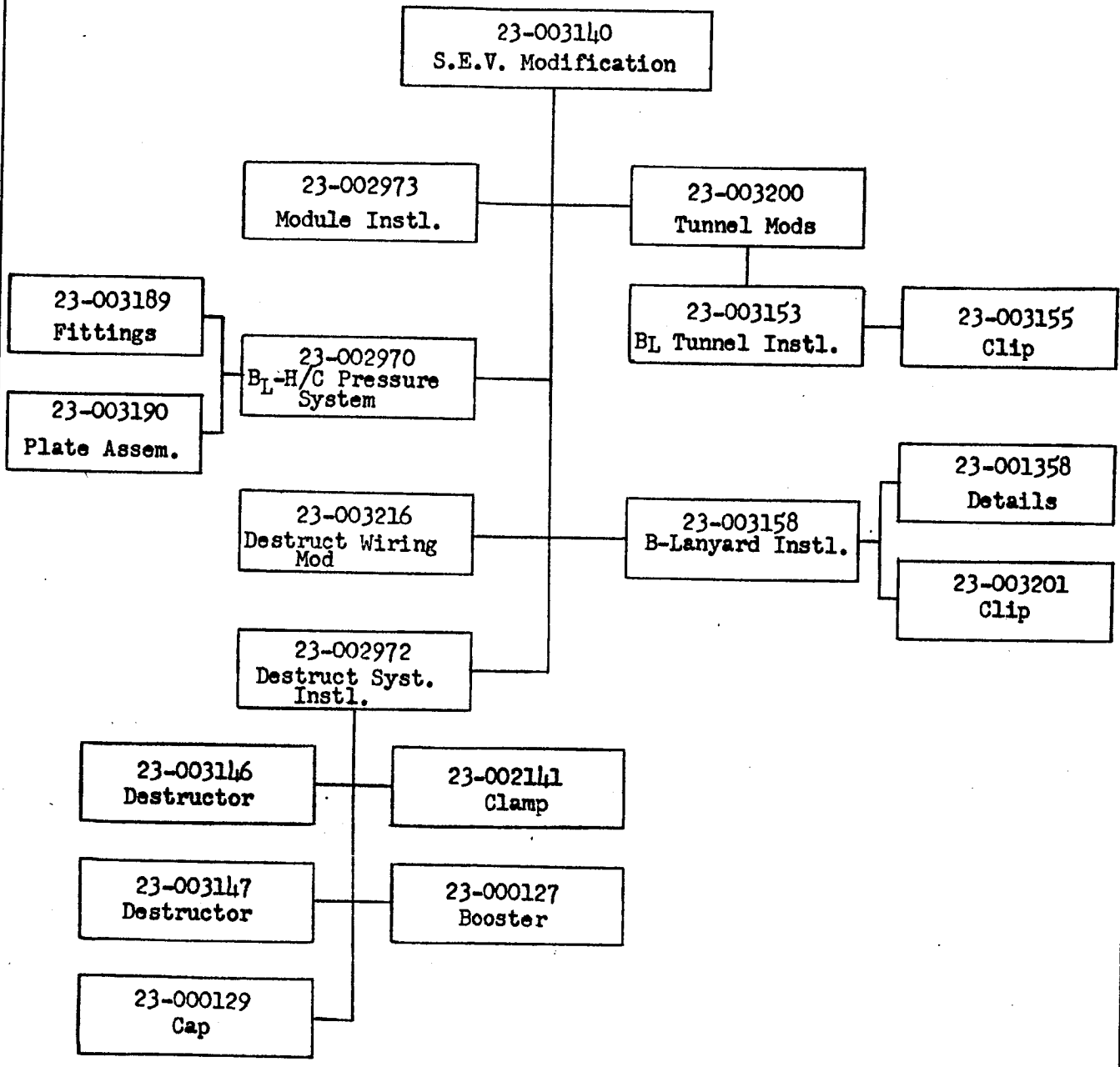
III. Future Installation Modifications -

a) The Destruct Module Installation on future vehicles has been defined by the following drawing system:



IV. Vehicle 131R(Systems Evaluation Vehicle)

a) The Destruct Module installation on Vehicle 131 is defined by the following drawing system and is presented for information only.



b) This installation contains only one Module which is located on the forward end of the Algol motor.

c) The B_L Headcap Pressure System on this vehicle contains a pressure check fitting and two pressure transducers.

V. Castor Motor Tunnel Tab Location -

a) In order to make the attachment of the Module interchangeable between the first and second stage motors, relocation of 3 Castor tunnel tabs is necessary. Drawing 23-003224 has been prepared to define the new tunnel tab requirements. Interim provisions have been incorporated into the module to permit its use on existing Castor motors.

VI. Acceptance Test Specification -

Acceptance criteria for the Module is specified in Spec 305-637.

VII. Mechanical Ground Support Equipment -

The effect of the addition of the Tunnel Mounted Auto Destruct Module on the mechanical GSE was investigated and found to be limited to the tie-down over the forward end of the Algol, the tie down over the forward end of the Castor, and the "C" section support arms on the Mark II and WTR launchers.

Engineering (in the form of EO's to appropriate drawings) has been prepared to accomplish the small changes required and will be released if a requirement is established for production incorporation of the Auto Destruct Module.

(Engineering necessary to permit use of the prototype module on Vehicle S-131R was released and the effort on the Algol forward tie-down has been completed under the SEV program).

VIII. Auto-Destruct Module Tooling

The following is a list of Project Tools fabricated for the A/D Module Program. These tools represent the total accountable tools for this program. Several miscellaneous templates, form blocks, etc. were fabricated by production as "shop aids" and are not accountable.

1. PCP 23-002966-3 S/N 906933 - This tool is a Plaster Pattern made to the inside mold line of the tunnel and is used to fabricate the KBMP 23-002966-3 Bonding Mold. It was fabricated as follows:

   A. The Engineering drawing (tracing) was photographed on a metal sheet (template stock). Cross sectional templates were fabricated at each transition station to a common Ref. line.
   B. The cross sectional templates were then mounted on an aluminum base to form guide for troweling plaster.
   C. Plaster (hydrocal) is then poured and troweled smooth to fit contour of templates. No tool drawing is used to fabricate this type tooling.

2. KBMP 23-002966-3 S/N 906934 - This tool is a Kirksite Bonding Mold that is used to bond the tunnel cover. It is fabricated by casting the mold from a pattern made from the template set-up PCP 23-002966-3, Item 1.

3. PCP 23-003152-2 S/N 906935 - This tool is similar to Item #1 tool and is fabricated in the same manner.

4. KBMP 23-003152-2 S/N 906936 - This tool is similar to Item #2 tool and is fabricated in the same manner.

5. KBMP 23-003153-2 S/N 906932 - This tool is similar to Item #2 tool and is fabricated in the same manner.

The "Shop Aid" tools mentioned above are tools that are only used for low quantity and "one shot" programs. They are made to the Engineering drawings by open set-up with no tool drawings required.

Page 3.6

REVISIONS			
DESCRIPTION	DATE	APPROVED	SYM ZONE

RECORD OF CURRENT REVISIONS ALL SHEETS

SHEET																							
SYM																							

REF					PART OR IDENTIFYING NUMBER	NOMENCLATURE OR DESCRIPTION	MATERIAL OR NOTE	UNIT WT
			8		NAS 352208H4	CAP SCREW		
			4		NAS1104-3	BOLT		
					NAS623-3-12	SCREW		
			6		AN960-C6L	WASHER		
			2		AN935-416	LOCKWASHER		
			1		AN 315	FLATWASHER		
			1		AN526-632-24	SCREW		
			1		AN526-632-16	SCREW		
			1		AN526-632-6	SCREW		
			11		AN 5-51-10	SCREW		
			1		AN507-632-6	SCREW		
			1	P&R	2453E-01	EXPLOSIVE INITIATOR		2.00
		C3,2	1		23-002942	WIRING DIAGRAM		
		B3,2	1		23-003125-1	WIRE BUNDLE INST		
	1	D4,2			23-002903-1	COVER ASSY		
	1	A4,2			23-002968-1	LANYARD SWITCH ASSY		.05
	1	C2,2			23-002967-1	SWITCH ADAPTER(PRESSURE)		.85
	1	C2,2			23-002972-2	TUNNEL COVER ASSY		.10
	1	C2,2			23-002974-1	TUNNEL COVER ASSY		
	1	C2,2			23-002902-1	COMPBRK ASSY		.55
	2	D4,2			23-002963-1	BATTERY ASSY		
	1	B4,2			23-002904-1	PRESSURE SWITCH ASSY		.10
				-3		MODULE ASSY-AUTO DESTRUCT		3.45
				-2		MODULE INST LOWER "C"		11.67
				-1		MODULE INST LOWER "B"		11.57

LIST OF MATERIAL

UNLESS OTHERWISE NOTED DIMENSIONS ARE IN INCHES AND TOLERANCES ON DRILLED HOLES AND DETAIL ASSEMBLY ANGULAR

GEN PROTECT VE SPEC

FOR DEFINITION OF PROTECTIVE FINISH CODE NUMBERS, AND APPLICABLE GOVERNMENT SPECIFICATIONS, SEE MIL-STD-171

IN PLACE OF 23-002035 REF
REPLACED BY

PROTECTIVE FINISH

PROJ ENGR
STR DSGN
QR APPD
CHK BY
DRAWN BY PHONE/EXT
ENGRG UNIT NO 3-52300
APPLIC

ASTRIONAUTICS DIVISION
A DIVISION OF FORD MOTOR COMPANY
P.O. BOX 306 • NEWPORT BEACH, CALIFORNIA

MODULE INSTALLATION
DESTRUCT TUNNEL
LOWER B&C SECT.

CODE IDENT NO 11813
SIZE J
23-002973
SHEET 1 OF 7
SCALE NONE
REV SYM

23-002973

REVISIONS

DESCRIPTION	DATE	APPROVED	SYM ZONE

QUANTITY REQUIRED

LIST OF MATERIAL

ZONE	CODE IDENT	PART OR IDENTIFYING NUMBER	NOMENCLATURE OR DESCRIPTION	MATERIAL OR NOTE	UNIT WT

USED ON | NEXT ASSEMBLY | FROM | THRU

MATERIAL SPECIFICATION

23-002973

NOTE:
1. SURFACE BOND IN ACCORDANCE WITH SPEC CSA 11-122 & MIL-B-5087 FOR STATIC DISCHARGE
2. MAY BE PUR FROM BECHMAN & WHITLEY INC MISSLE PROD DIV SAN CARLOS, CALIF.

23-00597[illegible]

PAGE 2 OF 7

23-002973

23-002973

SECTION A-A

SECTION B-B

SECTION C-C

SECTION D-D

SECTION E-E

SECTION F-F

SECTION G-G

SECTION H-H

SECTION J-J

SECTION K-K

SECTION L-L

SECTION M-M

SECTION N-N

SECTION P-P

SECTION Q-Q

SECTION R-R

SECTION S-S

SECTION T-T

SECTION U-U

SECTION V-V

SECTION W-W

SECTION X-X

SECTION Y-Y

SECTION Z-Z

SECTION AA

23-002973

4.0 ELECTRICAL DESIGN AND CIRCUIT ANALYSIS

4.1 Introduction

This section presents a description and analysis of the Destruct Module electrical system.

4.2 Description of Components

The electrical components in the auto-destruct module consist of a pressure switch (23-002964-1), two batteries (23-002632-1) and two lanyard switches (23-002968-1). All pyrotechnic circuits are wired with #20 AWG single conductor shielded wire.

PRESSURE SWITCH

The pressure switch is made up of two SPDT Hayden switches actuated by a pressure sensitive plunger (see Ref. 4.A). An input pressure of 100 to 150 psig is required to operate the plunger to close the contacts. A mechanical latching device is provided to secure the switch in the closed position. When the required pressure is reapplied to the switch the mechanism will unlatch and allow the contacts to open at a reduced input pressure level of 50 $\pm$ 5 psig.

AUTO-DESTRUCT BATTERIES

Each of the module batteries consists of eight PM05-7 battery cells packaged per Reference 4.B to deliver 12 volts with a one amp-hour capacity. Voltage regulation and discharge test results are tabulated in Reference 4.D.

LANYARD SWITCHES

An MS27240-1 snap-action switch is fitted with a lanyard-pull swivel nut to create the lanyard switch (see Reference 4.C). Connection to each contact of the SPDT switch is made through a #20 AWG, single conductor wire provided as a part of the switch. Wire shields are externally provided at installation.

4.3 Description of System Operation

An auto-destruct module, which incorporates a pressure switch as a part of the initiator circuitry, is installed in both first and second stages (Ref. Figures 4.1 and 4.2). Destr uct of third stage must be accomplished through direct command.

The pressure switch is latched mechanically (contact closure) prior to launch, completing the auto-destruct circuit except for the open contacts of the lanyard switches. A motor chamber pressure of 100 to 150 psi is required to unlatch the mechanism. Contact opening occurs when the motor headcap pressure decreases to 50 $\pm$ 5 psi, deactivating the auto-destruct system during normal staging.

While the switch is energized, closure of both lanyard switches in either stage is necessary to complete the circuit and initiate destruct. Closure of

The second stage lanyard switches prior to second stage ignition will result in both first and second stage destruct. A set of isolation contacts provided on a Stage II lanyard switch, is installed between stages to avoid destructing upstream (Reference Figure 4.3).

External monitoring of the physical positioning of the lanyard switches in both stages is provided up to the point of umbilical release (Reference Figure 4.4).

Since all modules are designed to be electrically identical, direct substitution may be made in either stage without changes in the module or vehicle wiring.

4.4 Circuit Analysis

Figure 4.5 shows a single system equivalent circuit of the complete auto-destruct system. The pressure switch is shown in the latched position and all line and component resistances are shown as lumped quantitites. If the stages separate independently of each other, the current provided to the squib is 16.5 amps at 5.5 volts (typical of both stages). If the stages separate at "C" section and remain intact, the current supplied to Stage I is 8.2 amps; Stage II current is 12.8 amps. A total of 21 amps is being supplied by Stage II battery at a level of 4.1 volts (see Reference 4.D). In each case stated above, the squib current is well in excess of two times the manufacturer's suggested minimum all-fire current. No maximum current limitations are placed on the squib by the manufacturer.

EGSE Modifications

Certain changes in Ground Support Equipment are necessary to accommodate the above design. They are:

1. Addition of adpater cable for pressure switch bench test.
2. Rework A/D Module Test Cable (see Ref. E)
3. Reidentify affected positions in test point selector switch and positions 11 and 13 on Ignition Ledex (Z305).
4. Update A/D cables in the cable plant (see Ref. F)
5. Reidentify Ledex selector positions 11 and 13 on B/H Arming Console (see Ref. G).
6. Add "A/D safe" indicator to Destruct Test Panel of C & E Test Set (Ref. H), B/H Arming Console (Ref. G), B/H Ignition/ Destruct Systems Monitor console (Ref. J), Portable Destruct Test Set (Ref. K), and Flyaway Simulator Test Set (Ref. L).
7. Revise B/H and B/H-to-Launcher wiring to accommodate Change 6.

PAGE 4.2

QUANTITY REQUIRED	ITEM	CODE IDENT	PART OR IDENTIFYING NUMBER	NOMENCLATURE OR DESCRIPTION	MATERIAL OR NOTE	UNIT WT
			LIST OF MATERIAL			
12 IN			AS31S005-7	TUBING		.013
6 IN			AS31S005-9			.007
10 IN			AS31S005-10			.009
60 IN			AS31S004-2			.011
10 IN			AS31S004-2			.016
84 IN			AS31S003-6W			.0615
24 IN			AS31S003-5W			.009
6 IN			AS31S003-3W	TUBING		.004
52 IN			BON ARRELT 3/16	BRAID	6	.0078
132 IN			BON ARRELT 3/8	BRAID	2	.0319
4			AS6705100-2	SPLICE		.0064
7			AS6705100-1	SPLICE		.002
124 IN			AS22759/16-20	WIRE		.0196
956 IN			AS22759/16	WIRE		.0048
4			RCR07DJ	RESISTOR	MIL-R-11	.005
1			44-169	CAP-DUST		
1			44-168	CAP-DUST		
1			5180S-16-26P	RECEPTACLE		.09
1			5180S-16-26S	PLUG		.3
1			DWG 77-0159	SHUNT		.38
1			CK05041X-150D	CAPACITOR		.021
1			23003185-1	WIRING DIAGRAM		

UNLESS OTHERWISE STATED DIMENSIONS ARE IN INCHES AND TOLERANCES ON DECIMALS ARE ± .010 DETAIL ASSEMBLY

GPI INDUSTRIES INC

WIRING DIAGRAM
AUTO-DESTRUCT
PRESSURE SW MODULE

SIZE B | CAGE IDENT 11813 | 23003229

NEXT ASSEMBLY | USED ON | MATERIAL | MATERIAL SPECIFICATION

DES	PART NUMBER
BT1	23-002632-1(REF)
BT1	
D101	DESTR S/A UNIT B&W22530 (REF)
J12	RECEPTACLE DEU-DS04-12PB-059
J12	
P11	PLUG ETK06141SP-059
P11	
P12	
P12	
P12	
P12	
S1C	SWITCH 23002968-1 (REF)
S1C	
S1C	SWITCH 23002964-1 (REF)
R1,F	RESISTOR RC20GF101J
R3,	

NOTES:

1. WIRING TO BE ASSEMBLED & INSTALLED PER SPEC 308-11-2.
2. SPLICES TO BE MADE PER SPEC 308-11-4.
3. IDENTIFY WIRES PER SPEC CVA11-27.
4. THIS MOD CHANGES WIRING OF DRAWINGS 23 002861 & 23 002701.
5. MEGGER & CONTINUITY CHECK REWORKED HARNESS PER SPEC 308-11-2.
6. WHERE DRAWING CALLS FOR CUT & CAP, WIRES MAY BE REROUTED WHEN WIRE LENGTH IS SUFFICIENT.

REVISIONS

ZONE	DESCRIPTION	DATE	APPROVED
	PAGE 4.3		

ADD:

REMOVE:

LIST OF MATERIAL

ITEM	ZONE	CODE IDENT	PART OR IDENTIFYING NUMBER	NOMENCLATURE OR DESCRIPTION	MATERIAL OR SPEC	UNIT WT
				WIRING DIA MOD		
				BATTERY		
				SW ASSY		
				RECEPTACLE		
				PLUG		
				PLUG		
				SW		

WIRING DIAGRAM MOD
AUTO DESTRUCT SYS
PRESSURE SWITCH

CODE IDENT NO. 11813 — SIZE J — 23-003145

GSE PROTECTIVE SYSTEM

MATERIAL SPECIFICATION

PHASE 4,5

GROUND MONITOR IGN & DESTRUCT SYS

SCHEMATIC
IGNITION & DESTRUCT SYS

ASTRIONAUTICS DIVISION
CHANCE VOUGHT CORP
A DIVISION OF LING-TEMCO-VOUGHT INC.

CODE IDENT NO 11813 | SIZE J | 23-00220

DRAWN BY
CHKD BY

GROUND MONITOR
IGNITION & DESTRUCT SYS

GROUND MONITOR
POWER SUPPLY
IGN & DEST SYS

FLYAWAY (T/M TUNNEL)

1ST STAGE IGNITION

2ND STAGE IGNITION

1ST STAGE DESTRUCT

2ND STAGE DESTRUCT

3RD STAGE DESTRUCT

ARM

SAFE

SYS #1

SYS #2

NO SAFE INDICATOR

INTERNAL

EXTERNAL

RECEIVERS INTERNAL
EXTERNAL
POWER

SPIN MOTORS & 4TH STAGE HEAT SHIELD #1

SPIN MOTORS & 4TH STAGE HEAT SHIELD #2

3RD & 4TH STAGE IGN & EXP BOLTS

SPIN MOTORS, 4TH STAGE HEAT SHIELD & BELLY BANDS

POWER SUPPLY 28V DC, COMD

ARM COMD #1

SAFE COMD

ARM COMD #2

K1 (2201) 1ST STAGE

K2 (2201) 2ND STAGE

K1 (2301)

K2 (2301)

K3 (2301)

K4 (2301)

IGNITION COMD

SEE [illegible] FOR CONTINUED

A

B

C

D

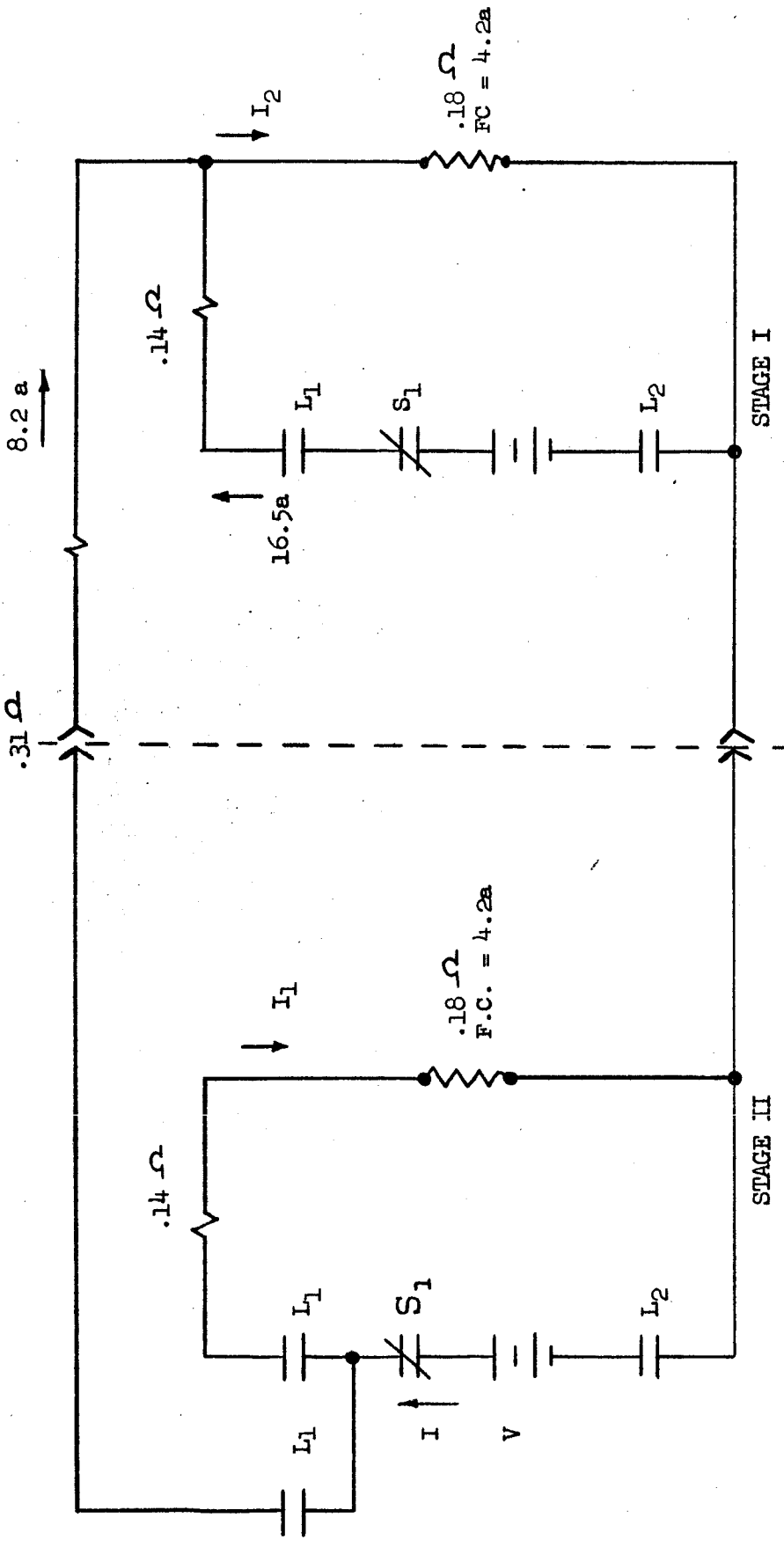


FIGURE 4.5 EQUIVALENT CIRCUIT - AUTO-DESTRUCT SYSTEM
(Single System Typical)

REFERENCES

4.A Pressure Switch Modification Auto-Destruct - 23-002964

4.B Battery Assembly Payload Separation "E" Section - 23-002632

4.C Switch Assembly Lanyard Release - Auto-Destruct System - 23-002968

4.D Voltage Regulation and Discharge Tests of Eight PM05 Battery Cells. LTV Report No. 23.93

4.E Cable Assy. Auto Destruct Module System Test - Electronic Test Equipment - 321-00261

4.F Wiring Book - Cable Plant Scout Std. Sys. Test Equipment - 331-39900

4.G Ign. Arming Console Unit #7 - NASA Scout B/H Equipment - 331-01500

4.H Destr. Test Panel Assy. - Scout in-plant Test Equipment - 401-30036

4.J Ign./Destr. Mon. Unit #14, NASA Scout B/H Equipment - 331-02350

4.K Destr. T/S - NASA Scout Test and C/O Equipment - 326-00125

4.L Test Set Assy. - Portable Simulator, Base A Electrical Support Equipment - 331-39881.

SECTION 5.0

Qualification Test Program

I. Introduction

This report documents the environmental qualification testing of the Auto-Destruct Module and associated tubing assembly which was performed under Contract No. NAS 1-3899, Task Order 17. Test results are summarized and the test requirements are presented by the Test Request. Test results were satisfactory and it is concluded that the Auto-Destruct Module and tubing assembly design satisfies Scout environmental qualification criteria.

SECTION 5.0

II. Environmental Qualification Testing of the Auto-Destruct Module (P/N 23-002973)

This test was conducted to demonstrate the structural, mechanical, and electrical adequacy of the Auto-Destruct Module by the successful completion of the environmental qualification test requirements. The environmental test requirements are detailed by the Qualification Test Request.

A. Pre-environmental Tests - The module was subjected to the pre-environmental tests as prescribed by the test request. No out-of-tolerance conditions were observed. A view of the module without cover is presented in figure 1.

B. Qualification Tests - The environmental qualification test parameters included vibration, shock, acceleration, temperature-shock, temperature-altitude, and humidity. Each test parameter is discussed briefly in the following paragraphs:

(1) Vibration tests - Fixture evaluation tests were first conducted in accordance with the requirements of the Test Request. Curves of the resulting amplification factors versus frequency are shown in figures 13 through 31. A photograph of a typical monitoring and recording setup for fixture evaluation and vibration is shown in figure 2.

Next, the vibration inputs for each axis were shaped according to results obtained from the fixture evaluation tests. These test inputs are shown by Tables 1, 2, and 3. The module was then subjected to these levels in each major axis as required by the Test Request. A typical vibration setup for the moduled is shown by figures 3 and 4. Curves of amplification factors versus frequency are shown in figures 32 through 51. Vibration equalization curves are given by figure 52. Performance of the Auto-Destruct Module during vibration and post-vibration was satisfactory.

(2) Shock tests - The module was shock tested as specified by the Test Request. The test setup is shown in the photograph of figure 5. Module performance under shock testing was satisfactory.

(3) Acceleration tests - The typical acceleration test setup for the Auto-Destruct Module is shown in figures 6 and 7. The Auto-Destruct Module satisfactorily completed the acceleration tests as prescribed by the Test Request.

(4) Temperature-Shock tests - Two chambers were prepared, one for high temperature and one for low temperature. The module was installed and monitored as shown by figures 8 and 9 for high and low temperatures respectively. The module satisfactorily completed the Temperature-Shock test as required

by the Test Request.

(5) Temperature-Altitude tests - The module was installed in the temperature-altitude chamber as shown in figures 10 and 11 and subjected to the tests as required by the Test Request. From thermocouples mounted outside and inside the cover, and on four of the components, a set of curves of temperature versus time were plotted and are presented as figures 53 through 62. This test was successfully completed.

(6) Humidity test - The module was installed in the humidity chamber, as shown in figure 12, and subjected to the test cycles as specified by the Test Request. Module performance under humidity testing was satisfactory.

C. Post-Environmental Tests - The post-environmental tests were conducted on the Auto-Destruct Module as specified by the Test Request. Test results were satisfactory.

SECTION 5.0

III. Environmental Qualification Testing of the Auto-Destruct Tubing Assembly

The purpose of this test was to demonstrate the design adequacy of the Auto-Destruct Tubing Assembly under vibration qualification conditions.

A. Qualification Tests - Environmental qualification testing of the Auto-Destruct Tubing Assembly consisted of vibration testing to the requirements specified for the tubing assembly by the Test Request.

Fixture evaluation for the vibration test setup was conducted and curves of the resulting amplification factors versus frequency are shown in figures 63 through 76.

The tubing assembly was subjected to the resulting shaped vibration inputs presented in Table 4. Curves of amplification factors versus frequency are presented in figures 77 through 93. Photographs of the test setup and instrumentation are presented by figures 94 through 97. During the first axis of the vibration test, the bonding between the pressure line support bracket and the test fixture broke. An investigation revealed the cause of failure to be due to improper handling of the bonding agent, EPON 934, prior to usage. With proper EPON 934 handling procedures, the bracketry was rebonded and retested under vibration. The tubing assembly successfully passed the prescribed qualification test.

SECTION 5.0

IV. Results and Conclusions

The Auto-Destruct Module and Tubing Assembly satisfactorily completed the prescribed environmental qualification test requirements. It is therefore concluded that the module and tubing assembly design is environmentally qualified to the Scout environmental qualification criteria. Also, it is concluded that the test objective of demonstrating structural, mechanical, and electrical adequacy is satisfied.

TABLE 1

Transverse Vibration Levels as shaped per Fixture Evaluation.

Test Duration (Sec.)	Frequency (cps) Lower	Upper	Level Random (G rms)	Sine (± G)
60	500	700	-	8.0
	700	1350	-	2.0
	1350	2000	-	8.0
240	40	80	-	4.5
144	20	700	-	6.0
	700	1350	-	1.5
	1350	2000	-	6.0
160	20	2000	3.0	-

TABLE 2

Thrust Vibration Levels as shaped per Fixture Evaluation.

Test Duration (Sec.)	Frequency (cps) Lower	Upper	Level Random (G rms)	Sine (± G)
66	500	1400	-	8.0
	1400	1500	-	4.0
	1500	2000	-	8.0
240	40	80	-	4.5
144	20	1400	-	6.0
	1400	1500	-	3.0
	1500	2000	-	6.0
160	20	2000	3.0	-

TABLE 3

Tangential Vibration Levels as shaped per Fixture Evaluation.

Test Duration (Sec.)	Frequency (cps) Lower	Upper	Level Random (G rms)	Sine (± G)
60	500	650	-	8.0
	650	950	-	2.0
	950	1900	-	8.0
	1900	2000	-	4.0
240	40	80	-	4.5
144	20	650	-	6.0
	650	950	-	1.5
	950	1900	-	6.0
	1900	2000	-	3.0
160	20	2000	3.0	-

TABLE 4

TUBING ASSEMBLY VIBRATION INPUTS AS
SHAPED PER FIXTURE EVALUATION
(Longitudinal and Transverse Axes Only)

Test Duration (Sec)	Frequency (CPS) Lower	Upper	Level Random GRMS	Sine ± "G"
	500	550	---	35.0
	550	1000	---	20.0
60	1000	1500	---	35.0
	1500	2000	---	12.0
240	40	80	---	4.5
	20	400	---	12.0
	400	550	---	35.0
144	550	1000	---	20.0
	1000	1500	---	35.0
	1500	2000	---	12.0
160	20	2000	3.0	---

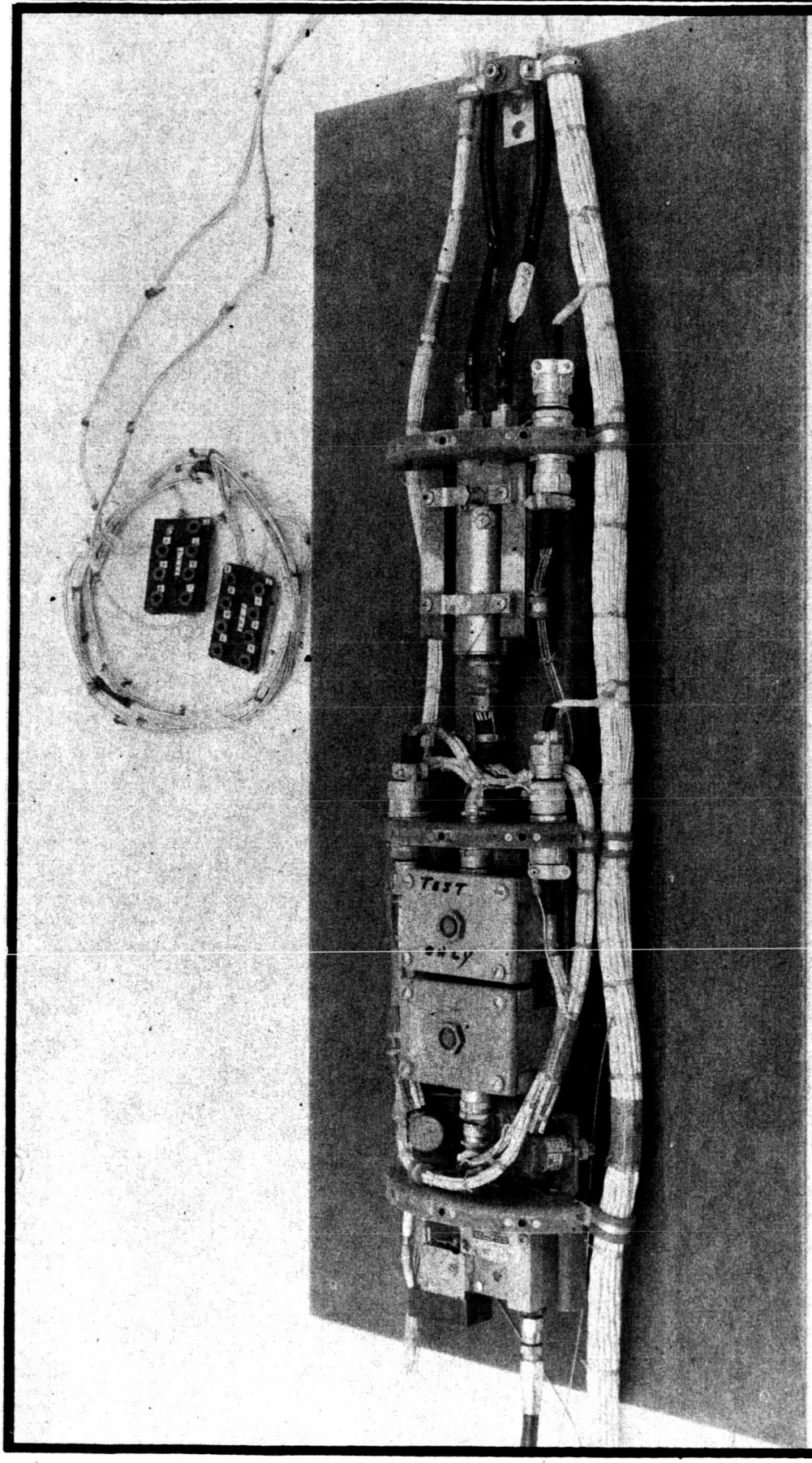


FIGURE 1

Tunnel Mounted Auto-Destruct Module (Shown without cover)

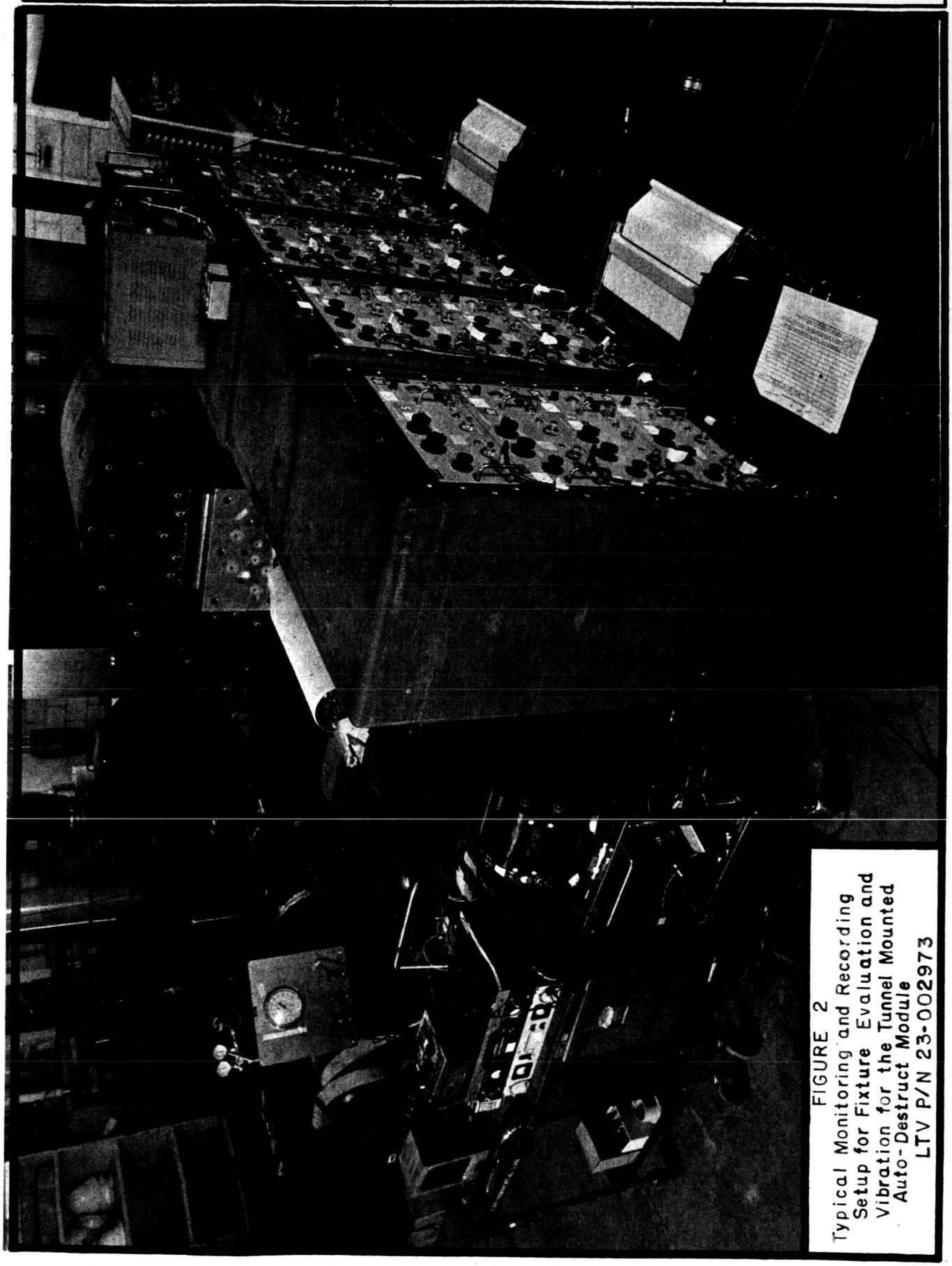


FIGURE 2
Typical Monitoring and Recording Setup for Fixture Evaluation and Vibration for the Tunnel Mounted Auto-Destruct Module LTV P/N 23-002973

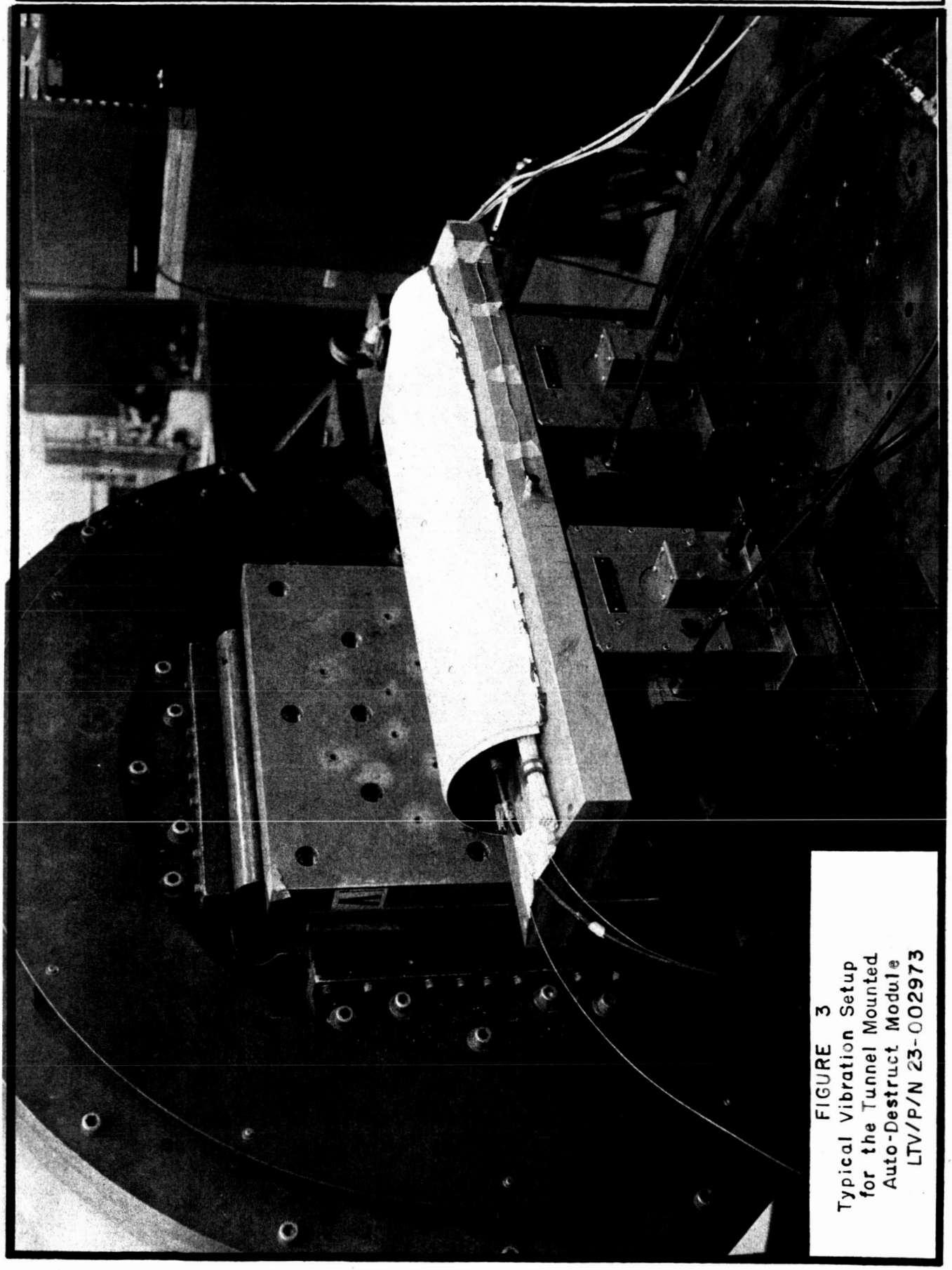


FIGURE 3
Typical Vibration Setup
for the Tunnel Mounted
Auto-Destruct Module
LTV/P/N 23-002973

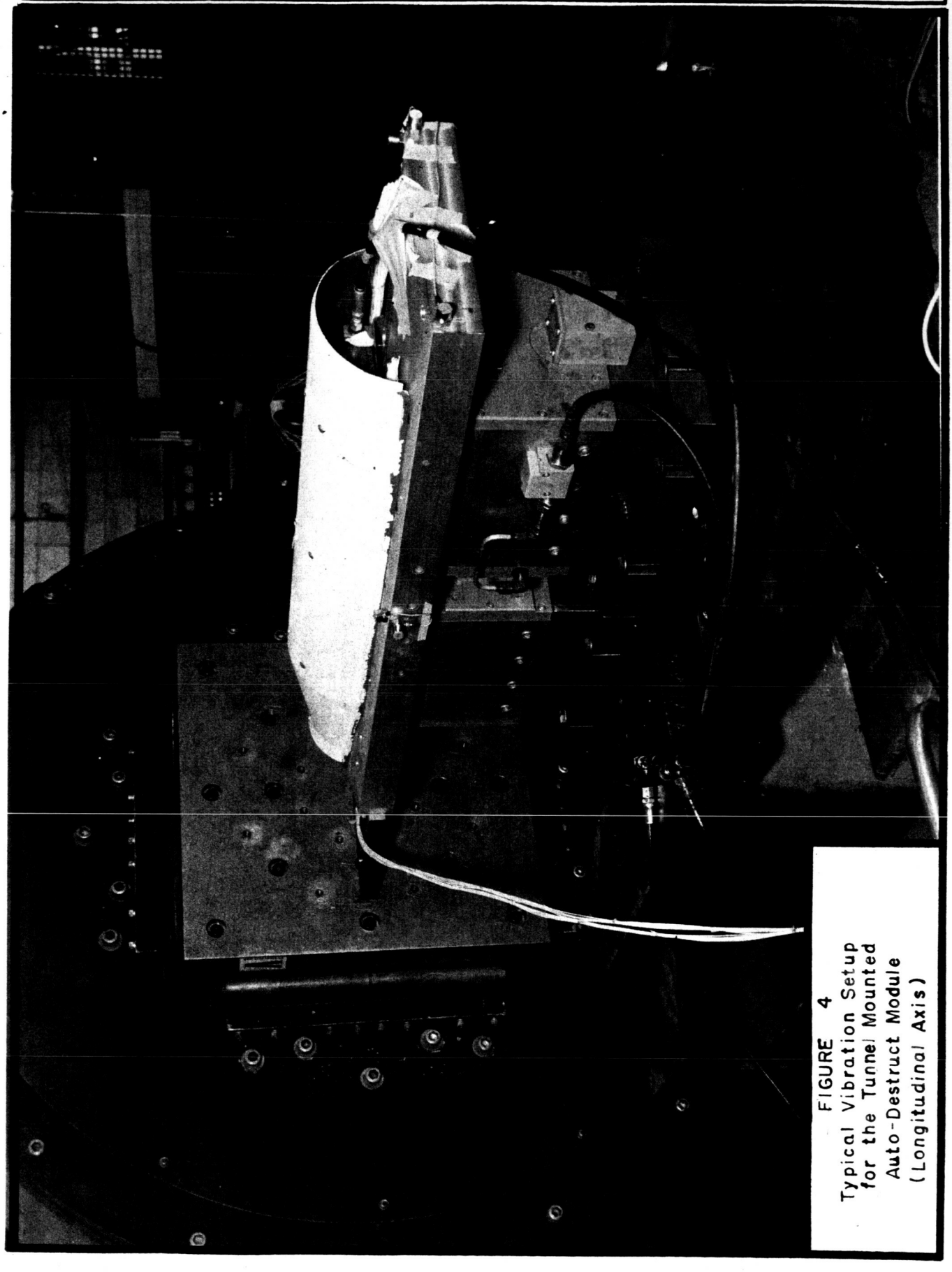


FIGURE 4
Typical Vibration Setup for the Tunnel Mounted Auto-Destruct Module (Longitudinal Axis)

FIGURE 5
Typical Mechanical Shock Setup
For the Tunnel Mounted
Auto-Destruct Module
LTV/P/N 23-002973

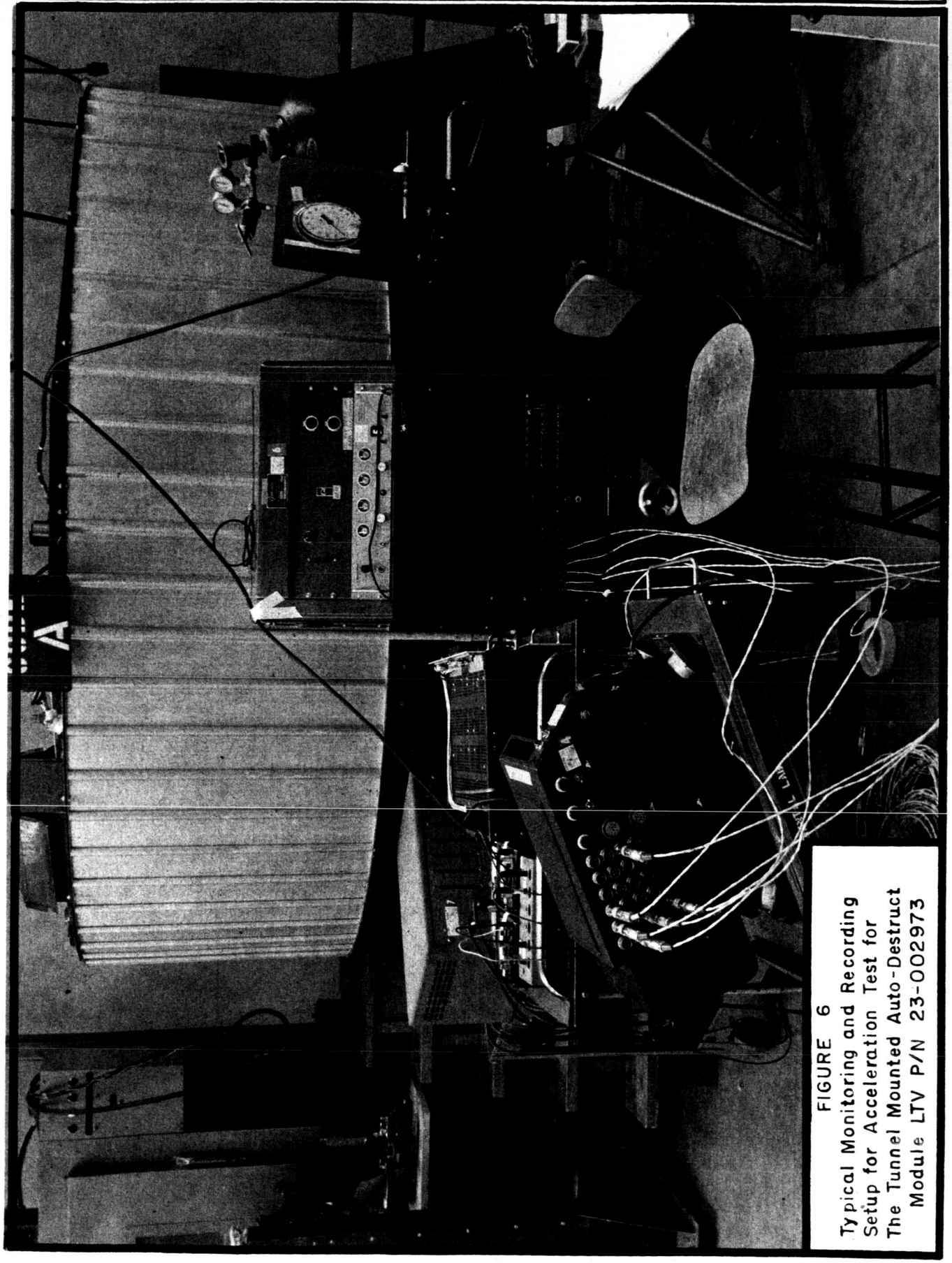


FIGURE 6
Typical Monitoring and Recording Setup for Acceleration Test for The Tunnel Mounted Auto-Destruct Module LTV P/N 23-002973

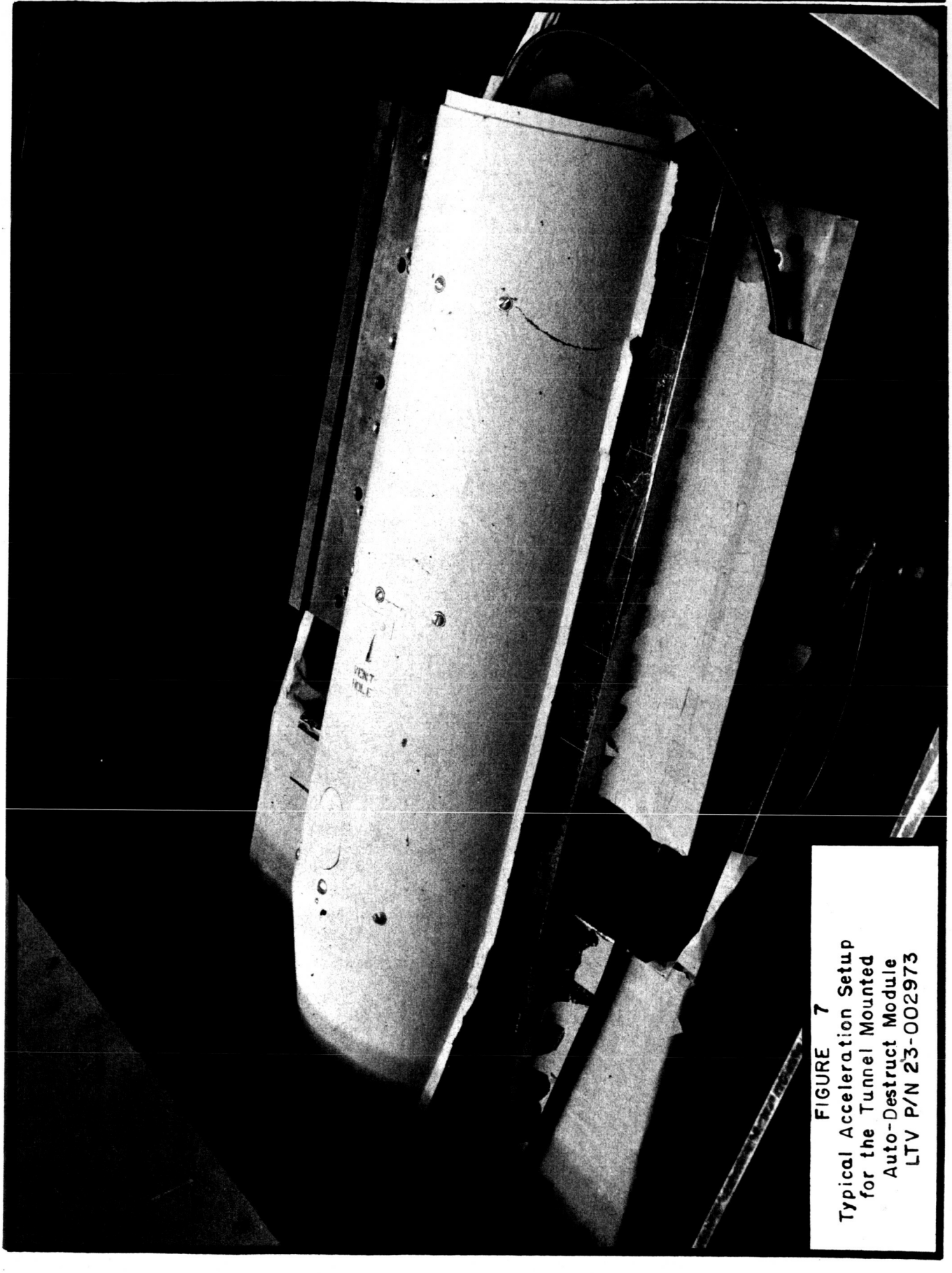


FIGURE 7
Typical Acceleration Setup for the Tunnel Mounted Auto-Destruct Module LTV P/N 23-002973

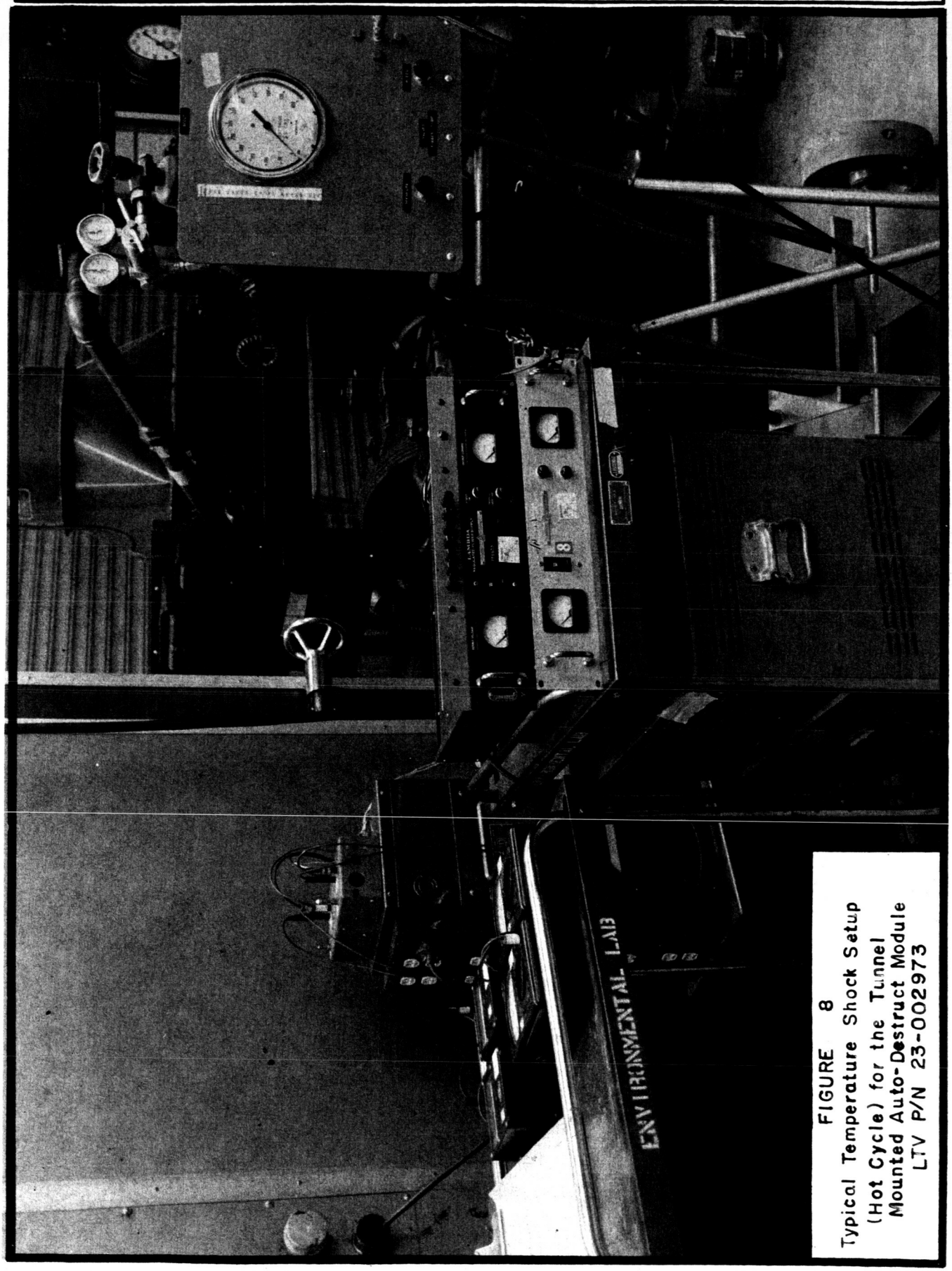


FIGURE 8
Typical Temperature Shock Setup
(Hot Cycle) for the Tunnel
Mounted Auto-Destruct Module
LTV P/N 23-002973

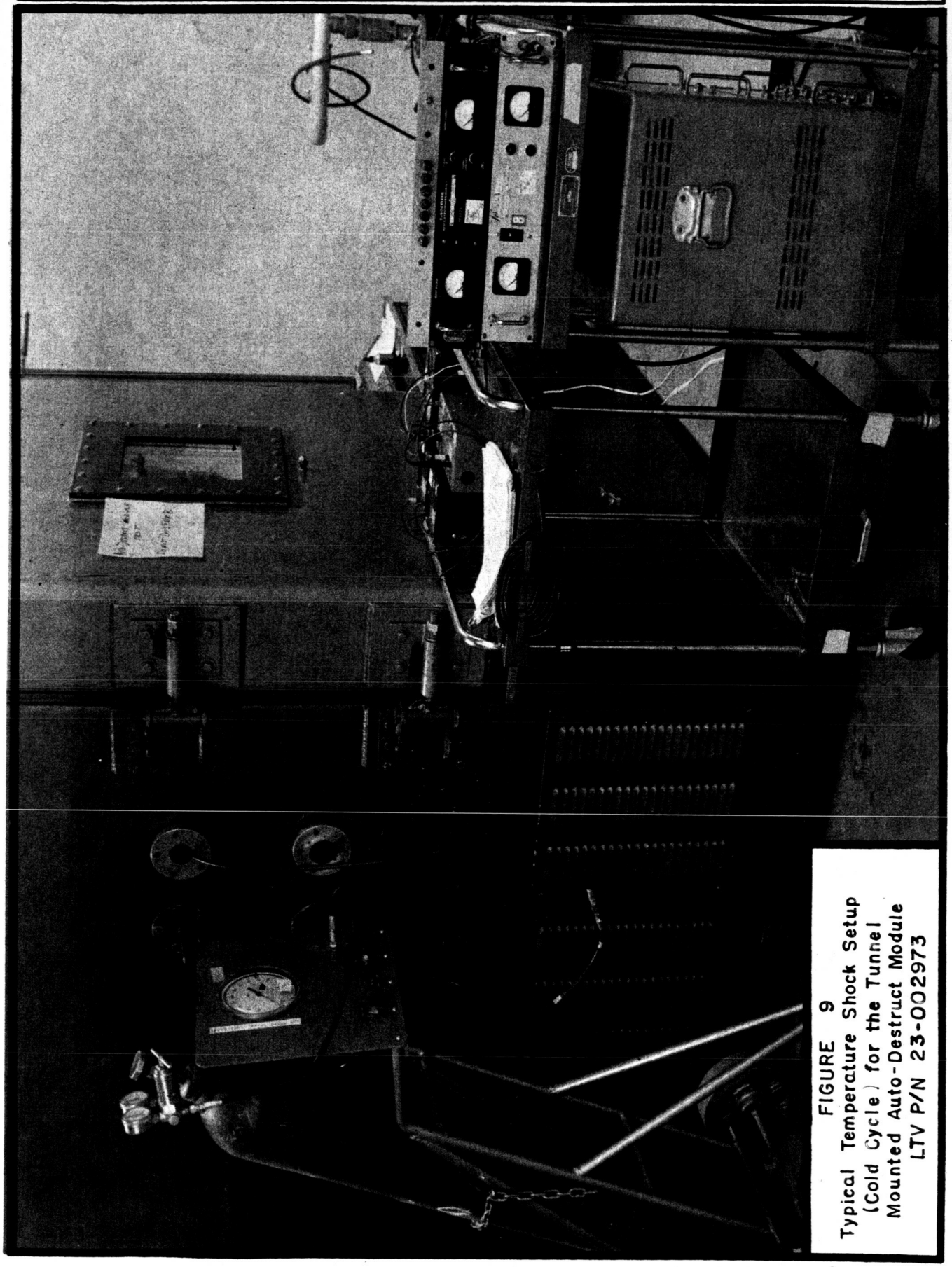


FIGURE 9
Typical Temperature Shock Setup
(Cold Cycle) for the Tunnel
Mounted Auto-Destruct Module
LTV P/N 23-002973

FIGURE 10
Typical Temperature-Altitude Setup for the Tunnel Mounted Auto-Destruct Module LTV P/N 23-002973

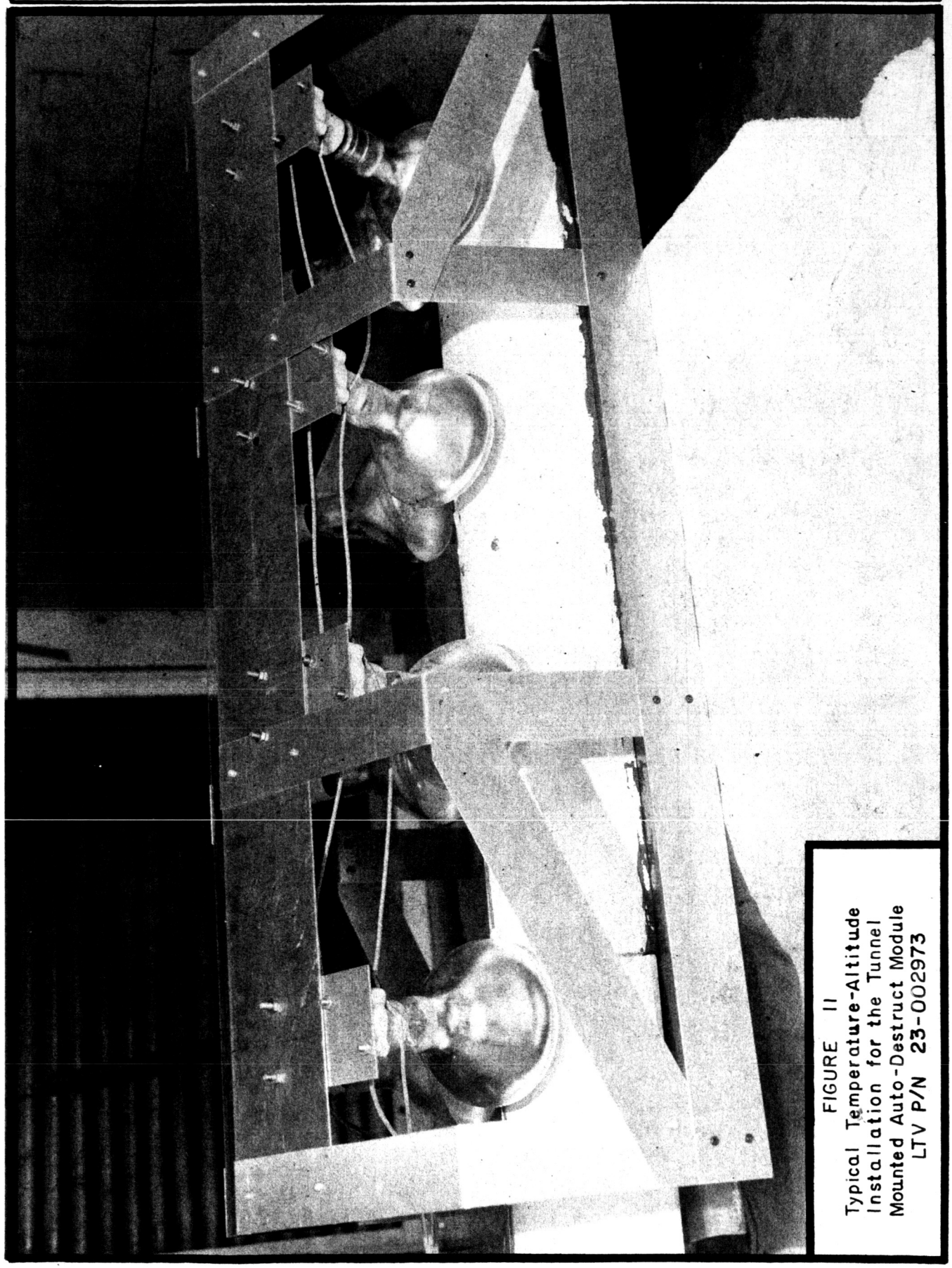


FIGURE 11
Typical Temperature-Altitude Installation for the Tunnel Mounted Auto-Destruct Module LTV P/N 23-002973

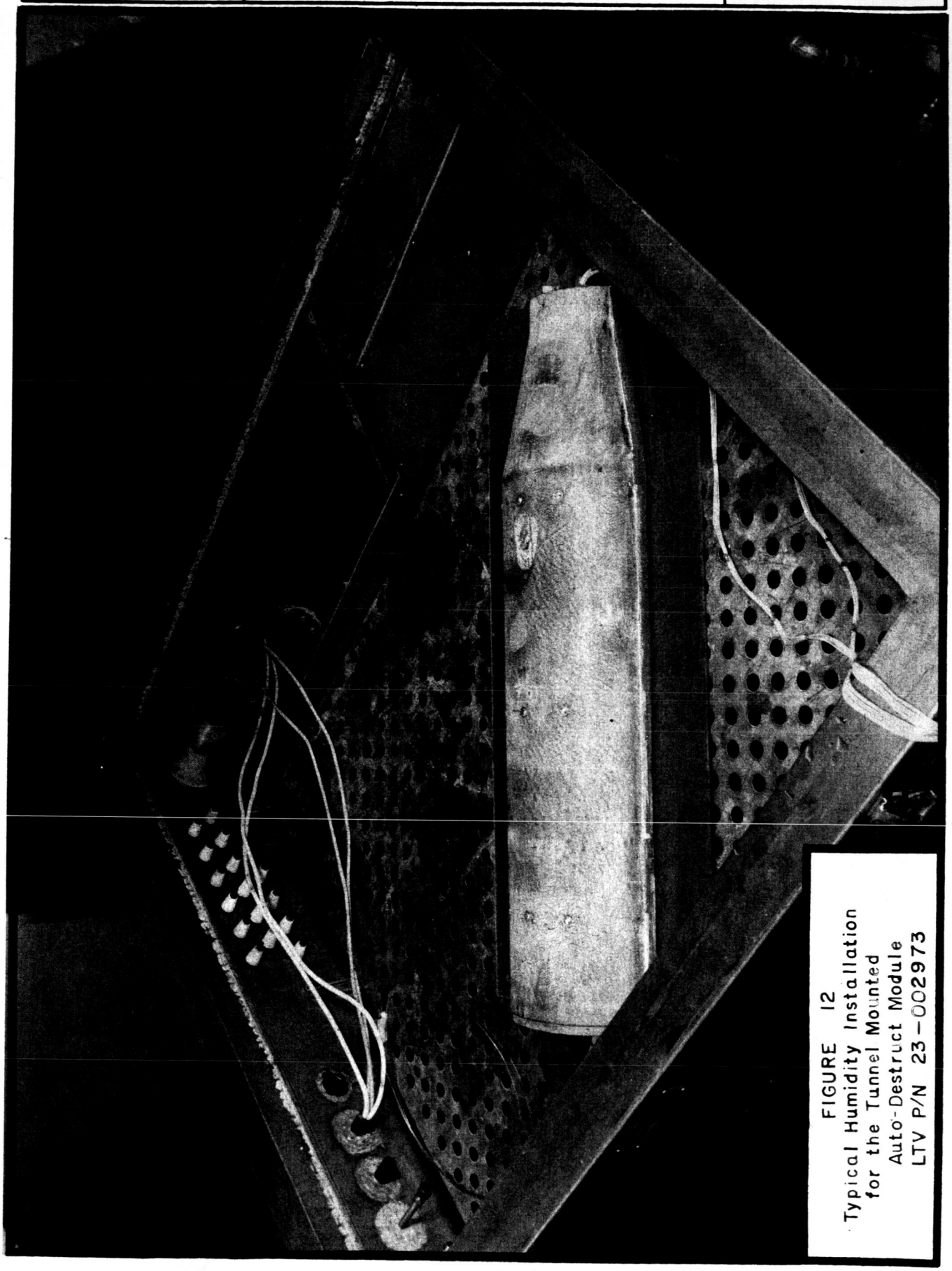
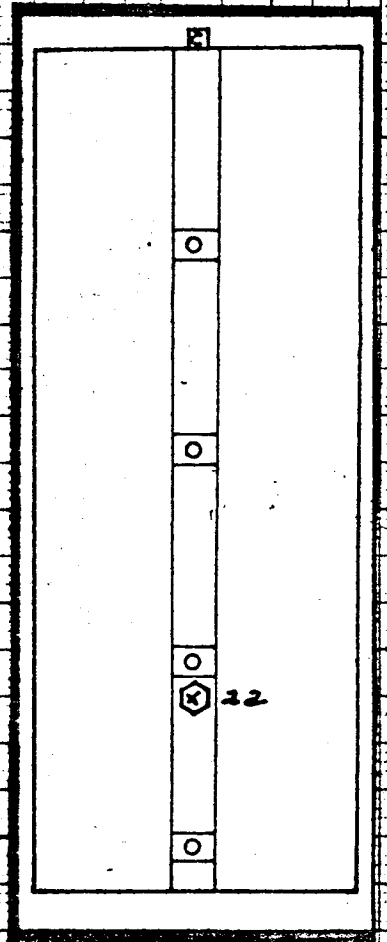


FIGURE 12
Typical Humidity Installation
for the Tunnel Mounted
Auto-Destruct Module
LTV P/N 23-002973

K&E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO. MADE IN U.S.A.
3 CYCLES X 140 DIVISIONS

FIGURE 13
Tunnel Mounted Auto-Destruct Module, LRV/AD P/N 23-002973 Accel. No. 22 & Control Thrust Axis Fixture Excitation



Amplification Factor

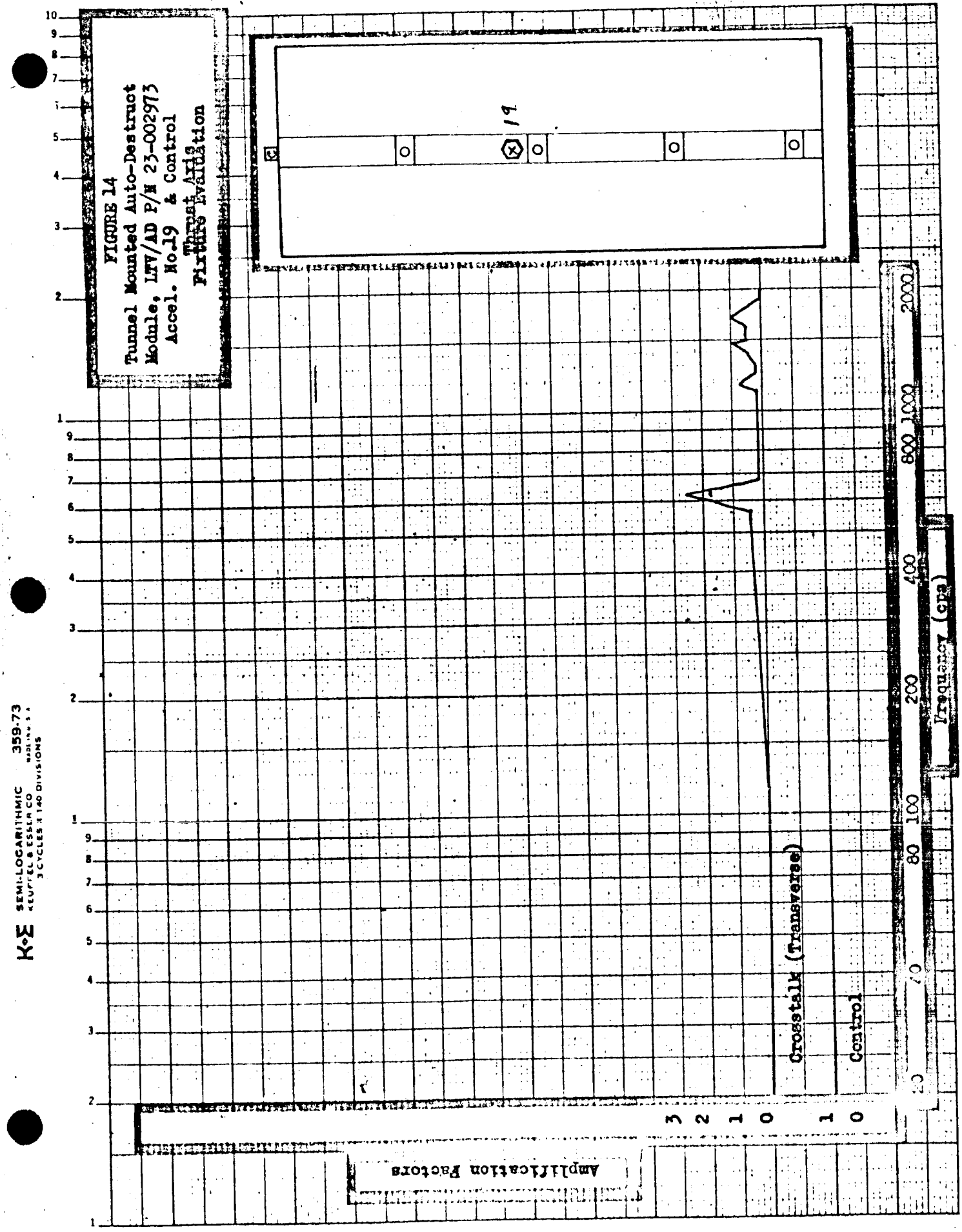
10
10

Crosstalk (Transverse)

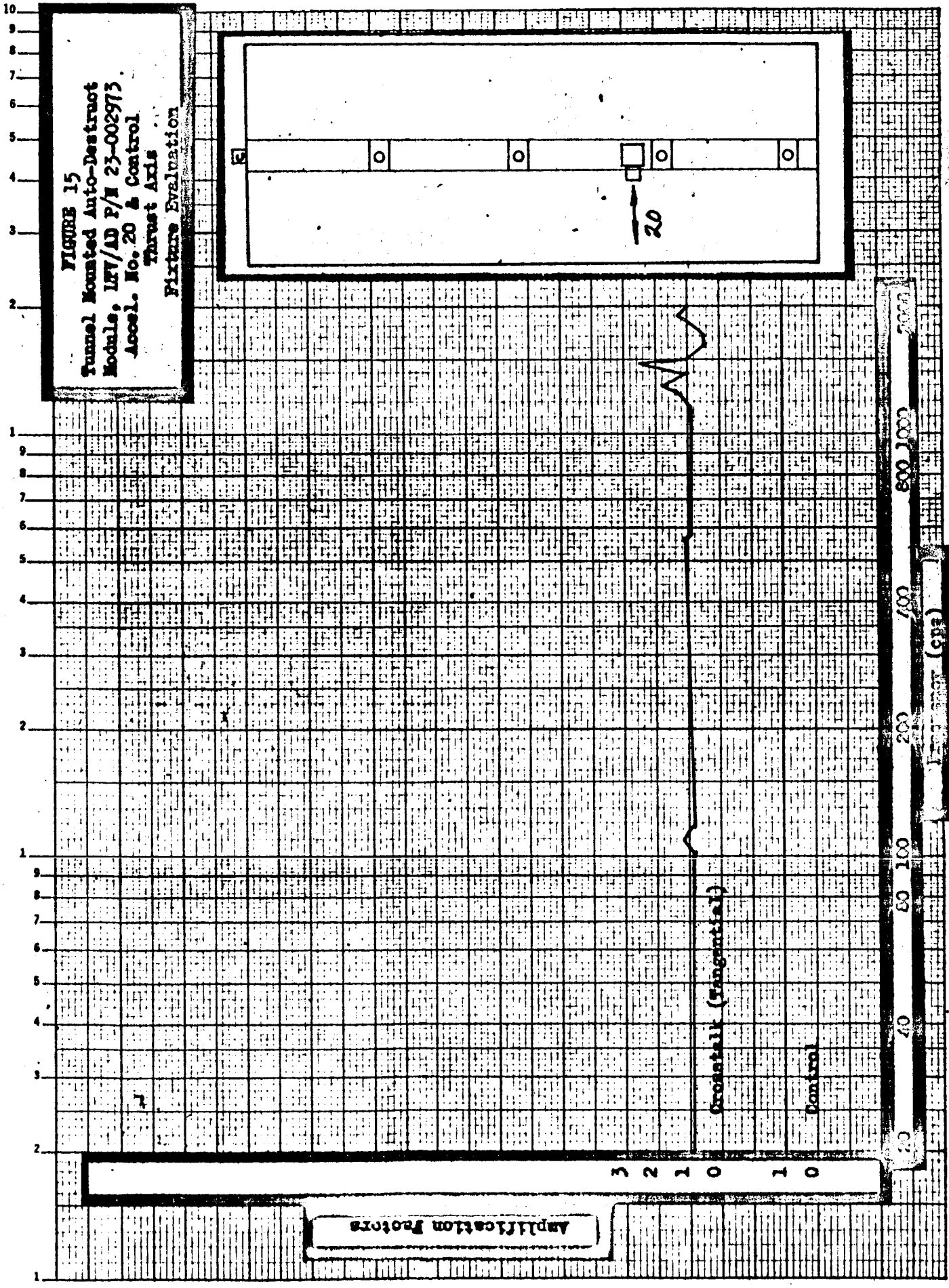
Control

80 100 200 400 600 1000

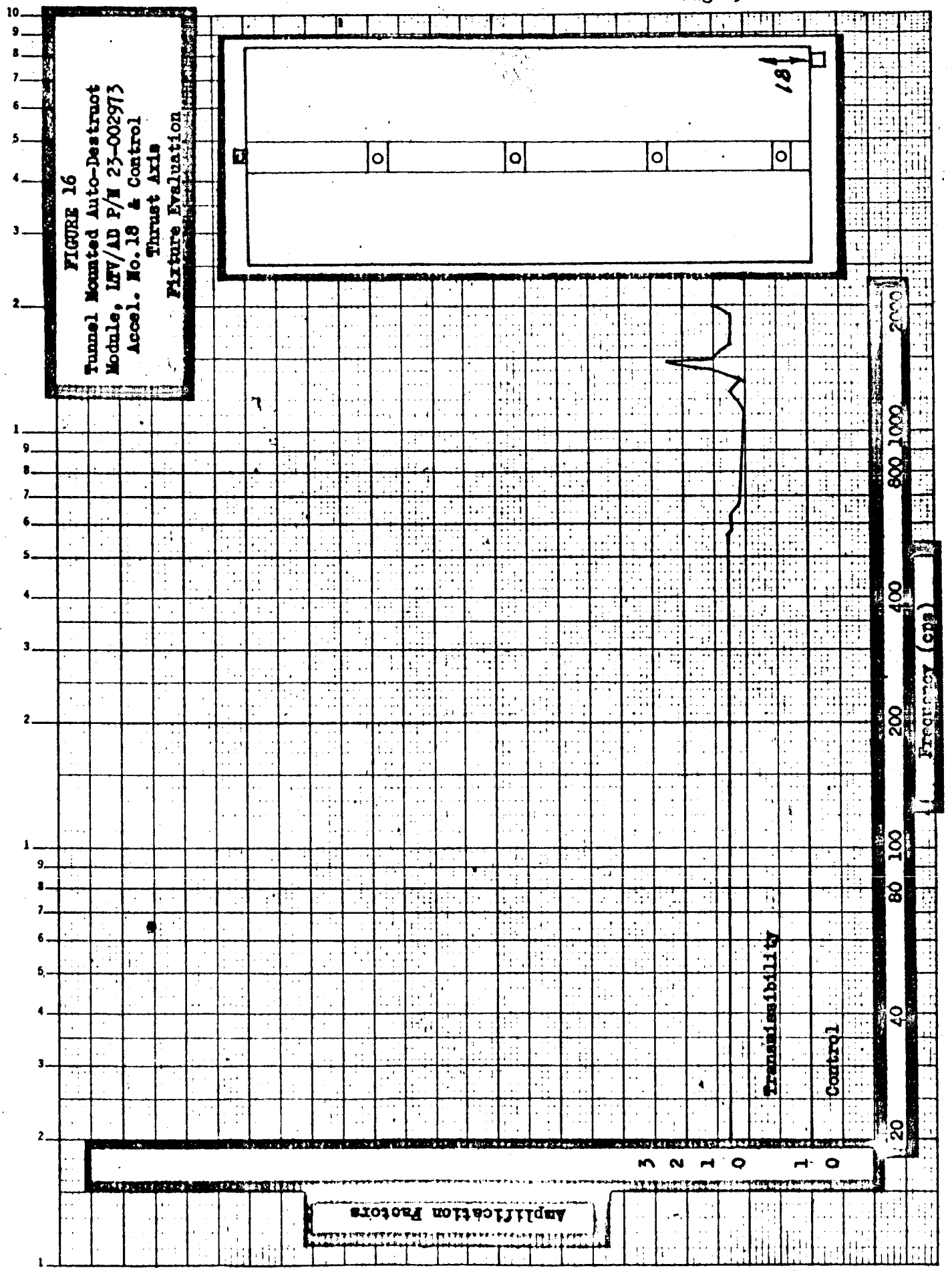
Frequency (cps)

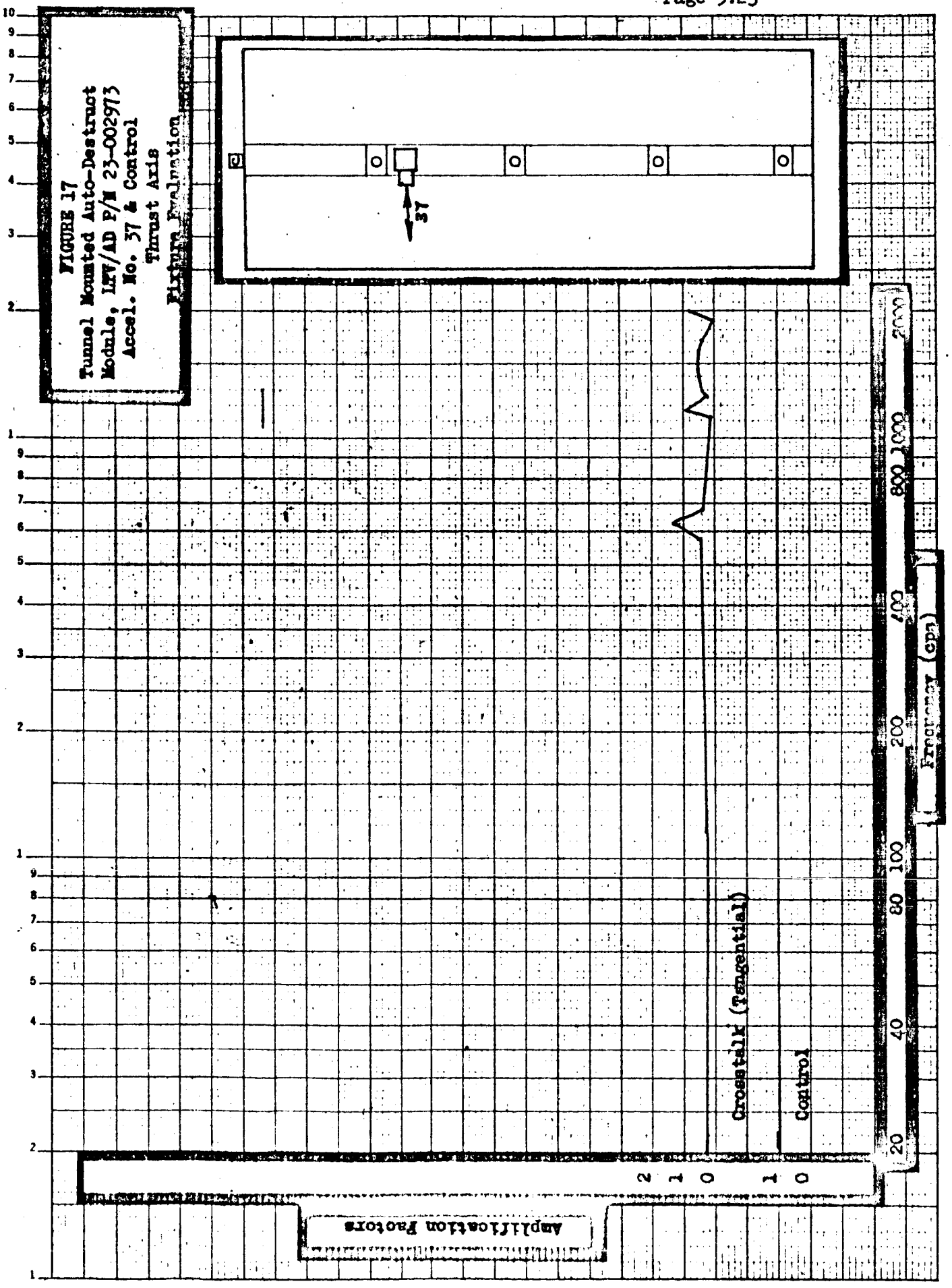


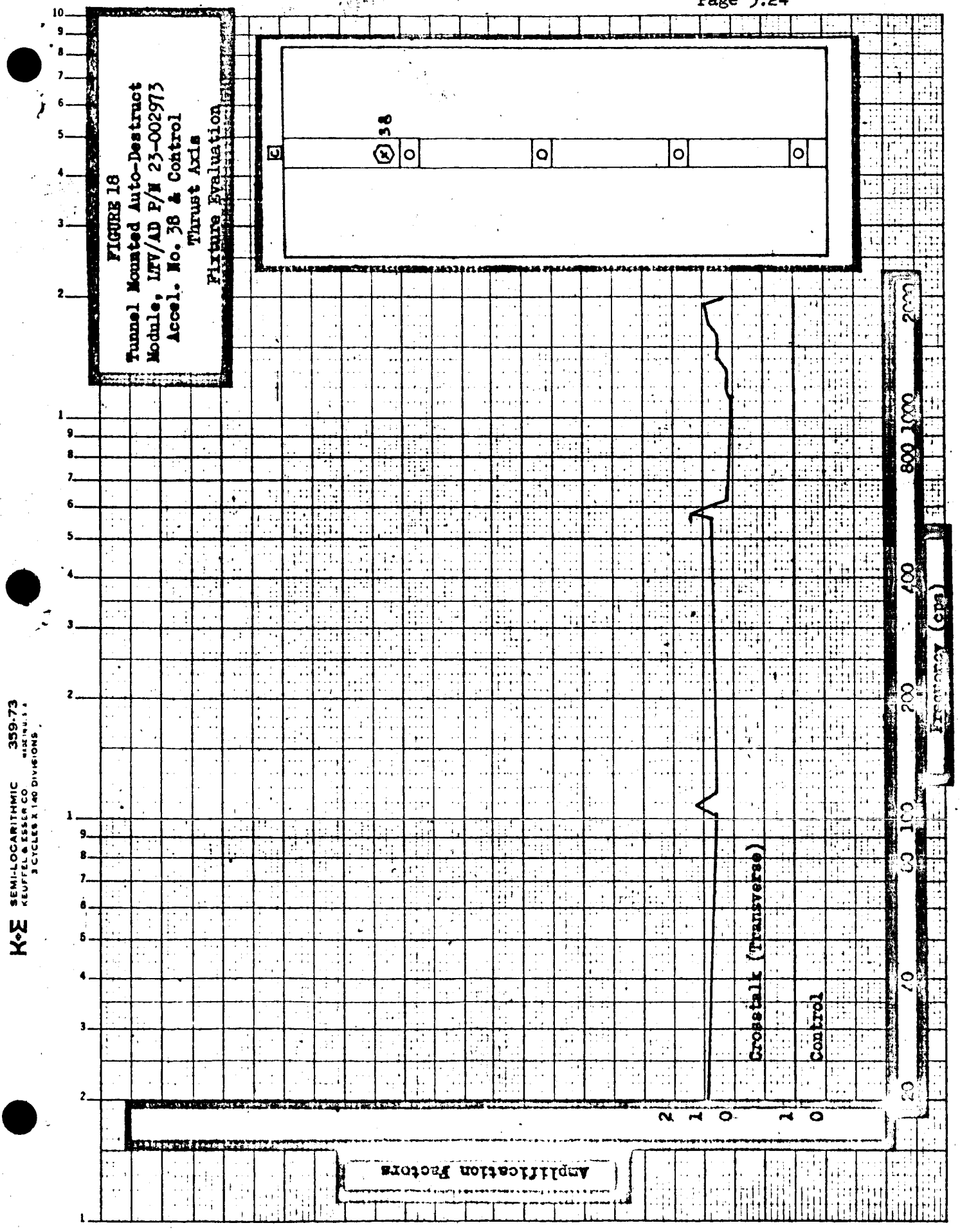
K+E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO
3 CYCLES X 140 DIVISIONS



K&E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO.
3 CYCLES X 140 DIVISIONS

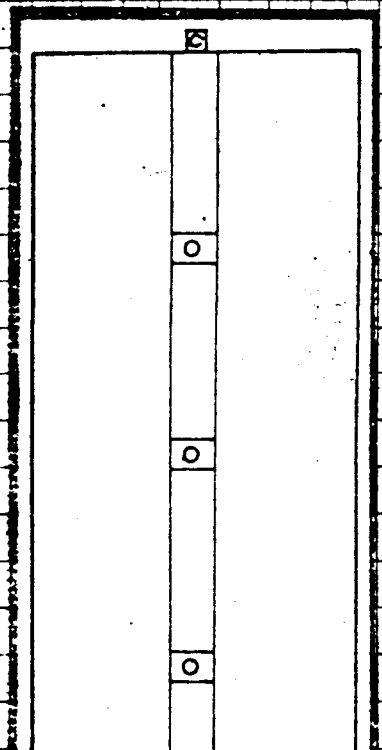

FIGURE 16
Tunnel Mounted Auto-Destruct Module, LEV/AD P/N 23-002973
Accel. No.18 & Control
Thrust Axis
Fixture Evaluation
18
Frequency (cps)
20
40
80
100
200
400
800
1000
2000
Transmissibility
Control
3 2 1 0 1 0
Amplification Factors
K+E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO.
3 CYCLES X 140 DIVISIONS


FIGURE 17
Tunnel Mounted Auto-Destruct Module, LRV/AD P/N 23-002973
Accel. No. 37 & Control
Thrust Axis
Figure Evaluation
37
Amplification Factors
2 1 0 1 0
Crosstalk (Tangential)
Control
Frequency (cps)
20 40 80 100 200 800 1000
K+E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO
3 CYCLES X 140 DIVISIONS


FIGURE 18
Tunnel Mounted Auto-Destruct
Module, LTV/AD P/N 23-002973
Accel. No. 38 & Control
Thrust Axis
Fixture Evaluation
38
Amplification Factors
Crosstalk (Transverse)
Control
Frequency (cps)
10
9
8
7
6
5
4
3
2
1
2
1
0
1
0
30
70
100
200
400
800
1000
2000

K&E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO
3 CYCLES X 140 DIVISIONS

FIGURE 19
Tunnel Mounted Auto-Destruct Module, LTV/AD P/N 23-002973 Accel. No.21 & Control Thrust Axis Fixture Evaluation



Amplification Factors

3
2
1
0
1
0

Crosstalk (Tangential)

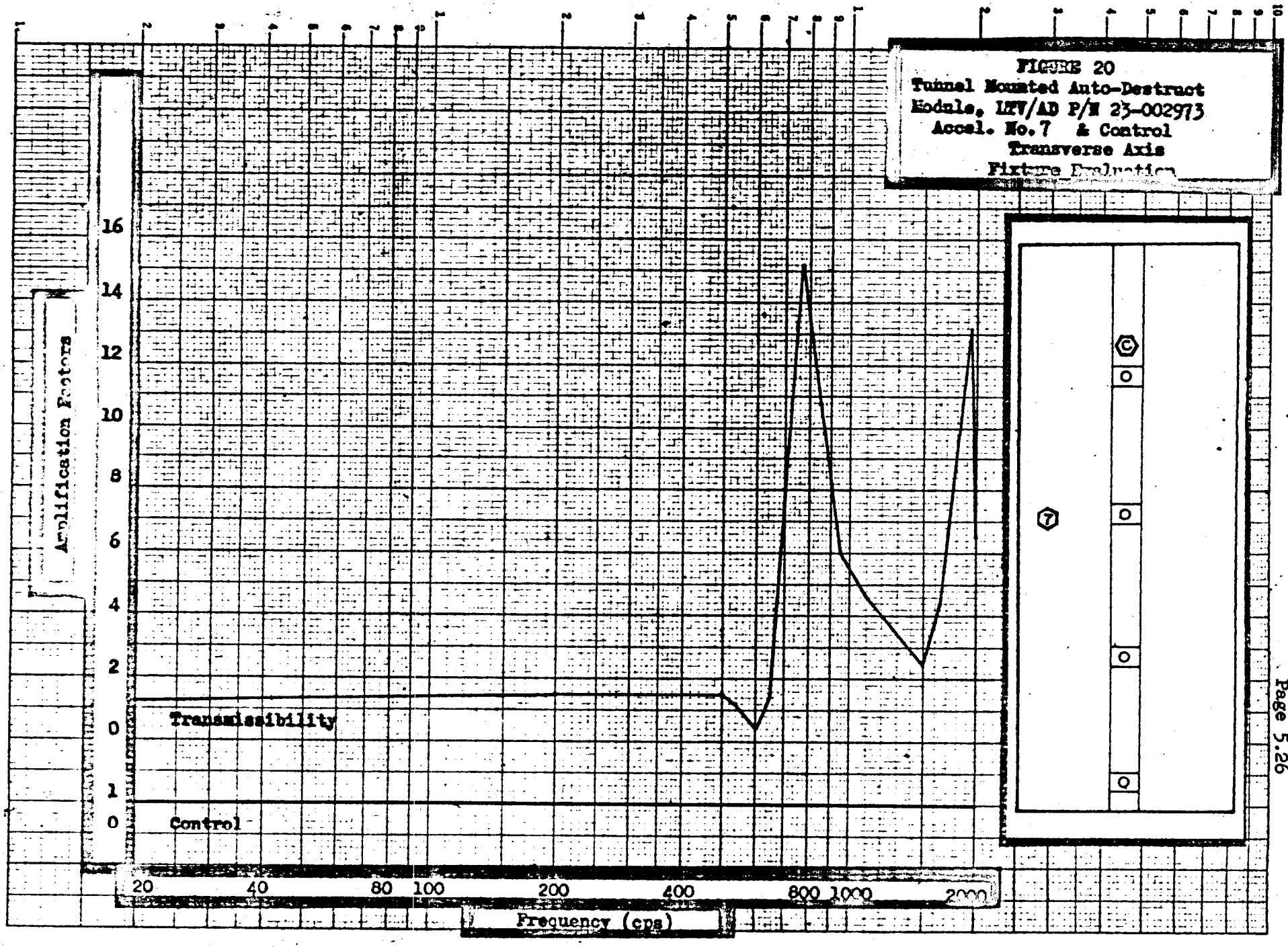
Control

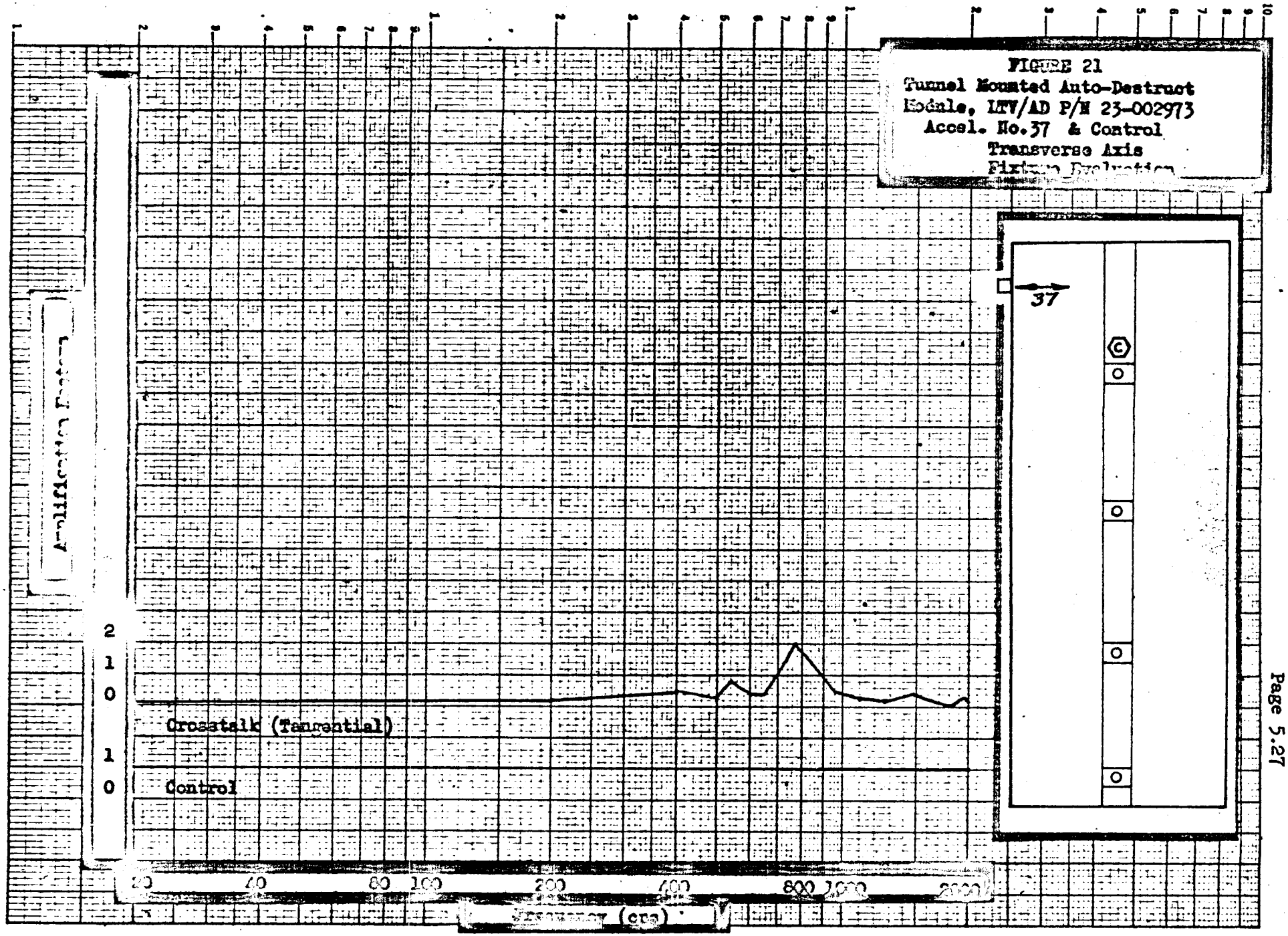
20 40 60 80 100 200 400 800 1000 2000

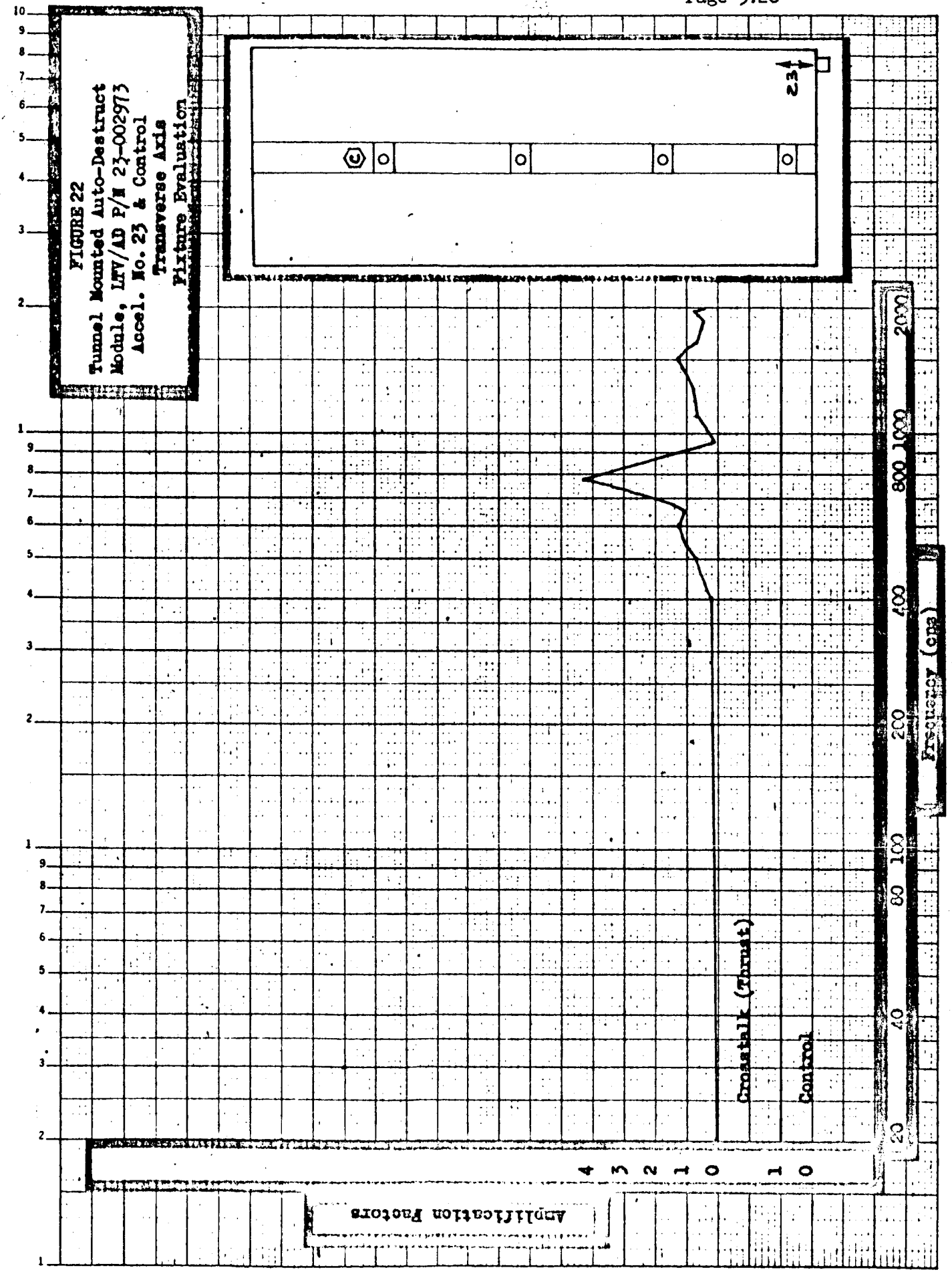
Frequency (cps)

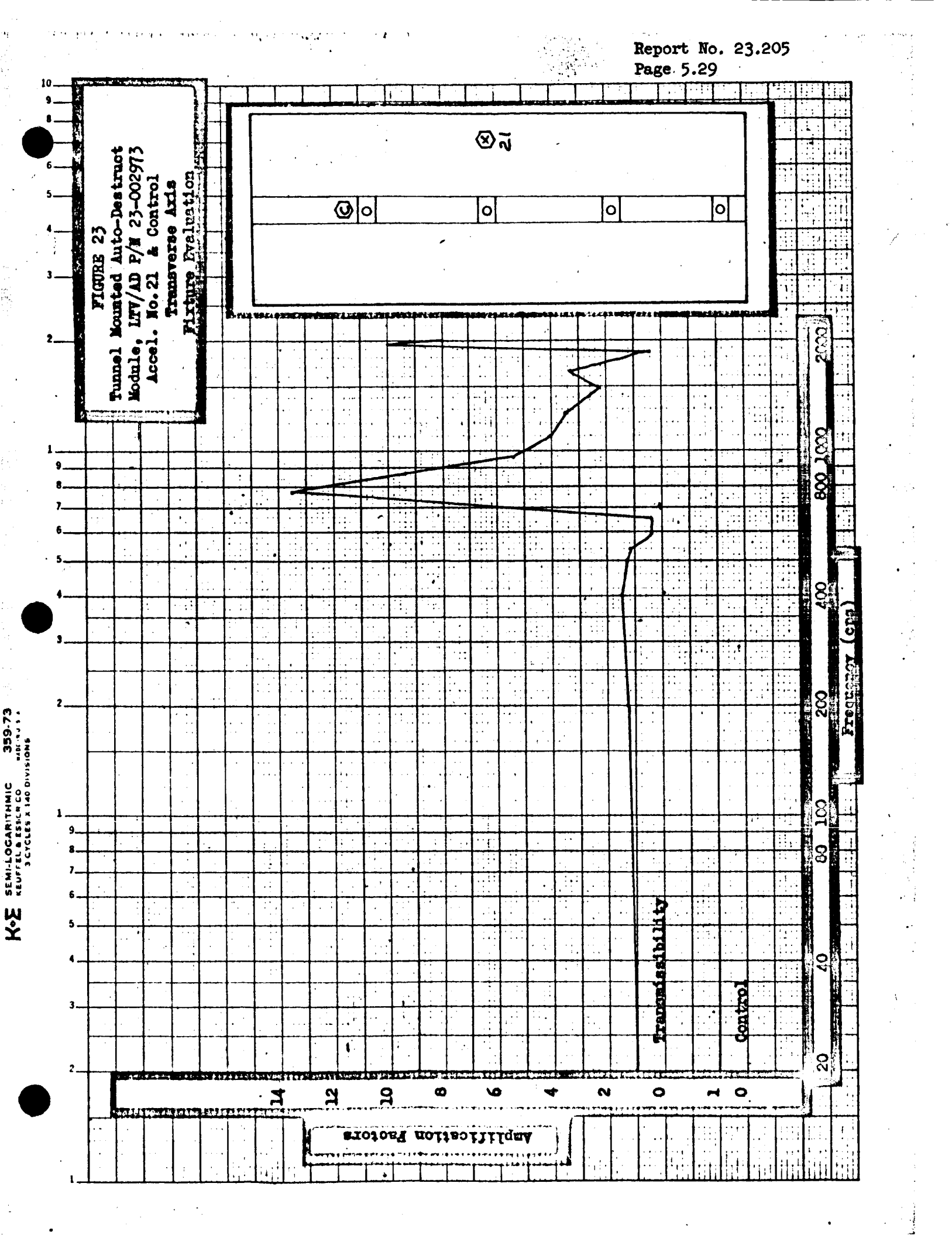
K·E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO. MADE IN U.S.A.
3 CYCLES X 140 DIVISIONS

FIGURE 20
Tunnel Mounted Auto-Destruct Module, LTV/AD P/N 23-002973
Accel. No.7 & Control
Transverse Axis
Fixture Evaluation



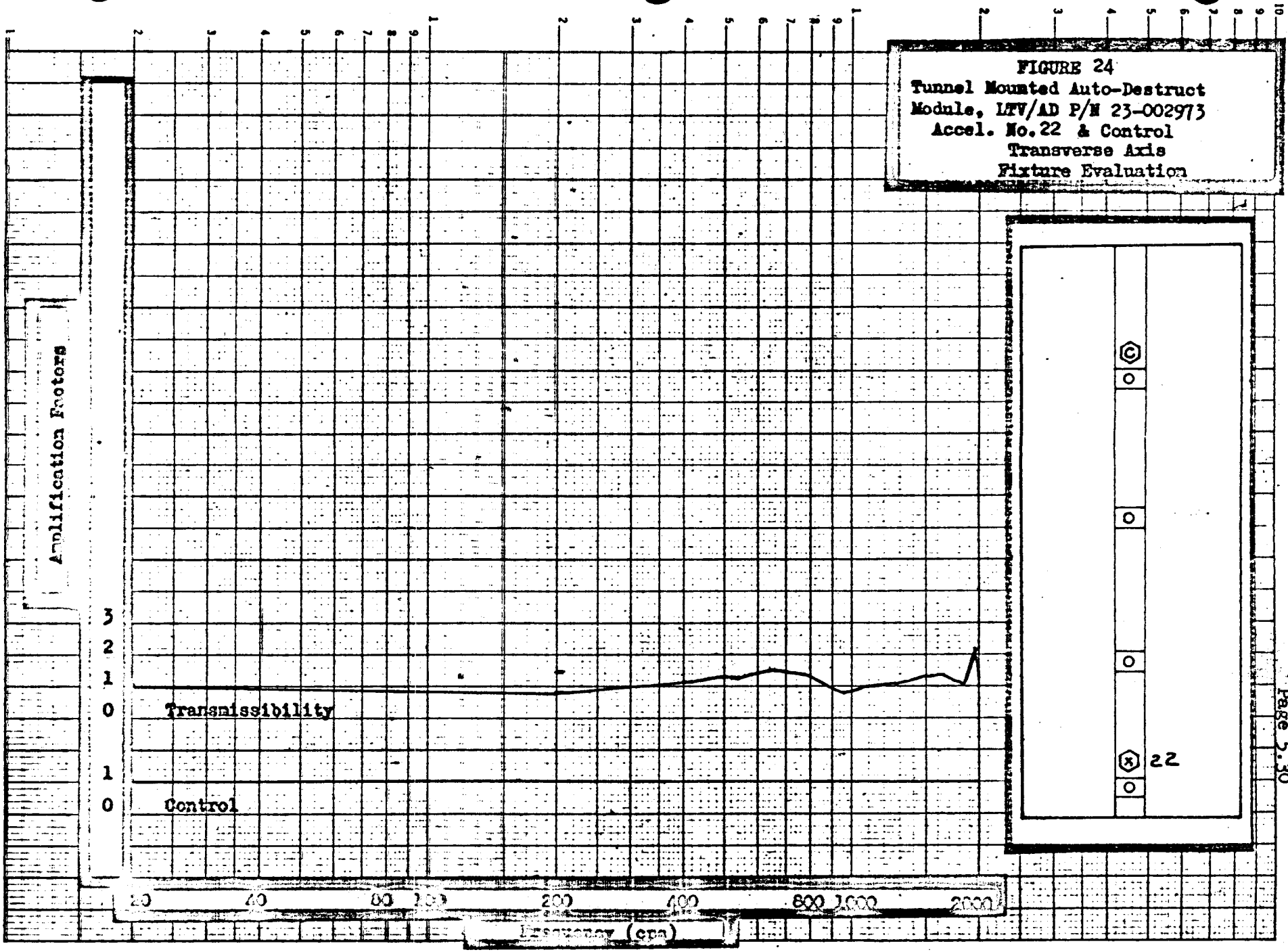

K·E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO.
3 CYCLES X 140 DIVISIONS
FIGURE 21
Tunnel Mounted Auto-Destruct
Module, LTV/AD P/N 23-002973
Accel. No.37 & Control
Transverse Axis
37
Amplification Factor
2
1
0
1
0
Crosstalk (Tangential)
Control
20
40
80
100
200
400
800
1000
2000
Frequency (cps)

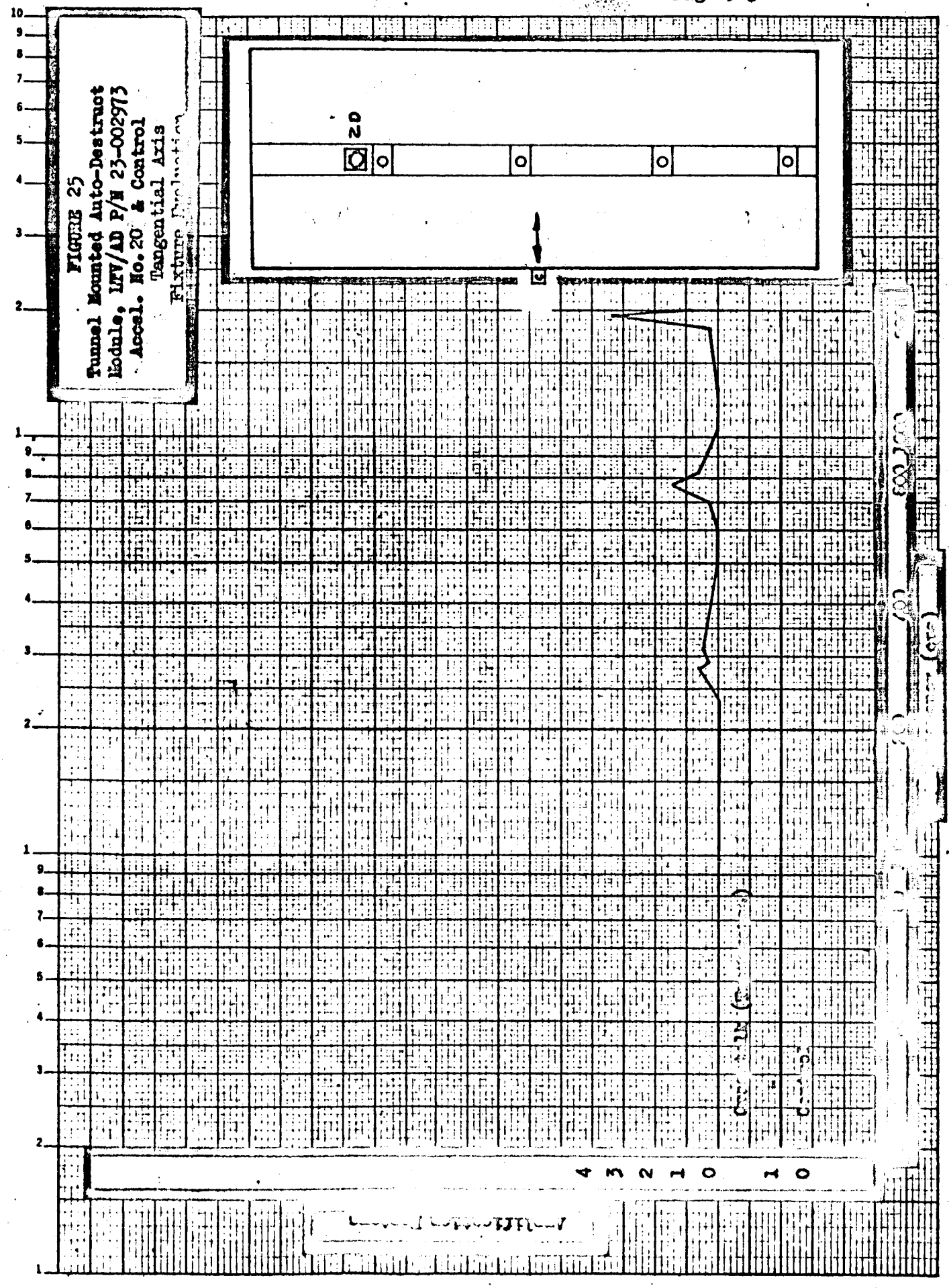

FIGURE 22
Tunnel Mounted Auto-Destruct Module, LRV/AD P/N 23-002973
Accel. No. 23 & Control
Transverse Axis
Picture Evaluation
23
Crosstalk (Thrust)
Control
Amplification Factors
Frequency (cps)
4 3 2 1 0 1 0
20 40 80 100 200 400 800 1000 2000
K-E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO
3 CYCLES X 140 DIVISIONS


FIGURE 23
Tunnel Mounted Auto-Destruct
Module, LTV/AD P/N 23-002973
Accel. No. 21 & Control
Transverse Axis
Fixture Evaluation
21
Transmissibility
Control
Frequency (cps)
Amplification Factors
SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO
3 CYCLES X 140 DIVISIONS

K•E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO.
3 CYCLES X 140 DIVISIONS

FIGURE 24
Tunnel Mounted Auto-Destruct Module, LTV/AD P/N 23-002973 Accel. No.22 & Control Transverse Axis Fixture Evaluation

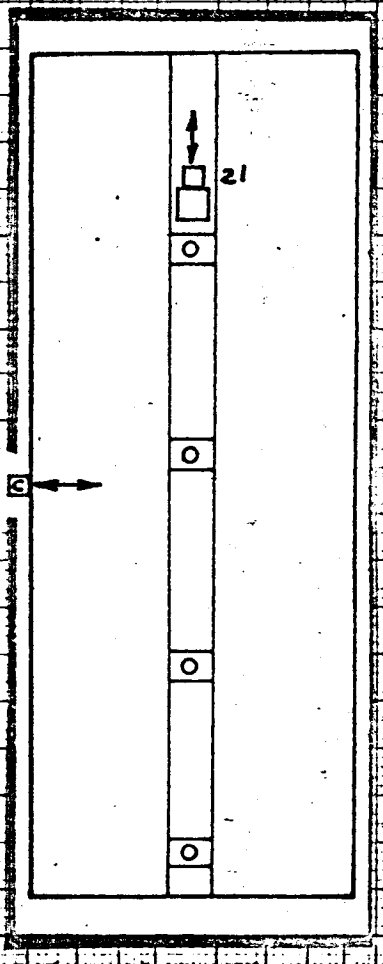




K+E 359-73 SEMI-LOGARITHMIC
KEUFFEL & ESSER CO.
3 CYCLES X 140 DIVISIONS

K-Σ SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO. MADE IN U.S.A.
3 CYCLES X 140 DIVISIONS

FIGURE 26
Tunnel Mounted Auto-Destruct Module, LTV/AD P/N 23-002973
Accel. No. 21 & Control
Tangential Axis
Fixture Evaluation



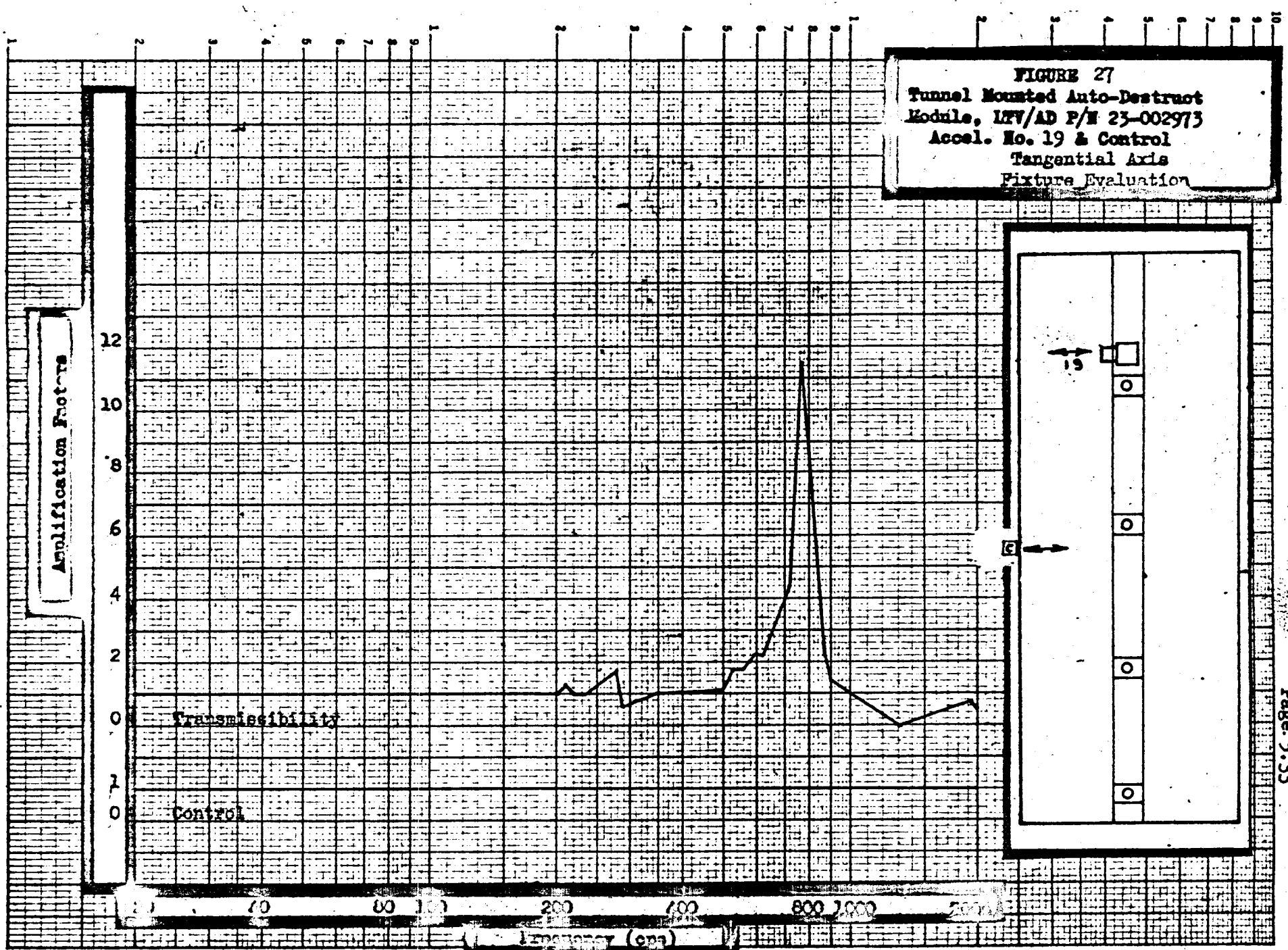
Amplification Factor

10
8
6
4
2
0
1
0

Control

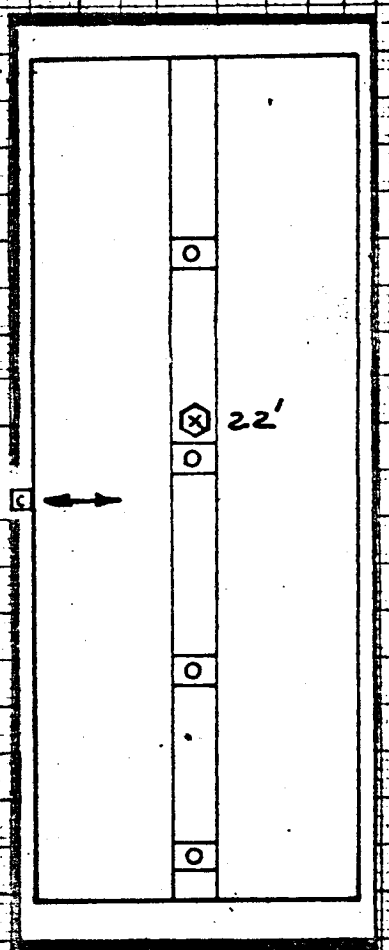
100 200 400 800 1000

(cps)


K•E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO. MADE IN U.S.A.
3 CYCLES X 140 DIVISIONS
FIGURE 27
Tunnel Mounted Auto-Destruct
Module, LTV/AD P/N 23-002973
Accel. No. 19 & Control
Tangential Axis
Fixture Evaluation
Amplification Factors
12
10
8
6
4
2
0
Transmissibility
Control
19
C
100
200
400
800
1000
Frequency (cps)

K&E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO. MADE IN U.S.A.
3 CYCLES X 140 DIVISIONS

FIGURE 28
Tunnel Mounted Auto-Destruct Module, LEV/AD P/N 23-002973 Accel. No. 22 & Control Tangential Axis
Fixture Evaluation



Amplification Factor

4
3
2
1
0

1
0

Crosstalk (Transverse)

Control

10 20 40 60 100 200 400 800 1000 2000

Frequency (cps)

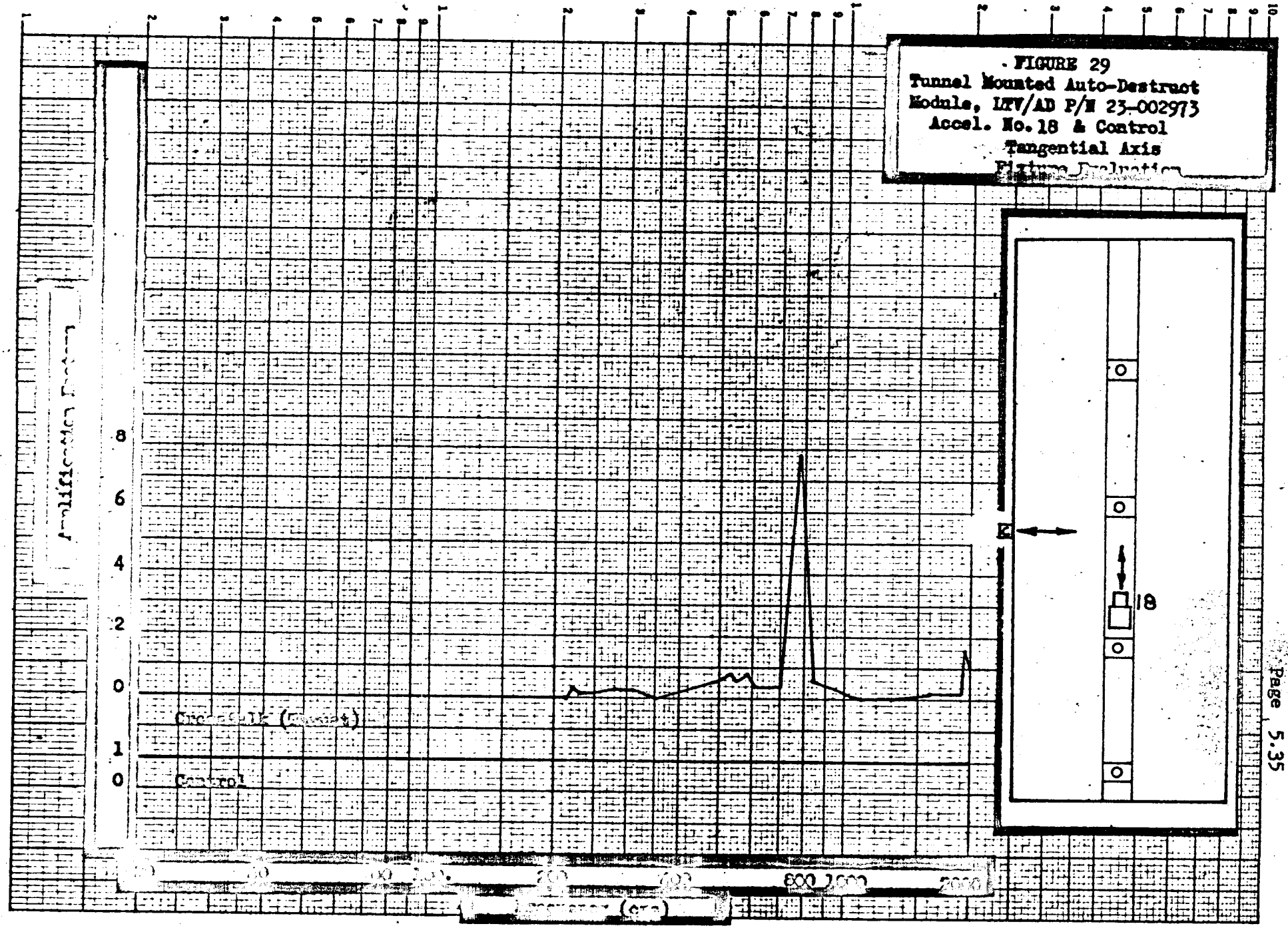
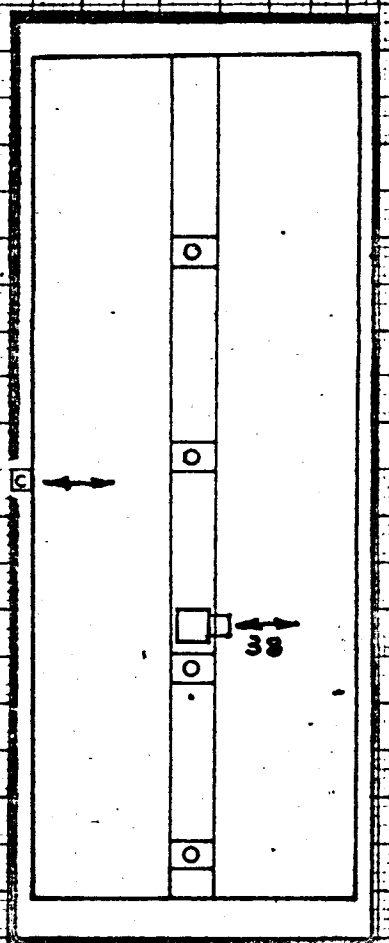
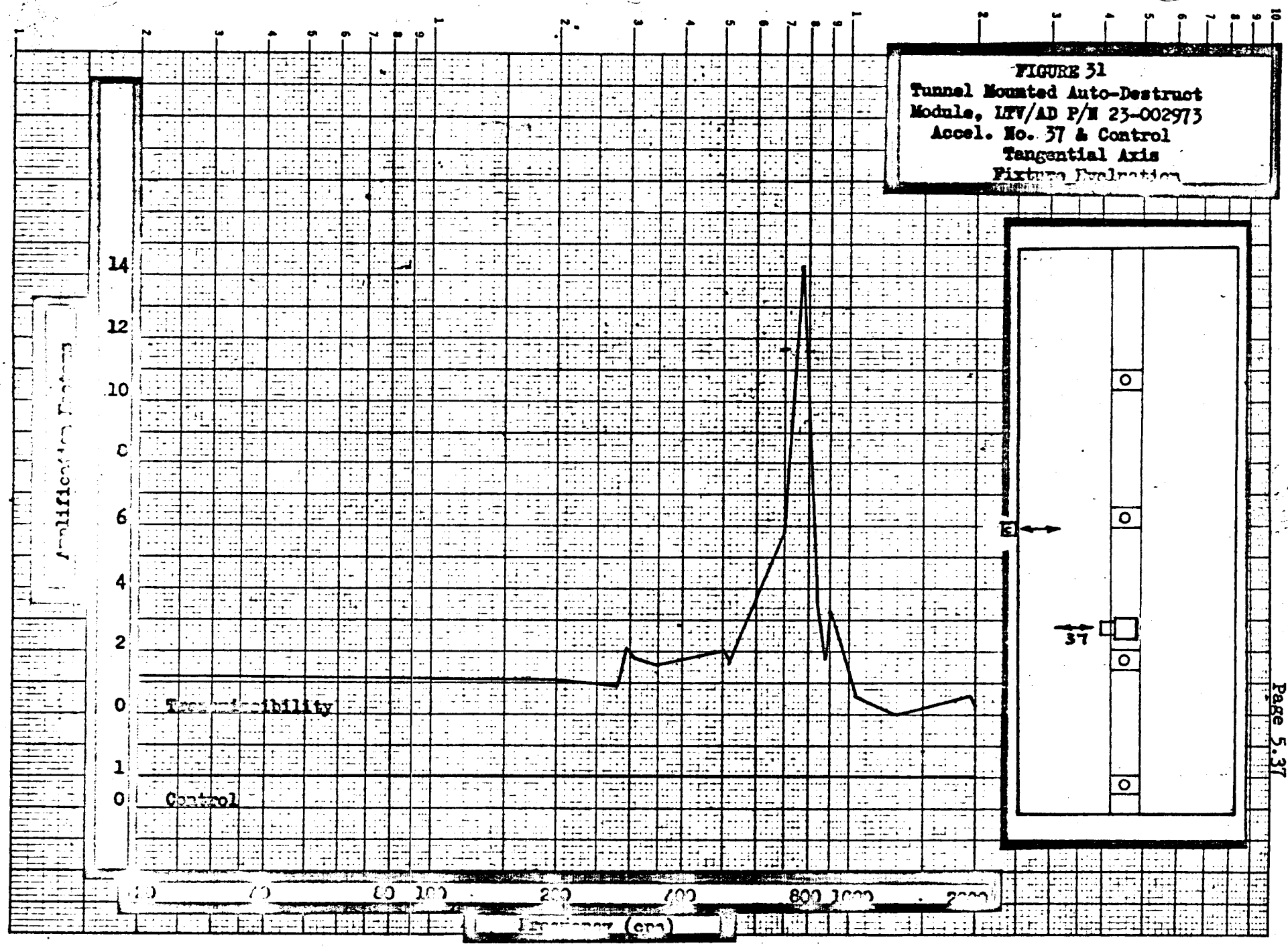


FIGURE 29
Tunnel Mounted Auto-Destruct Module, LTV/AD P/N 23-002973
Accel. No. 18 & Control
Tangential Axis
Fixture Evaluation

K•E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO.
3 CYCLES X 140 DIVISIONS

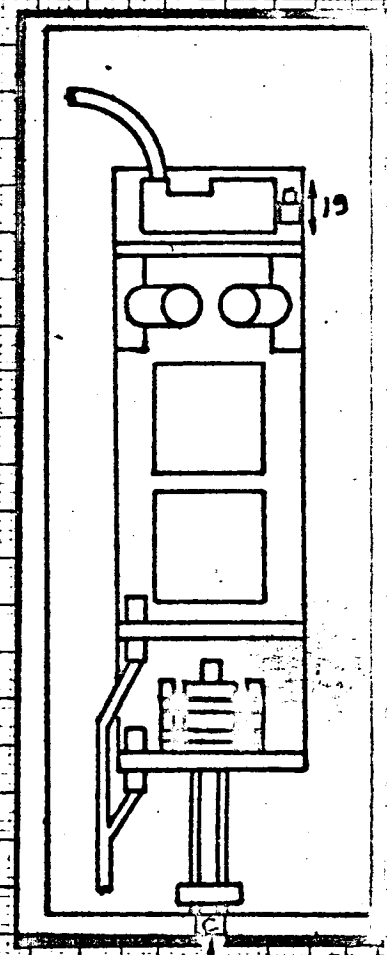
FIGURE 30
Tunnel Mounted Auto-Destruct Module, LTV/AD P/N 23-002973 Accel. No. 38 & Control Tangential Axis Fixture Evaluation




K•E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO. MADE IN U.S.A.
3 CYCLES X 140 DIVISIONS
FIGURE 31
Tunnel Mounted Auto-Destruct
Module, LFV/AD P/N 23-002973
Accel. No. 37 & Control
Tangential Axis
Fixture Evaluation
14
12
10
C
6
4
2
0
1
0
Control
37
80 100
800

K•E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO. MADE IN U.S.A.
3 CYCLES X 140 DIVISIONS

FIGURE 32
Tunnel Mounted Auto-Destruct Module, LTV/AD P/N 23-002973 Accel. No. 19 & Control Thrust Axis Vibration Monitoring



Traceability

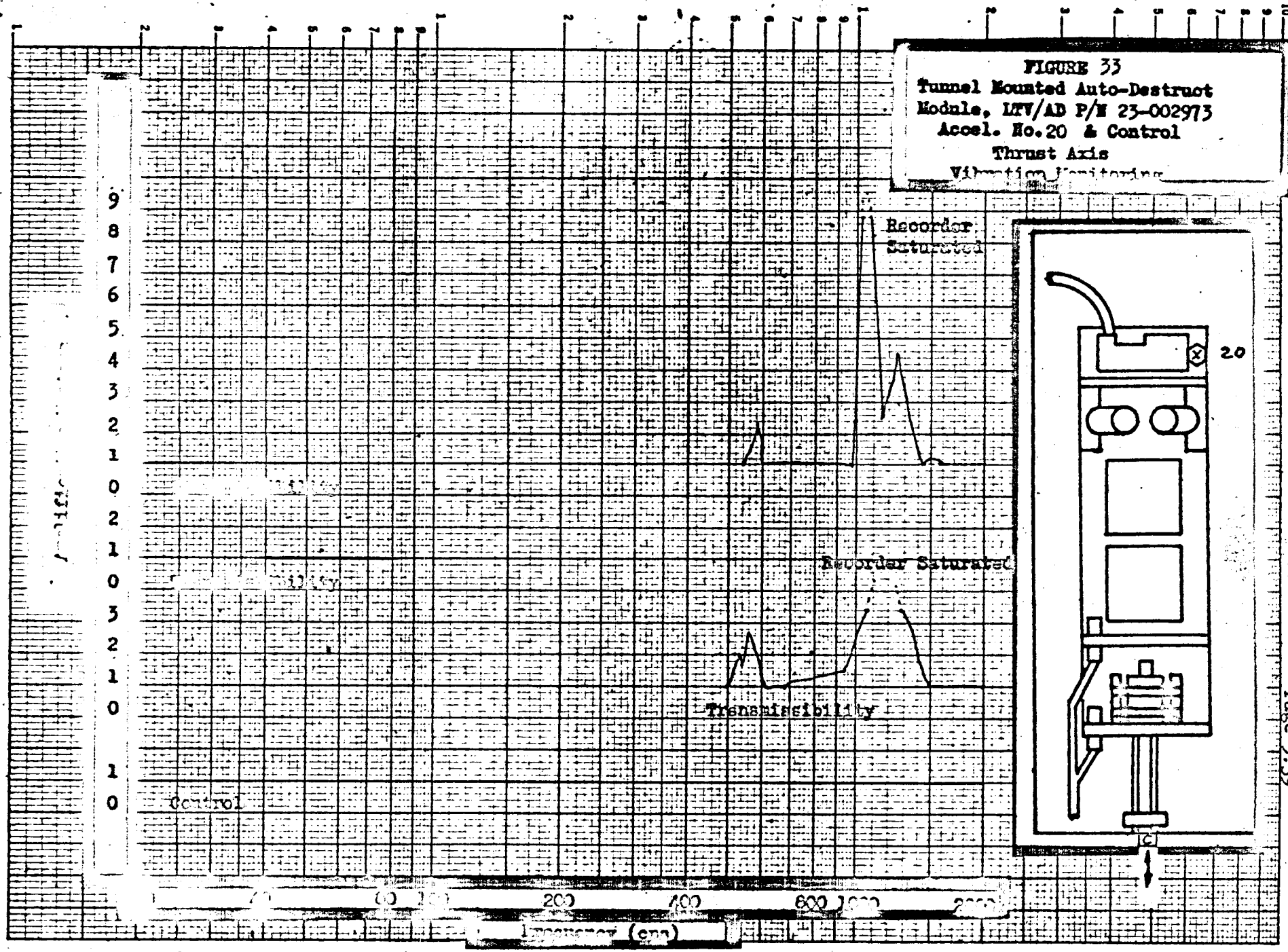
5 4 3 2 1 0 2 1 0 3 2 1 0 1 0

200 400 800 1000 2000

Frequency (cps)

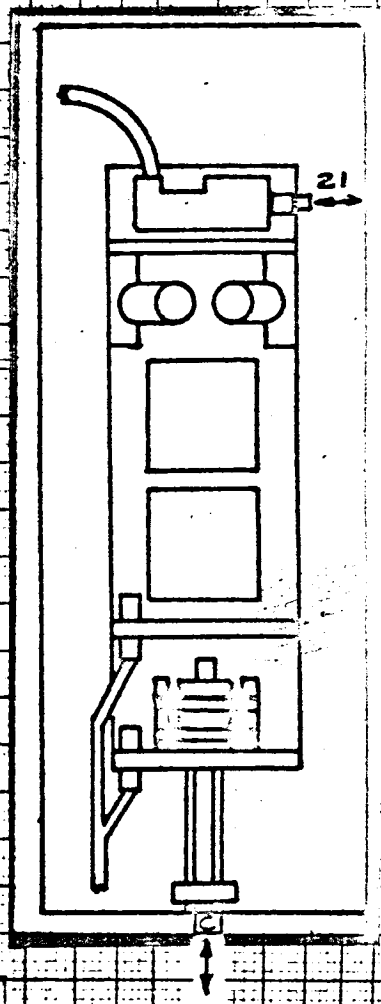
K·E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO. MADE IN U.S.A.
3 CYCLES X 140 DIVISIONS

FIGURE 33
Tunnel Mounted Auto-Destruct Module, LTV/AD P/N 23-002973 Accel. No. 20 & Control Thrust Axis Vibration Monitoring



K·E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO. MADE IN U.S.A.
3 CYCLES X 140 DIVISIONS

FIGURE 34
Tunnel Mounted Auto-Destruct Module, LTV/AD P/N 23-002973 Accel. No. 21 & Control
Thrust Axis
Vibration Monitoring



Crosstalk

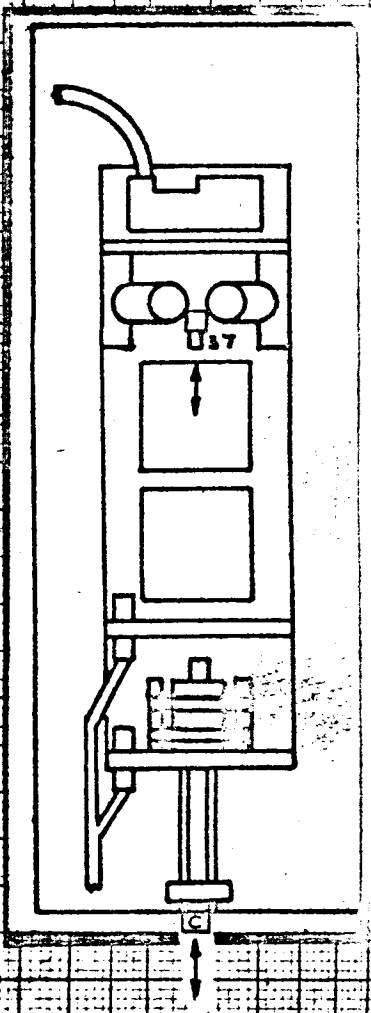
5 4 3 2 1 0 2 1 0 3 2 1 1 0

60 100 200 400 800

Frequency (cps)

K•E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO. MADE IN U.S.A.
3 CYCLES X 140 DIVISIONS

FIGURE 35
Tunnel Mounted Auto-Destruct Module, LTV/AD P/N 23-002973 Accel. No. 37 & Control Thrust Axis Vibration Monitoring

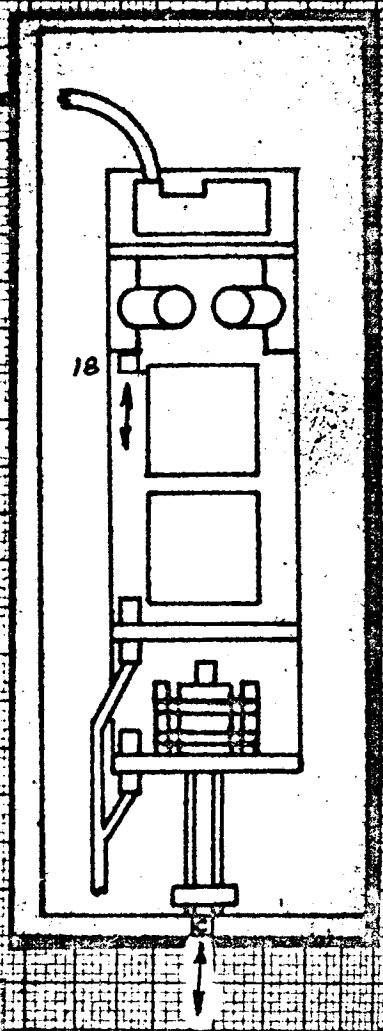


Recorder

Frequency (cps)

K&E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO. MADE IN U.S.A.
3 CYCLES X 140 DIVISIONS

FIGURE 36
Tunnel Mounted Auto-Destruct Module, LEV/AD P/N 23-002973 Accel. No. 18 & Control Thrust Axis Vibration Monitoring



Amplitude Factors

5 4 3 2 1 1 6 5 4 3 2 1 1 0

Transmissibility

Transmissibility

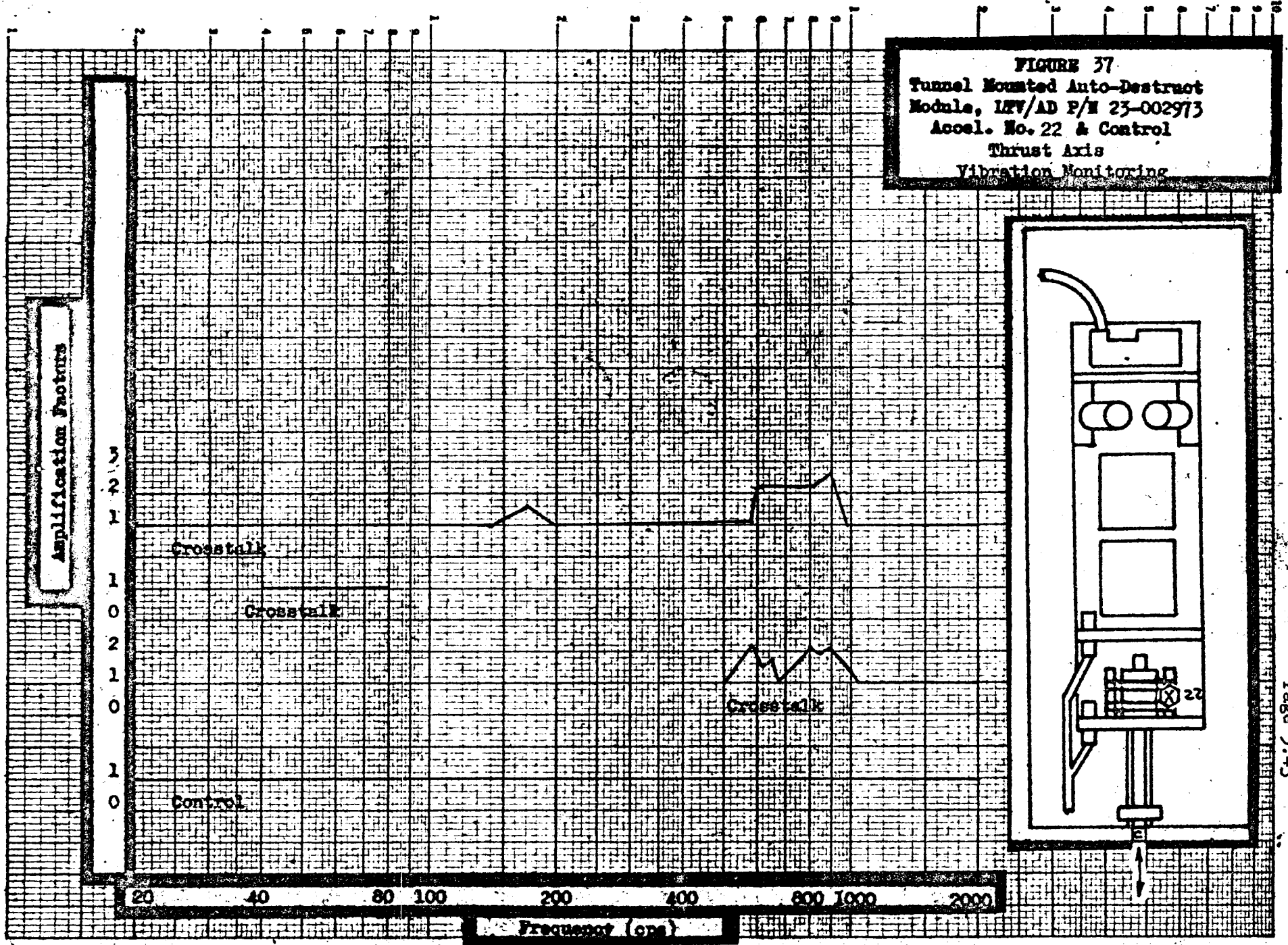
Control

20 40 80 100 200 400 800 1000 2000

Frequency (cps)

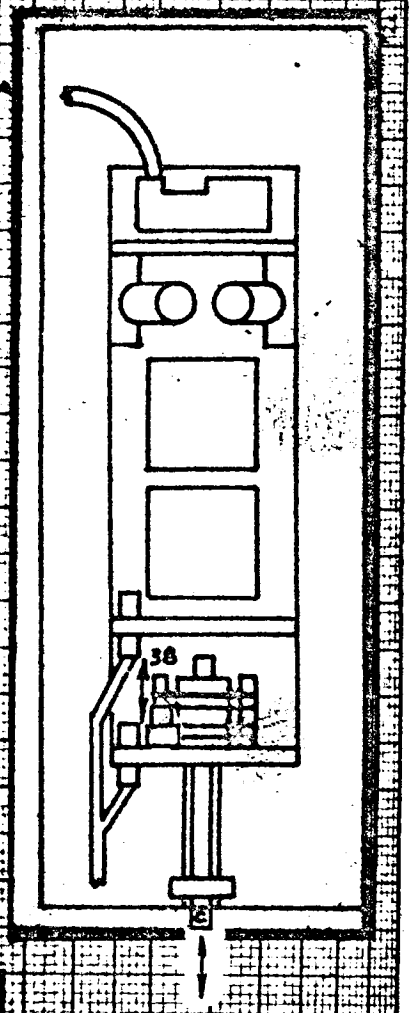
K•E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO. MADE IN U.S.A.
3 CYCLES X 140 DIVISIONS

FIGURE 37
Tunnel Mounted Auto-Destruct Module, LEV/AD P/N 23-002913 Accel. No. 22 & Control
Thrust Axis
Vibration Monitoring



K·E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO. MADE IN U.S.A.
3 CYCLES X 140 DIVISIONS

FIGURE 38
Tunnel Mounted Auto-Destruct Module, LEV/AD P/N 23-002973 Accel. No. 38 & Control Thrust Axis Vibration Monitoring



Amplification Factors

4 3 2 1 0 1

Transmissibility

Transmissibility

Transmissibility

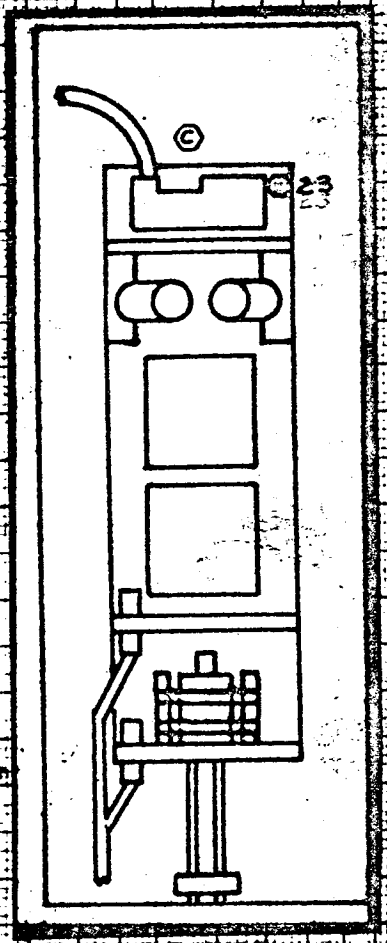
Control

20 40 80 100 200 400 800 1000 2000

Frequency (cps)

K&E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO. MADE IN U.S.A.
3 CYCLES X 140 DIVISIONS

FIGURE 39.
Tunnel Mounted Auto-Destruct Module, LTV/AD P/N 23-002973 Accel. No. 23 & Control Transverse Axis Vibration Monitoring



Amplification Factors

6 5 4 3 2 1 0 2 1 0 4 3 2 1 0 1 0

Transmissibility

Transmissibility

Transmissibility

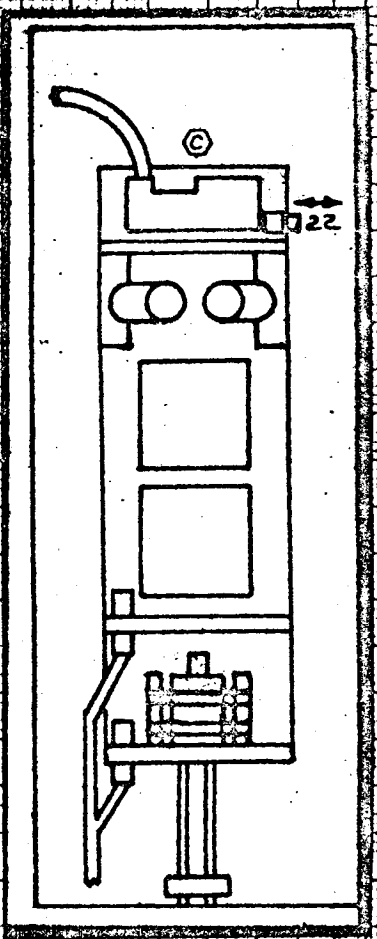
Control

20 40 80 100 200 400 800 1000 2000

Frequency (cps)

K&E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO. MADE IN U.S.A.
3 CYCLES X 140 DIVISIONS

FIGURE 40
Tunnel Mounted Auto-Destruct Module, LTV/AD P/N 23-002973 Accel. No. 22 & Control Transverse Axis Vibration Monitoring



Application Factors

4
3
2
1
2
1
0
2
1
0
1
0

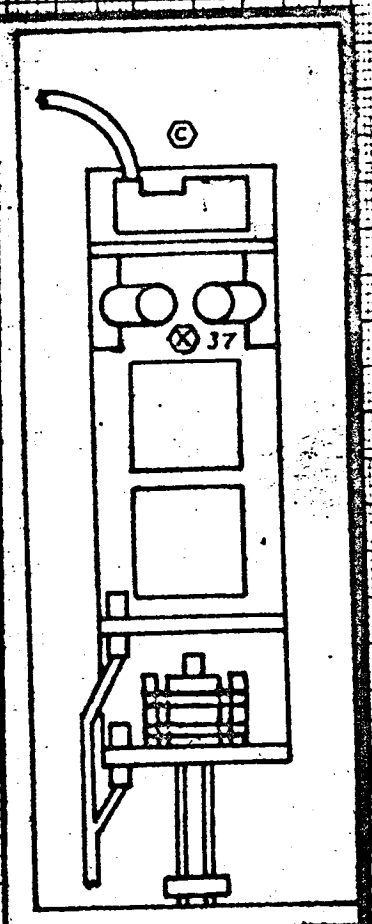
Crosstalk
Crosstalk
Crosstalk
Control

20 40 80 100 200 400 800 1000 2000

Frequency (cps)

K&E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO. MADE IN U.S.A.
3 CYCLES X 140 DIVISIONS

FIGURE 41
Tunnel Mounted Auto-Destruct Module, LTV/AD P/N 23-002973
Accel. No. 37 & Control
Transverse Axis
Vibration Monitoring



Amplification Factors

6 5 4 3 2 1 0 2 1 0 3 2 1 0 1 0

Transmissibility

Transmissibility

Transmissibility

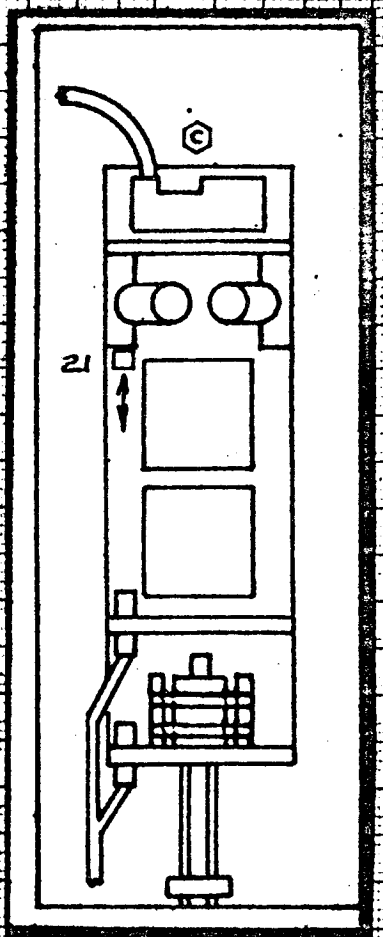
Control

20 40 80 100 200 400 800 1000 2000

Frequency (cps)

K&E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO. MADE IN U.S.A.
3 CYCLES X 140 DIVISIONS

FIGURE 42
Tunnel Mounted Auto-Destruct Module, LTV/AD P/N 23-002973 Accel. No. 21 & Control Transverse Axis Vibration Monitoring



Amplification Factors

4
3
2
1

Crosstalk

2
1

Crosstalk

3
2
1

Crosstalk

1

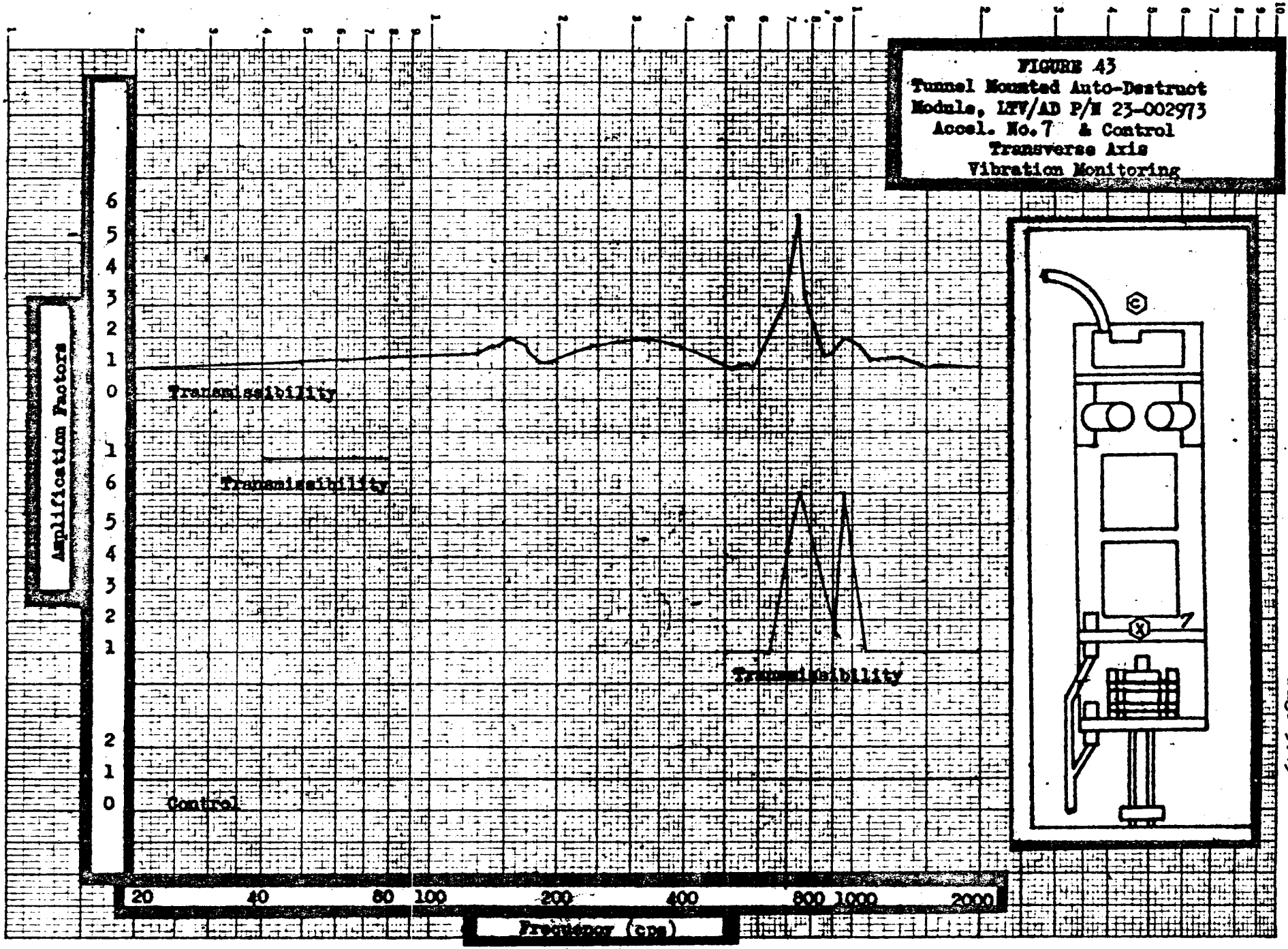
Control

20 40 80 100 200 400 800 1000 2000

Frequency (cps)

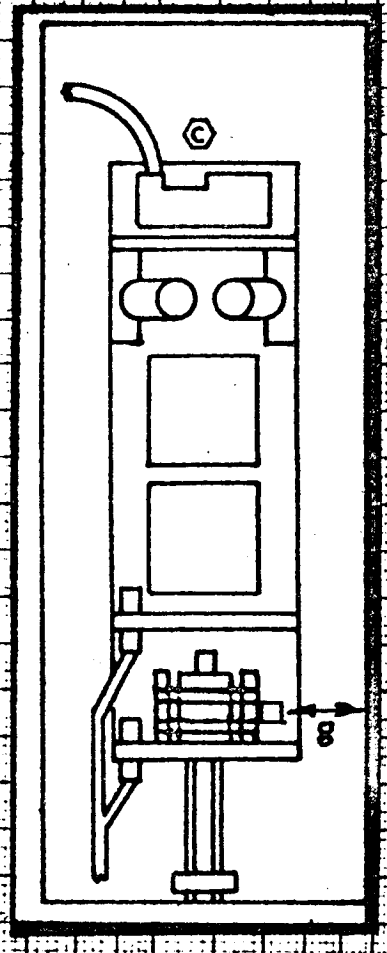
K•E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO. MADE IN U.S.A.
3 CYCLES X 140 DIVISIONS

FIGURE 43
Tunnel Mounted Auto-Destruct Module, LTV/AD P/N 23-002973 Accel. No. 7 & Control Transverse Axis Vibration Monitoring



K&E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO. MADE IN U.S.A.
3 CYCLES X 140 DIVISIONS

FIGURE 44
Tunnel Mounted Auto-Destruct Module, LTV/AD P/N 23-002973 Accel. No. 8 & Control Transverse Axis Vibration Monitoring



Amplification Factors

6 5 4 3 2 1 0 2 1 0 3 2 1 0 2 1 0

Crosstalk

Crosstalk

Crosstalk

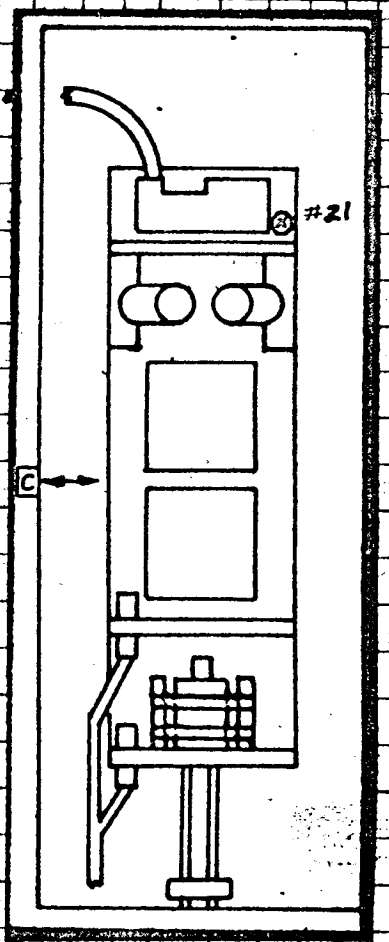
Control

20 40 80 100 200 400 800 1000 2000

Frequency (cps)

K&E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO. MADE IN U.S.A.
3 CYCLES X 140 DIVISIONS

FIGURE 45
Tunnel Mounted Auto-Destruct Module, LTV/AD P/N 23-002973
Accel. No. 21 & Control
Tangential Axis
Vibration Monitoring



Amplification Factors

5 4 3 2 1 0 2 1 0 6 5 4 3 2 1 0 1 0

Crosstalk

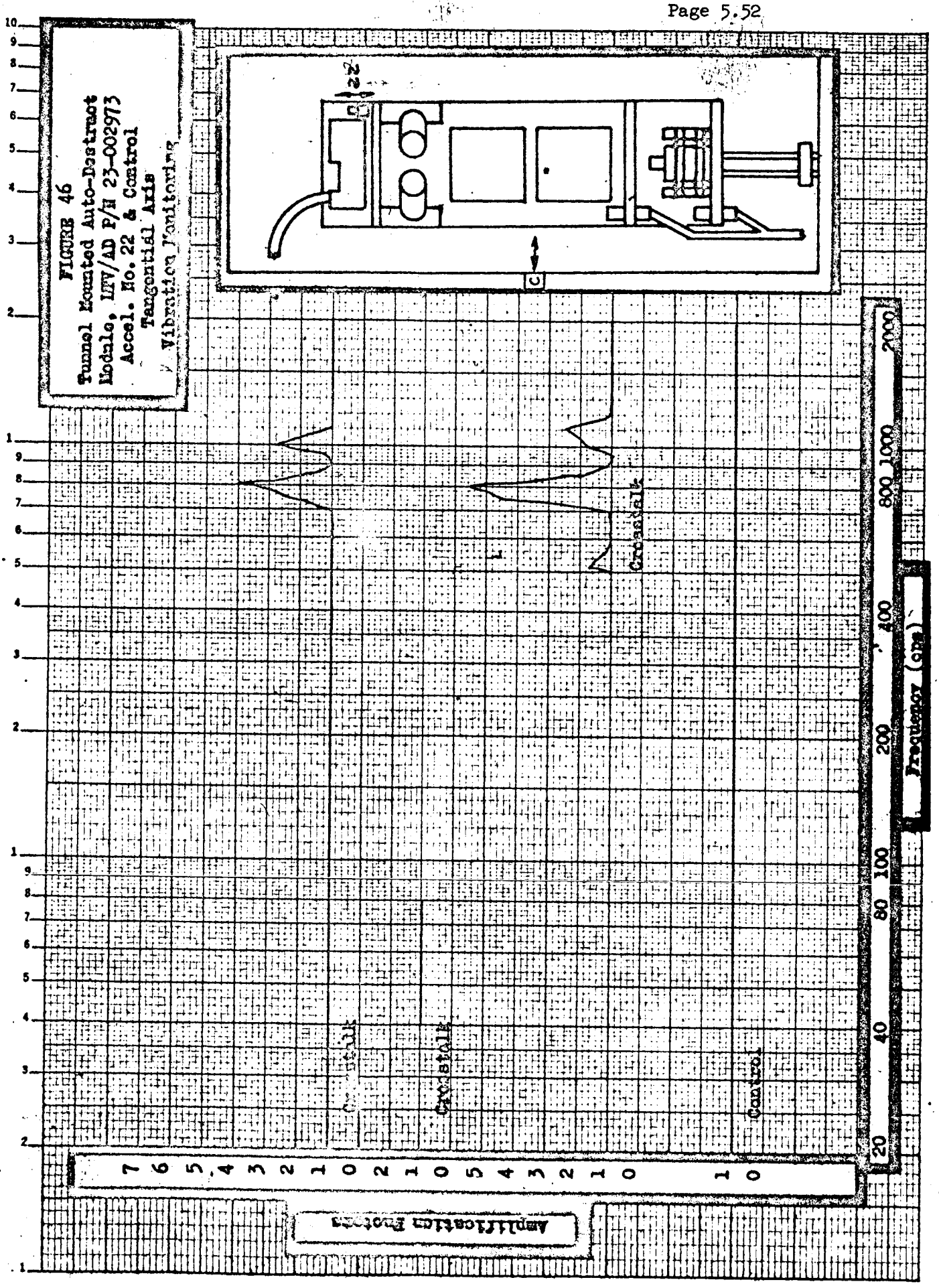
Crosstalk

Crosstalk

Control

20 40 80 100 200 400 800 1000 2000

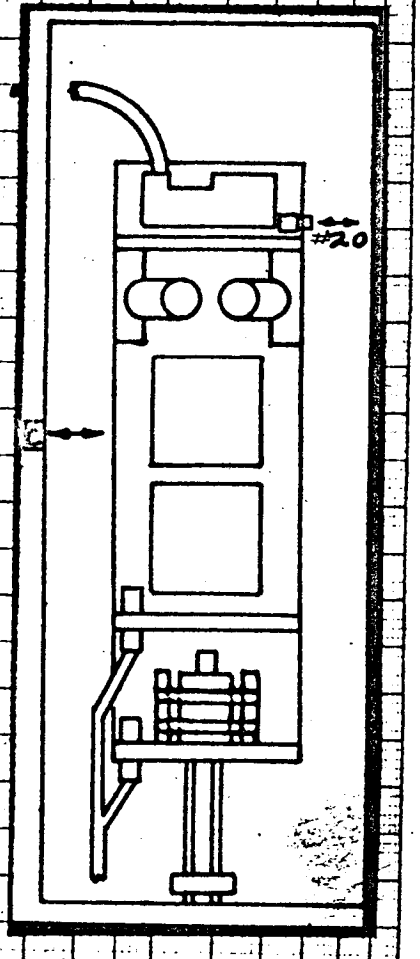
Frequency (cps)



K+E 359-73 SEMI-LOGARITHMIC KEUFFEL & ESSER CO. MADE IN U.S.A. 3 CYCLES X 140 DIVISIONS

K&E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO MADE IN U.S.A.
3 CYCLES X 140 DIVISIONS

FIGURE 47
Tunnel Mounted Auto-Destruct Module, LTV/AD P/N 23-002973
Accel. No. 20 & Control
Tangential Axis
Vibration Monitoring



Amplification Factors

8 6 4 2 0 2 1 0 10 8 6 4 2 0 1 0

Transmissibility

Transmissibility

Transmissibility

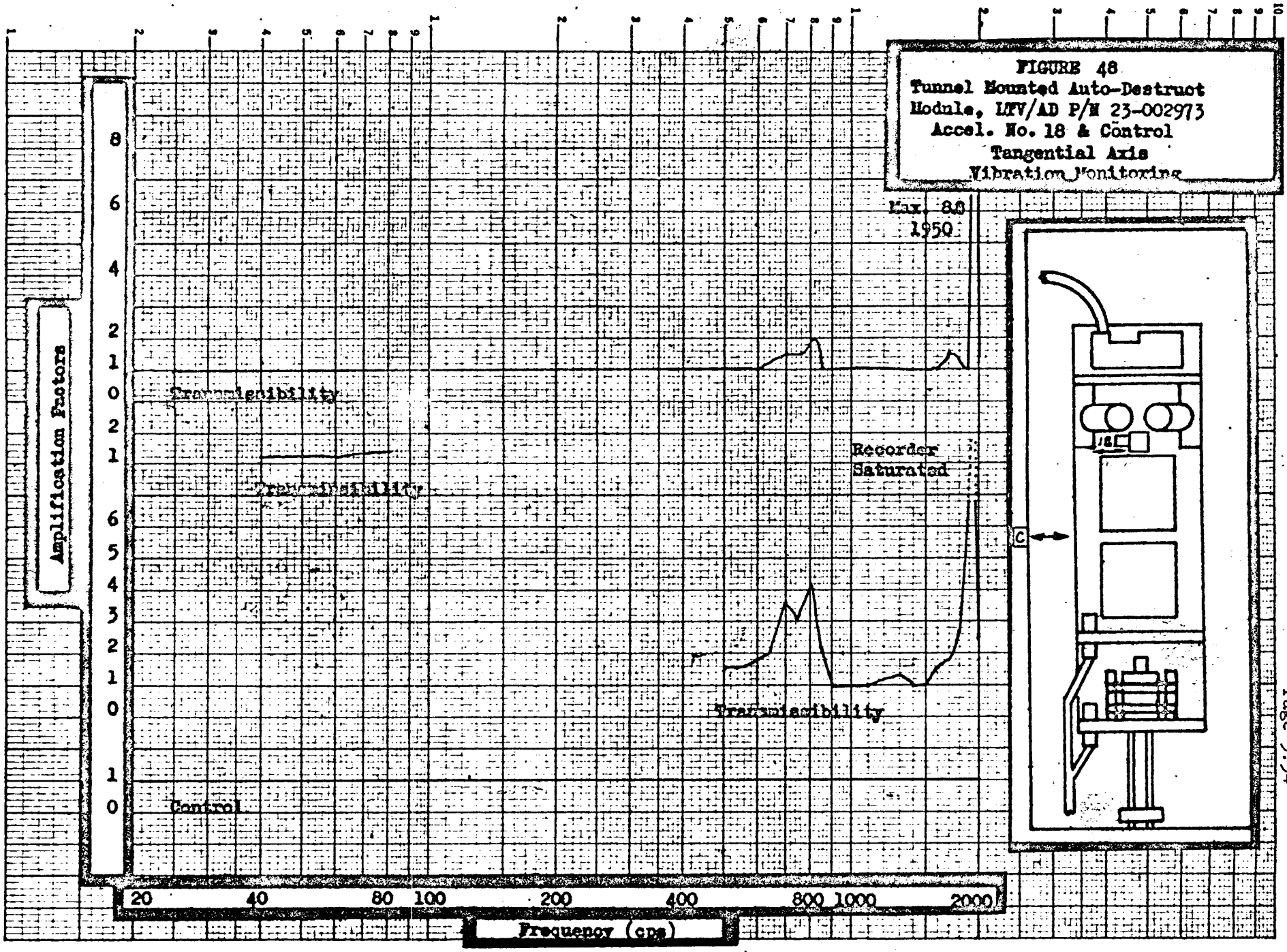
Control

20 40 80 100 200 400 800 1000 2000

Frequency (cps)

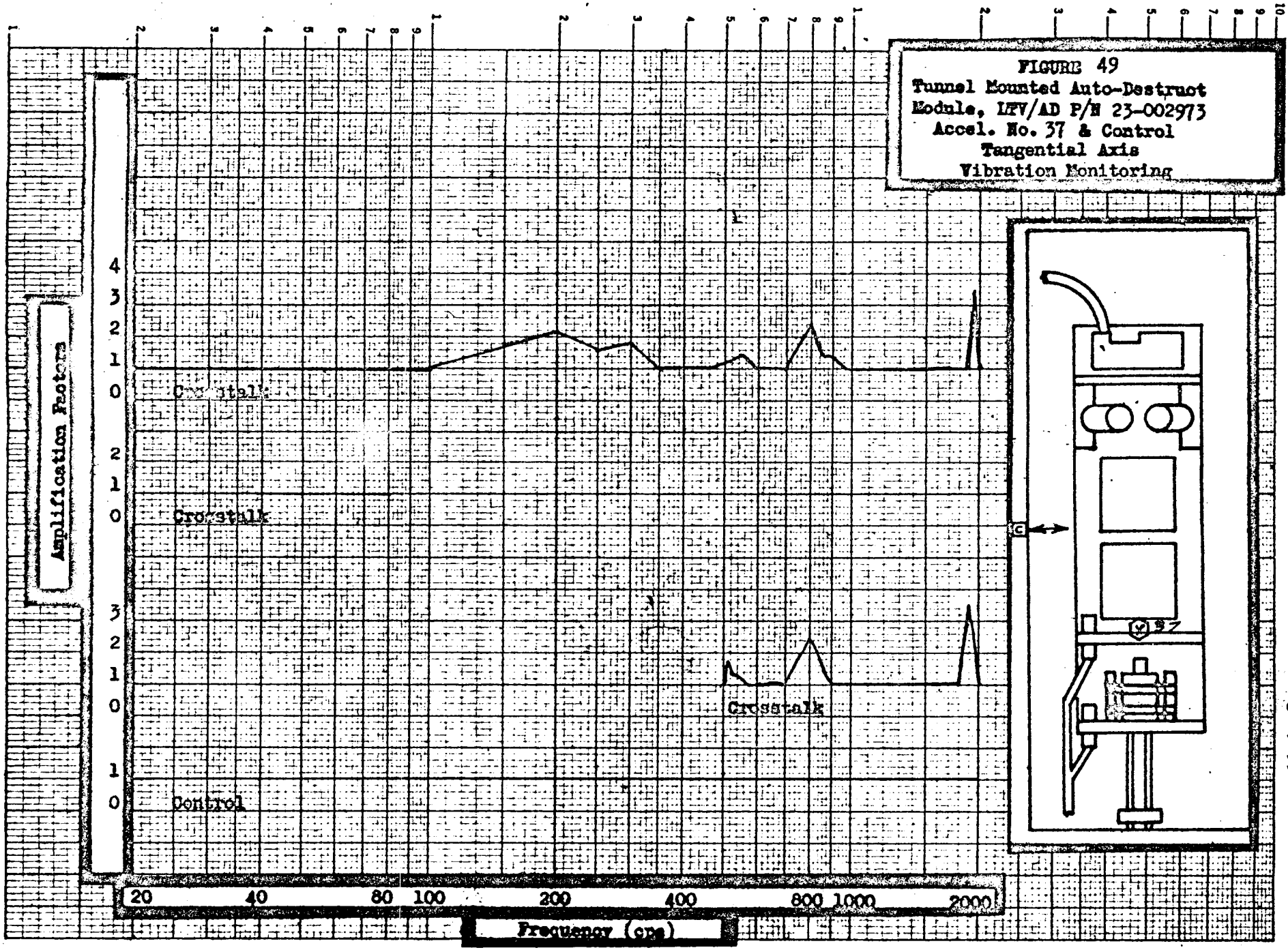
K+E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO. HOBOKEN, N.J., U.S.A.
3 CYCLES X 140 DIVISIONS

FIGURE 48
Tunnel Mounted Auto-Destruct Module, LTV/AD P/N 23-002973
Accel. No. 18 & Control
Tangential Axis
Vibration Monitoring



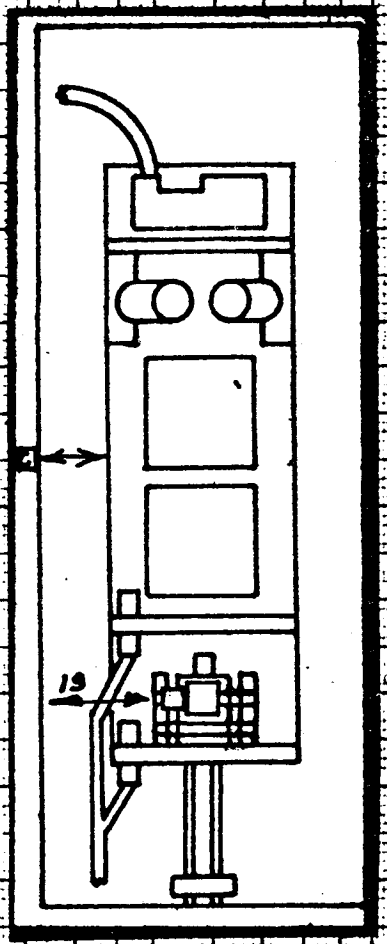
K&E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO. MADE IN U.S.A.
3 CYCLES X 140 DIVISIONS

FIGURE 49
Tunnel Mounted Auto-Destruct Module, LTV/AD P/N 23-002973
Accel. No. 37 & Control
Tangential Axis
Vibration Monitoring



K•E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO. MADE IN U.S.A.
3 CYCLES X 140 DIVISIONS

FIGURE 50
Tunnel Mounted Auto-Destruct Module, LTV/AD P/N 23-002973 Accel. No.19 & Control Tangential Axis Vibration Monitoring



Amplification Factors

9 8 7 6 5 4 3 2 1 0

Transmissibility

Transmissibility

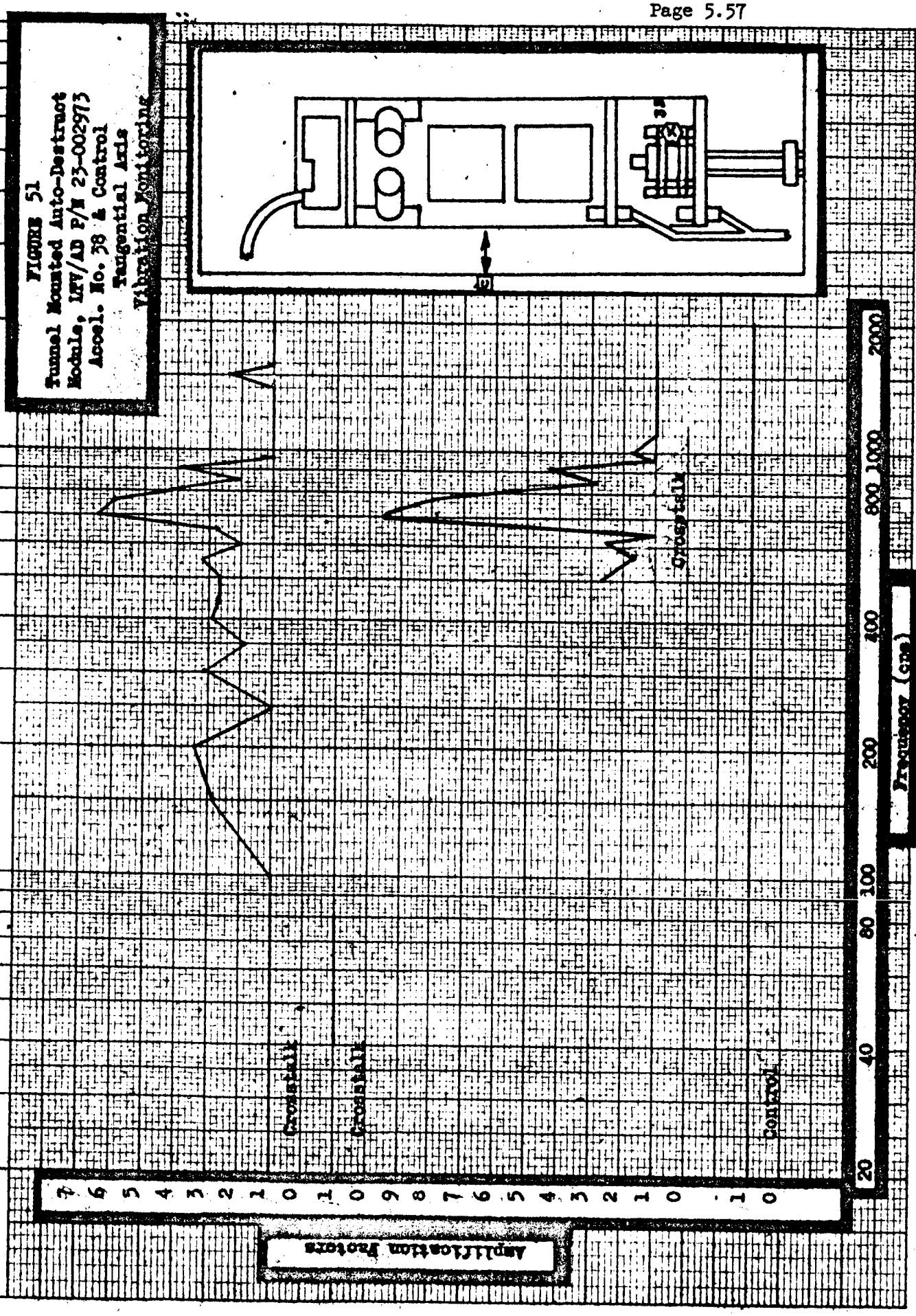
4 3 2 1 0 2 1 0

Transmissibility

Control

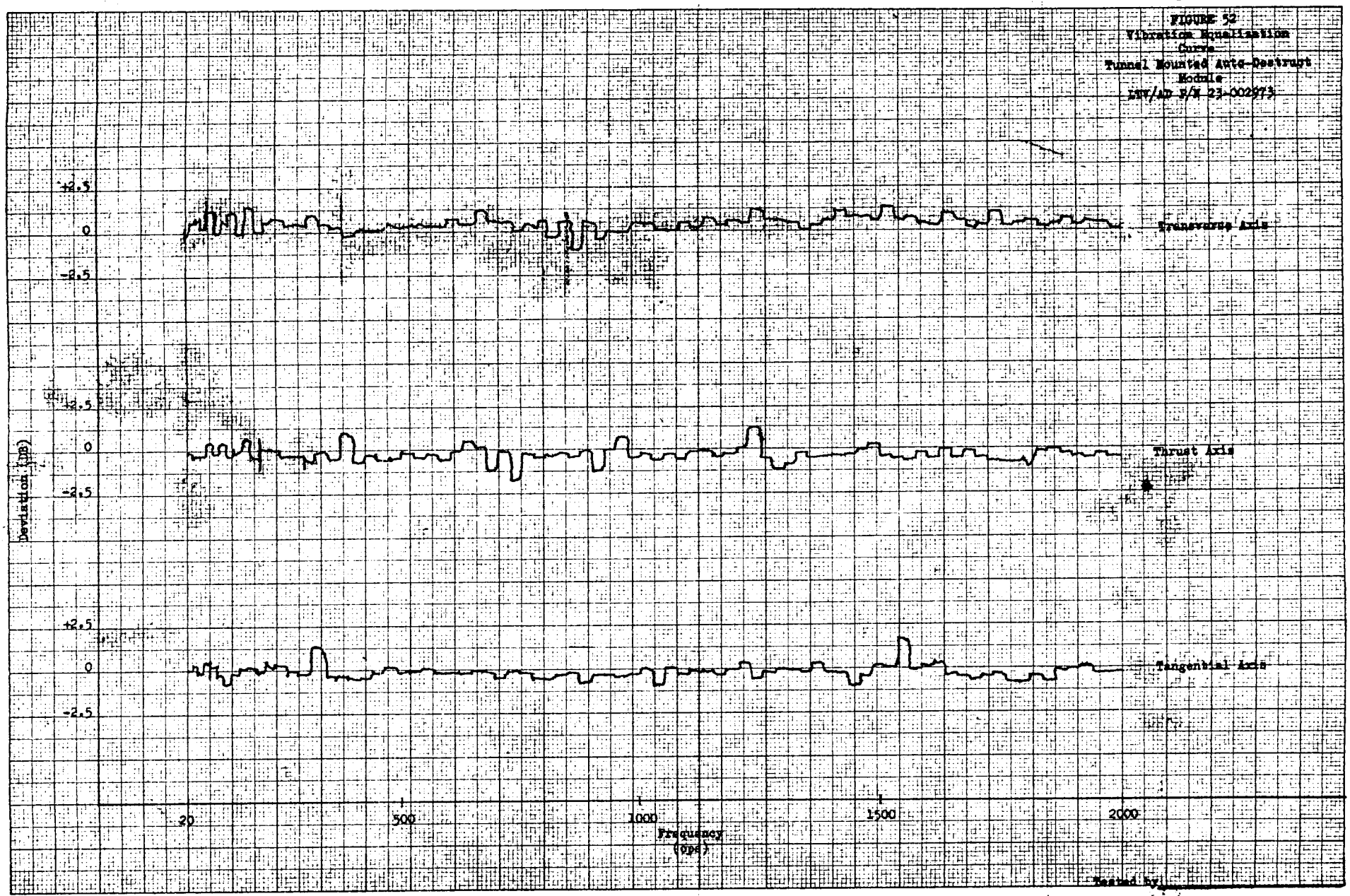
20 40 80 100 200 400 800 1000 2000

Frequency (cps)



K+E 359-73 SEMI-LOGARITHMIC KEUFFEL & ESSER CO. 3 CYCLES X 140 DIVISIONS

FIGURE 52
Vibration Equalization Curve
Tunnel Mounted Auto-Destruct Module
LMV/AD P/N 23-002973



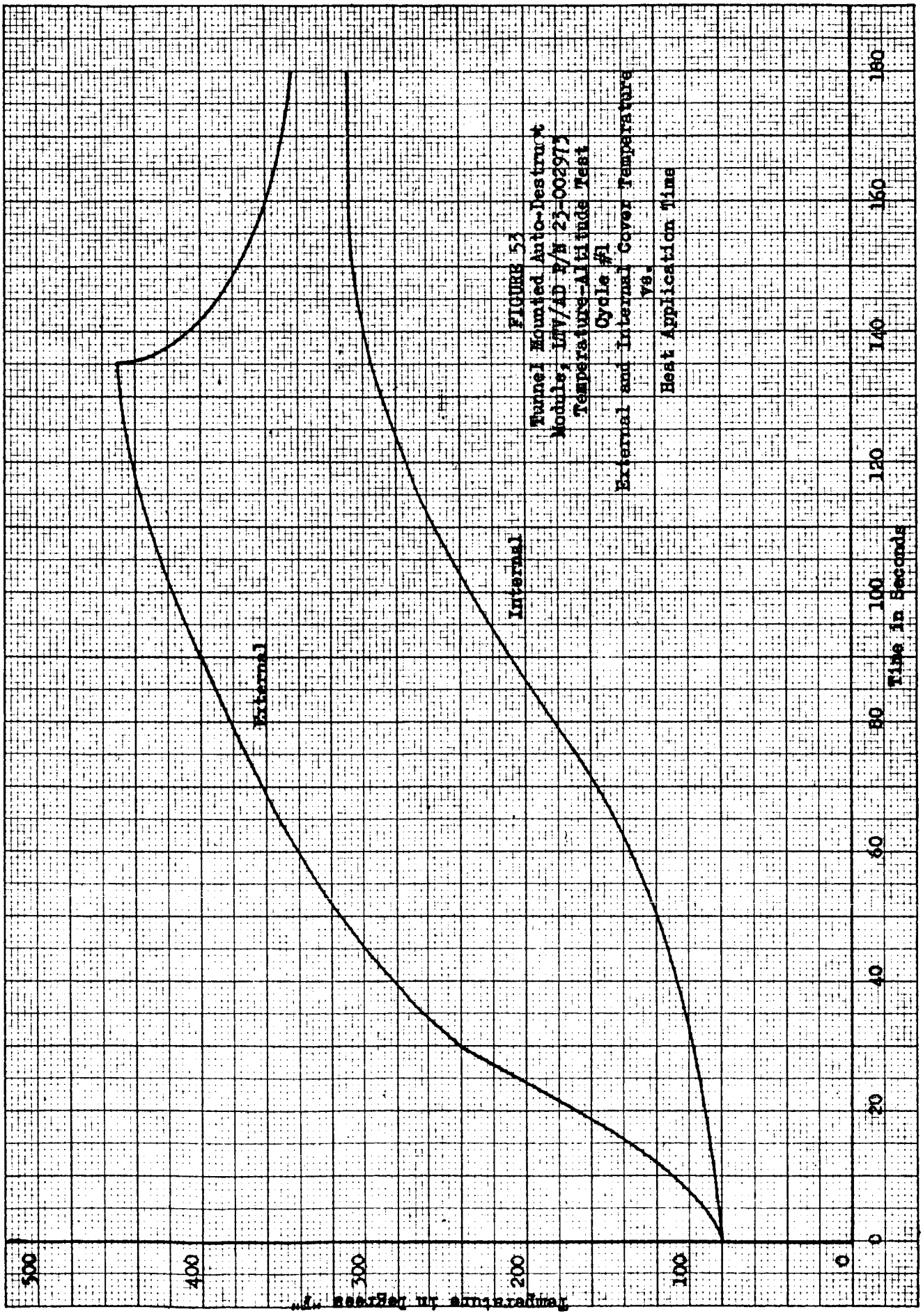


FIGURE 53
Tunnel Mounted Auto-Destruct
Modules LRV/AD P/N 23-002975
Temperature-Altitude Test
Cycle #1
External and Internal Cover Temperature
Vs.
Heat Application Time

K+E 10 X 10 TO THE ½ INCH 359-11
KEUFFEL & ESSER CO. MADE IN U.S.A.

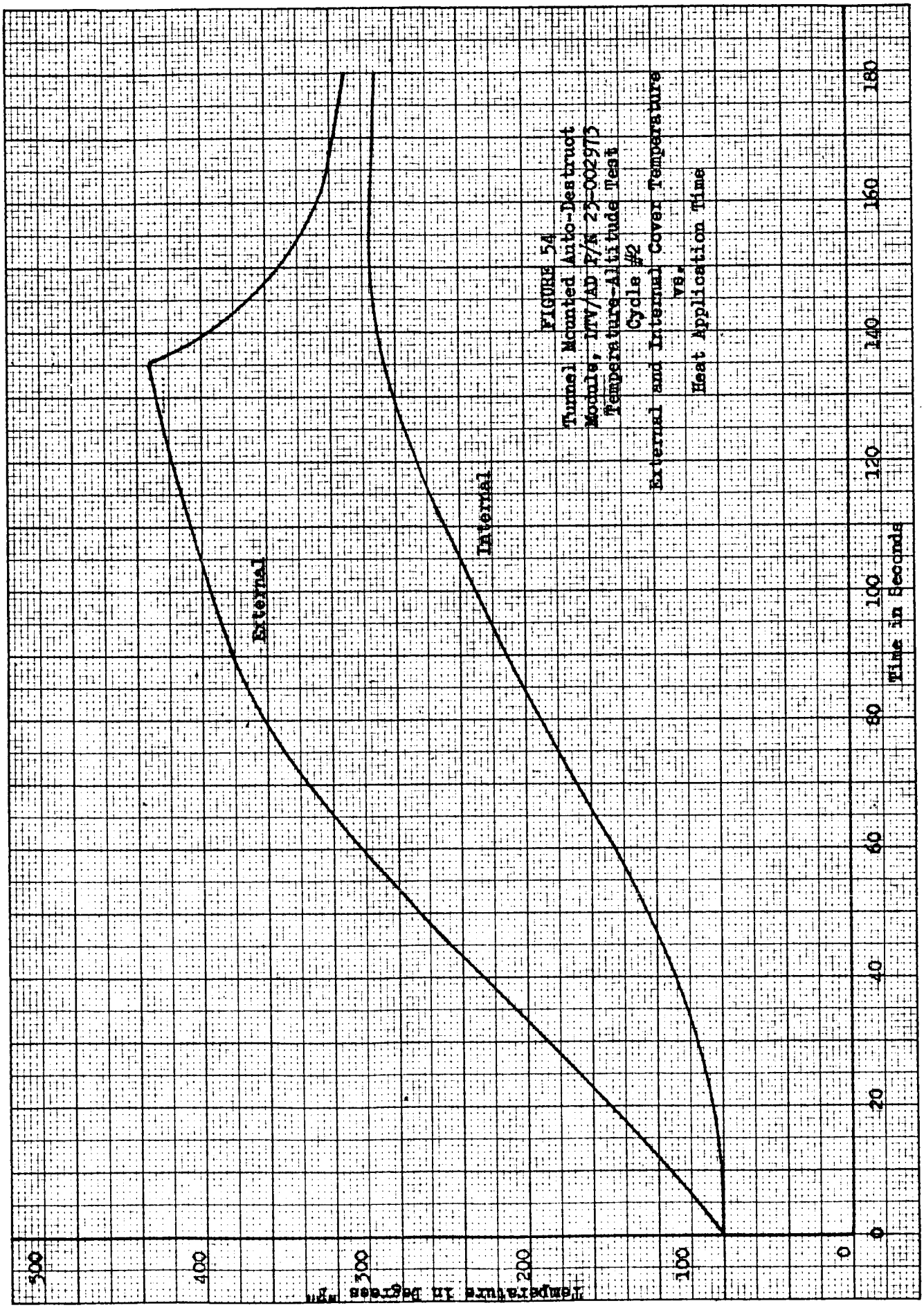


FIGURE 54
Tunnel Mounted Auto-Destruct
Module, ITV/AD F/A 23-002973
Temperature-Altitude Test
Cycle #2
External and Internal Cover Temperature
vs.
Heat Application Time

K+E 10 X 10 TO THE ½ INCH 359-11
KEUFFEL & ESSER CO. MADE IN U.S.A.

K-E 10 X 10 TO THE ½ INCH 359-11
KEUFFEL & ESSER CO. MADE IN U. S. A.

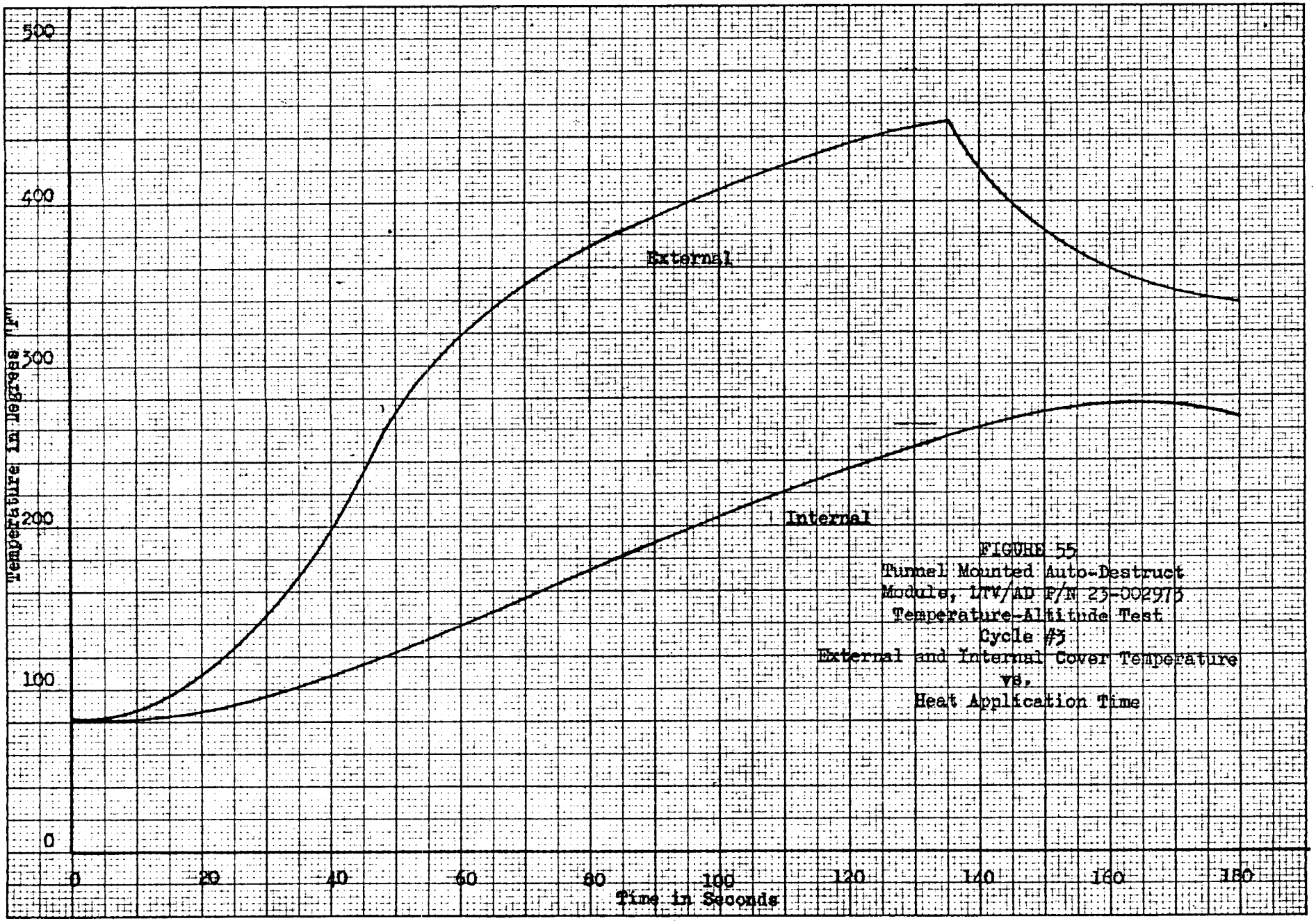


FIGURE 55
Tunnel Mounted Auto-Destruct
Module, LTV/AD F/N 23-002975
Temperature-Altitude Test
Cycle #3
External and Internal Cover Temperature
vs.
Heat Application Time

K+E 10 X 10 TO THE ⅛ INCH 359-11
KEUFFEL & ESSER CO. MADE IN U.S.A.

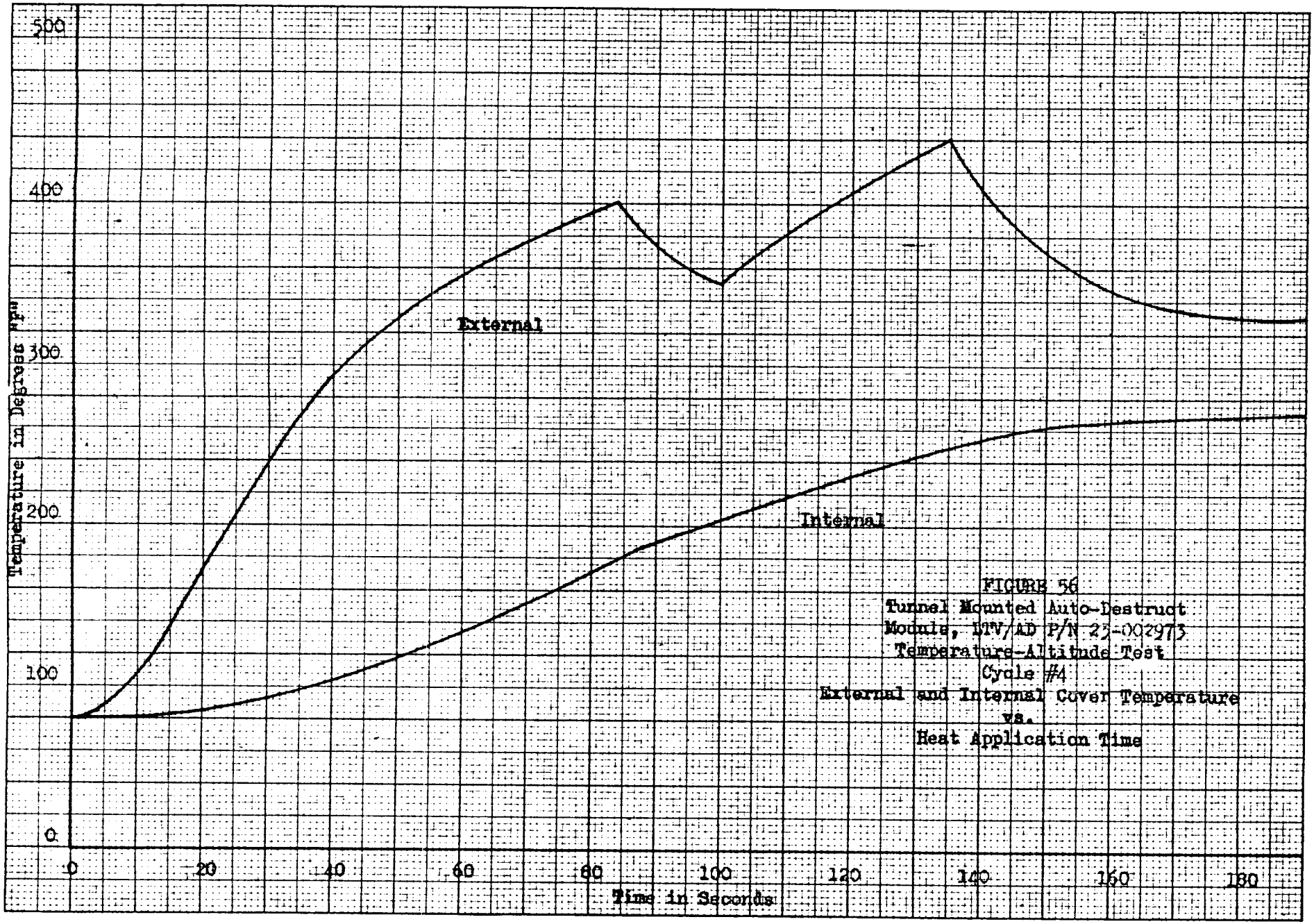


FIGURE 56
Tunnel Mounted Auto-Destruct Module, LTV/AD P/N 23-002973
Temperature-Altitude Test
Cycle #4
External and Internal Cover Temperature vs.
Heat Application Time

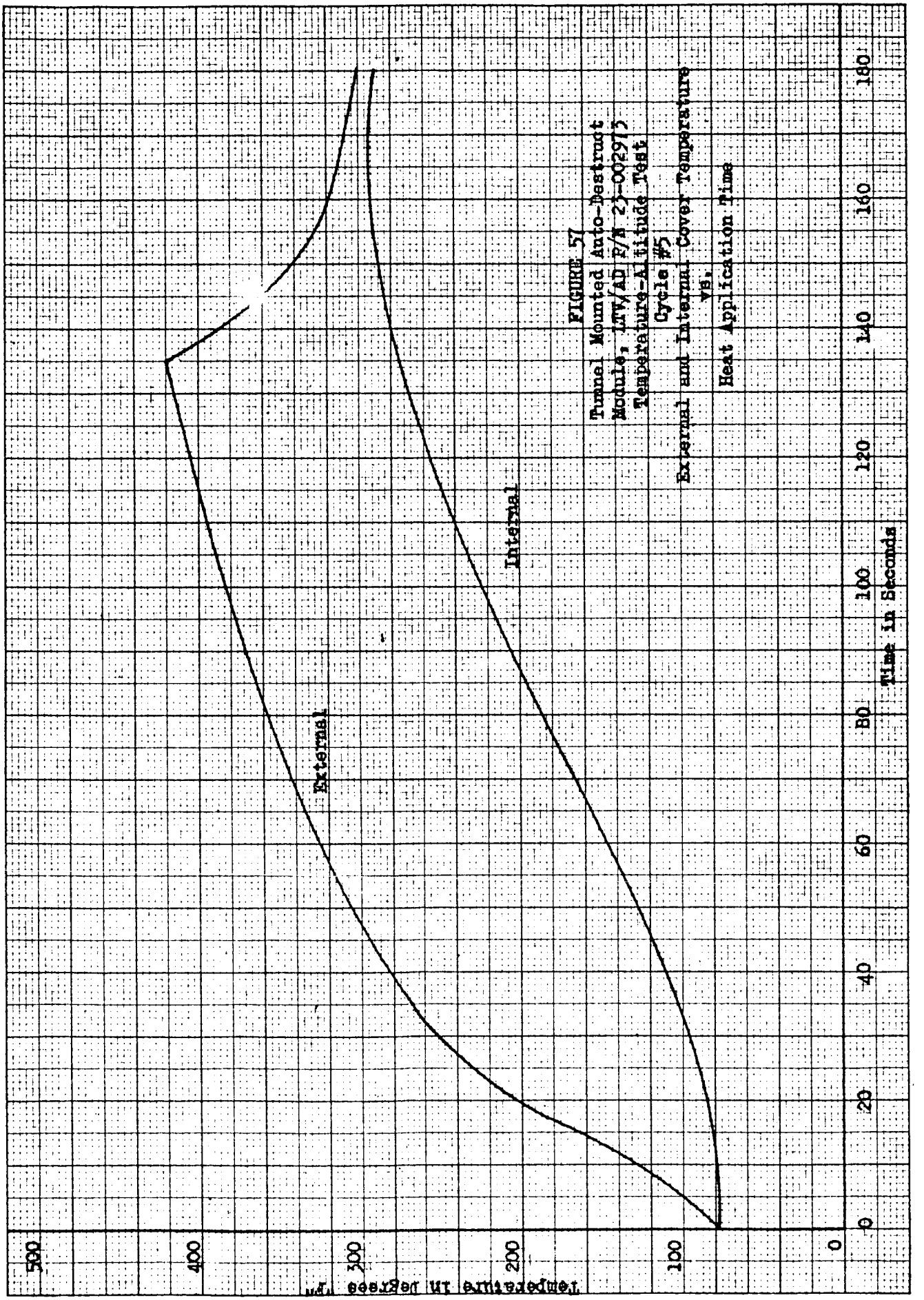
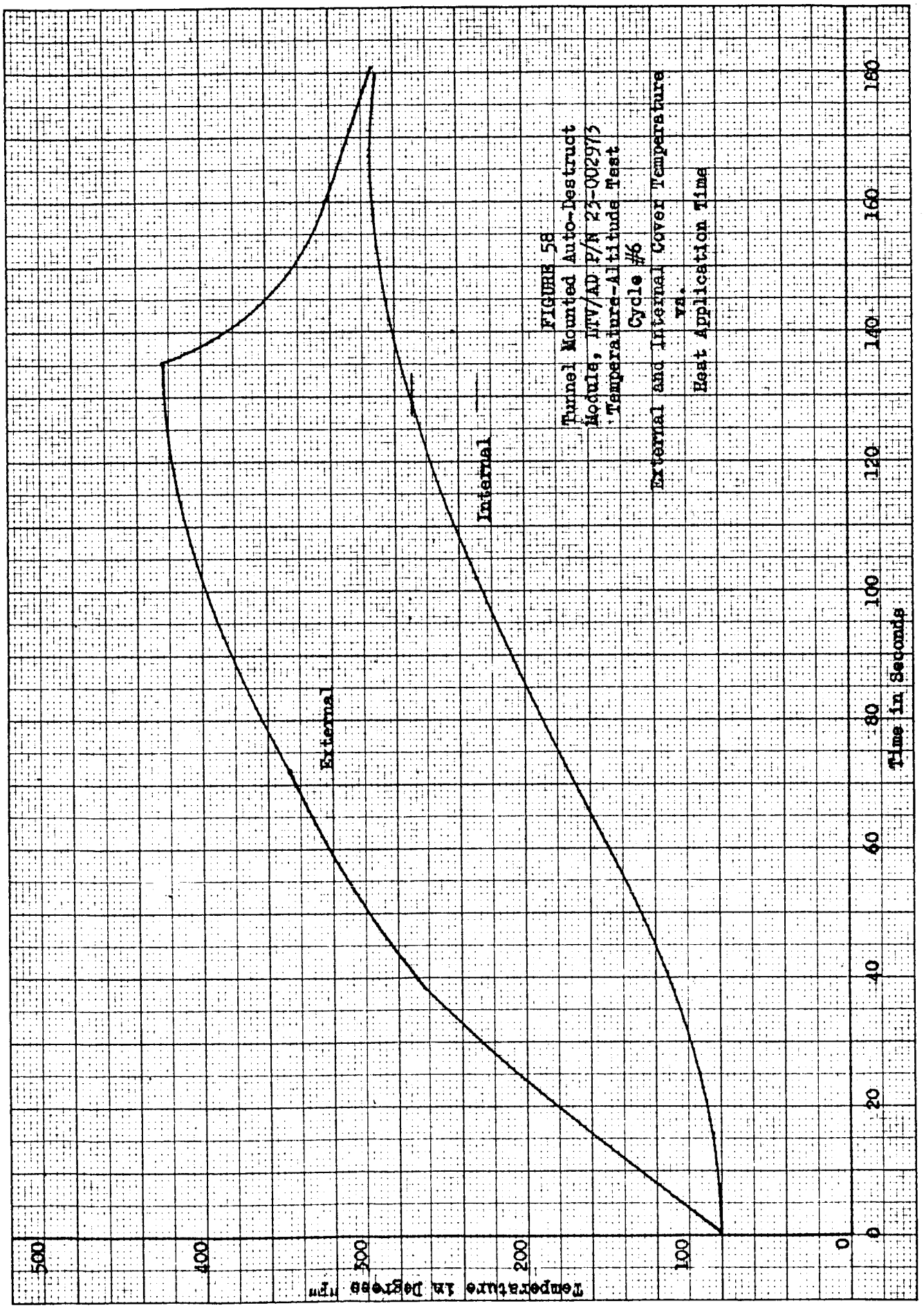


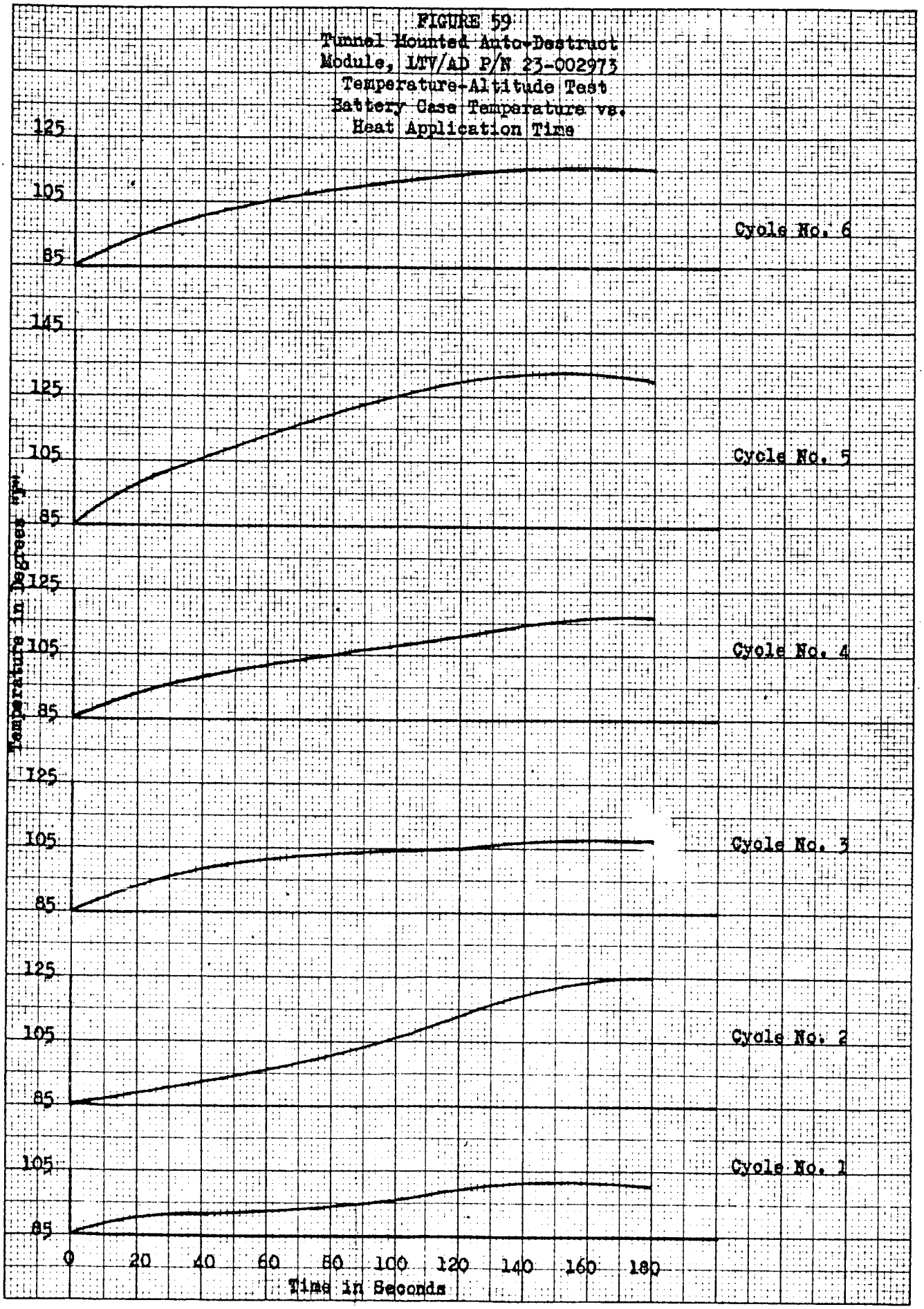
FIGURE 57
Tunnel Mounted Auto-Destruct
Module, LTV/AD P/N 23-002913
Temperature-Altitude Test
Cycle #5
External and Internal Cover Temperature
vs.
Heat Application Time

K+E 10 X 10 TO THE ½ INCH 359-11
KEUFFEL & ESSER CO. MADE IN U.S.A.



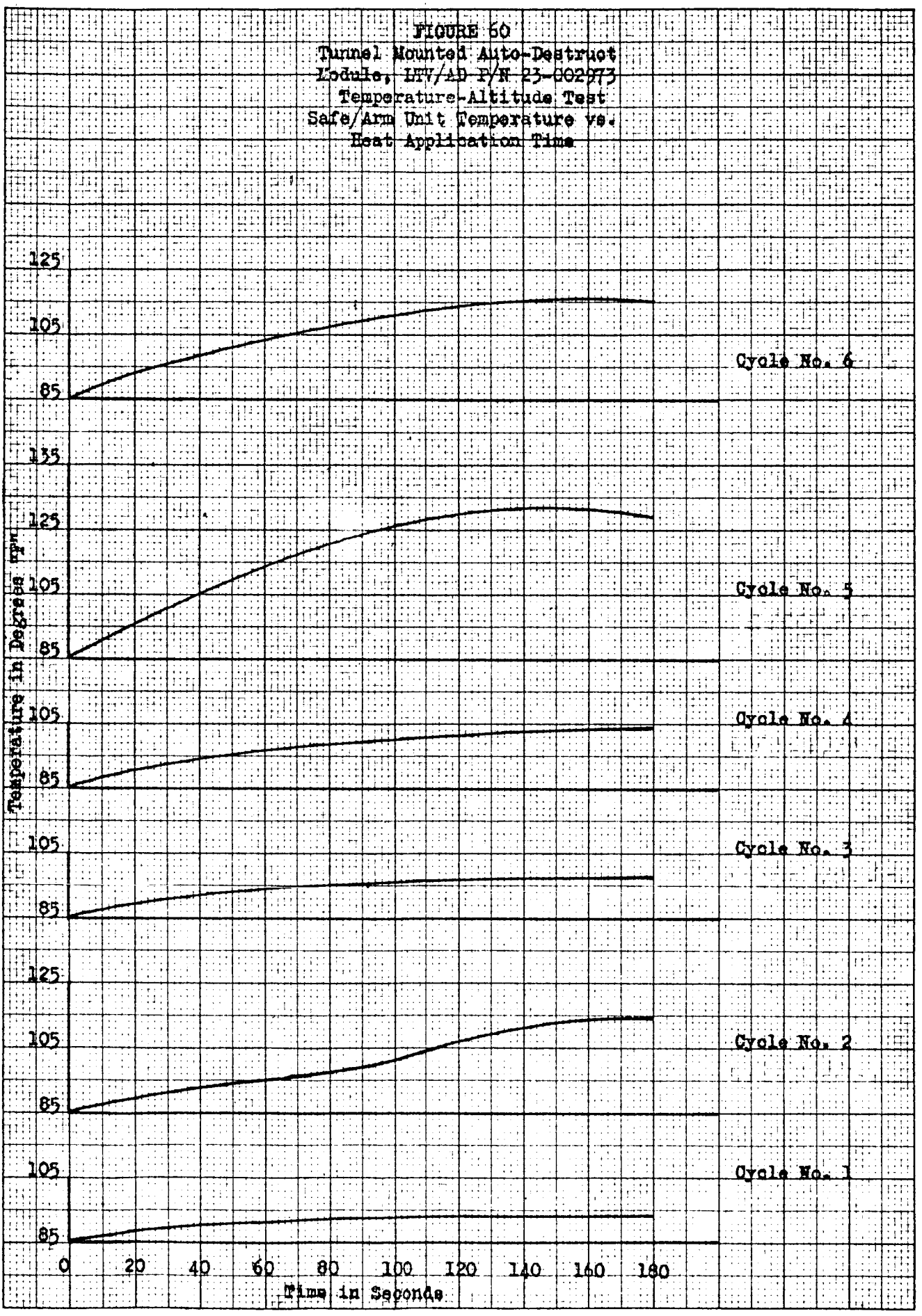
K+E 10 X 10 TO THE ½ INCH 359-11
KEUFFEL & ESSER CO. MADE IN U.S.A.

FIGURE 59
Tunnel Mounted Auto-Destruct
Module, LTV/AD P/N 23-002973
Temperature-Altitude Test
Battery Case Temperature vs.
Heat Application Time



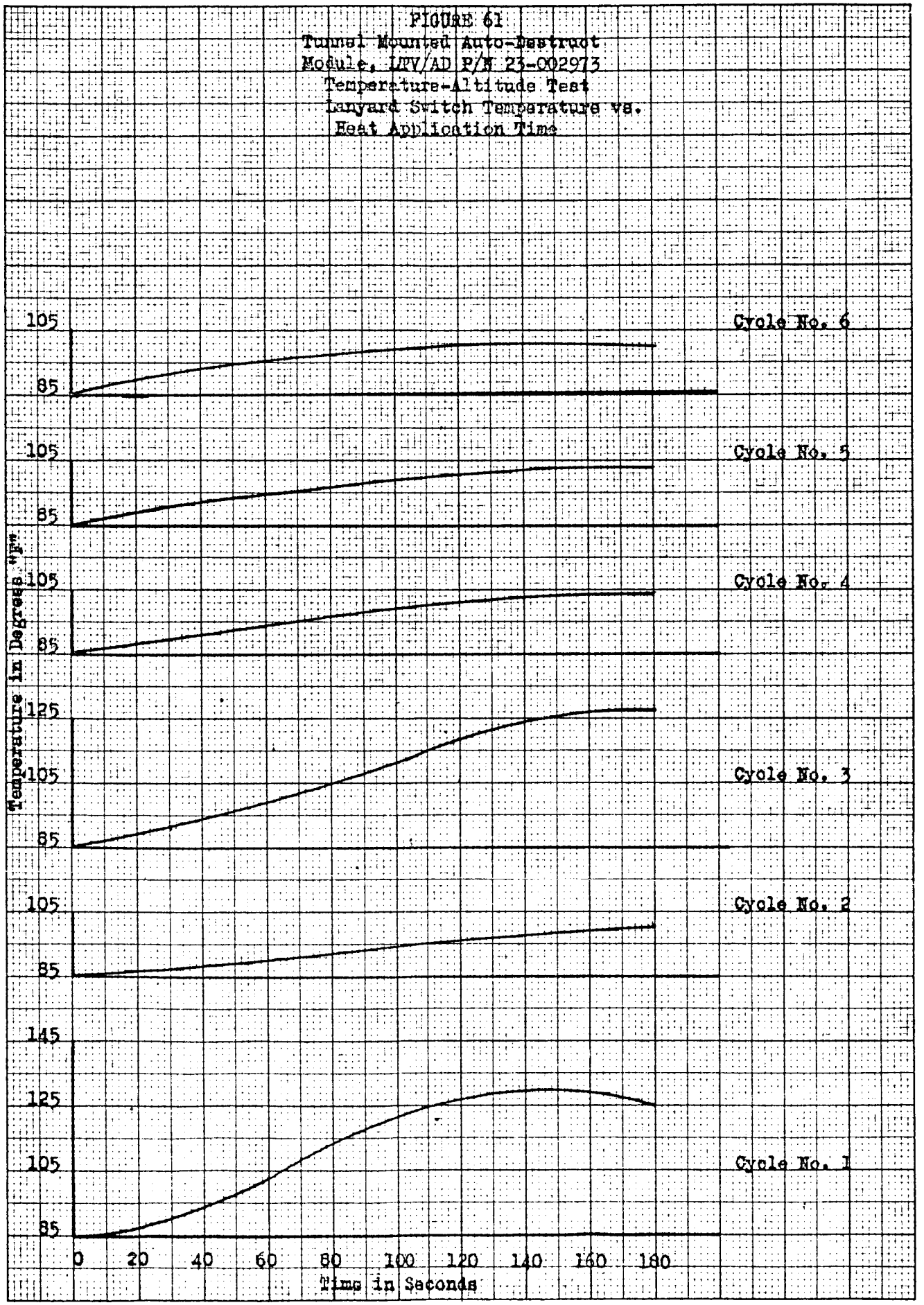
10 X 10 TO THE ½ INCH 359-11
KEUFFEL & ESSER CO. MADE IN U.S.A.

FIGURE 60
Tunnel Mounted Auto-Destruct
Module, LTV/AD P/N 23-002973
Temperature-Altitude Test
Safe/Arm Unit Temperature vs.
Heat Application Time



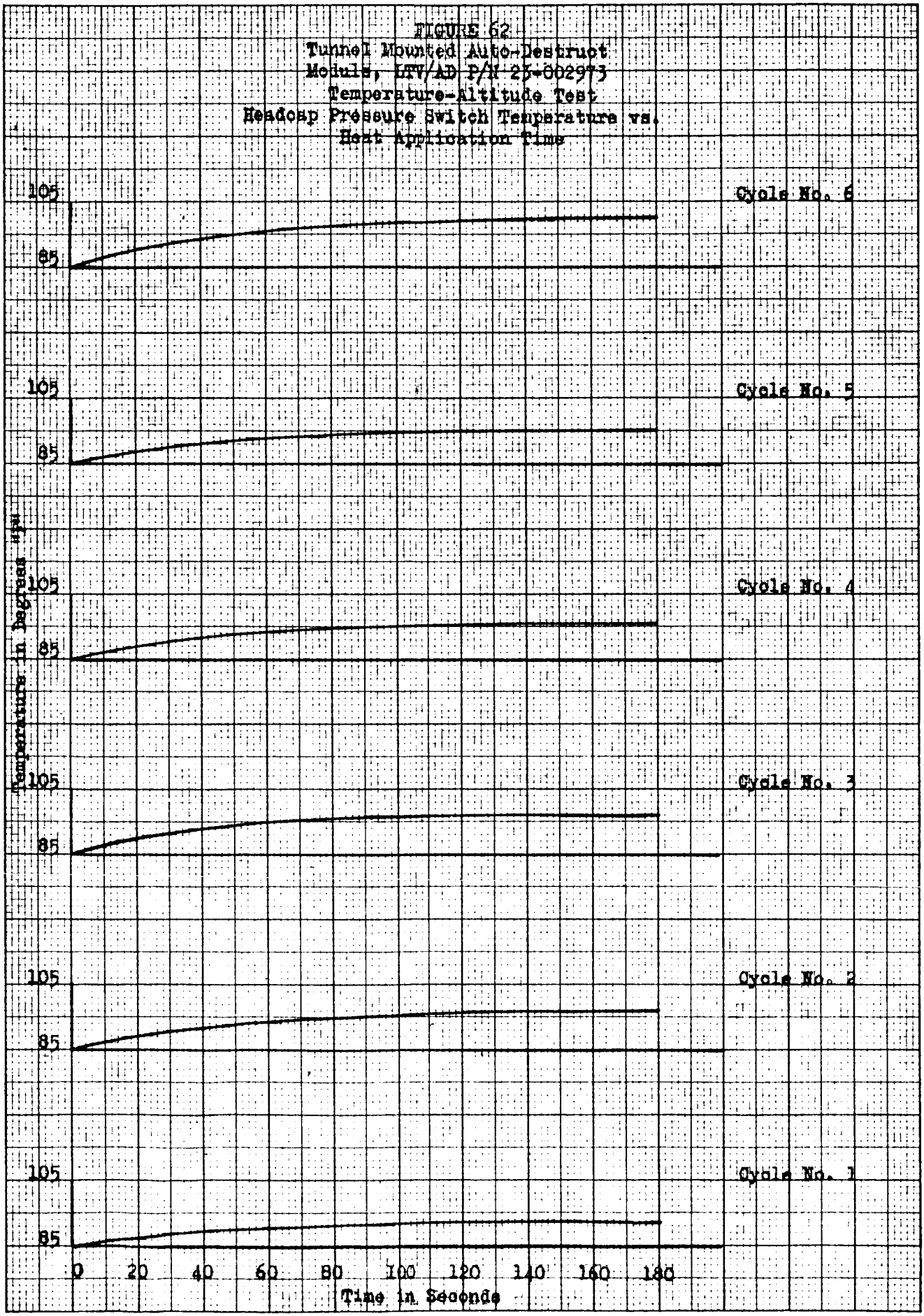
K&E 10 X 10 TO THE ½ INCH 359-11
KEUFFEL & ESSER CO. MADE IN U.S.A.

FIGURE 61
Tunnel Mounted Auto-Destruct Module, LFV/AD P/N 23-002973
Temperature-Altitude Test
Lanyard Switch Temperature vs. Heat Application Time

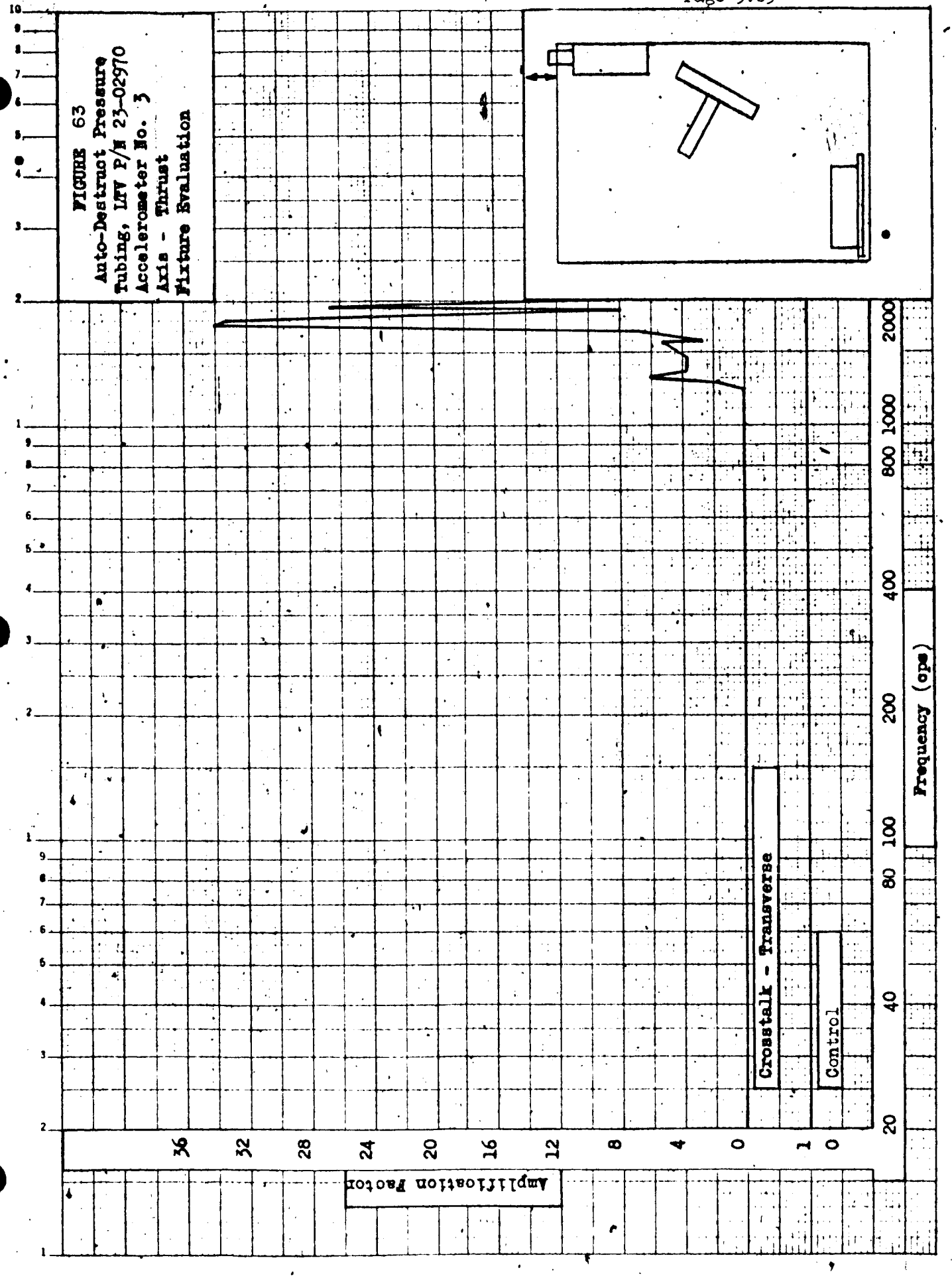


K+E 10 X 10 TO THE ½ INCH 359-11 KEUFFEL & ESSER CO. MADE IN U.S.A.

FIGURE 62
Tunnel Mounted Auto-Destruct
Module, LTV/AD P/N 25-002973
Temperature-Altitude Test
Headcap Pressure Switch Temperature vs.
Heat Application Time

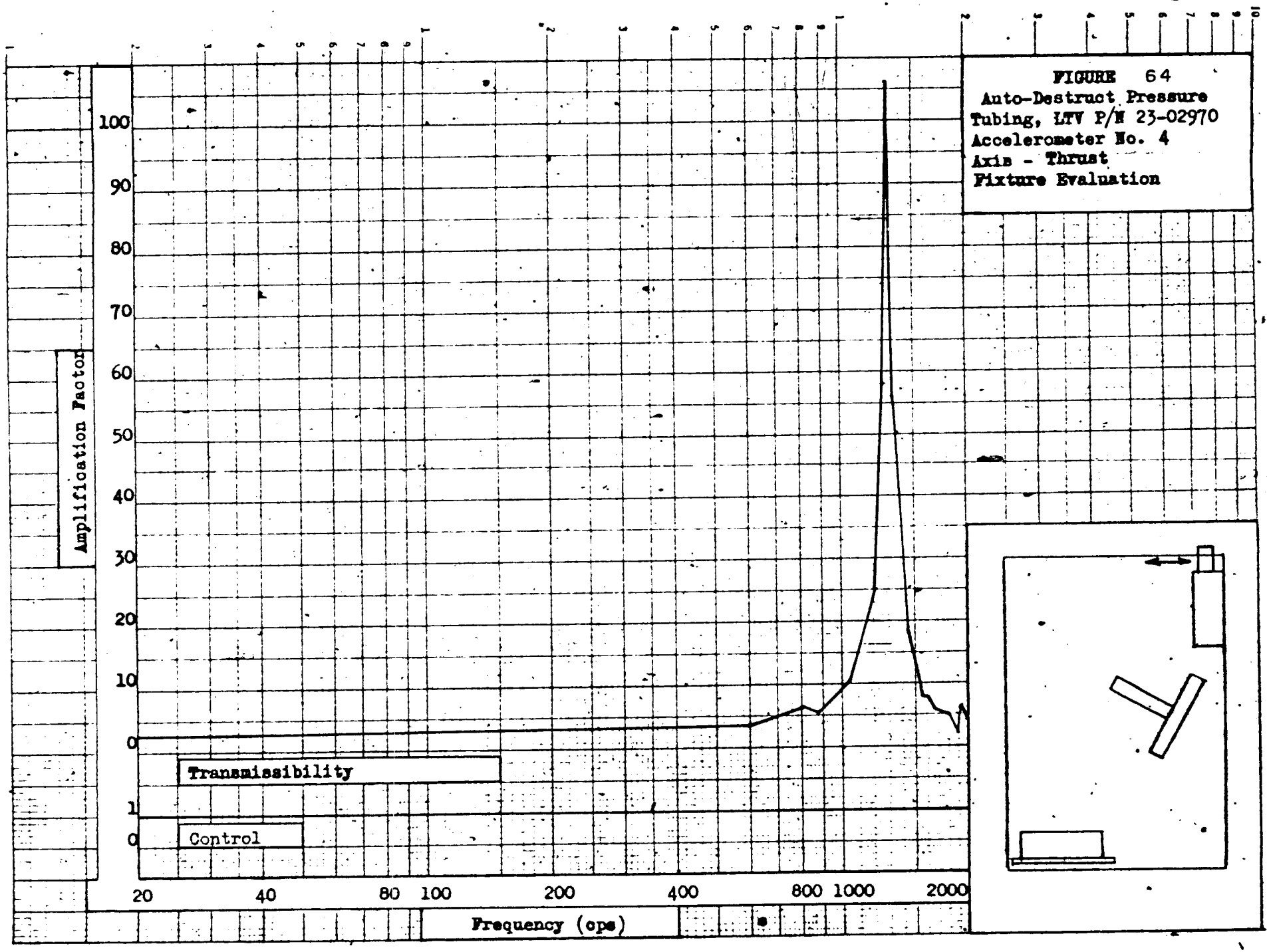


K+E 10 X 10 TO THE ½ INCH 359-11 KEUFFEL & ESSER CO. MADE IN U.S.A.


FIGURE 63
Auto-Destruct Pressure
Tubing, LTV P/N 23-02970
Accelerometer No. 3
Axis - Thrust
Fixture Evaluation
Amplification Factor
36
32
28
24
20
16
12
8
4
0
1
0
Crosstalk - Transverse
Control
20
40
80
100
200
400
800
1000
2000
Frequency (cps)

K•E SEMI-LOGARITHMIC 359-73 KEUFFEL & ESSER CO 3 CYCLES X 140 DIVISIONS

FIGURE 64
Auto-Destruct Pressure Tubing, LTV P/N 23-02970
Accelerometer No. 4
Axis - Thrust
Fixture Evaluation



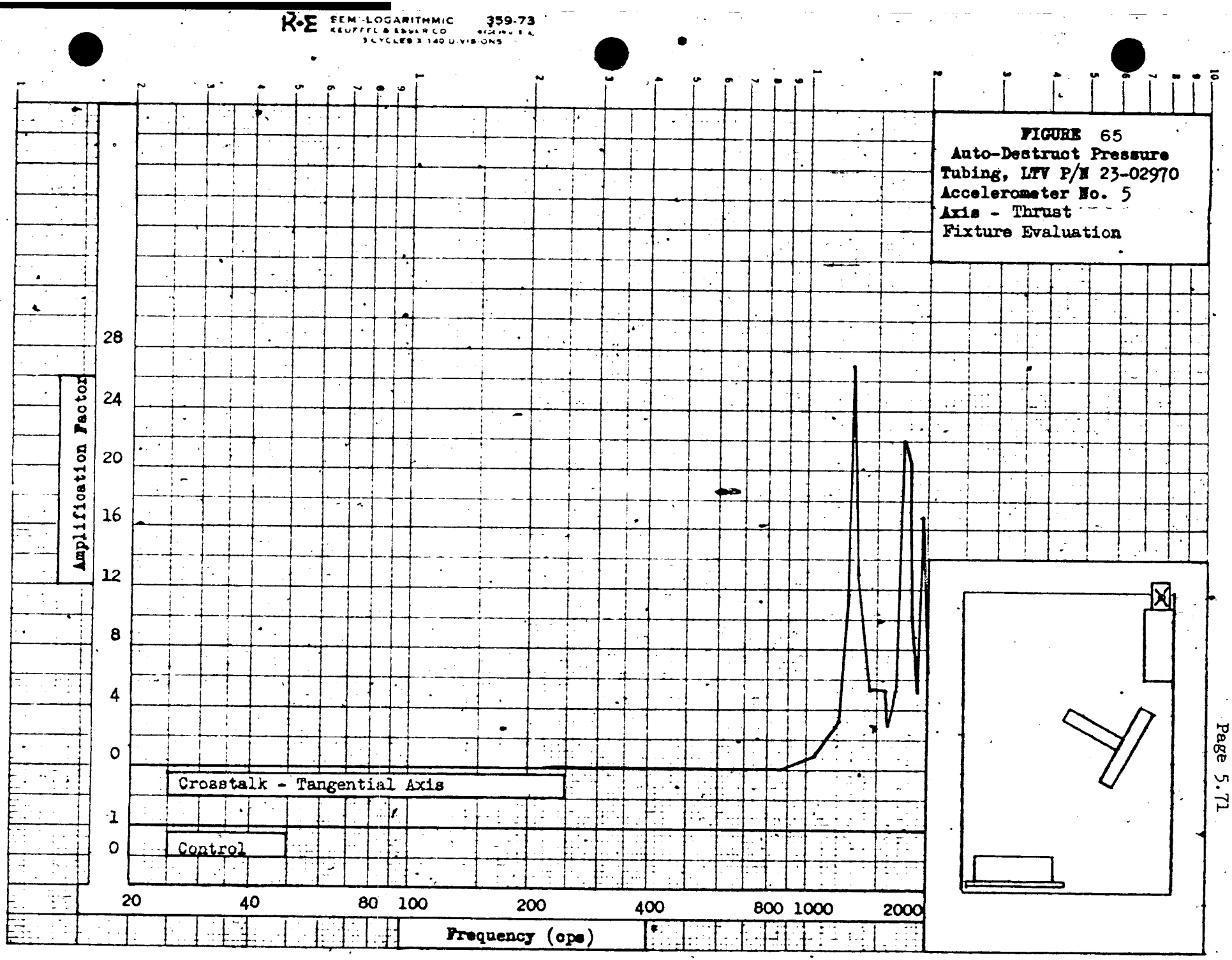


FIGURE 65
Auto-Destruct Pressure Tubing, LTV P/N 23-02970
Accelerometer No. 5
Axis - Thrust
Fixture Evaluation

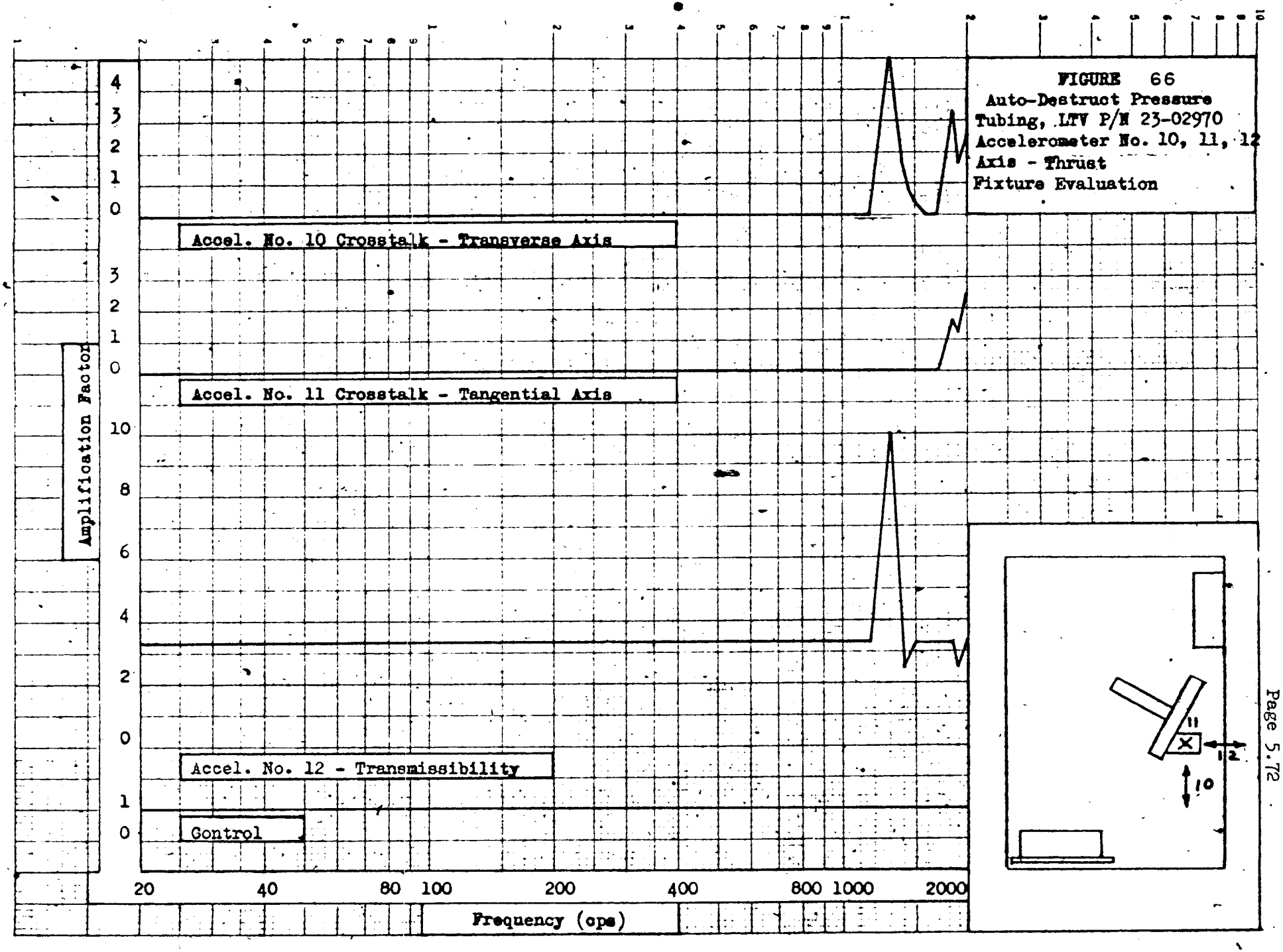
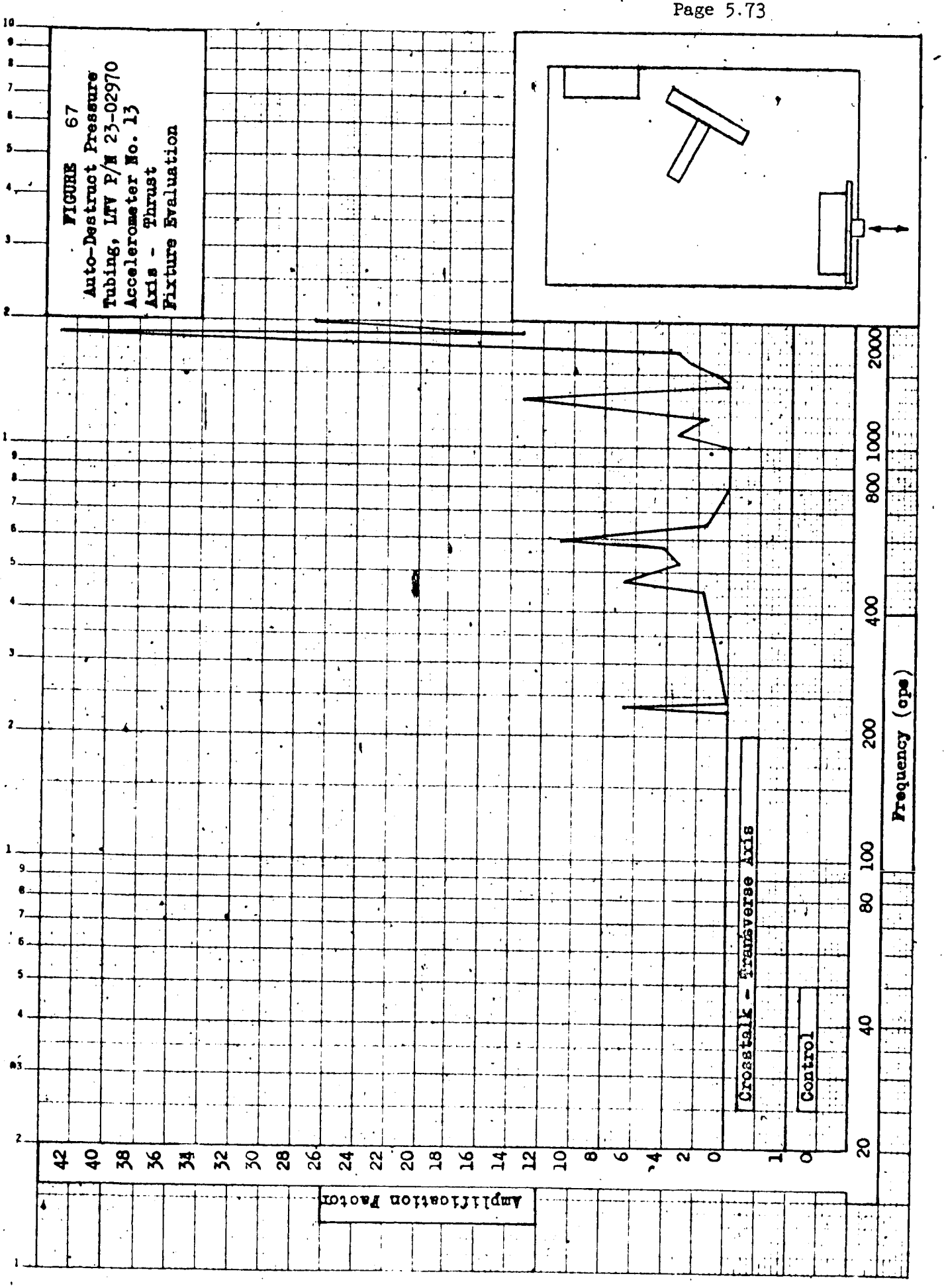
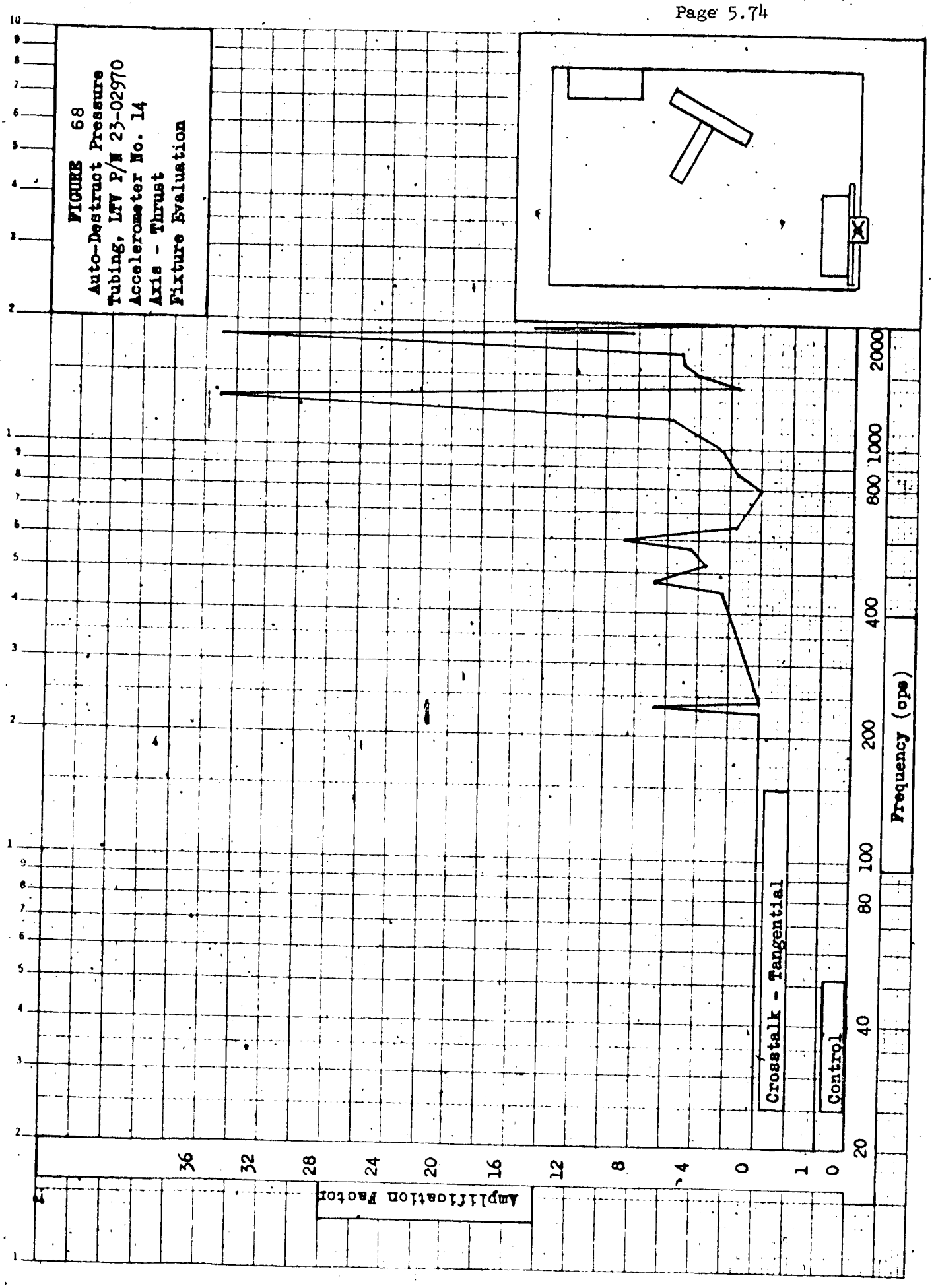


FIGURE 66
Auto-Destruct Pressure
Tubing, LTV P/N 23-02970
Accelerometer No. 10, 11, 12
Axis - Thrust
Fixture Evaluation


FIGURE 67
Auto-Destruct Pressure Tubing, LTV P/N 23-02970
Accelerometer No. 13
Axis - Thrust
Fixture Evaluation
Amplification Factor
Frequency (cps)
Crosstalk - Transverse Axis
Control


FIGURE 68
Auto-Destruct Pressure Tubing, LTV P/N 23-02970
Accelerometer No. 14
Axis - Thrust
Fixture Evaluation
Amplification Factor
Frequency (cps)
Crosstalk - Tangential
Control
36
32
28
24
20
16
12
8
4
0
1
0
20
40
80
100
200
400
800
1000
2000

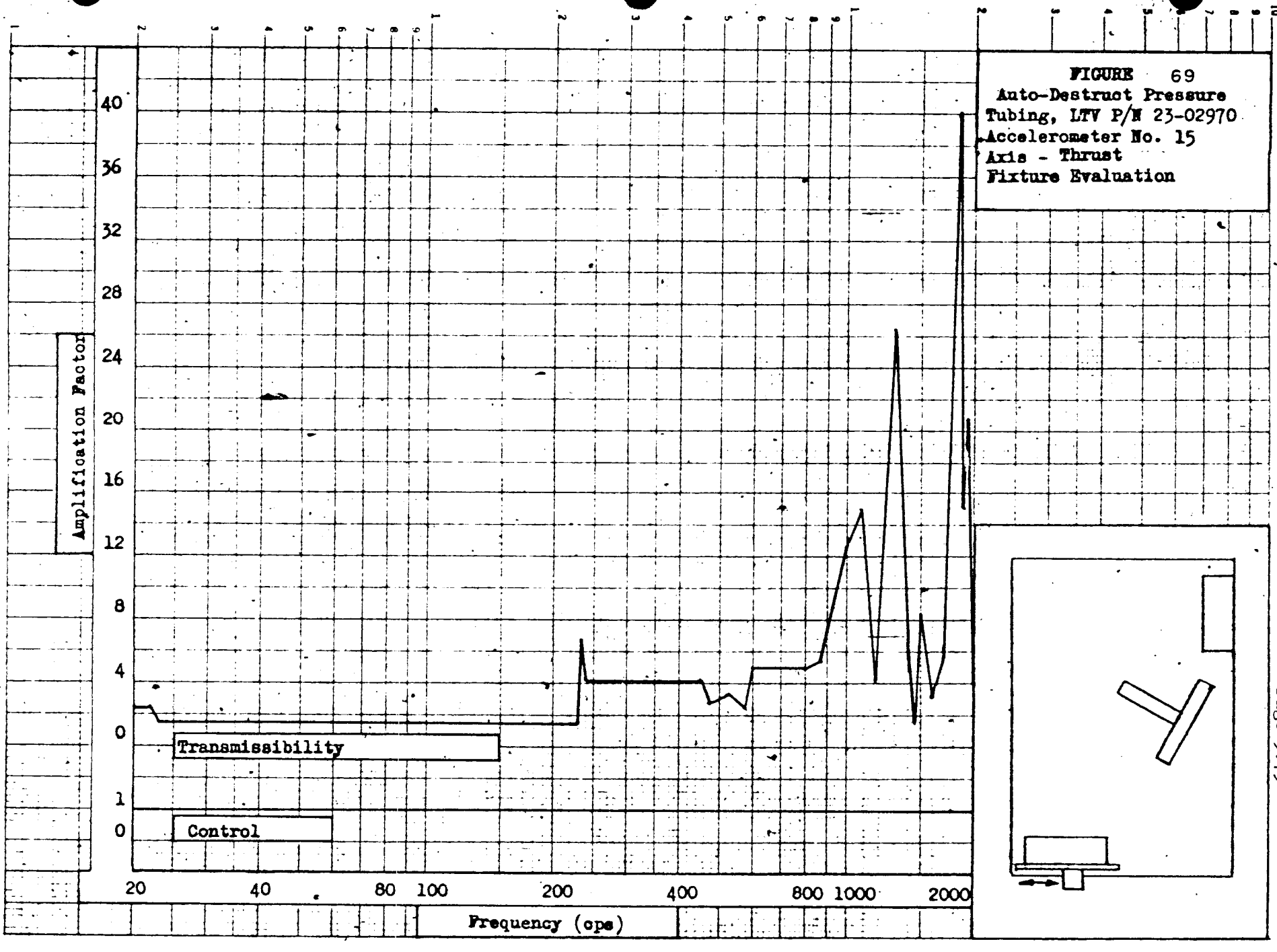
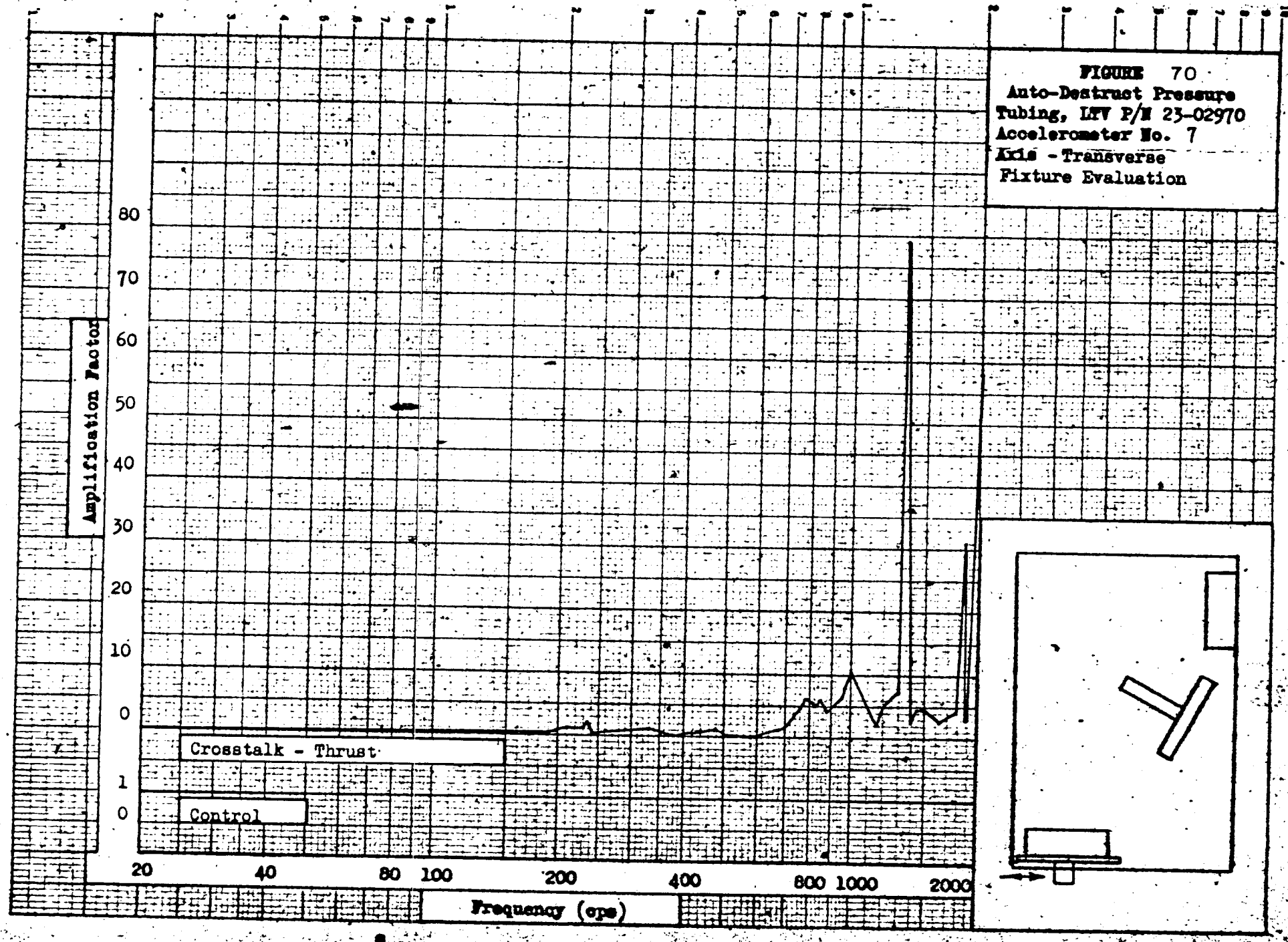


FIGURE 69
Auto-Destruct Pressure Tubing, LTV P/N 23-02970
Accelerometer No. 15
Axis - Thrust
Fixture Evaluation

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3 CYCLES X 140 DIVISIONS

FIGURE 70
Auto-Destruct Pressure Tubing, LRV P/N 23-02970
Accelerometer No. 7
Axis - Transverse
Fixture Evaluation



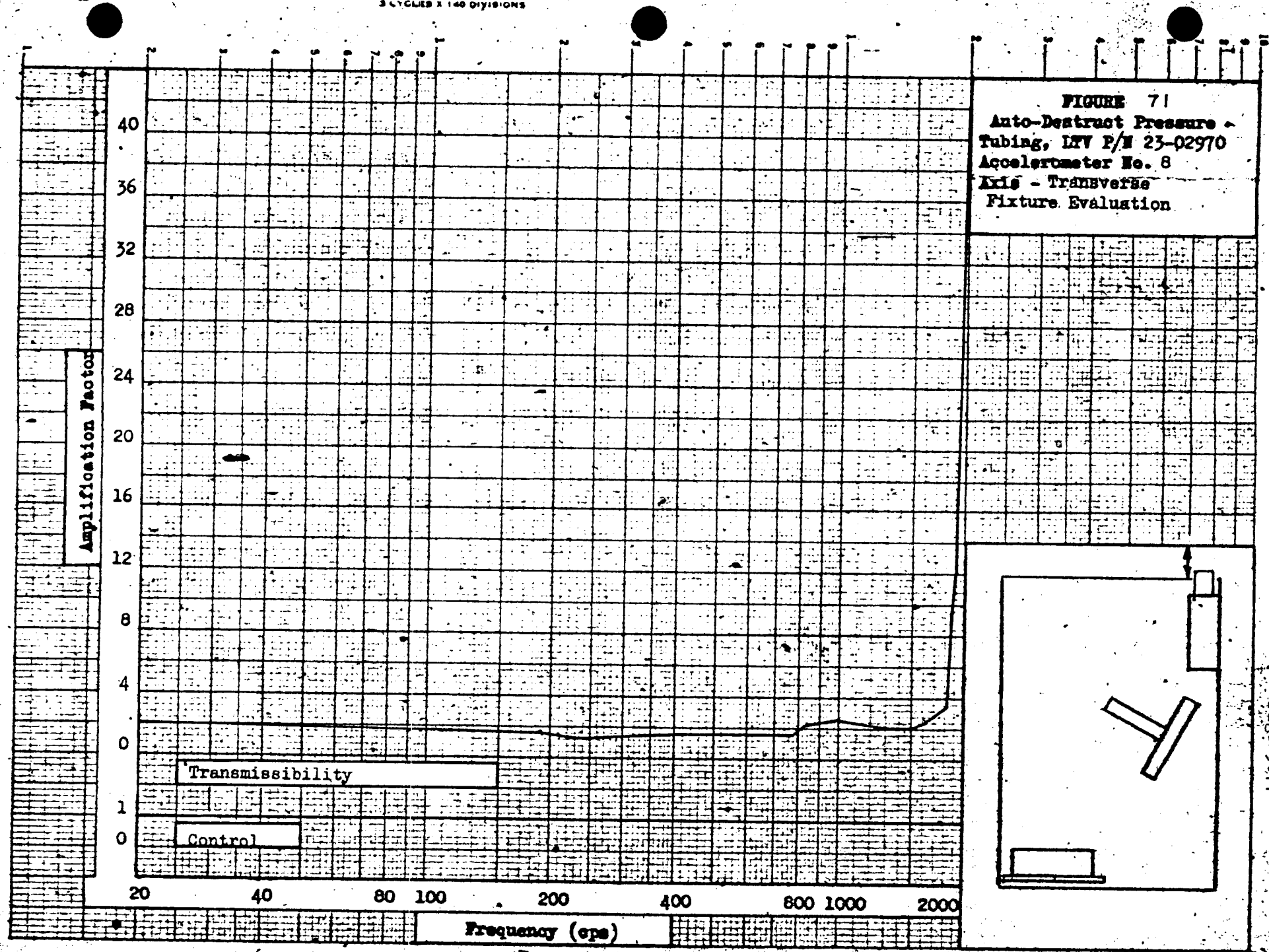
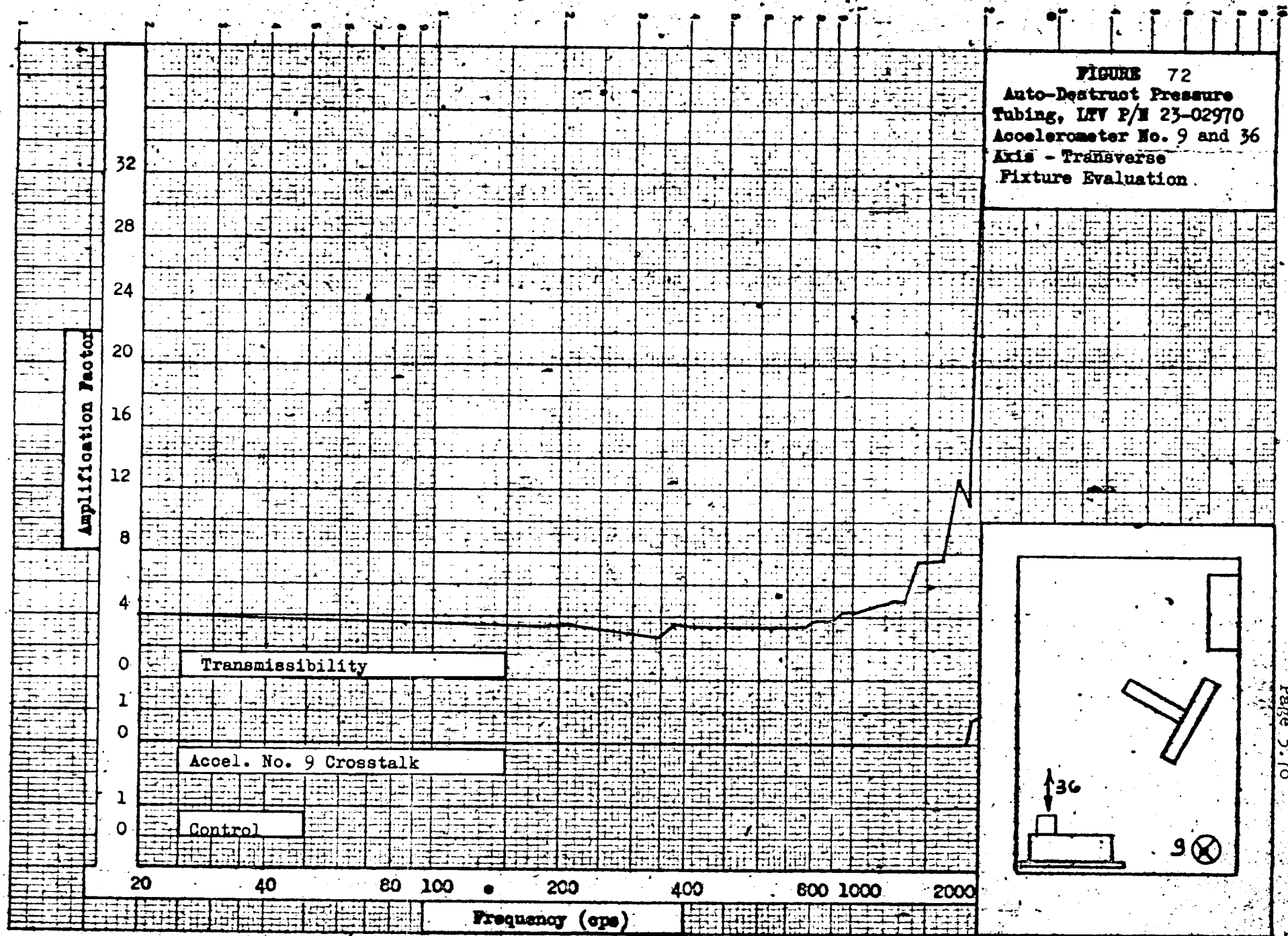


FIGURE 71
Auto-Destruct Pressure - Tubing, LTV P/N 23-02970
Accelerometer No. 8
Axis - Transverse
Fixture Evaluation

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KEUFFEL & ESSER CO. MADE IN U.S.A.
3 CYCLES X 140 DIVISIONS

FIGURE 72
Auto-Destruct Pressure Tubing, LTV P/N 23-02970
Accelerometer No. 9 and 36
Axis - Transverse
Fixture Evaluation



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KEUFFEL & ESSER CO. MADE IN U.S.A.
5 CYCLES X 140 DIVISIONS

FIGURE 73
Auto-Destruct Pressure
Tubing, LTV P/N 23-02970
Accelerometer No. 18, 19
Axis - Transverse
Fixture Evaluation

Amplification Factor

6
5
4
3
2
1
0

5
4
3
2
1
0

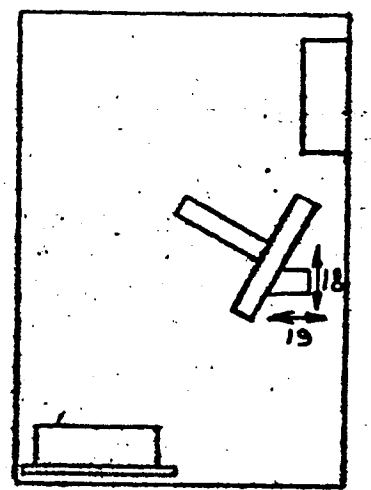
Accel. 19 - Crosstalk - Thrust

Accel. 18 - Transmissibility

Control

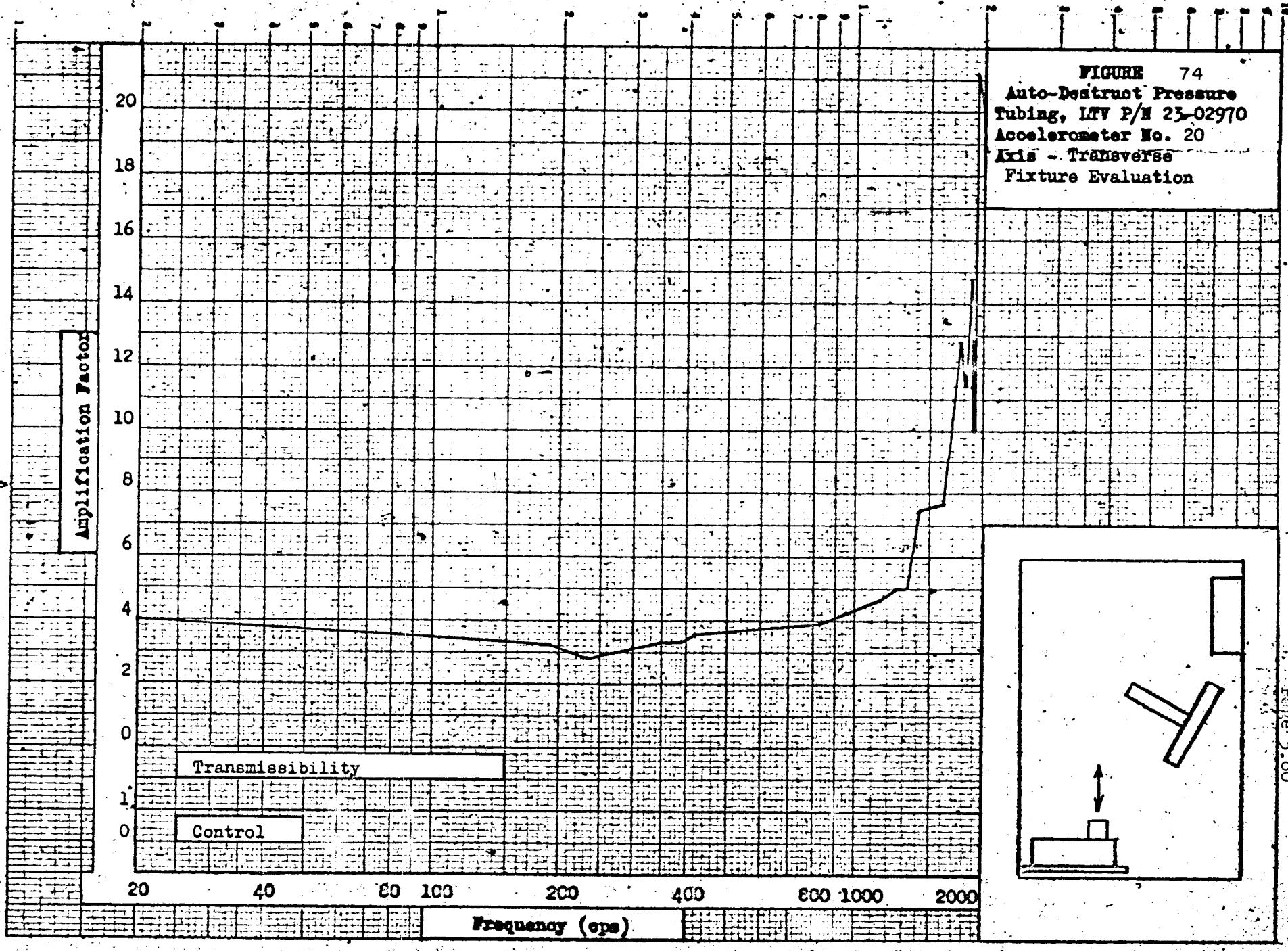
20 40 80 100 200 400 800 1000 2000

Frequency (cps)



K&E SEMI-LOGARITHMIC 359-78
KEUFFEL & ESSER CO. MADE IN U.S.A.
3 CYCLES X 140 DIVISIONS

FIGURE 74
Auto-Destruct Pressure
Tubing, LTV P/N 23-02970
Accelerometer No. 20
Axis - Transverse
Fixture Evaluation



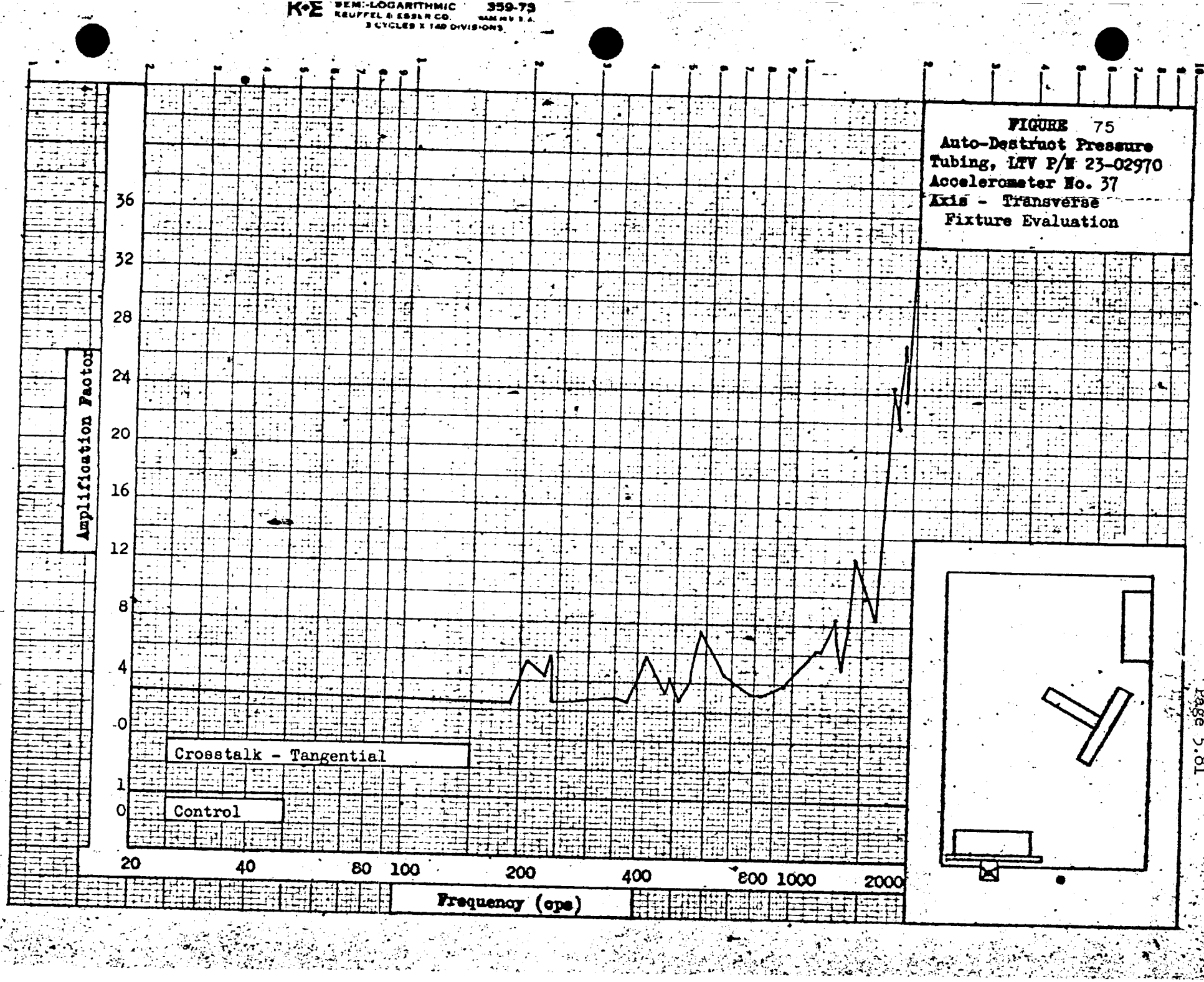


FIGURE 75
Auto-Destruct Pressure Tubing, LTV P/N 23-02970
Accelerometer No. 37
Axis - Transverse
Fixture Evaluation

K&E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO. MADE IN U.S.A.
3 CYCLES X 140 DIVISIONS

FIGURE 76
Auto-Destruct Pressure Tubing, LTV P/N 23-02970
Accelerometer No. 38
Axis - Transverse
Fixture Evaluation

Amplification Factor

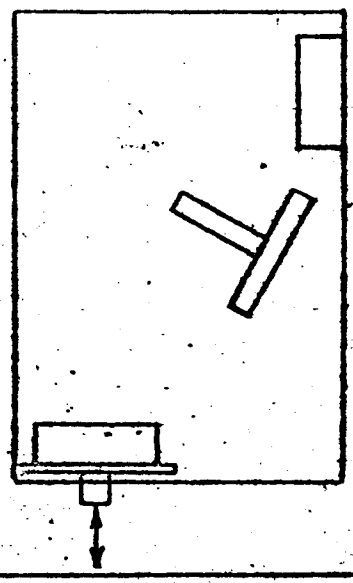
70
60
50
40
30
20
10
0
1
0

Transmissibility

Control

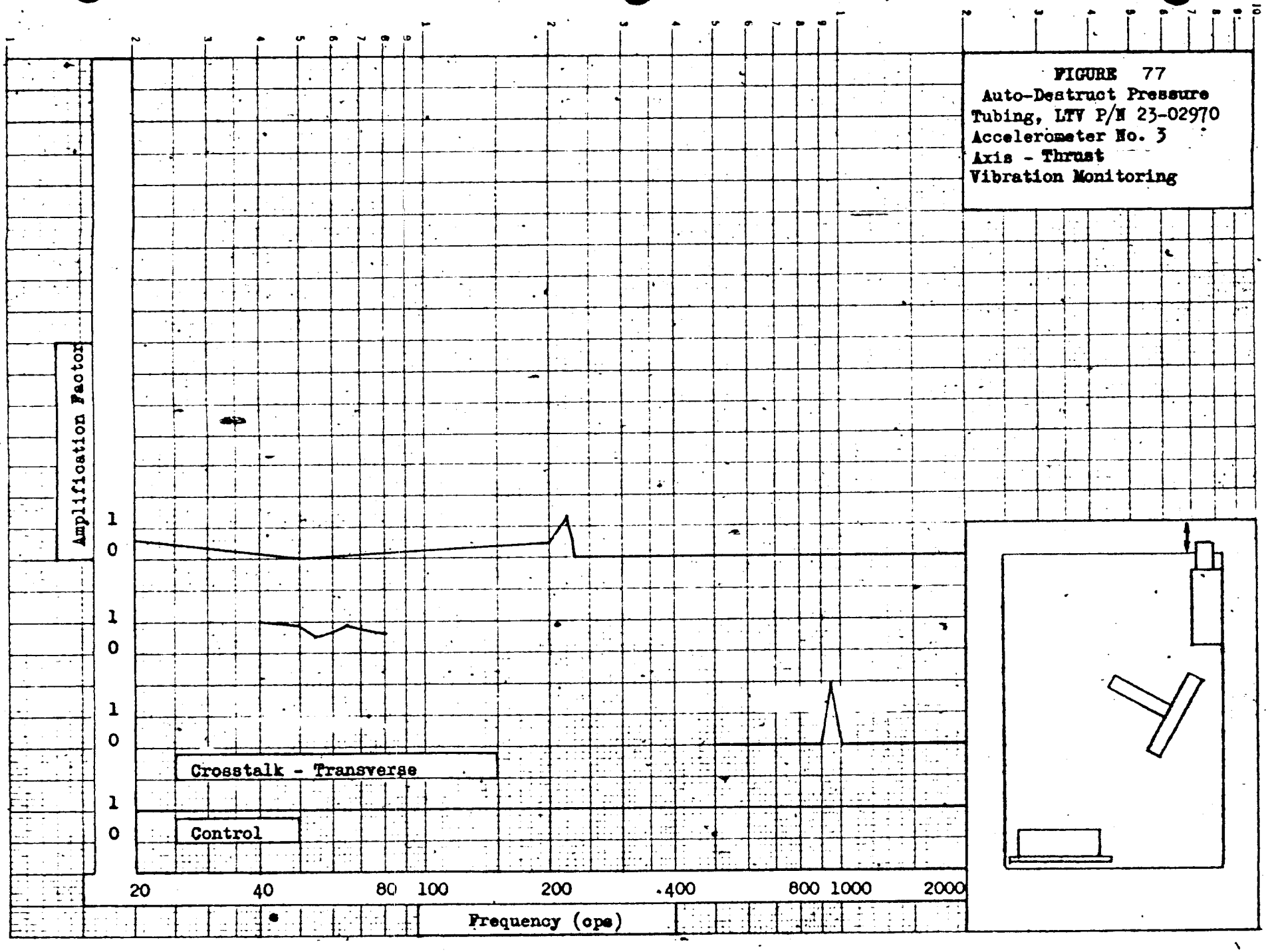
20 40 80 100 200 400 800 1000 2000

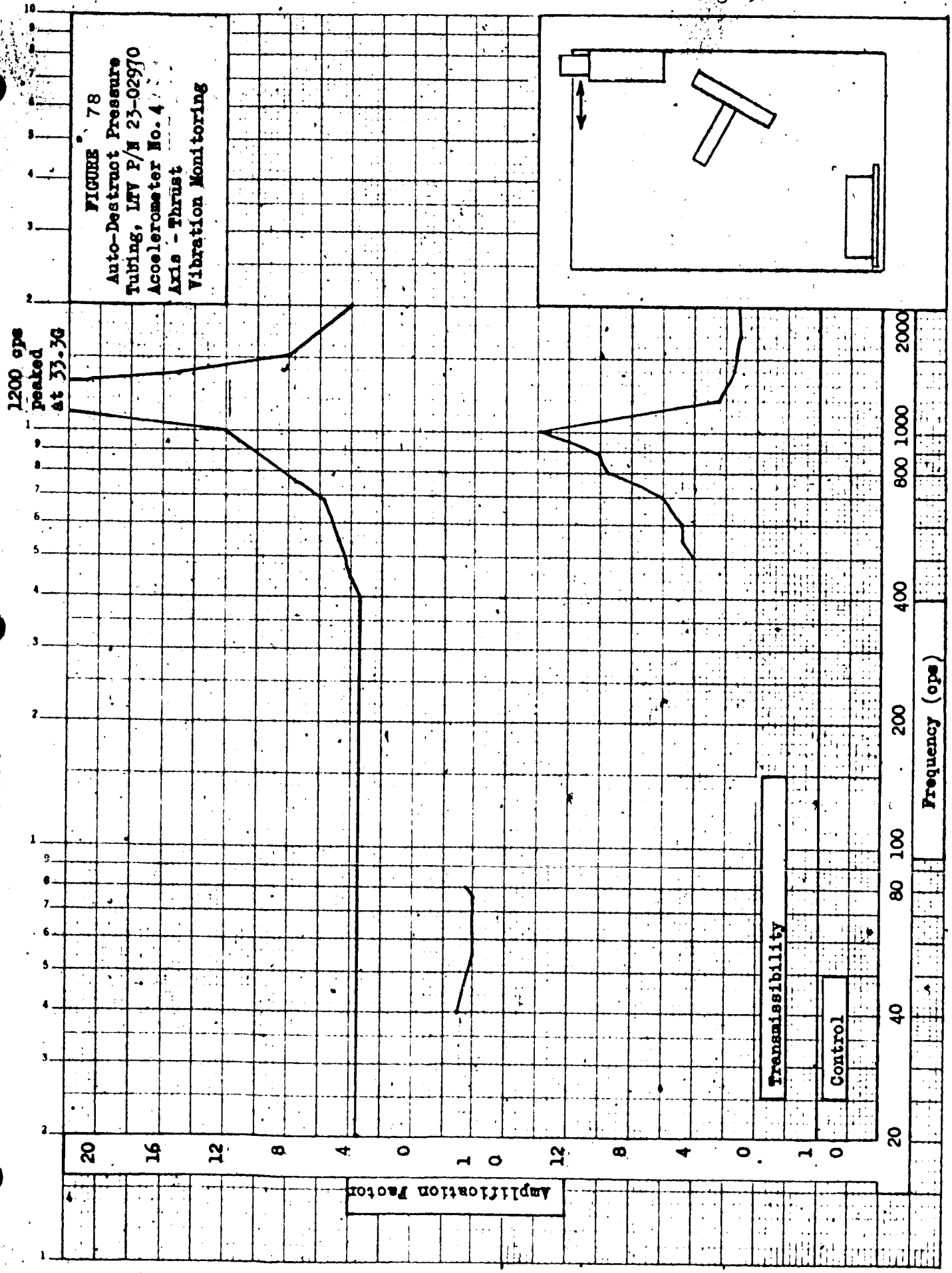
Frequency (cps)

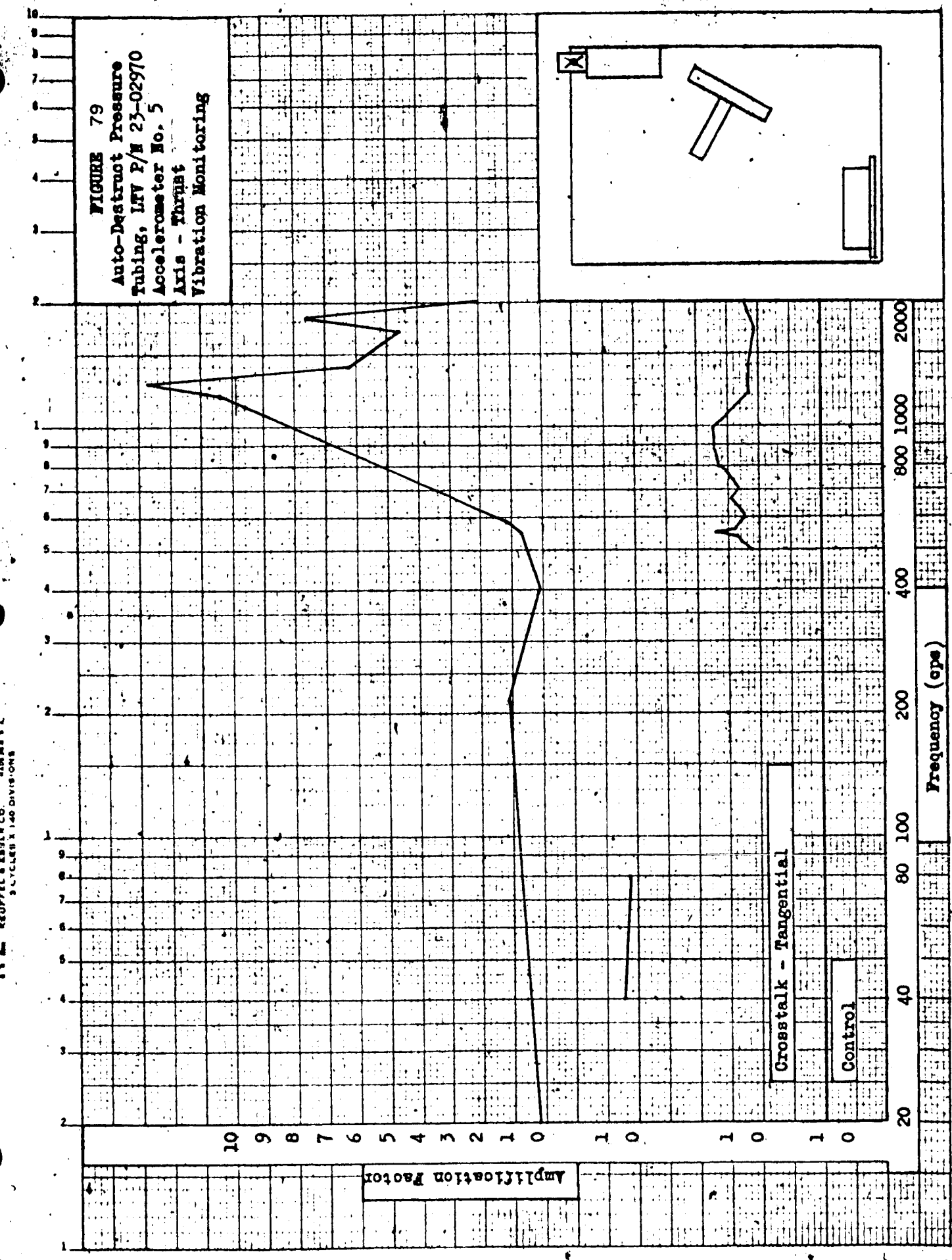


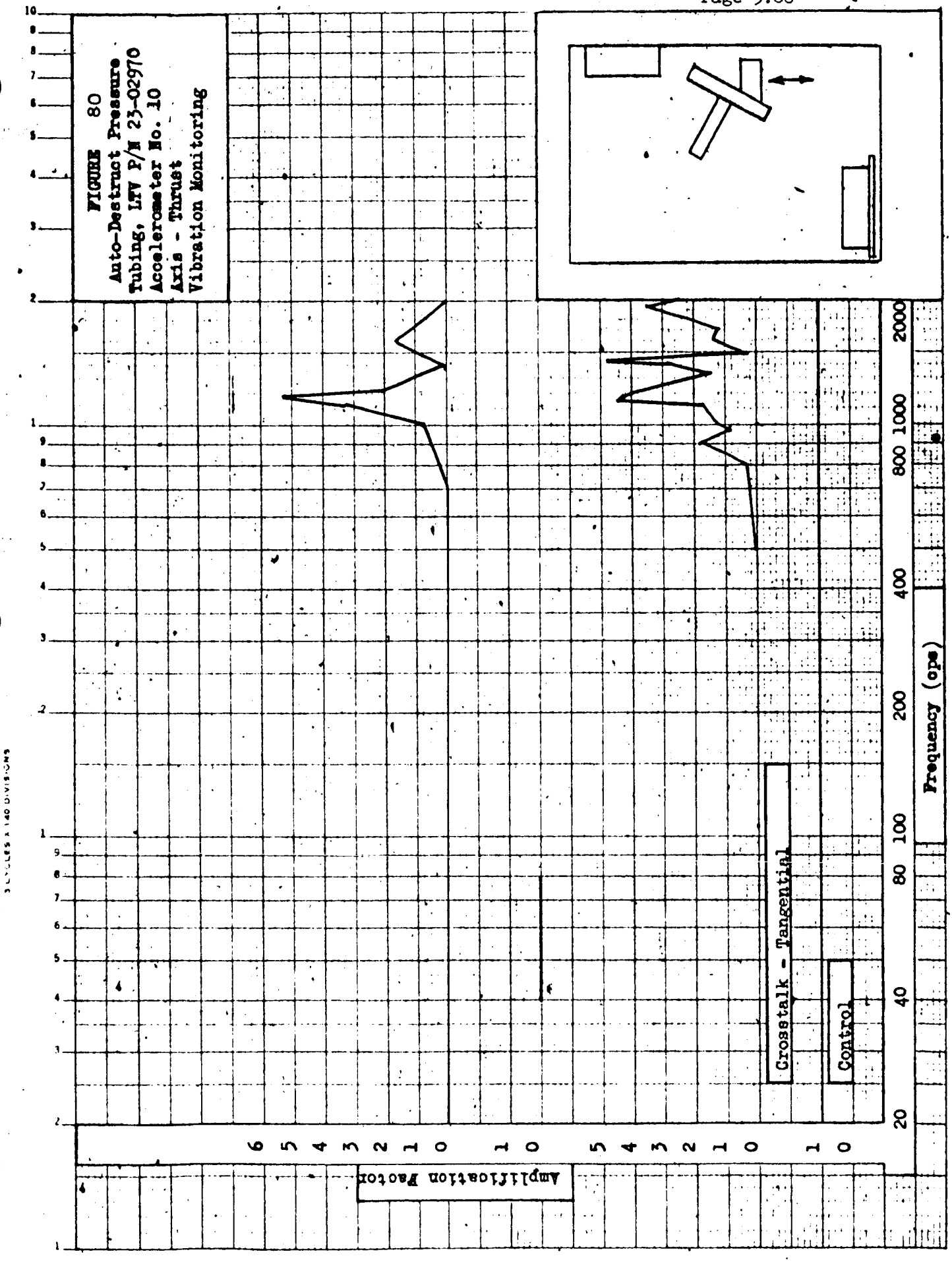
K•E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO
3 CYCLES X 140 DIVISIONS

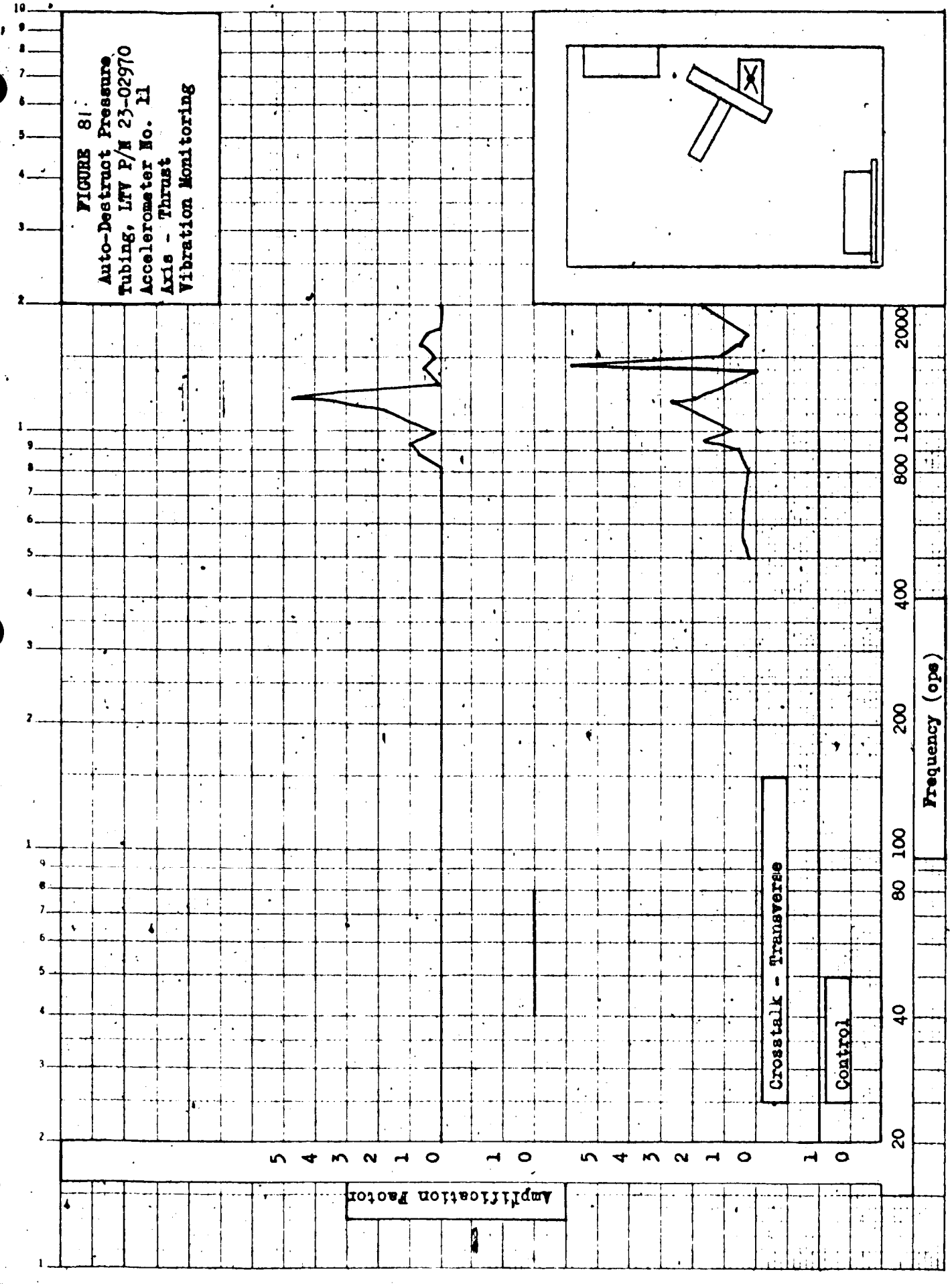
FIGURE 77
Auto-Destruct Pressure Tubing, LTV P/N 23-02970
Accelerometer No. 3
Axis - Thrust
Vibration Monitoring

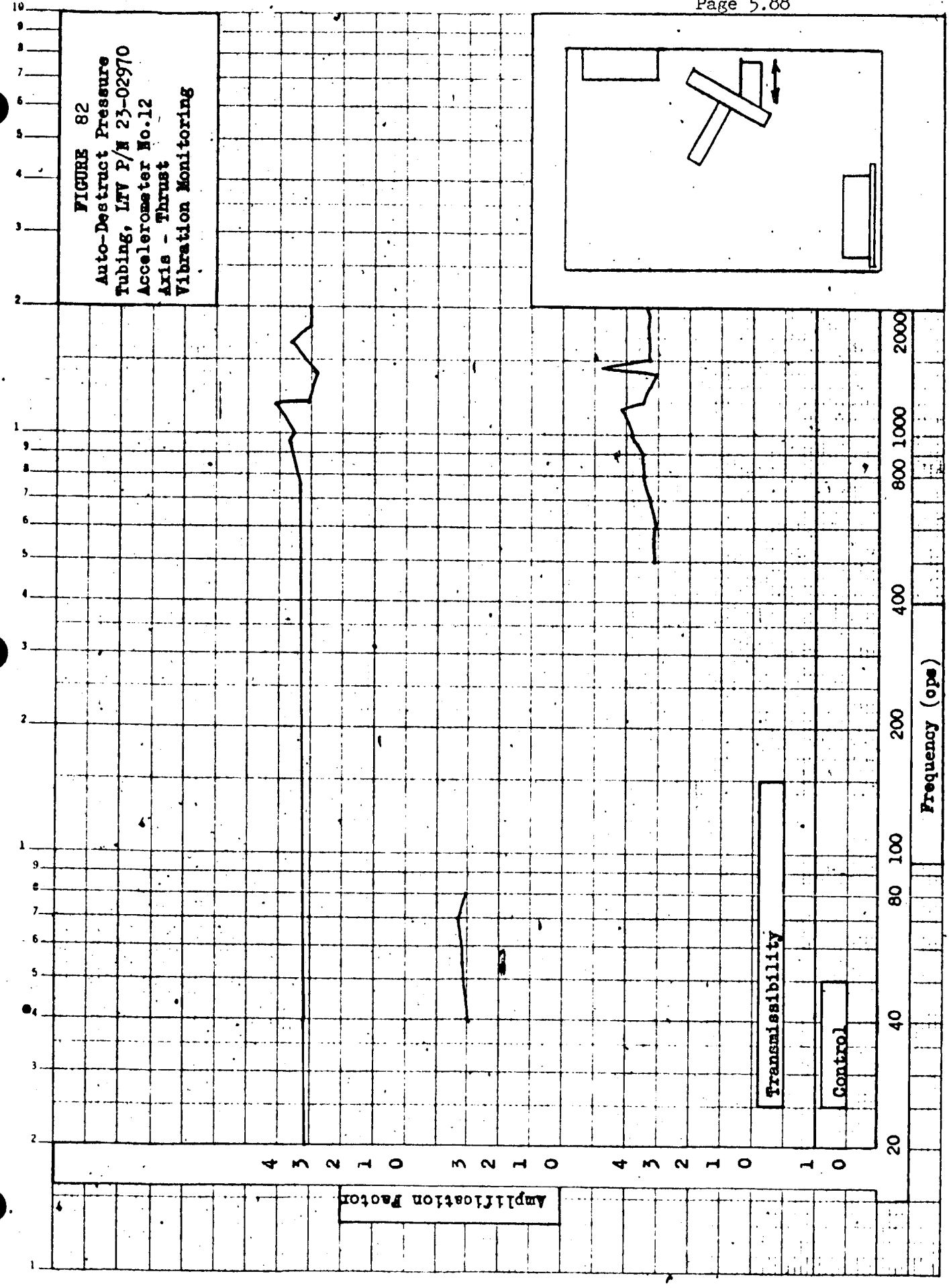



FIGURE 78
Auto-Destruct Pressure Tubing, LTV P/N 23-02970
Accelerometer No. 4
Axis - Thrust
Vibration Monitoring
1200 cps peaked at 33.38
Amplification Factor
Transmissibility
Control
Frequency (cps)
20
16
12
8
4
0
1
0
12
8
4
0
1
0
20
40
80
100
200
400
800
1000
2000


FIGURE 79
Auto-Destruct Pressure Tubing, LTV P/N 23-02970
Accelerometer No. 5
Axis - Thrust
Vibration Monitoring
Amplification Factor
Frequency (cps)
Crosstalk - Tangential
Control
20
40
80
100
200
400
800
1000
2000


FIGURE 80
Auto-Destruct Pressure Tubing, LEV P/N 23-02970
Accelerometer No. 10
Axis - Thrust
Vibration Monitoring
Amplification Factor
Frequency (cps)
Crosstalk - Tangential
Control
10
9
8
7
6
5
4
3
2
1
0
20
40
80
100
200
400
800
1000
2000


FIGURE 81
Auto-Destruct Pressure Tubing, LTV P/N 23-02970
Accelerometer No. 11
Axis - Thrust
Vibration Monitoring
Amplification Factor
Frequency (cps)
Crosstalk - Transverse
Control
10
9
8
7
6
5
4
3
2
1
20
40
80
100
200
400
800
1000
2000


FIGURE 82
Auto-Destruct Pressure Tubing, LTV P/N 23-02970
Accelerometer No.12
Axis - Thrust
Vibration Monitoring
Amplification Factor
Transmissibility
Control
Frequency (cps)
20
40
80
100
200
400
800
1000
2000

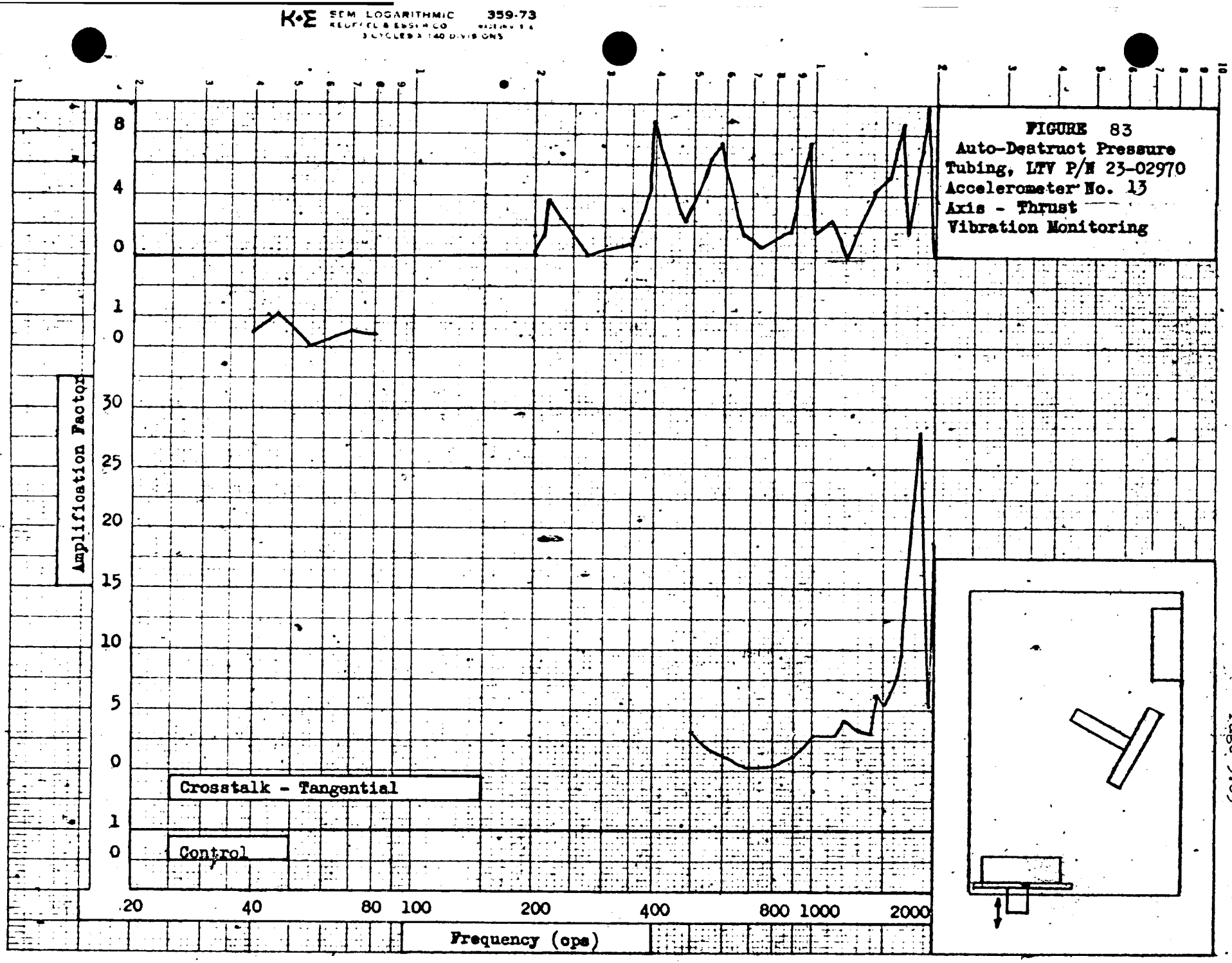
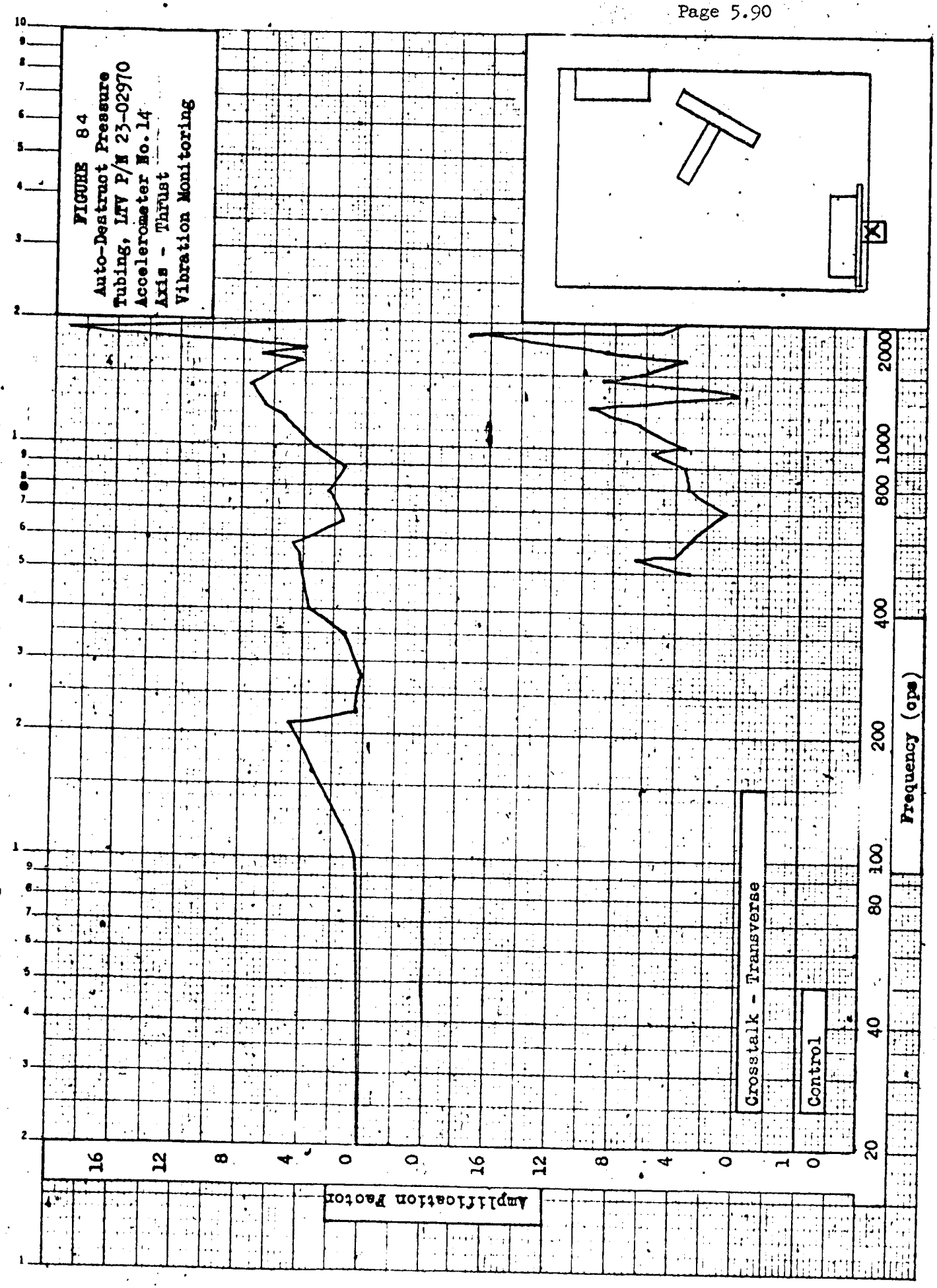


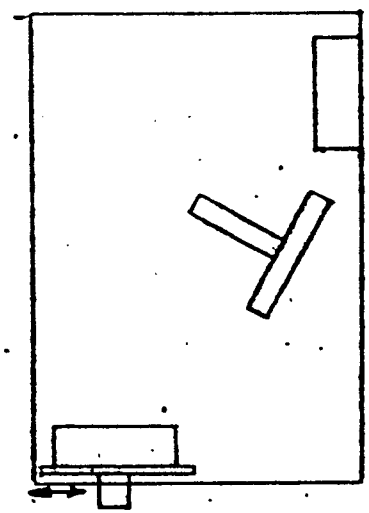
FIGURE 83
Auto-Destruct Pressure Tubing, LTV P/N 23-02970
Accelerometer No. 13
Axis - Thrust
Vibration Monitoring



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KEUFFEL & ESSER CO.
3 CYCLES X 140 DIVISIONS

K-E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO
3 CYCLES X 140 DIVISIONS

FIGURE 85
Auto-Destruct Pressure Tubing, LFV P/N 23-02970
Accelerometer No. 15
Axis - Thrust
Vibration Monitoring



Amplification Factor

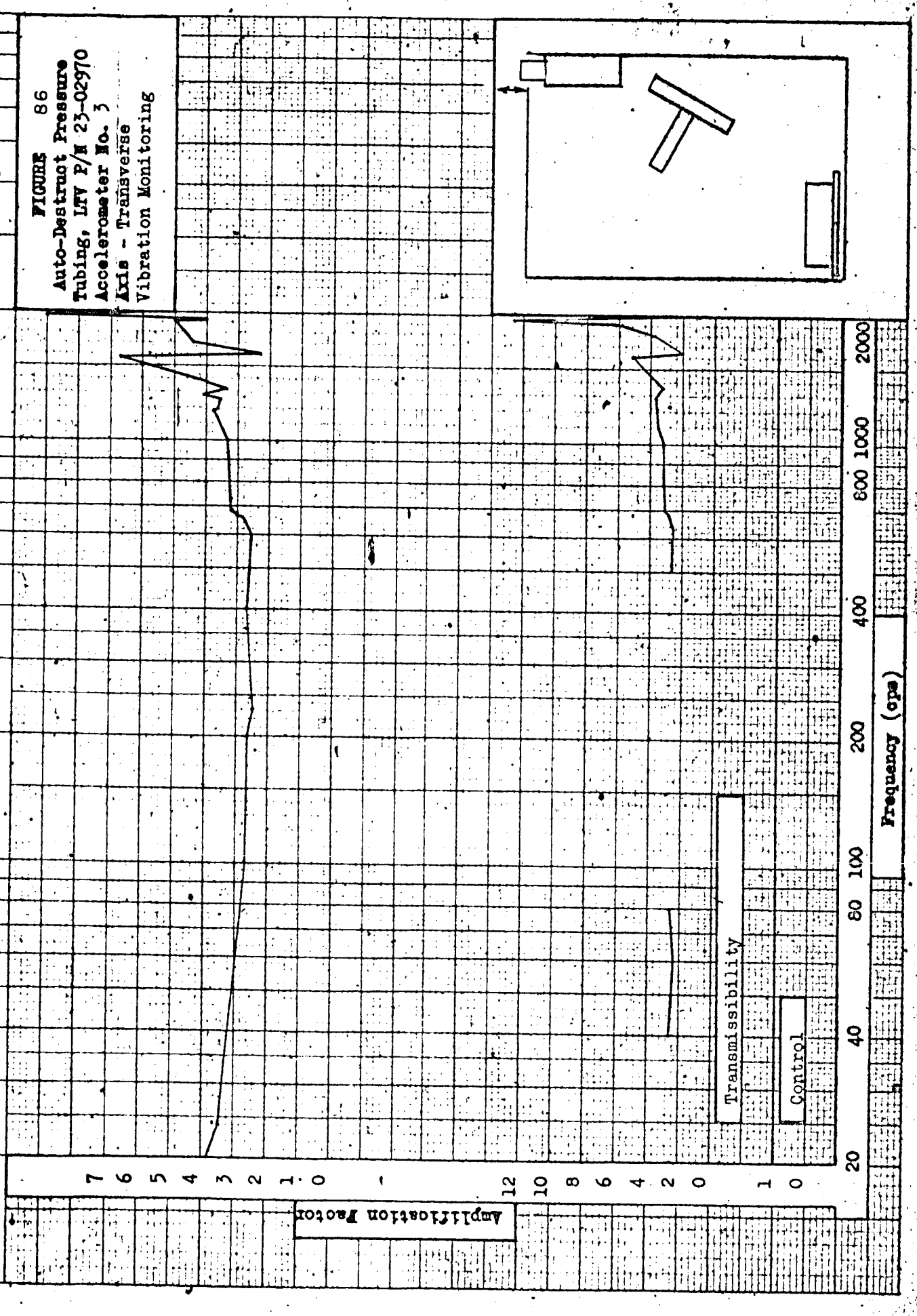
12 8 4 0 1 0 20 16 12 8 4 0 1 0

Transmissibility

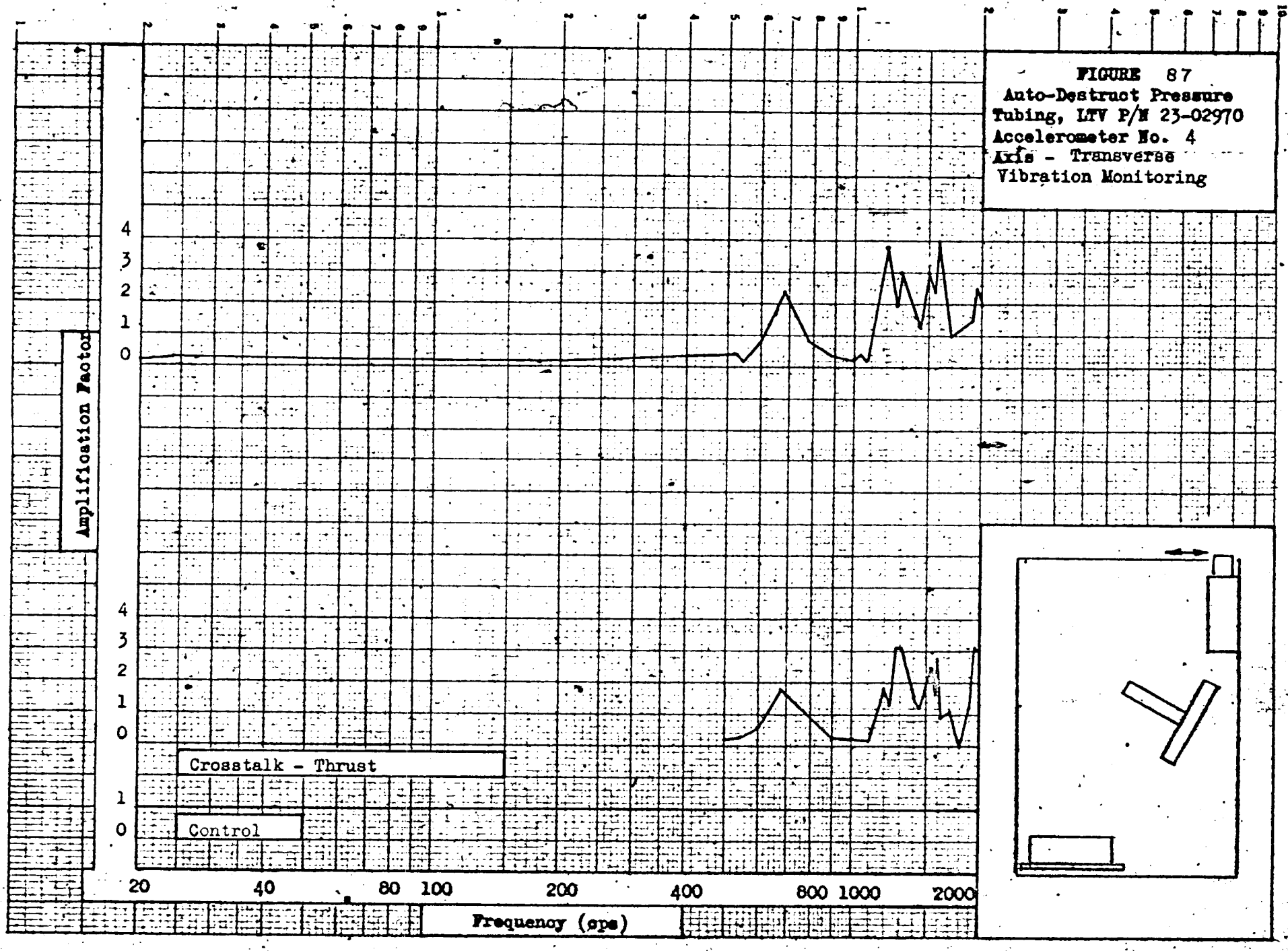
Control

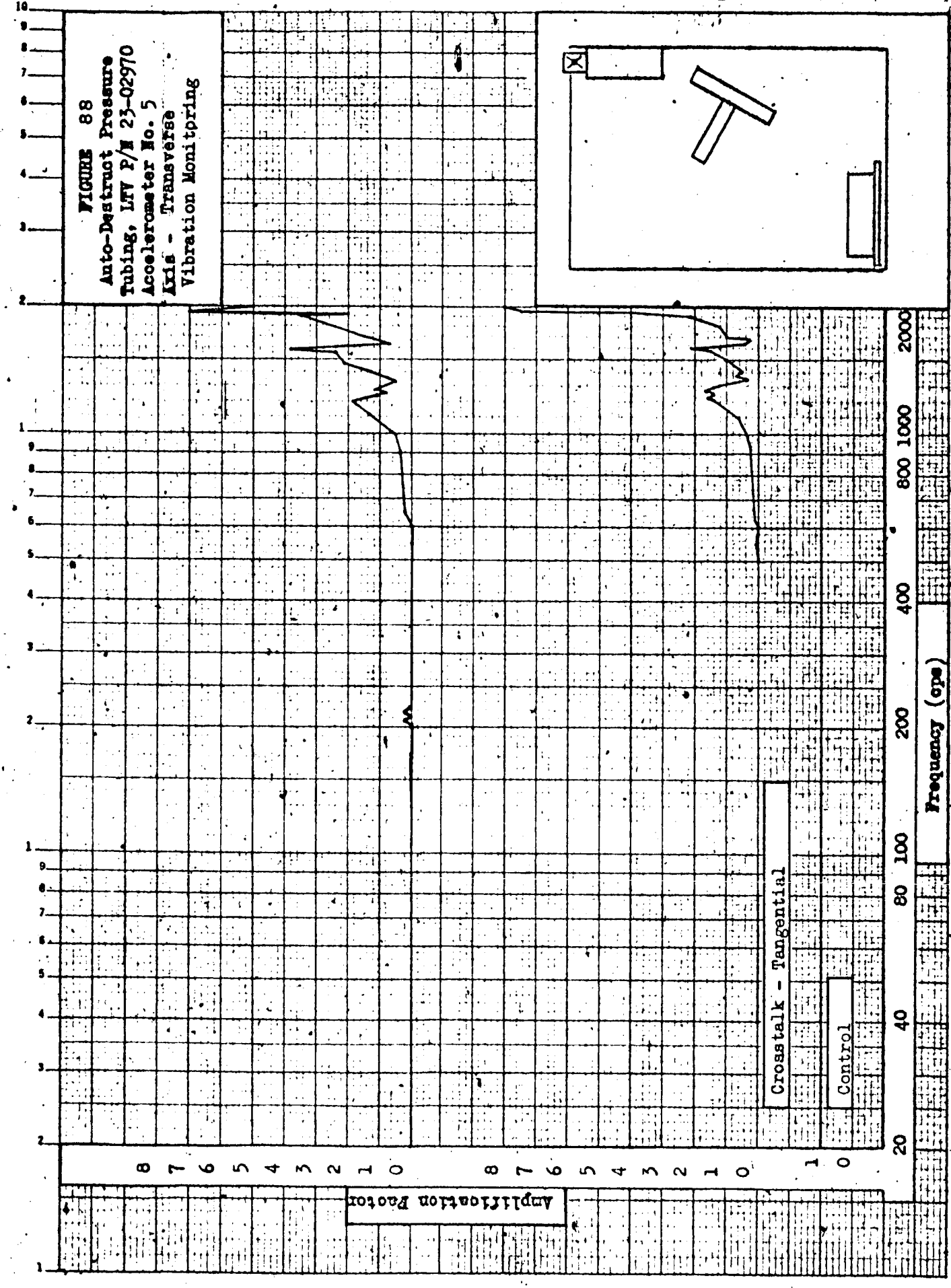
20 40 80 100 200 400 800 1000 2000

Frequency (cps)



KE SEMI-LOGARITHMIC 359-23
KEUFFEL & ESSER CO
3 CYCLES X 140 DIVISIONS


K•E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO
3 CYCLES X 140 DIVISIONS
FIGURE 87
Auto-Destruct Pressure
Tubing, LTV P/N 23-02970
Accelerometer No. 4
Axis - Transverse
Vibration Monitoring
Amplification Factor
4
3
2
1
0
Crosstalk - Thrust
Control
20
40
80
100
200
400
800
1000
2000
Frequency (cps)


FIGURE 88
Auto-Destruct Pressure
Tubing, LTV P/N 23-02970
Accelerometer No. 5
Axis - Transverse
Vibration Monitoring
Amplification Factor
Frequency (cps)
Crosstalk - Tangential
Control
20
40
80
100
200
400
800
1000
2000
K-E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO
3 CYCLES X 140 DIVISIONS

K&E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO. MADE IN U.S.A.
3 CYCLES X 140 DIVISIONS

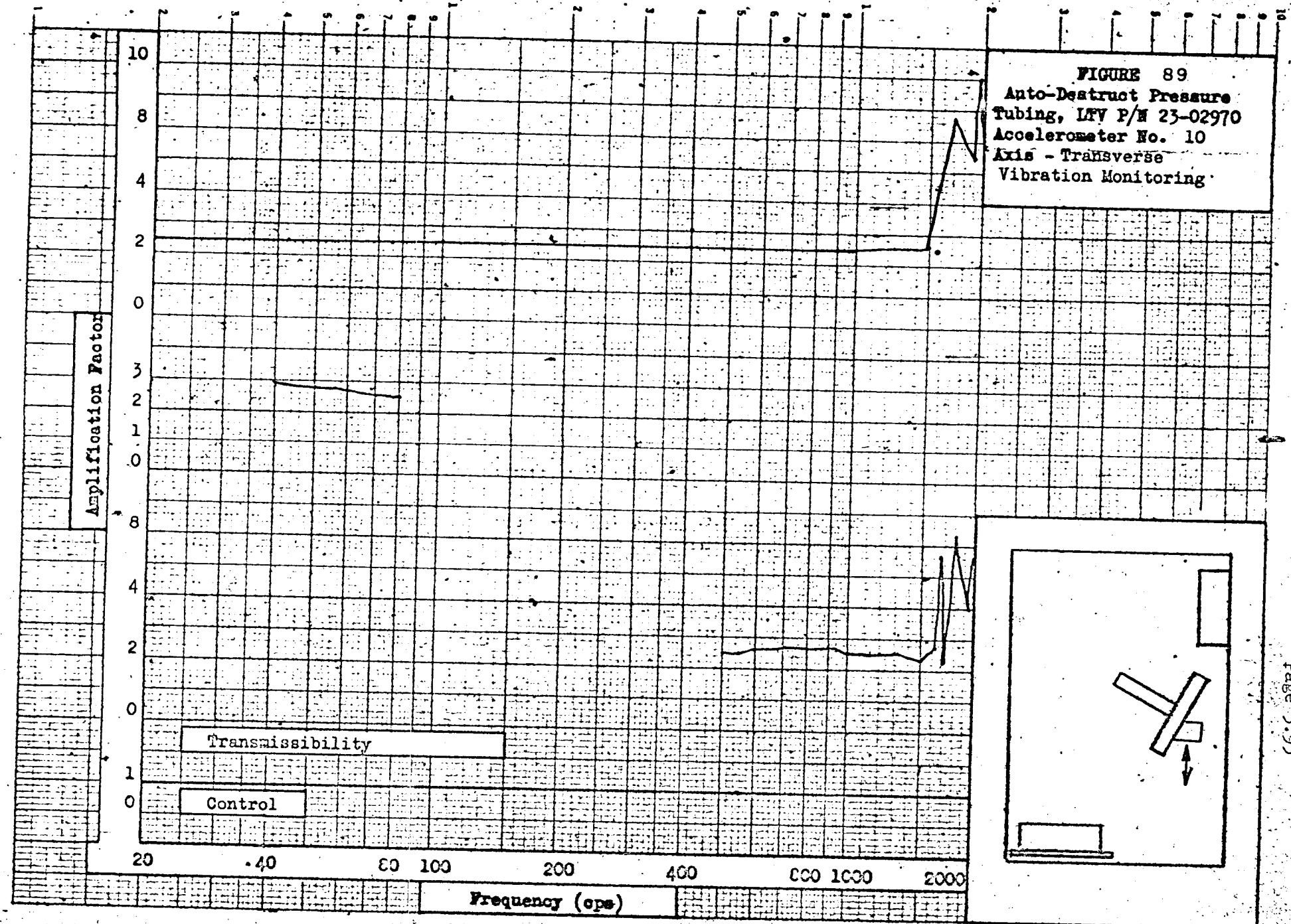


FIGURE 89
Auto-Destruct Pressure Tubing, LTV P/N 23-02970
Accelerometer No. 10
Axis - Transverse
Vibration Monitoring

K·E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO. MADE IN U.S.A.
3 CYCLES X 140 DIVISIONS

FIGURE 90
Auto-Destruct Pressure Tubing, LTV P/N 23-02970
Accelerometer No. 11 and 12
Axis - Transverse
Vibration Monitoring

Amplification Factor

10
100
10
100
10
100
10

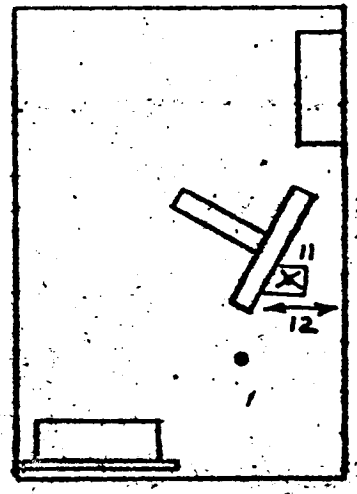
Accel. 12 - Crosstalk

Accel. 11 - Crosstalk

Control

20 40 80 100 200 400 800 1000 2000

Frequency (cps)



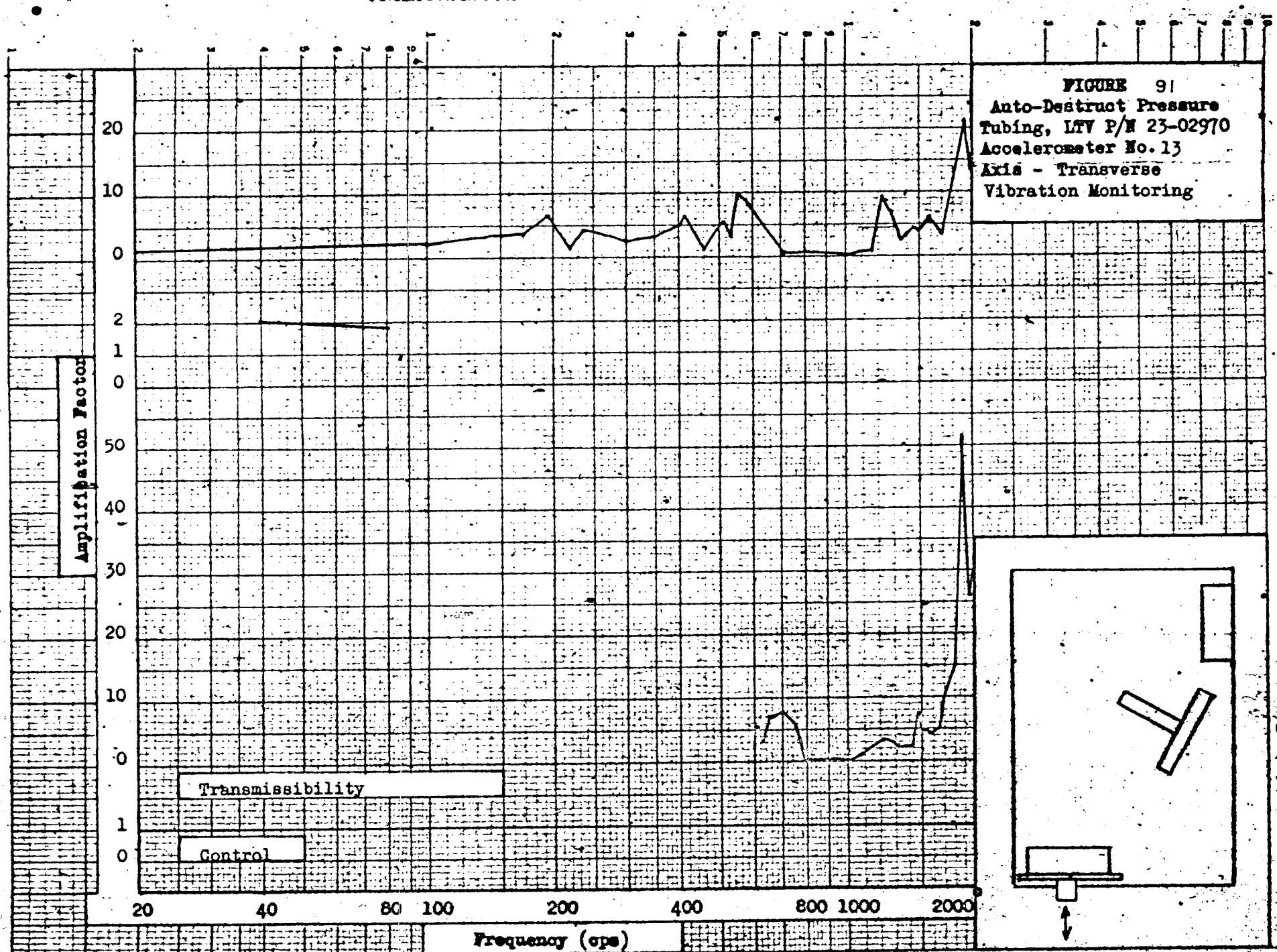


FIGURE 91
Auto-Destruct Pressure Tubing, LTV P/N 23-02970
Accelerometer No. 13
Axis - Transverse
Vibration Monitoring

K·E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO
3 CYCLES X 140 DIVISIONS

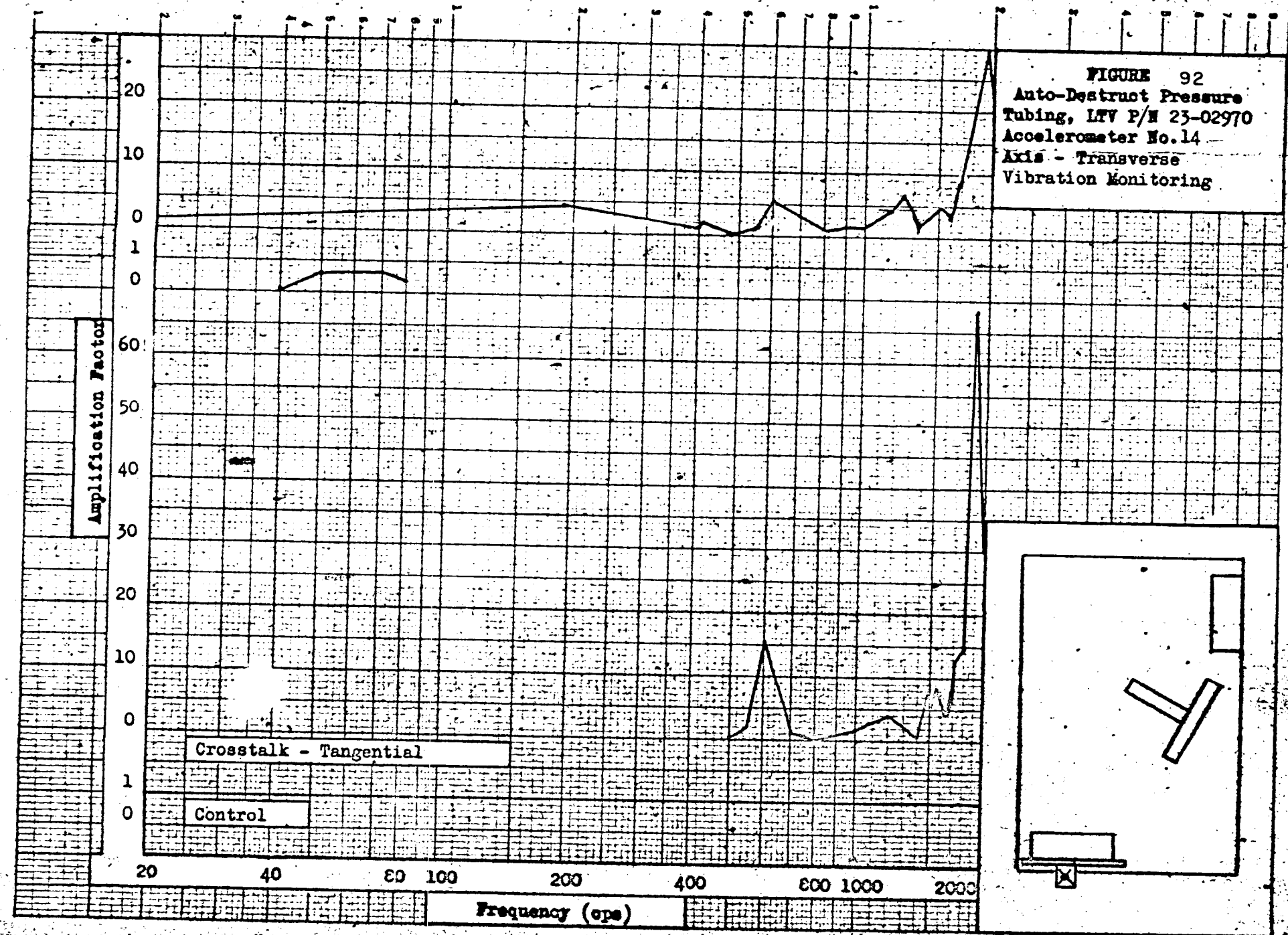
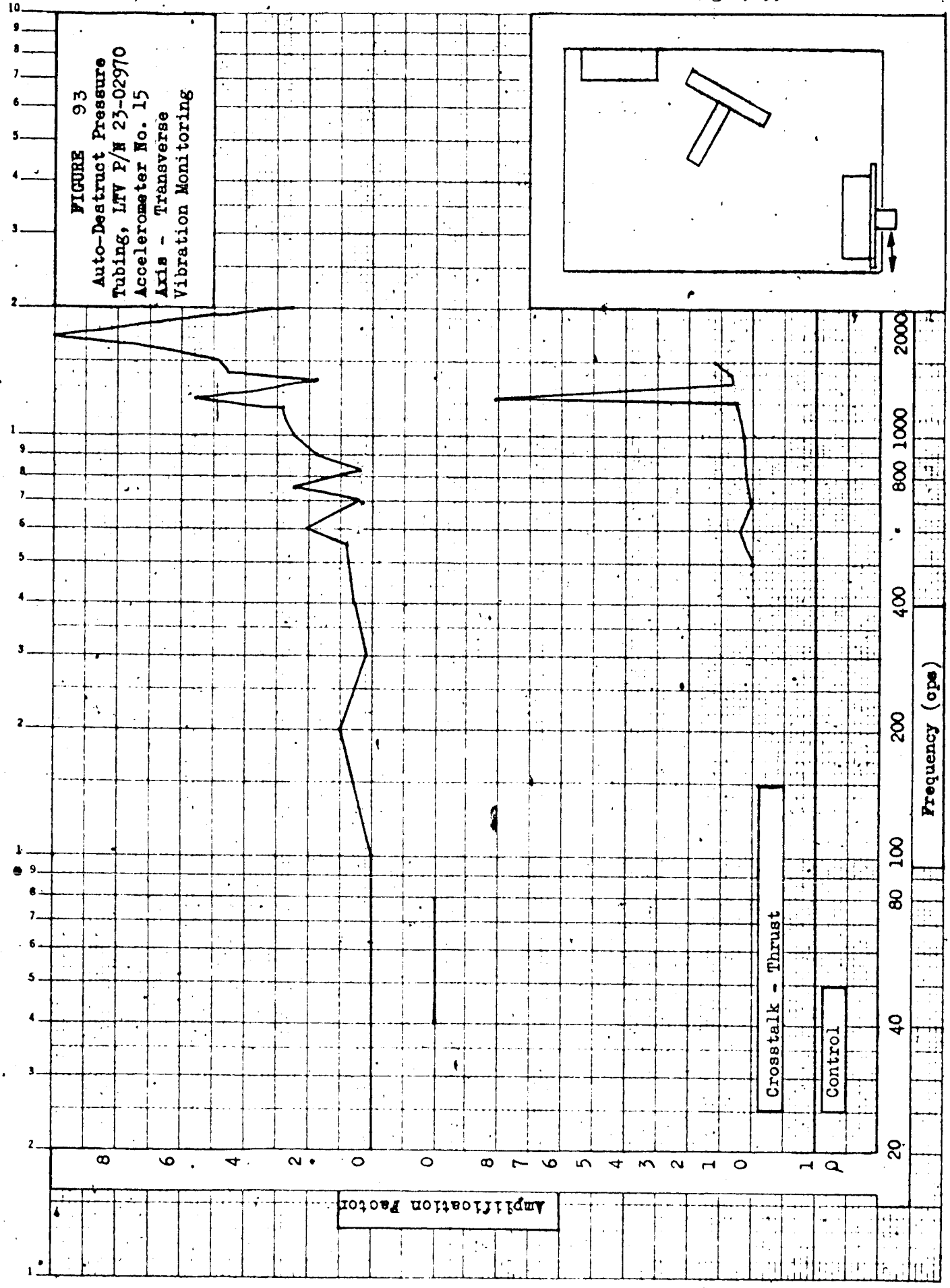


FIGURE 92
Auto-Destruct Pressure Tubing, LTV P/N 23-02970
Accelerometer No.14 — Axis - Transverse
Vibration Monitoring


FIGURE 93
Auto-Destruct Pressure Tubing, LTV P/N 23-02970
Accelerometer No. 15
Axis - Transverse
Vibration Monitoring
Amplification Factor
Frequency (cps)
Crosstalk - Thrust
Control
20
40
80
100
200
400
800
1000
2000

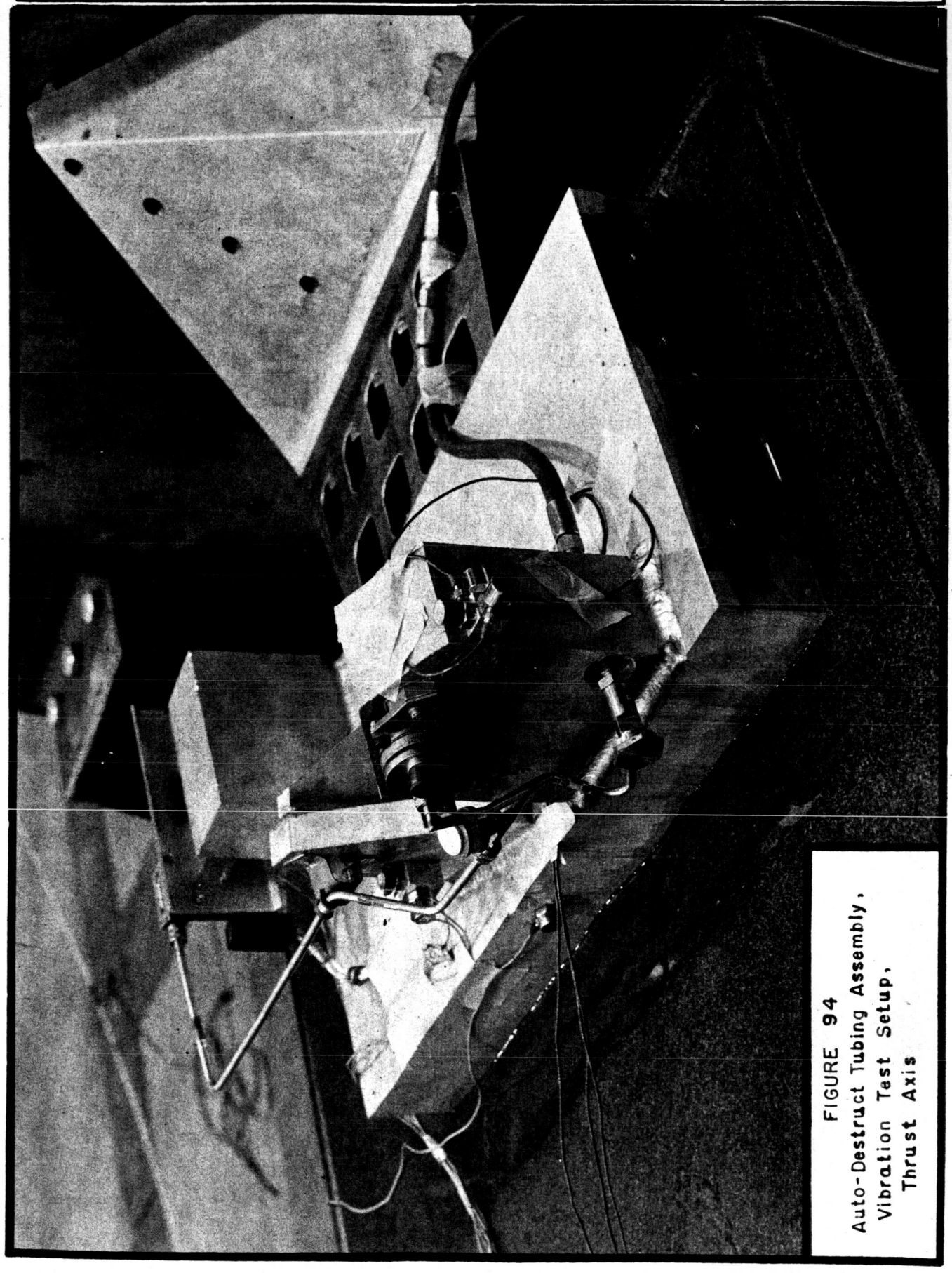


FIGURE 94
Auto-Destruct Tubing Assembly,
Vibration Test Setup,
Thrust Axis

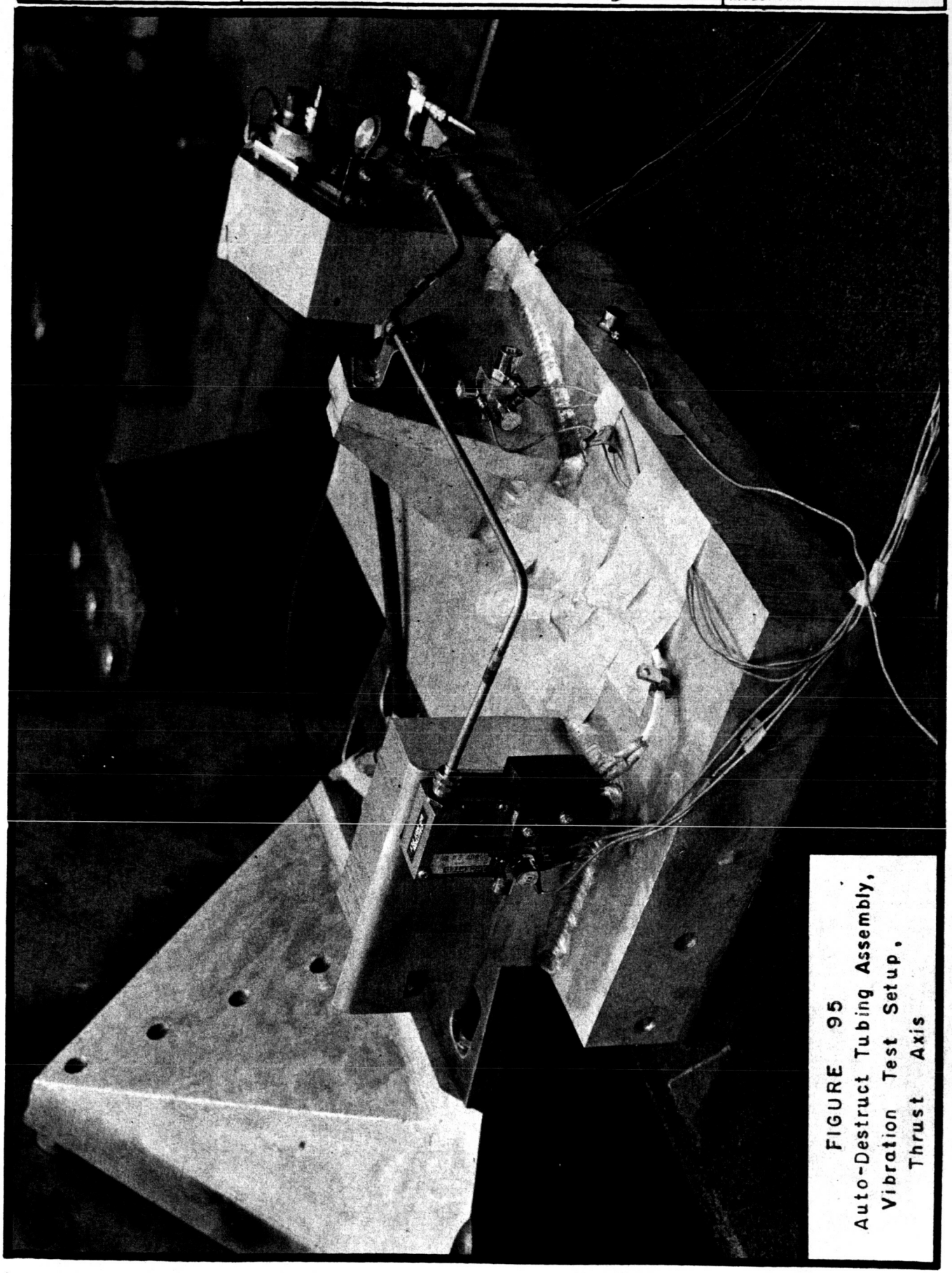


FIGURE 95
Auto-Destruct Tubing Assembly,
Vibration Test Setup,
Thrust Axis

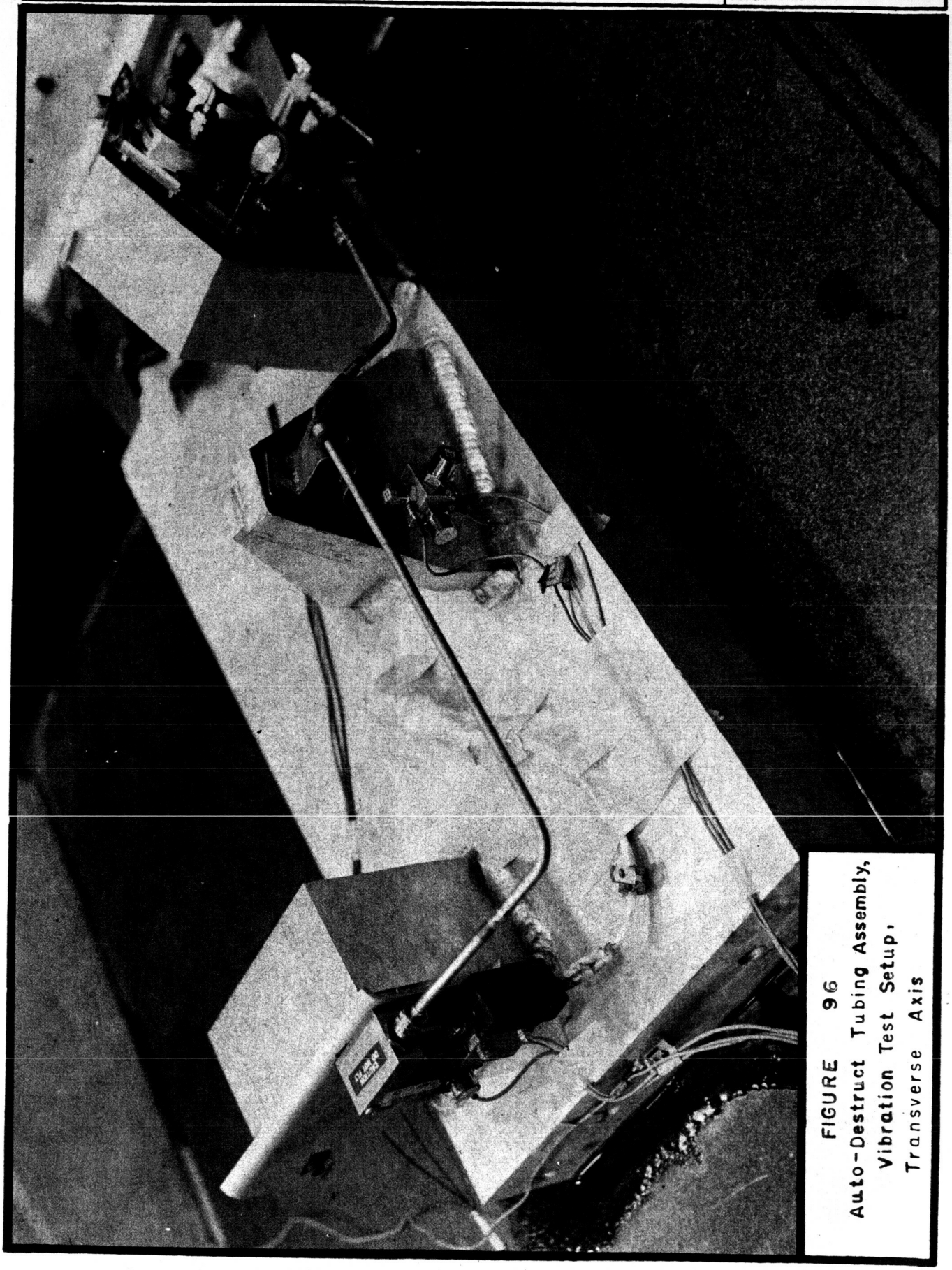


FIGURE 96
Auto-Destruct Tubing Assembly,
Vibration Test Setup,
Transverse Axis

FIGURE 97
Auto-Destruct Tubing Assembly, Vibration Qualification Test, Instrumentation Setup

TEST REQUEST-QUALIFICATION TESTING OF

THE AUTO-DESTRUCT MODULE AND TUBING ASSEMBLY

Paragraph 1. The Auto-Destruct Module

1.1 PURPOSE - The purpose of this test is to demonstrate the structural, mechanical and electrical adequacy of the Tunnel-Mounted Auto-Destruct Module by the successful completion of these environmental qualification tests.

1.2 TEST SPECIMEN - The test specimen shall be the prototype Tunnel-Mounted Auto-Destruct Module LTV P/N 23-002973.

1.3 TEST PROCEDURE -

1.3.1 Inspection - (1) Upon receipt of the test specimen, the laboratory personnel shall visually inspect it for evidence of damage received during shipping.

(2) After each environmental exposure the test specimen shall be inspected for mechanical degradation (cracks, loose parts, etc.). If a discrepancy is observed during testing, it shall be recorded on the data sheet and the Astro Reliability Engineering Representative shall decide whether to continue testing.

1.3.2 Pre-Environmental Performance Requirements - The test specimen shall be tested at standard laboratory (ambient) conditions. The results of this test shall be recorded and all further performance checks recorded and compared to these results.

1.3.2.1 Test Setup

1.3.2.1.1 With Tunnel Cover Removed

1. Disconnect P122 and P123 from J122 and J123 respectively. Place clean, dry plastic caps over J122 and J123 for protection.

2. If the lanyard pins are not installed, install them.

3. If the safety pin is installed in the S & A unit, remove it and do not replace it until test completion.

4. Check for continuity between pins 5 and 6 of P125 (continuity indicates that the S & A unit is in the safe position). If no continuity is indicated, apply 28 VDC momentarily to pins 2(+) and 1(-) of P125. Recheck for continuity between pins 5 & 6 of P125.

5. Connect the N_2 pressure source to the headcap pressure switch. Do not apply pressure. (Ensure that the pressure switch latch pins are disengaged).

1.3.2.1.2 Continuity Checks - With:

1. Lanyard pins installed in lanyard switches.
2. S & A unit in safe position.
3. No pressure applied to pressure switch.
4. No power applied at battery connectors.
5. Continuity is defined as a resistance indication of less than one (1) ohm. For an indication of greater than one (1) ohm, the value shall be recorded on the data sheet.
6. Check continuity as indicated by the table that follows:

P125 From Pin	P125 To Pin	Continuity Yes	No (value)
9	7		
5	6		
3 (+) *	1 (-) *		
2 (+) **	1 (-) **		

Power Circuit - * 4.8 to 6 ohms in SAFE position
** 4.8 to 6 ohms in ARM position
No continuity shall constitute failure.

1.3.2.1.3 Measure Resistance for Same Conditions:

From	To	Correct Value	Value Read
P124 - Pin 5	P124 - Pin 1	100 ± 6%	
P124 - Pin 3	P124 - Pin 2	ohms	

An out of tolerance reading shall constitute failure.

1.3.2.1.4 Pull the lanyard pin of switch S101 and read continuity between:

From	To	Continuity Yes	Continuity No (value)
Pin 5 of P122	Pin 4 of P124		
Pin 5 of P123	Pin 6 of P124		

A no continuity condition shall constitute failure.

1.3.2.1.5 Pull the lanyard pin of switch S102 and read continuity between:

From	To	Continuity Yes	No (value)
Pin 1 of J121	Pin 3 of P124		
Pin 4 of J121	Pin 5 of P124		

A no continuity condition shall constitute failure.

1.3.2.1.6 Gradually apply pressure to the headcap pressure switch. Monitor and record the pressure at which switch activation occurred as indicated on pins 2 and 1 of P121 also on pins 5 and 4 of P121. Switch activation shall occur at 100 to 150 psi. Stop applying pressure at 600 psi. Maintain the pressure constant at 600 psi. Check for continuity between pins 1 and 2 of P121 also between pins 4 and 5 of P121. A no continuity shall constitute failure.

1.3.2.1.7 (No power applied to P122 and P123). Momentarily apply 28 VDC to pins 3 (+) and 1(-) of P125. Check for continuity between pins 5 and 4 of P125 also pins 1 and 2 of P125. A no continuity condition shall constitute failure.

1.3.2.1.8 Apply 28 VDC to pins 2(+) and 1(-) of P125 (This places the S and A unit in "safe" position, check for continuity between pins 5 and 6 of P125.)

1.3.2.1.9 Gradually vent the pressure to the headcap pressure switch. Monitor and record the pressure at which switch deactivation occurs as indicated on pins 2 and 1 of P121, also on pins 5 and 4 of P121. Switch deactivation shall occur at 50, -10 psi, +12 psi.

1.3.2.2 Insulation Resistance Measurements- No pressure to the pressure switch, install lanyard pins, and make all electrical connectors. Using a megohmmeter, measure the insulation resistance between the pins indicated below. Record any value less than 2 megohms.

From	To	Check OK or record value Less than 2 Megohms
Pin 5 of P124	Pin 6 of P124	
5	3	
5	4	
5	2	
5	All pins of P125	
Pin 7 of P124	All pins of P124 and P125	

From	To	Check OK or record value Less than 2 Megohms
Pin 6 of P124	Pin 3 of P124	
6	4	
6	1	
6	2	
6	All pins of P125	
Pin 3 of P124	Pin 4 of P124	
3	1	
3	All pins of P125	
Pin 4 of P124	Pin 1 of P124	
4	2	
4	All pins of P125	
Pin 1 of P124	Pin 2 of P124	
	All pins of P125	
Pin 2 of P124	All pins of P125	
Pin 9 of P125	Pin 4 of P125	
9	5	
9	6	
9	2	
9	3	
9	1	
Pin 4 of P125	Pin 5 of P125	
4	6	
4	2	
4	3	
4	1	
4	7	

From	To	Check OK or record value Less than 2 Megohms
Pin 5 of P125	Pin 2 of P125	
5	3	
5	1	
5	7	
Pin 6 of P125	Pin 2	
6	3	
6	1	
6	7	
Pin 2 of P125	Pin 3 of P125	
2	1	
2	7	
Pin 3 of P125	Pin 7 of P125	
Pin 1 of P125	Pin 7 of P125	

1.3.2.3 Voltage Checks - With all electrical connectors mated:

1. S & A unit in safe position
2. 600 psi applied to pressure switch
3. Pull the lanyard pins of both switches
4. Monitor and record the following voltages under a one ampere load: (Resistive load applied between monitoring points)

Voltage Callout		From	To
11.5 ± 1 VDC	Sys #1	Pin 4 (-) P124	Pin 3(+) P124
11.5 ± 1 VDC	Sys #2	Pin 6(-) P124	Pin 5(+) P124

NOTE: Do not apply load more than 30 seconds. A voltage other than specified shall constitute failure.

5. Vent the pressure to the pressure switch and note that the voltages go to zero.
6. Disconnect P122 and P123 and place caps over J122 and J123 for protection.

1.3.3 Environmental Conditions Required - The environmental conditions required are vibration, shock, acceleration, temperature-shock, temperature-altitude, and humidity. The test procedure and test sequence shall be as follows:

1.3.3.1 A. Vibration - shall be conducted in accordance with paragraph 3.9 of LTV Specification 304-50 except that the "G" level, frequency range, and sweep rates shall be as specified in Table I. The vibration schedule of Table I shall be performed only one time for each axis. Random vibration shall be performed after the sinusoidal in each axis prior to orientation for vibration in another axis.

TABLE I

Test Duration (Sec.)	Frequency (cps)		Level	
	Lower	Upper	Random "G" RMS	Sine ± "G"
60	500	2000	-	8.0
240	40	80	-	4.5
144	20	2000	-	6.0
160	20	2000	3.0	-

Axes definitions are presented in Figure I on page 5.115.

1.3.3.1.1 Accelerometer Monitoring Requirements During Vibration - Accelerometers shall be mounted at the base of each component to monitor the vibration input. A minimum of two accelerometers per component shall be used. (This is inclusive of monitoring the sensitive axis.) Location of the accelerometers shall be designated by the LTV reliability engineer monitoring the test. After completion of the test, the data shall be reduced and presented on 8 1/2 x 11 graph of amplification factor versus frequency for all amplification factors greater than one. Each graph shall include a sketch showing vibration input axis and orientation of the monitoring accelerometer for the component involved. The reduced data shall be included in the test report.

1.3.3.1.2 Fixture Evaluation - Prior to the vibration test, the fixture shall be evaluated without the test specimen attached to the vibration exciter. The evaluation shall be performed utilizing a sufficient number of accelerometers or multiple sweeps so that information is obtained in each axis. The amplitude of vibration shall be ± 2 "G", frequency range of 20 - 2000 cps and sweep rate of 99 seconds. One accelerometer shall be designated as control. All accelerometer outputs shall be recorded and evaluated relative to the control output. Input spectrum shaping shall be utilized as required to provide the most uniform vibration input to the test specimen.

1.3.3.2 B. Shock - Shall be performed in accordance with paragraph 3.8 of LTV Specification 304-50. The total number, and direction of the shocks shall be as specified in paragraph 3.8.2 (c) of spec. 304-50 except that the magnitude shall be 30 g's. Axes orientations are shown in Figure I.

1.3.3.3 C. Acceleration - Shall be applied in both directions of the thrust axis only (Reference Figure I). It shall be performed in accordance with LTV Specification 304-50 paragraph 3.7 except that the acceleration level shall be 20 "G" and the time duration per direction shall be sufficient to determine proper operation of the test specimen but not less than two minutes.

1.3.3.4 D. Temperature Shock - Shall be performed in accordance with paragraph 3.3 of LTV Specification 304-50 except that the number of cycles shall be six (6).

1.3.3.5 E. Temperature - Altitude - The test specimen shall be placed in the test chamber and the internal chamber pressure shall be reduced as rapidly as possible to simulate 100,000 feet altitude (i.e., 0.32 inches of HG). While maintaining this altitude, heat shall be applied to the outer surface of the tunnel cover on the test specimen. The temperature profile of Figure II shall be followed as closely as possible. When the temperature of the inner surface of the tunnel cover reaches 335°F (i.e., at approximately 135 seconds on Figure II), external heating shall be concluded. From this point, the test shall be continued for no less than three nor more than five minutes as required to determine proper operation of the test specimen. After test specimen operation, the internal chamber pressure shall be increased to room ambient pressure and the temperature of the test specimen shall be allowed to stabilize to that of room ambient. The above shall constitute one complete cycle and shall be repeated five times for a total of six cycles.

1.3.3.6 F. Humidity - Shall be performed in accordance with paragraph 3.6 of LTV Specification 304-50 except that the number of cycles shall be 3 (i.e., 72 hours) instead of 10 (240 hours).

1.3.4 Performance Requirements During Application of Environments -

1.3.4.1 Vibration - System configuration for sinusoidal vibration shall be:

1. All electrical connectors mated (live batteries)
2. Lanyard pins installed in lanyard switches
3. 600 psi N_2 pressure applied to headcap pressure switch
4. S & A unit in "arm" position

1.3.4.1.1 Monitor on a continuous recorded for a no voltage condition as follows:

From	To
Pin 3(+) of P124	Pin 4(-) of P124
Pin 5(+) of P124	Pin 6(-) of P124

A voltage indication shall constitute failure

1.3.4.1.2 Monitor on a continuous recorder for continuity as follows:

From	To
Pin 4 of P125	Pin 5 of P125

From	To	
Pin 2 of P125*	Pin 1 of P125*	* Power circuit
Pin 7 of P125	Pin 9 of P125	

Discontinuity greater than 10 milliseconds shall constitute failure.

System configuration for random vibration shall be:

1. All electrical connectors mated.
2. Lanyard pins installed in the lanyard switches
3. 600 psi N_2 pressure applied to headcap pressure switch
4. S & A unit in "arm" position
5. After 40 seconds of random vibration remove lanyard pins

1.3.4.1.3 Monitor for continuity for the first 40 seconds across the following:

From	To
Pin 5(+) of P124	Pin 6(-) of P124
Pin 3(+) of P124	Pin 4(-) of P124

Discontinuity greater than 10 milliseconds shall constitute failure.

Prior to pulling lanyards, place the S & A in the SAFE position. Pull the lanyards and monitor continuously the voltages that appear as follows:

From	To	Correct Voltage
Pin 5(+) of P124	Pin 6(-) of P124	11.5 ± 1 VDC
Pin 3(+) of P124	Pin 4(-) of P124	

An out of tolerance voltage shall constitute failure.

1.3.4.1.4 Upon completion of sinusoidal vibration in each of the first two axes perform the following:

1. Place the S & A unit in the "safe" position and verify.
2. Pull both lanyard pins.
3. Measure and record under a one ampere load the following voltages: (Load will be applied at the monitor point)

From	To	Correct Voltage
Pin 3(+) of P124	Pin 4(-) of P124	11.5 ± 1 VDC
Pin 5(+) of P124	Pin 6(-) of P124	

Do not apply load for more than 30 seconds. An out of tolerance voltage shall constitute failure.

4. Vent the 600 psi applied to the pressure switch and note that the above voltages do not exist.
5. Install lanyard pins
6. Apply 600 psi N_2 pressure to pressure switch

1.3.4.1.5 After completion of vibration test and prior to subjecting the test specimen to shock, repeat the tests of paragraph 1.3.2.

1.3.4.2 Shock - Monitor the same as for sinusoidal vibration per paragraph 1.3.4.1. After completion of shock test and prior to subjecting the test specimen to acceleration, repeat tests of paragraph 1.3.2.

1.3.4.3 Acceleration - Monitor the same as for sinusoidal vibration per paragraph 1.3.4.1.(Note only one axis but both directions). Perform the test of paragraph 1.3.2.3 after acceleration in one direction and prior to continuing to the other direction. After acceleration and prior to subjecting the test specimen to the temperature-altitude, repeat the tests of paragraph 1.3.2.

1.3.4.4 Temperature-Shock - System configuration for each 30 minute temperature soak shall be:

1. All electrical connectors mated.
2. Lanyard pins installed in both lanyard switches.
3. Ambient pressure applied to the pressure switch.
4. S & A unit in the "arm" position.

1.3.4.4.1 At the end of each of the 30 minute temperature soak and prior to transferring the test specimen to the other test chamber, perform the following:

1. Check for a no voltage condition between the following pins:

From	To
Pin 3 of P124	Pin 4 of P124
Pin 5 of P124	Pin 6 of P124

A voltage indication shall constitute failure.

2. Place the S & A unit in the "safe" position
3. Apply 600 psi pressure to the pressure switch
4. Pull both lanyard pins
5. Monitor and record the voltages under a 1 ampere load as indicated: (Load applied between monitoring points)

From	To	Correct Voltage
Pin 3(+) of P124	Pin 4(-) of P124	11.5 $\pm$ 1 VDC
Pin 5(+) of P124	Pin 6(-) of P124	

An out of tolerance voltage shall constitute failure. Do not apply load for more than thirty seconds.

1.3.4.4.2 After completion of the last cycle and prior to subjecting the test specimen to temperature-altitude repeat the tests of paragraph 1.3.2.

1.3.4.5 Temperature-Altitude - System configuration for each cycle during application of altitude and temperature shall be:

1. All electrical connectors mated.
2. Lanyard pins installed in both lanyard switches.
3. 600 psi pressure applied to the pressure switch.
4. S & A unit in "armed" position

Note: Paint shall be stripped from the fiberglass tunnel covering prior to temperature-altitude exposure.

1.3.4.5.1 At the conclusion of external heating for each cycle and prior to repressurization perform the following operations:

1. Check for a no voltage condition between the following pins:

From	To
Pin 3 of P124	Pin 4 of P124
Pin 5 of P124	Pin 6 of P124

Any voltage indication shall constitute failure.

2. Place the S & A unit in the "safe" position.
3. Pull both lanyard pins
4. Monitor and record the voltages under a one ampere load as indicated: (Load applied between monitoring points)

From	To	Correct Voltage
Pin 3(+) of P124	Pin 4(-) of P124	11.5 ± 1 VDC
Pin 5(+) of P124	Pin 6(-) of P124	11.5 ± 1 VDC

Do not apply load for more than 30 seconds, an out of tolerance voltage shall constitute failure.

1.3.4.5.2 After completion of the last cycle and prior to subjecting the test specimen to humidity repeat the tests of paragraph 1.3.2.

1.3.4.6 Humidity - System configuration for each of the 24 hour cycles shall be:

1. All electrical connectors mated
2. S & A unit in "safe" position
3. Lanyard pins installed
4. No external pressure applied to the pressure switch

1.3.4.6.1 No monitoring required during humidity application. Within one hour after completion of the humidity test perform the tests of paragraph 1.3.2.2 except that a 1.0 megohm criteria is required.

1.3.5 Post-Environmental Performance Requirements - Repeat the tests of paragraph 1.3.2.

1.3.6 Reporting of Malfunctions

1.3.6.1 Failure of items to meet the requirements of this Test Request shall be recorded on Malfunction Report Form AST-40100. All applicable items on the report shall be completed by the originator.

1.3.6.2 The originator's copy of the Malfunction Report shall be retained by LTV MED Test Lab and the pink copy shall be forwarded to Astro Reliability Engineering within 24 hours. The master and all remaining copies shall be forwarded to Reliability Assurance, Astronautics Division.

1.3.7 Special Instructions for Batteries - In the event of an out-of-tolerance voltage condition, check the voltage at the battery connectors. If a battery voltage is low, recharge both the batteries and then repeat the check. In as much as this test is not intended to qualify the batteries, voltages of from 9.8 to 12.6 VDC during the test are considered acceptable.

Paragraph 2. The Auto-Destruct Tubing Assembly

2.1 Test Specimen - The test specimen shall be the Headcap Pressure Tubing Assembly as shown in Figure III. The tubing assembly configuration shall simulate vehicle installation.

2.2 Test Requirements - Vibration only is required. Vibration shall be applied one time in each of two axes. The two axes are (with respect to the vehicle) longitudinal (thrust), and transverse (radial). Fixture Evaluation shall be performed in each axis by the method outlined in paragraph 1.3.3.1.2 of this Test Request.

Any visual predominant vibration mode shape shall be explored immediately after completion of the vibration test in that axis. Exploration by a hand held vibrometer is suggested.

2.3 Test Procedure

2.3.1 Pre-Vibration - The tubing shall be visually inspected and then assembled on the test fixture. Respective torque values shall be as specified on Drawing 23-002970. The Tubing Assembly shall then be checked for leakage by applying 600 psi hydrostatic pressure. If any leakage is detected at connections, eliminate and proceed with test. Any leakage at seams shall constitute failure.

2.3.2 Vibration - Constant 600 psia hydrostatic pressure shall be applied during vibration. Leakage shall constitute failure.

2.3.3 Post-Vibration -

1. Check the torque on each connection and record the value.
2. Check for leakage similar to the procedure used during pre-vibration.

FIGURE I

DEFINITION OF AXES

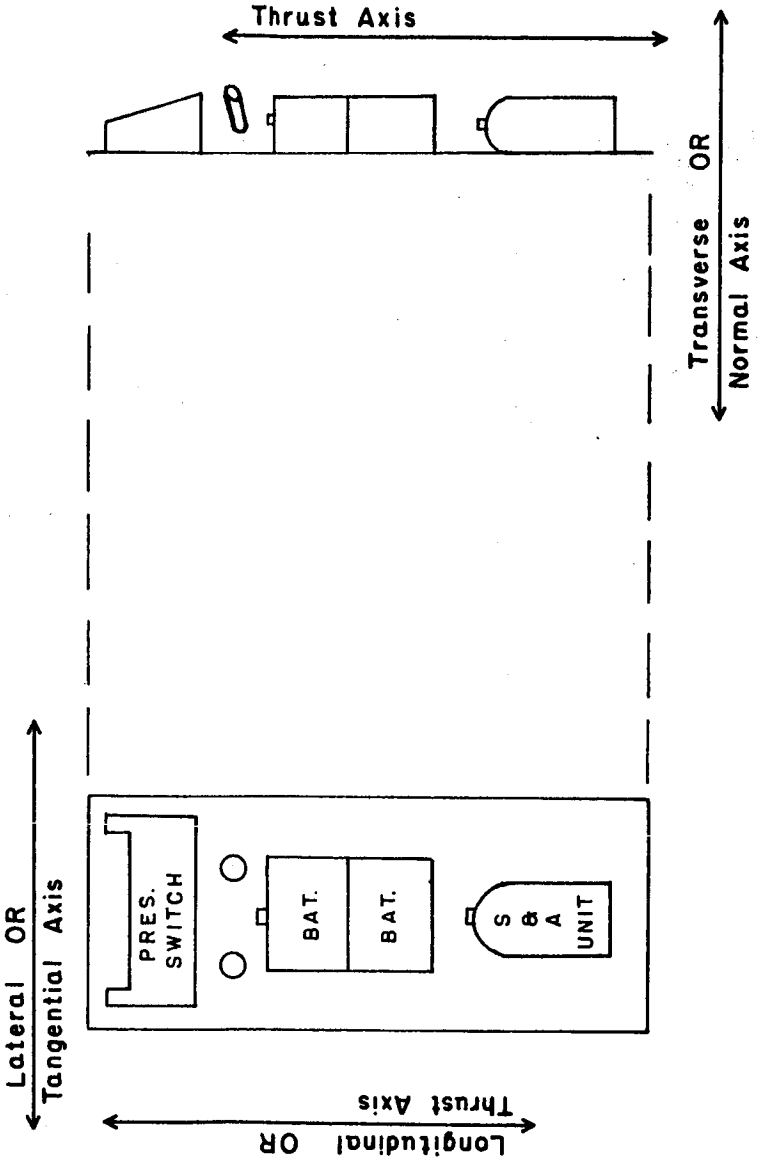


FIGURE II

Caution should be exercised to obtain this temperature profile without exceeding an external cover temperature of 450°F.

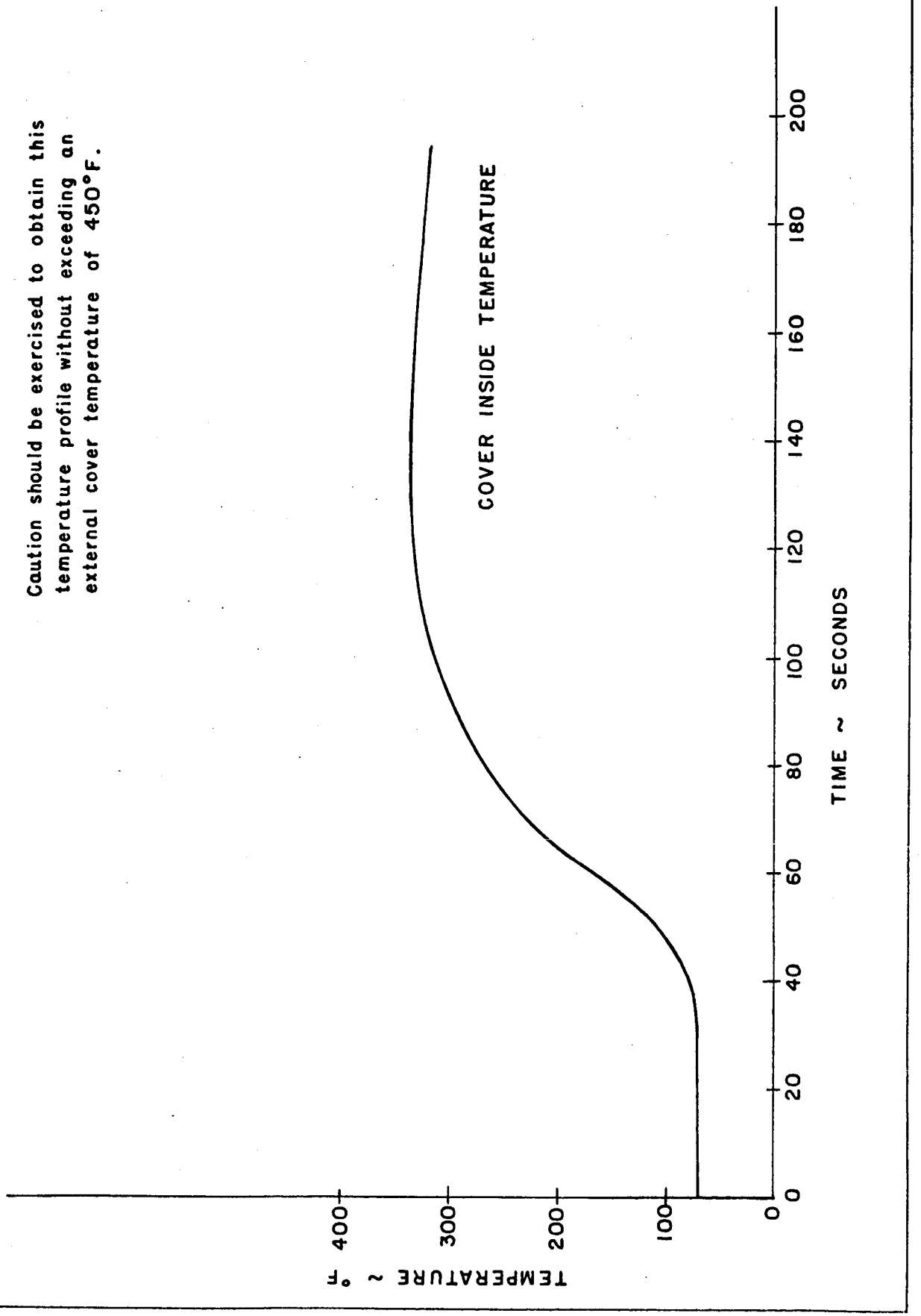
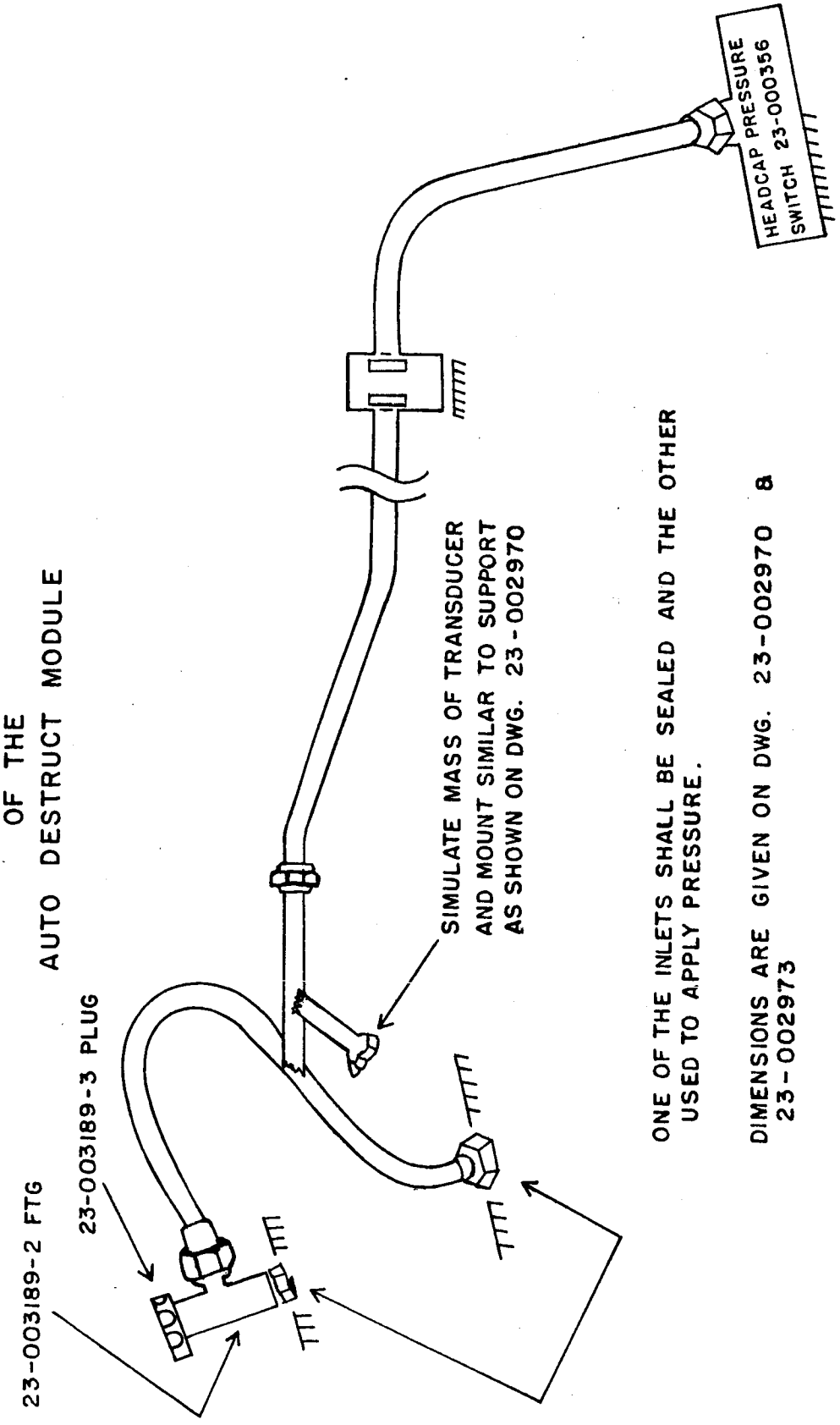


FIGURE III

VIBRATION TEST CONFIGURATION
FOR
HEADCAP PRESSURE TUBING ASSEMBLY
OF THE
AUTO DESTRUCT MODULE



ONE OF THE INLETS SHALL BE SEALED AND THE OTHER USED TO APPLY PRESSURE.

DIMENSIONS ARE GIVEN ON DWG. 23-002970 & 23-002973

//// ⟶ TUBING SUPPORTED AT THESE POINTS

USE HEADCAP PRESSURE SWITCH FROM AUTO DESTRUCT MODULE

CCN #1 DESIGN

APPENDIX A

INTRODUCTION

Under Contract NAS1-3899 Task Order 17 CCN Number 1, the contractor was authorized to incorporate a pressure check capability into the Tunnel Mounted Auto Destruct Module Installation. The contractor was authorized (Reference NASA TWX S-9488 dated 25 March 1965) to furnish the necessary services and materials to accomplish the following:

(A) Incorporate provisions in the designs of the Scout B and C section Tunnel Mounted Auto-destruct Module Installations for pressure checking the associated plumbing installation up to 150 percent of the pressure anticipated during flight. Dual seals shall be used on any joint that cannot be pressure checked to above levels.

(B) Fabricate necessary tubing installations for paragraph D below and the prototype module installation required under the task order.

(C) Provide detailed procedures (on appropriate drawings) for installation of the system on the vehicles, performance of pressure checks and preparation for flight.

(D) Demonstrate mechanical fit, pressure check capability and accessibility requirements using appropriate Scout hardware.

(E) Provide the test plans and perform the necessary tests to qualify the system as part of the module installation designs required under the task order.

(F) Update and incorporate all E.O.'s on drawings and submit final drawings to NASA.

(G) Include this item in reports to be submitted under this task order.

The contractor has performed a design study to incorporate a dual seal on the joints between the Scout first and second stage motor and the pressure lines and found that the "pipe thread" port in the motor does not lend itself to making a double seal type joint. The pipe thread is considered the primary seal, and an "O" ring installed in conjunction with the pipe thread would be considered the secondary seal. Since the pipe thread depends upon a "jam" condition for sealing, the final position of the "O" ring retaining surface on the pipe fitting cannot be predicted within 0.05 inch. This figure is the result of installation and thread tolerances.

Other designs investigated included special retainers using two "O" rings for sealing or one "O" ring and paste type silicone compounds which would then age to a seal like consistency. These designs were considered inadequate and impractical. Such designs also precluded proper pipe thread installation since they blocked a view of the exposed threads which are counted to assure proper installation.

In view of the above, the contractor recommended no change in the current method of installation using General Electric RTV-88 as a thread sealant on both the first stage (23-002432) and the second stage (23-002430).

After a review by the NASA, it was agreed that no change would be made in the "pipe thread joint" seal on both the first and second stage motors. (Reference NASA TWX S-9922 dated 1 July 1965).

During the test on the basic Tunnel Mounted Auto Destruct Module, the 'g' levels were monitored on the module pressure switch while transition section inputs were being applied to the module. This monitored output on the pressure switch was then used as the 'g' level input for testing the pressure line to the motor head cap.

The pressure check capability developed under Contract NAS1-3899 Task Order 17 CCN Number 1 was designed and fabricated using the Vehicle 140C and subsequent configuration.

The vibration tests were conducted on the pressure line for the Scout first stage motor since it was considered most critical due to its longer length line.

APPENDIX A

TEST RESULTS

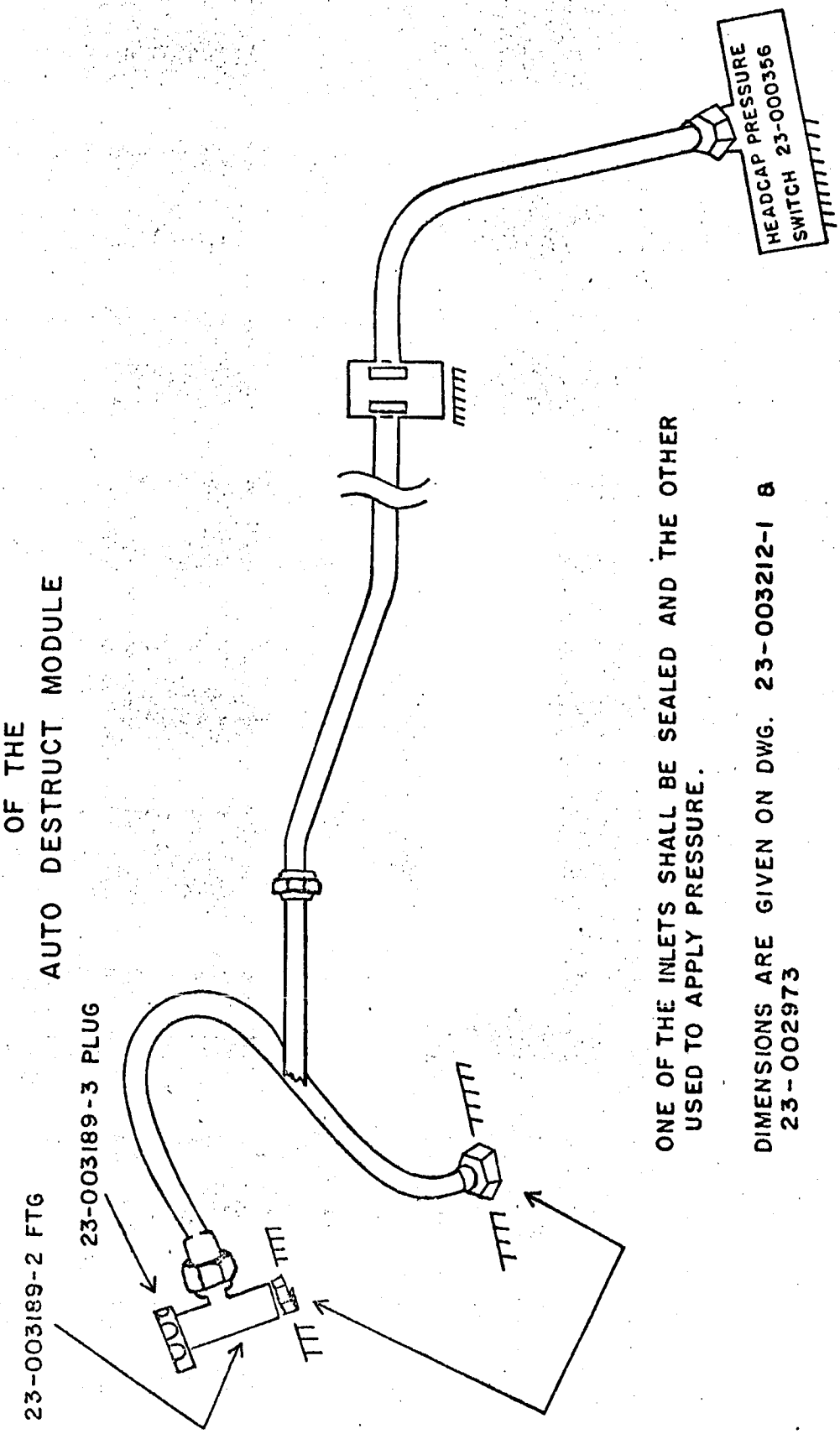
A test specimen of the headcap pressure tubing assembly, LTV P/N 23-003213-1 with the configuration simulating vehicle installation (Vehicle 140 and sub) was subjected to vibration qualification to demonstrate the design adequacy of the assembly. The configuration is shown in Figure 1. Vibration criteria utilized was in accordance with the test request enclosed herein as part of the basic report. The vibration test was conducted in accordance with test request TR No. 3-52300.0024, Rev. A, Amendment 1C for both the transverse and thrust axes.

The major difference between the previous configuration (P/N 23-002970) and the present configuration (P/N 23-003212-1) is that the section of tubing to the simulated transducer has been deleted as indicated in Figure 1. This section of tubing and transducer is not required for vehicles 140 and sub. With the tubing, transducer, and mounting point removed, the requalification of this assembly was deemed necessary. While undergoing vibration, support bracket P/N 23-003212-9 broke loose from the test fixture during the 20 - 2000 cps vibration sweep at approximately 500 cps, in the transverse axis. The adhesive Epon 934 which was utilized in attaching the bracket was completely removed and replaced with RTV-88 as directed by the Test Laboratory's Change Notice No. 4-24300 W/5CN-Scout-189. The test was repeated in the transverse axis and then in the thrust axis with no discrepancies occurring. LTV production drawings have been changed to reflect the use of RTV-88 adhesive in place of Epon 934. Complete test results are presented herein. Figure 2 illustrates the mounting set-up of the headcap pressure tubing assembly for the vibration test. Figure 3 shows the support bracket bonded to the test fixture with RTV-88 adhesive. Figures 3A through 3I indicate the vibration monitoring of the tubing assembly in the transverse axis utilizing accelerometers. Figures 3J through 3S indicate the vibration monitoring of the tubing assembly in the thrust axis utilizing accelerometers.

The results obtained after completion of the vibration test were satisfactory and it is concluded that the auto-destruct headcap pressure tubing assembly satisfies the Scout Environmental Qualification Criteria.

FIGURE 1

VIBRATION TEST CONFIGURATION
FOR
HEADCAP PRESSURE TUBING ASSEMBLY
OF THE
AUTO DESTRUCT MODULE



ONE OF THE INLETS SHALL BE SEALED AND THE OTHER USED TO APPLY PRESSURE.

DIMENSIONS ARE GIVEN ON DWG. 23-003212-1 & 23-002973

//// → TUBING SUPPORTED AT THESE POINTS

USE HEADCAP PRESSURE SWITCH FROM AUTO DESTRUCT MODULE

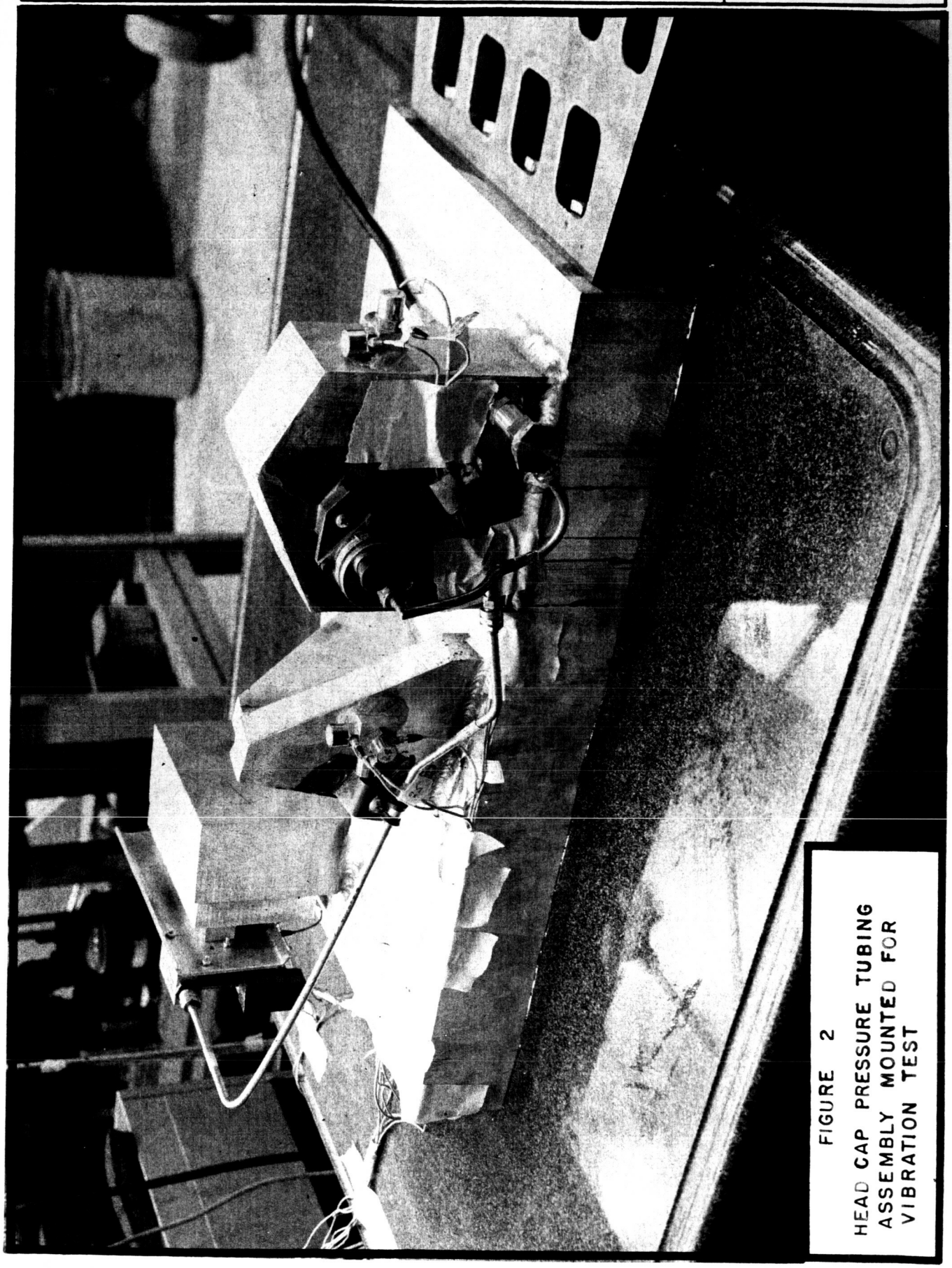


FIGURE 2

HEAD CAP PRESSURE TUBING ASSEMBLY MOUNTED FOR VIBRATION TEST

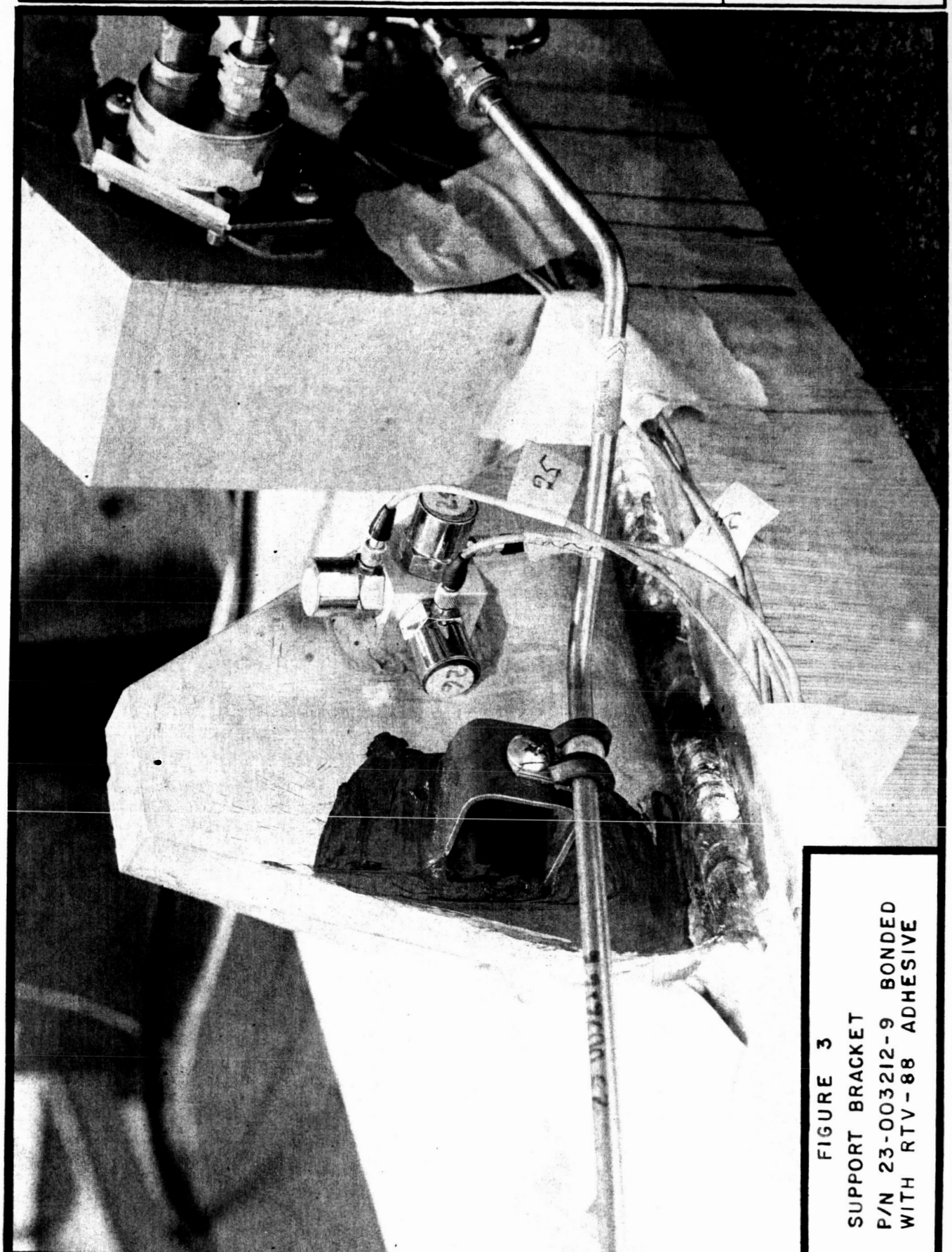
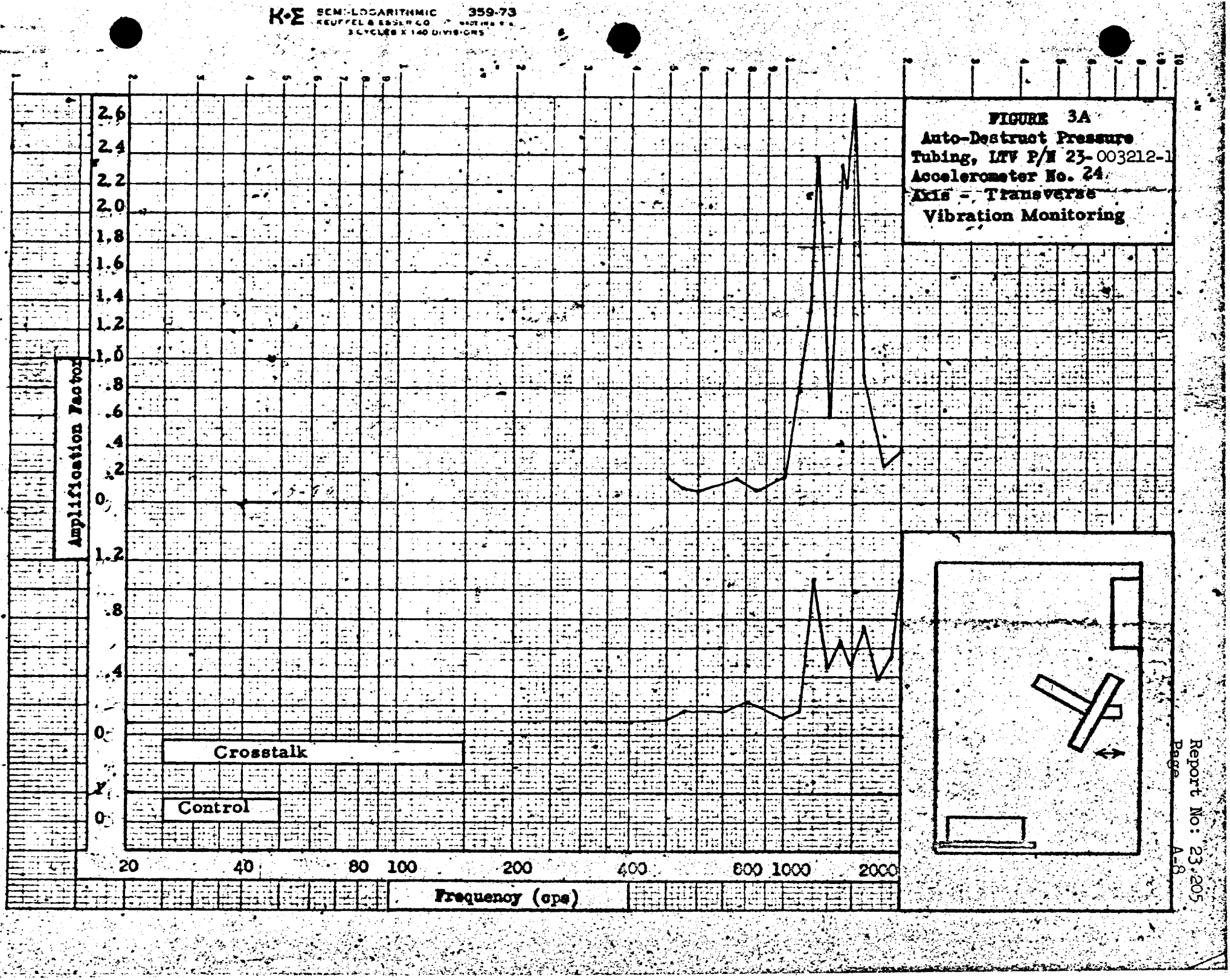
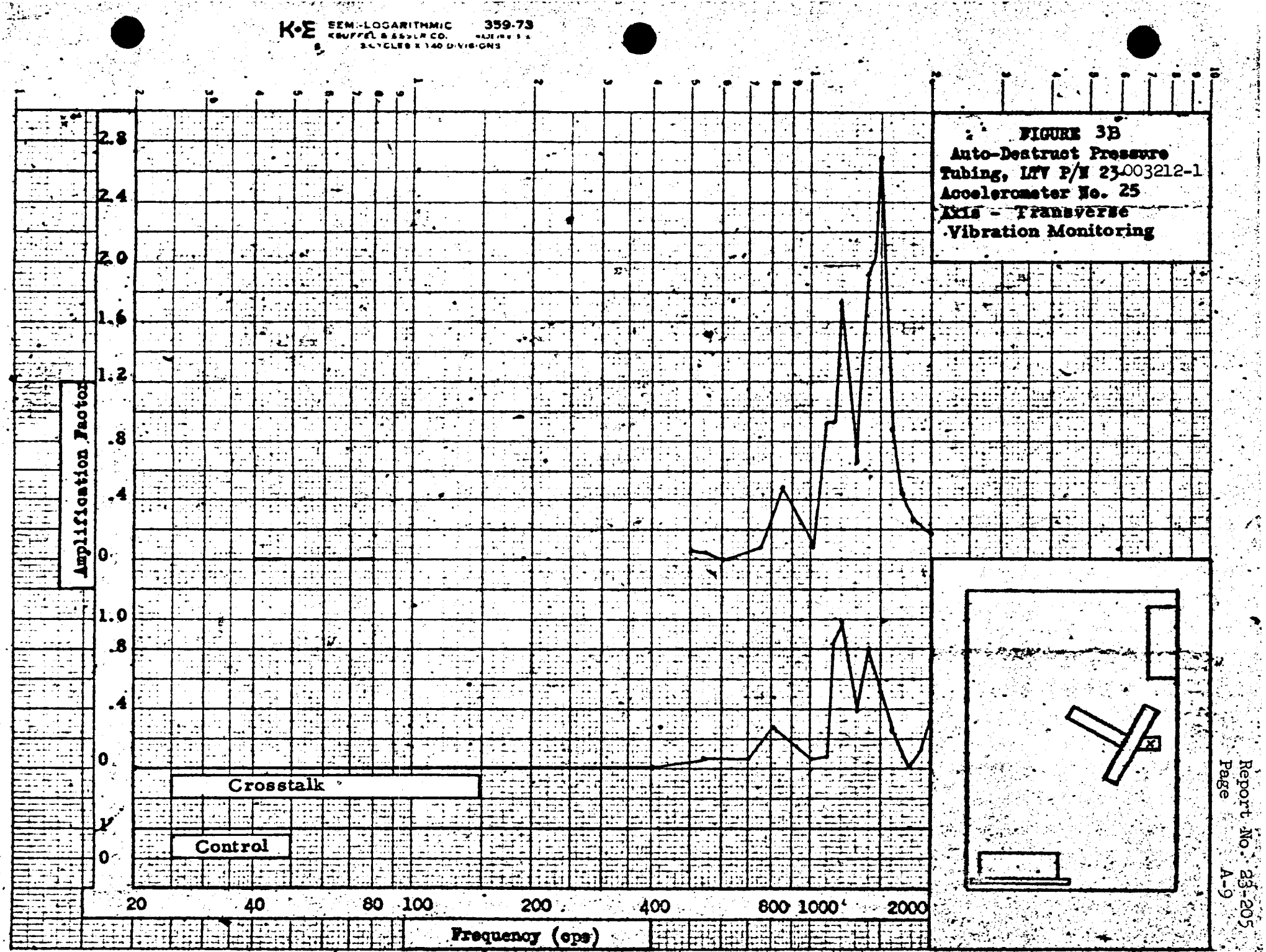
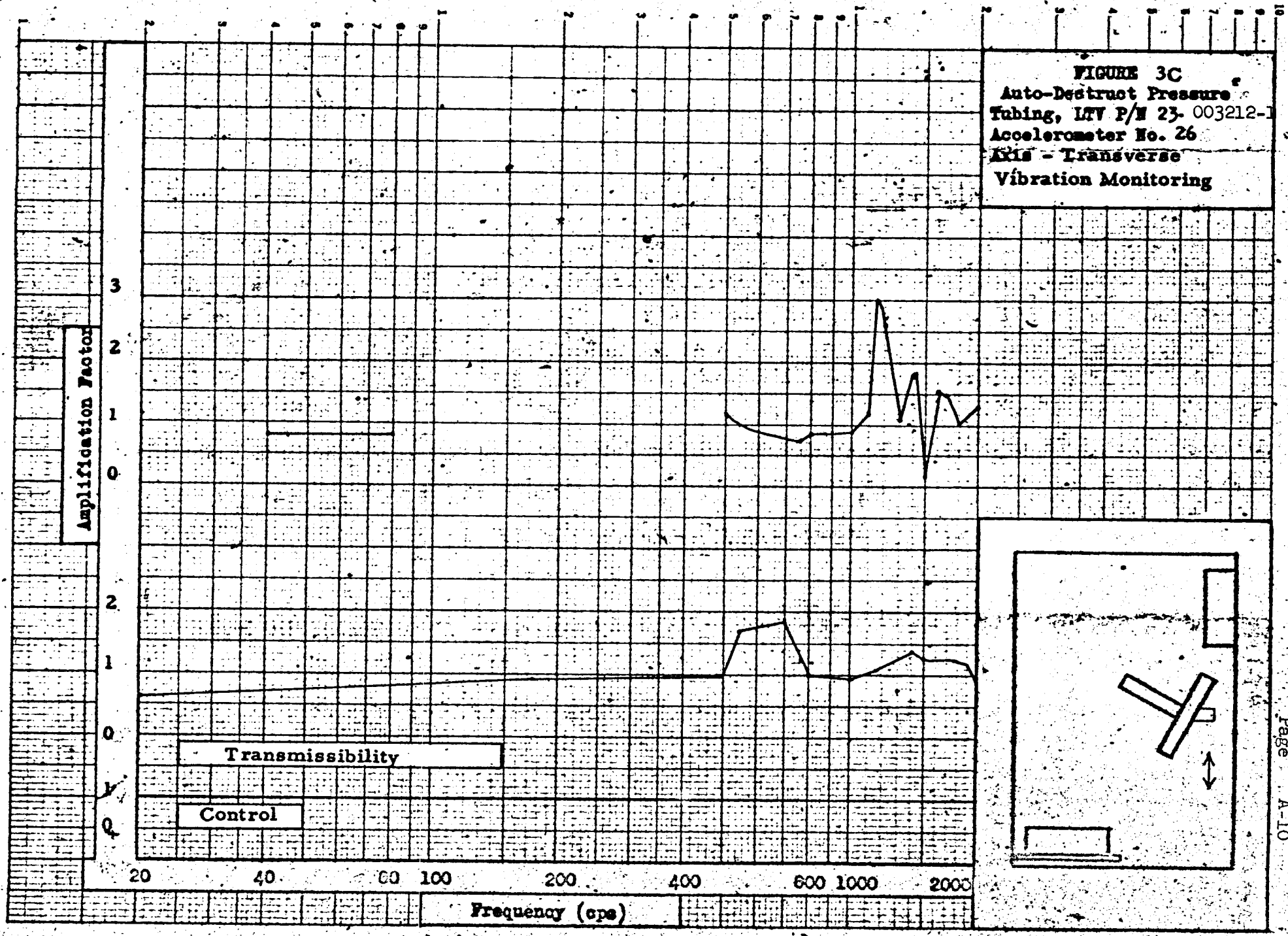
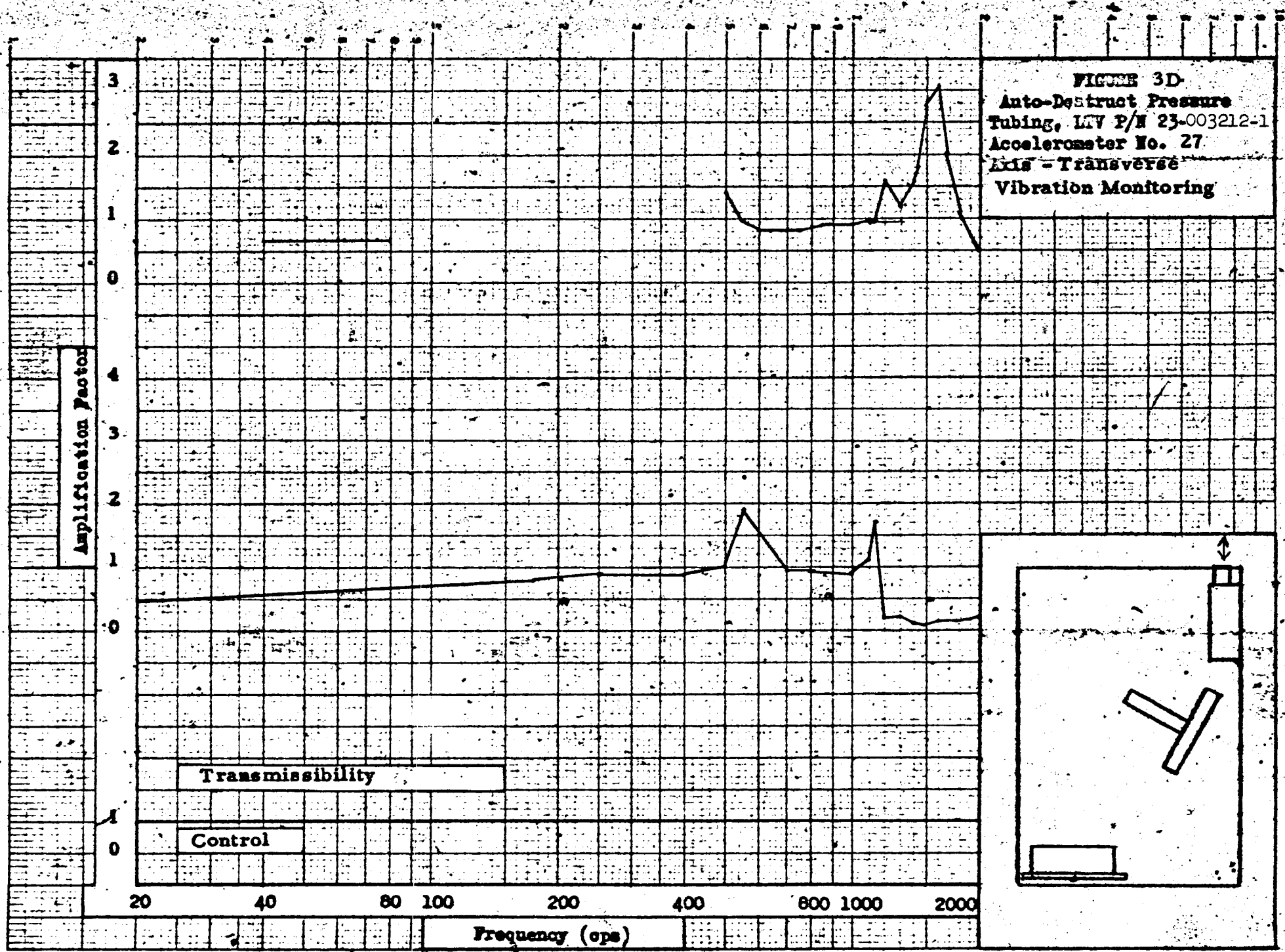


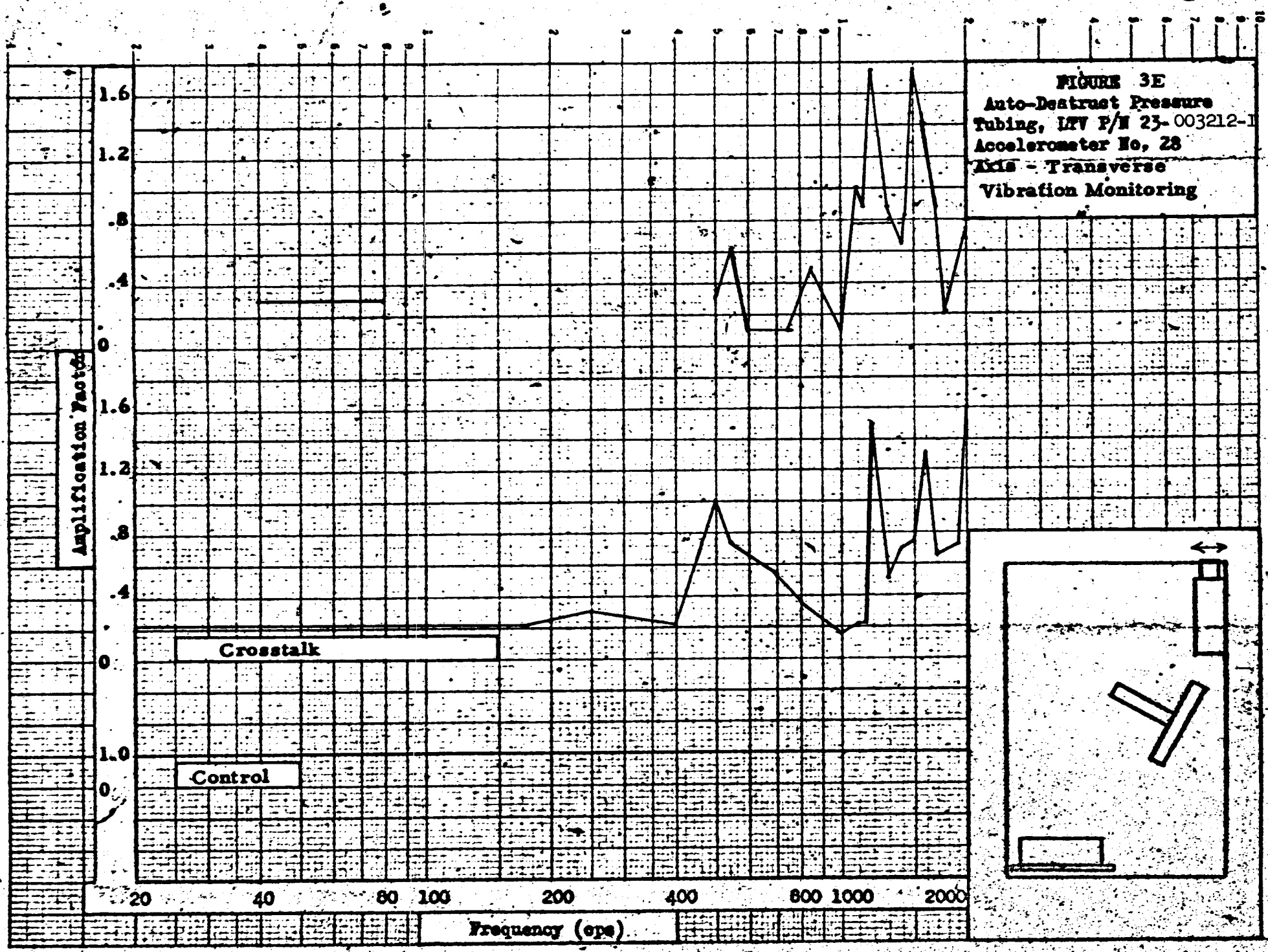
FIGURE 3
SUPPORT BRACKET
P/N 23-003212-9 BONDED
WITH RTV-88 ADHESIVE

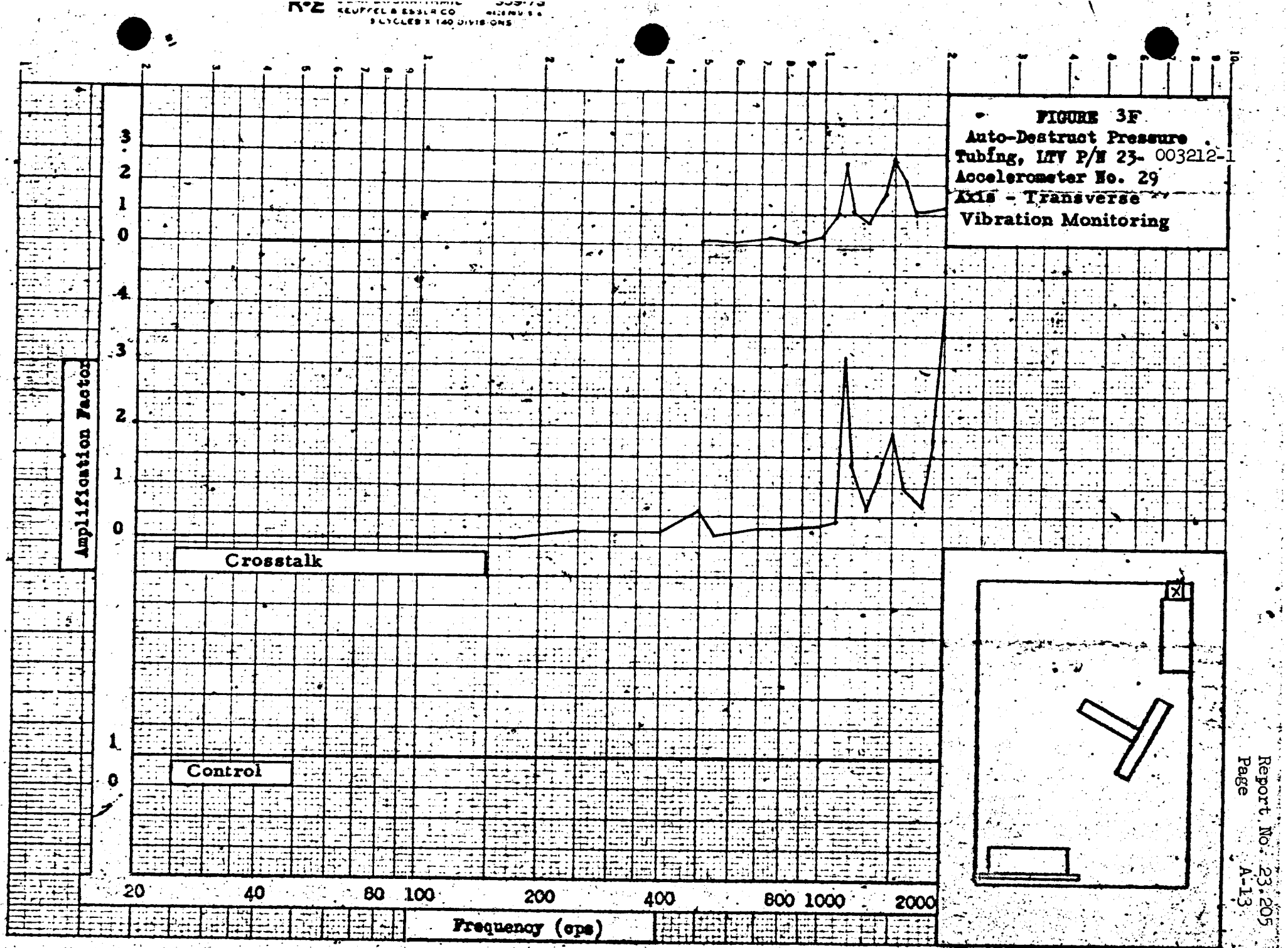

K·E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO
3 CYCLES X 140 DIVISIONS
FIGURE 3A
Auto-Destruct Pressure
Tubing, LTV P/N 23-003212-1
Accelerometer No. 24
Axis - Transverse
Vibration Monitoring
Amplification Factor
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
.8
.6
.4
.2
0
1.2
.8
.4
0
0
Crosstalk
Control
20
40
80
100
200
400
800
1000
2000
Frequency (cps)

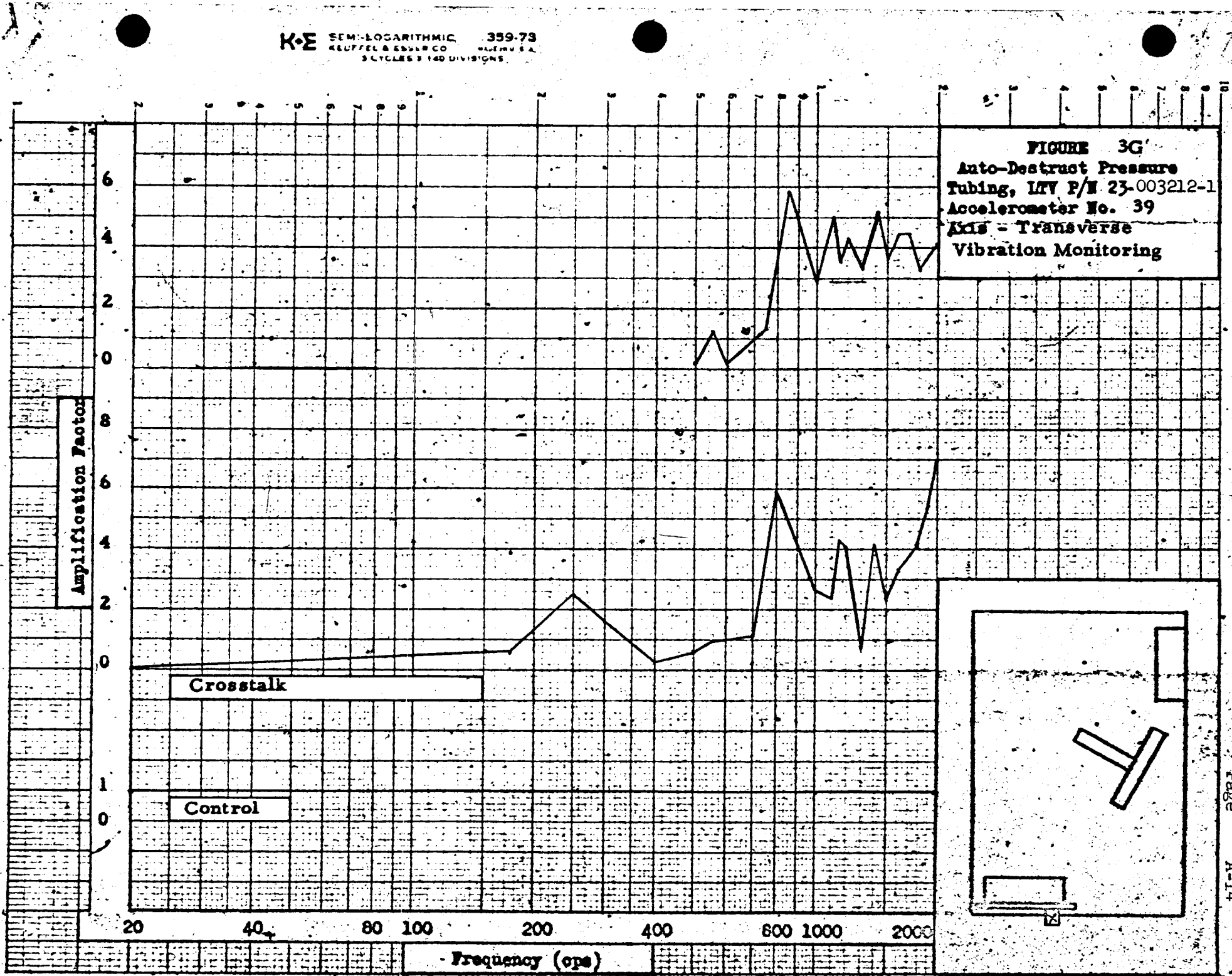

K&E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO.
3 CYCLES X 140 DIVISIONS
FIGURE 3B
Auto-Destruct Pressure
Tubing, LTV P/N 23-003212-1
Accelerometer No. 25
Axis - Transverse
Vibration Monitoring
Amplification Factor
2.8
2.4
2.0
1.6
1.2
.8
.4
0
1.0
.8
.4
0
0
Crosstalk
Control
20
40
80
100
200
400
800
1000
2000
Frequency (cps)


K·E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO.
3 CYCLES X 140 DIVISIONS
FIGURE 3C
Auto-Destruct Pressure
Tubing, LTV P/N 23-003212-1
Accelerometer No. 26
Axis - Transverse
Vibration Monitoring
Amplification Factor
3
2
1
0
2
1
0
Transmissibility
Control
20
40
60
100
200
400
600
1000
2000
Frequency (cps)


K·E SEMI-LOGARITHMIC 359-73
4 CYCLES X 140 DIVISIONS
FIGURE 3D
Auto-Destruct Pressure
Tubing, LTV P/N 23-003212-1
Accelerometer No. 27
Axis - Transverse
Vibration Monitoring
Amplification Factor
3
2
1
0
4
3
2
1
0
1
0
Transmissibility
Control
20
40
60
100
200
400
800
1000
2000
Frequency (cps)


K·E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO
3 CYCLES X 140 DIVISIONS
FIGURE 3E
Auto-Destruct Pressure
Tubing, LTV P/N 23-003212-1
Accelerometer No, 28
Axis - Transverse
Vibration Monitoring
Amplification Factor
1.6
1.2
.8
.4
0
1.6
1.2
.8
.4
0
1.0
0
Crosstalk
Control
20
40
60
100
200
400
800
1000
2000
Frequency (cps)


FIGURE 3F
Auto-Destruct Pressure Tubing, LTV P/N 23-003212-1
Accelerometer No. 29
Axis - Transverse
Vibration Monitoring
Amplification Factor
3
2
1
0
4
3
2
1
0
1
0
Crosstalk
Control
20
40
60
100
200
400
800
1000
2000
Frequency (cps)


K•E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO
3 CYCLES X 140 DIVISIONS
FIGURE 3G
Auto-Destruct Pressure
Tubing, LTV P/N 23-003212-1
Accelerometer No. 39
Axis - Transverse
Vibration Monitoring
Amplification Factor
6
4
2
0
8
6
4
2
0
1
0
Crosstalk
Control
20
40
80
100
200
400
600
1000
2000
Frequency (cps)

K·E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO
2 CYCLES X 140 DIVISIONS

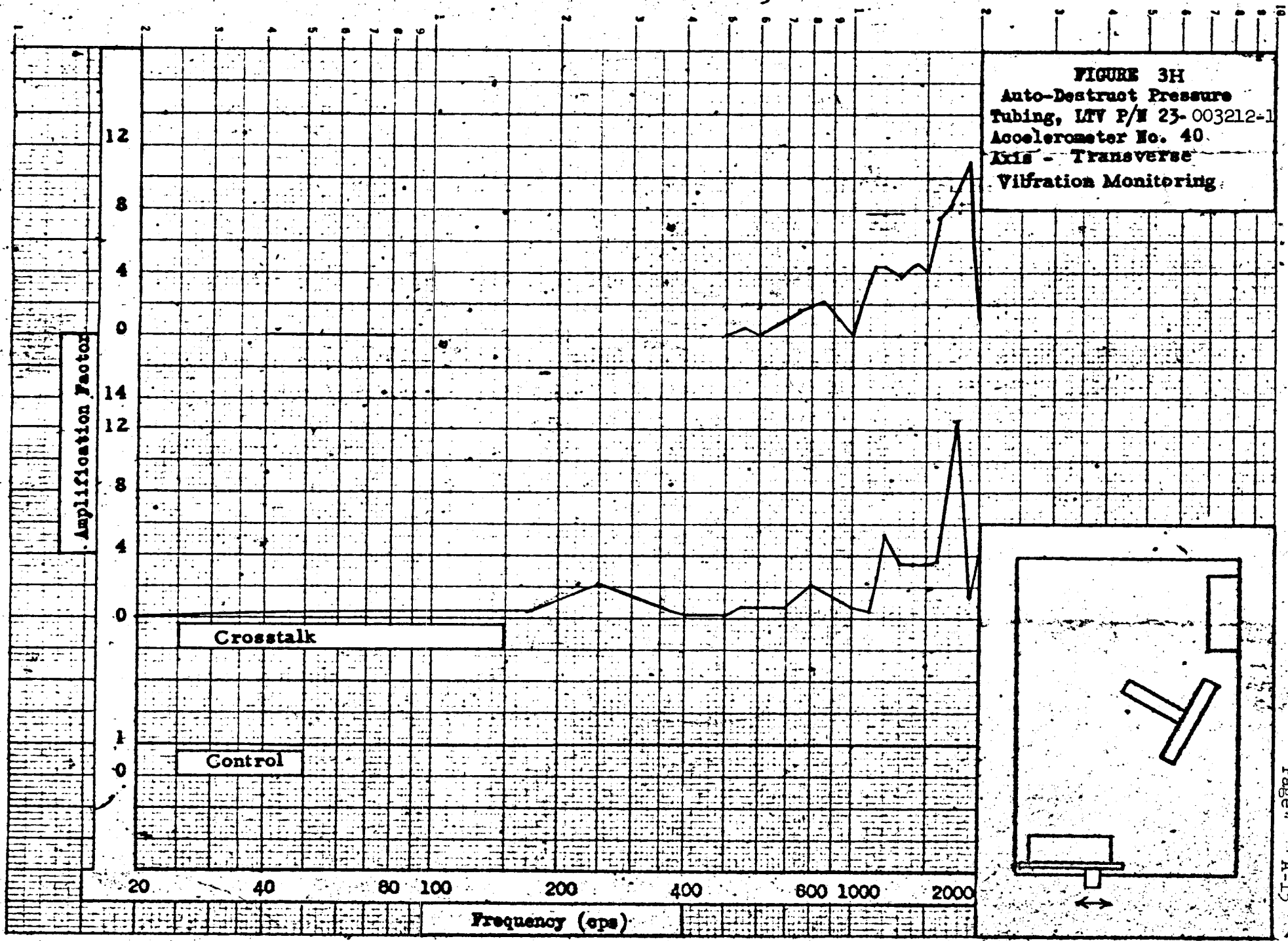
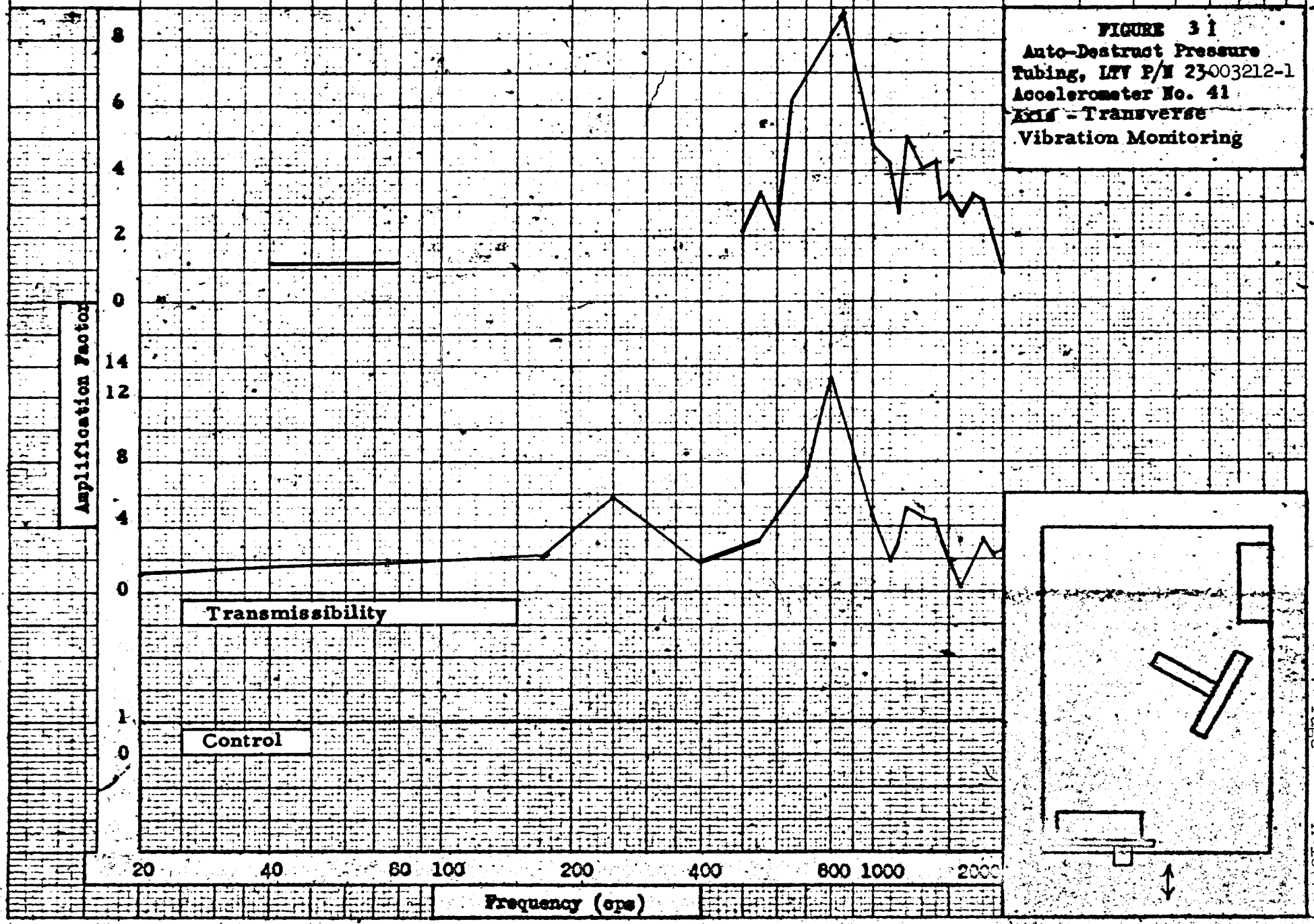
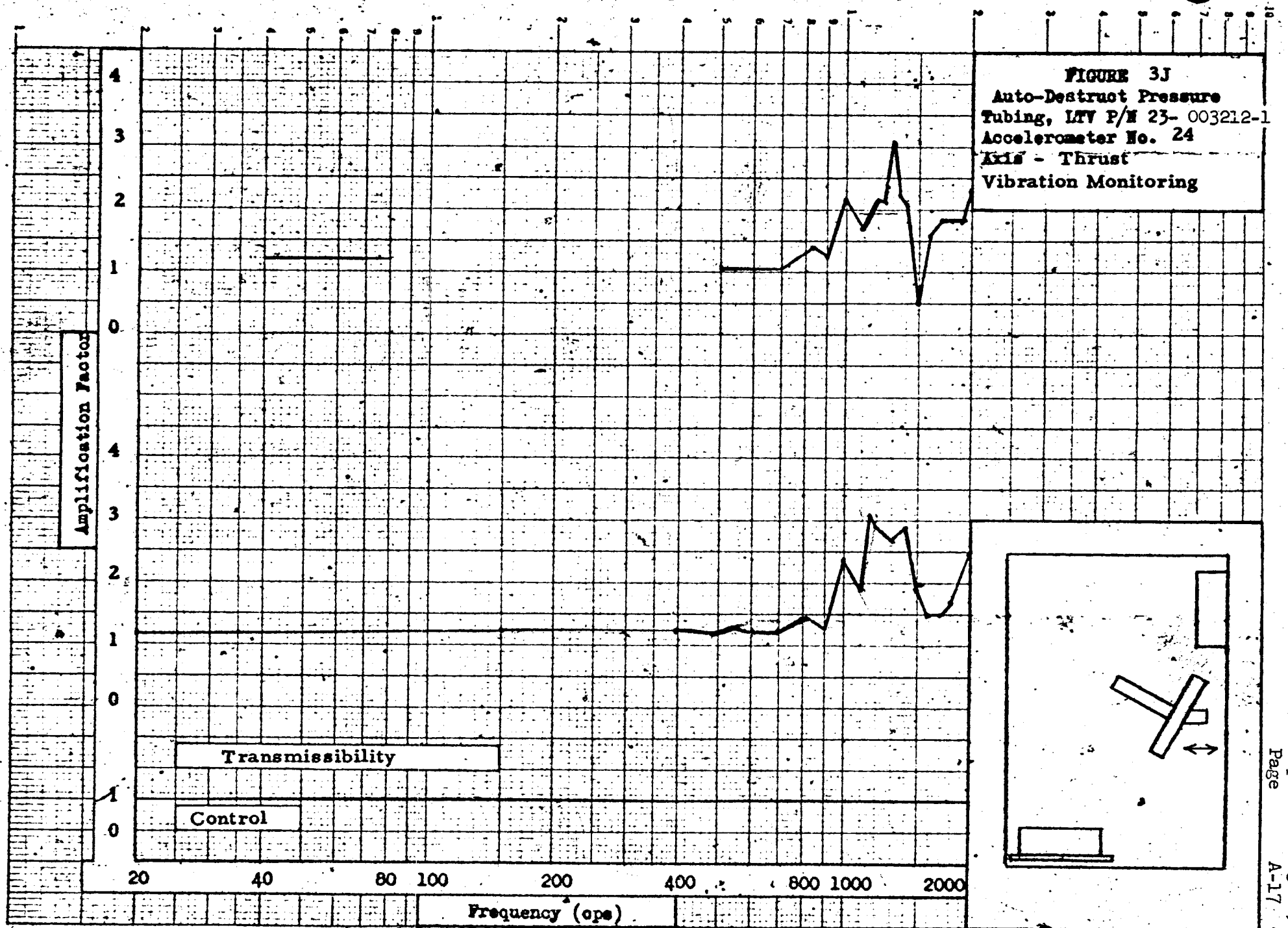


FIGURE 3H
Auto-Destruct Pressure Tubing, LTV P/N 23-003212-1
Accelerometer No. 40
Axis - Transverse
Vibration Monitoring

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3 CYCLES X 140 DIVISIONS

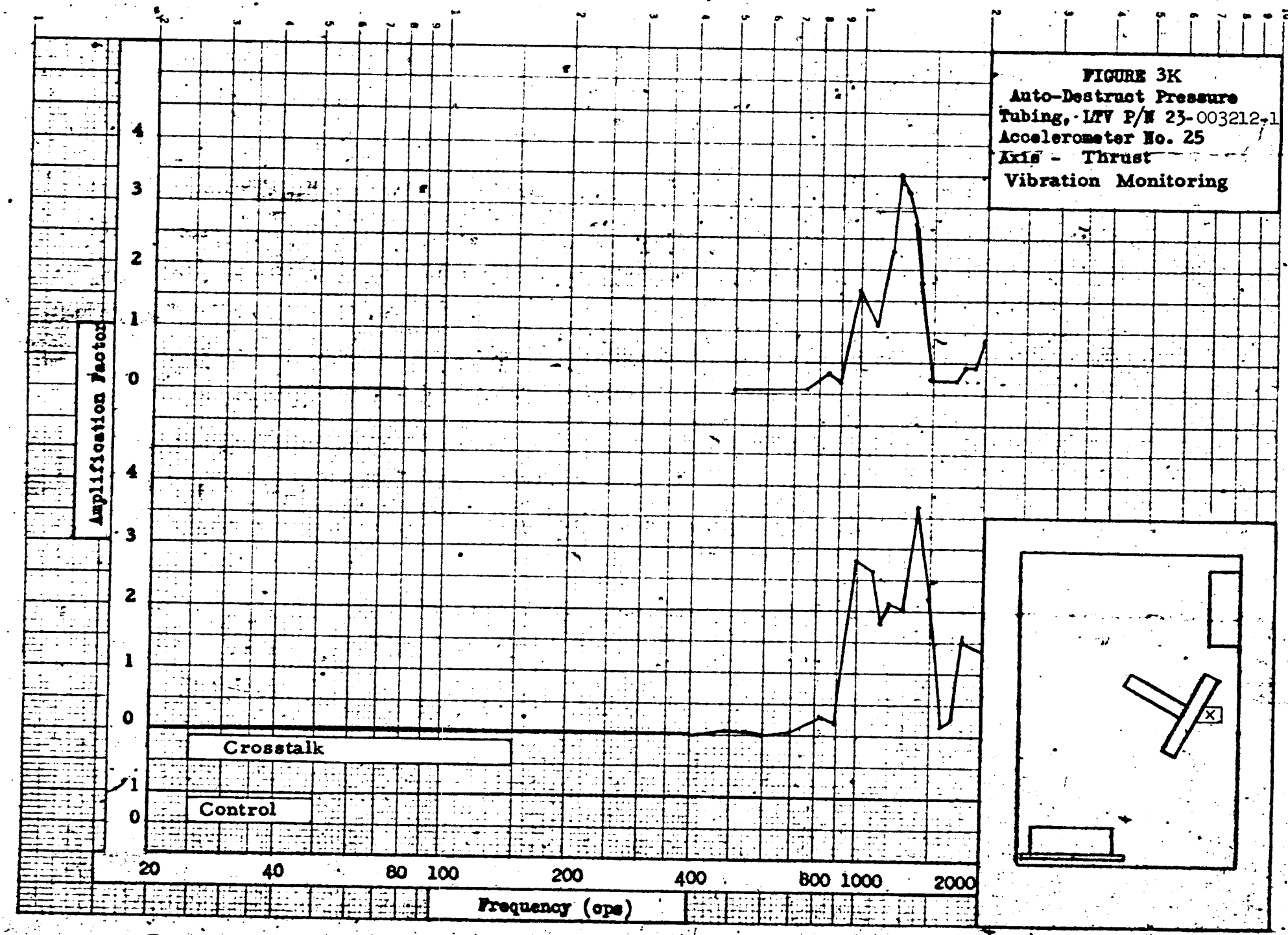
FIGURE 31
Auto-Destruct Pressure Tubing, LTV P/N 23003212-1
Accelerometer No. 41
Axis - Transverse
Vibration Monitoring




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KEUFFEL & ESSER CO.
3 CYCLES X 140 DIVISIONS
FIGURE 3J
Auto-Destruct Pressure
Tubing, LTV P/N 23- 003212-1
Accelerometer No. 24
Axis - Thrust
Vibration Monitoring
Amplification Factor
4
3
2
1
0
4
3
2
1
0
1
0
Transmissibility
Control
20
40
80
100
200
400
800
1000
2000
Frequency (cps)

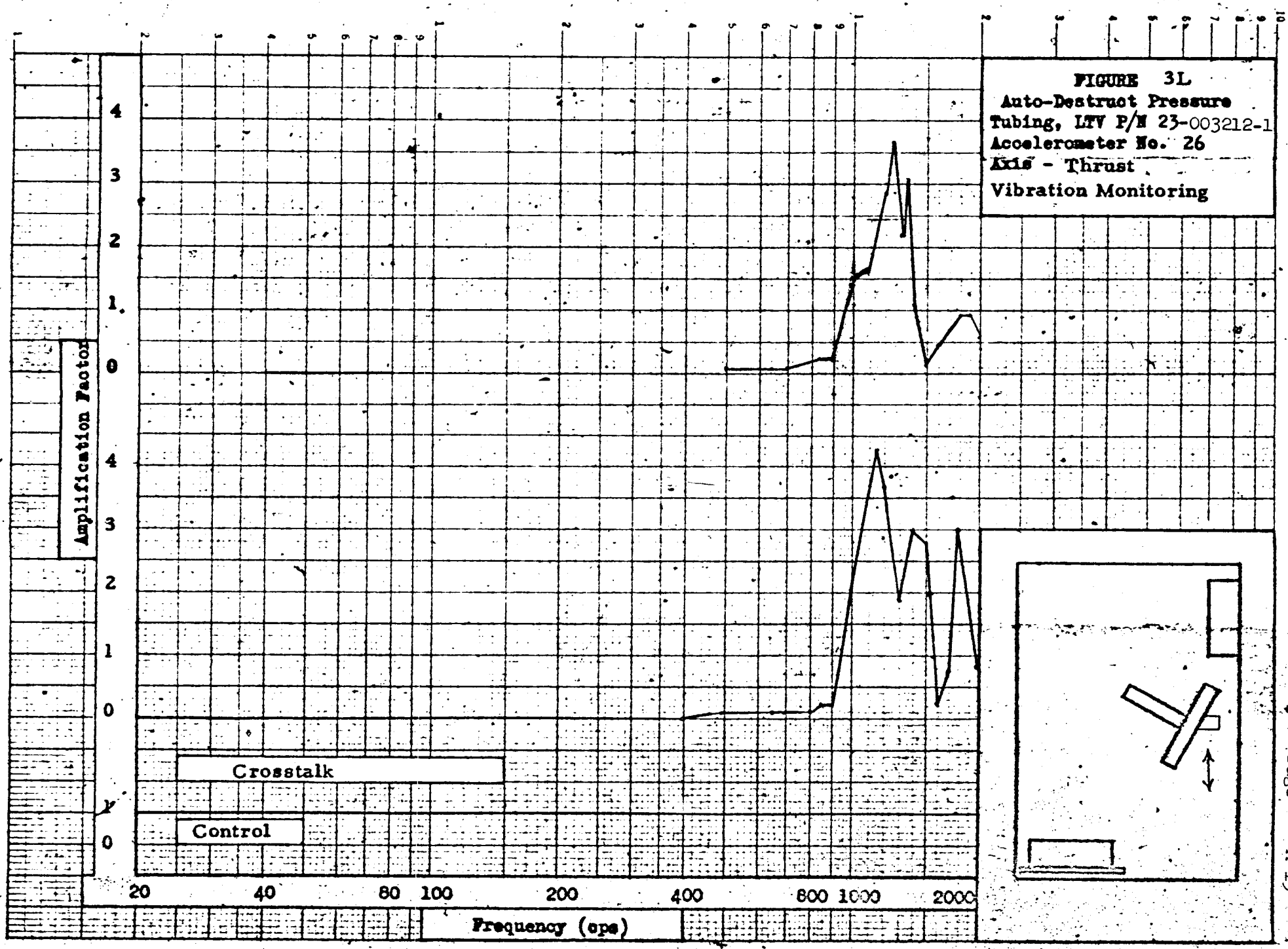
K•E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO.
3 CYCLES X 140 DIVISIONS

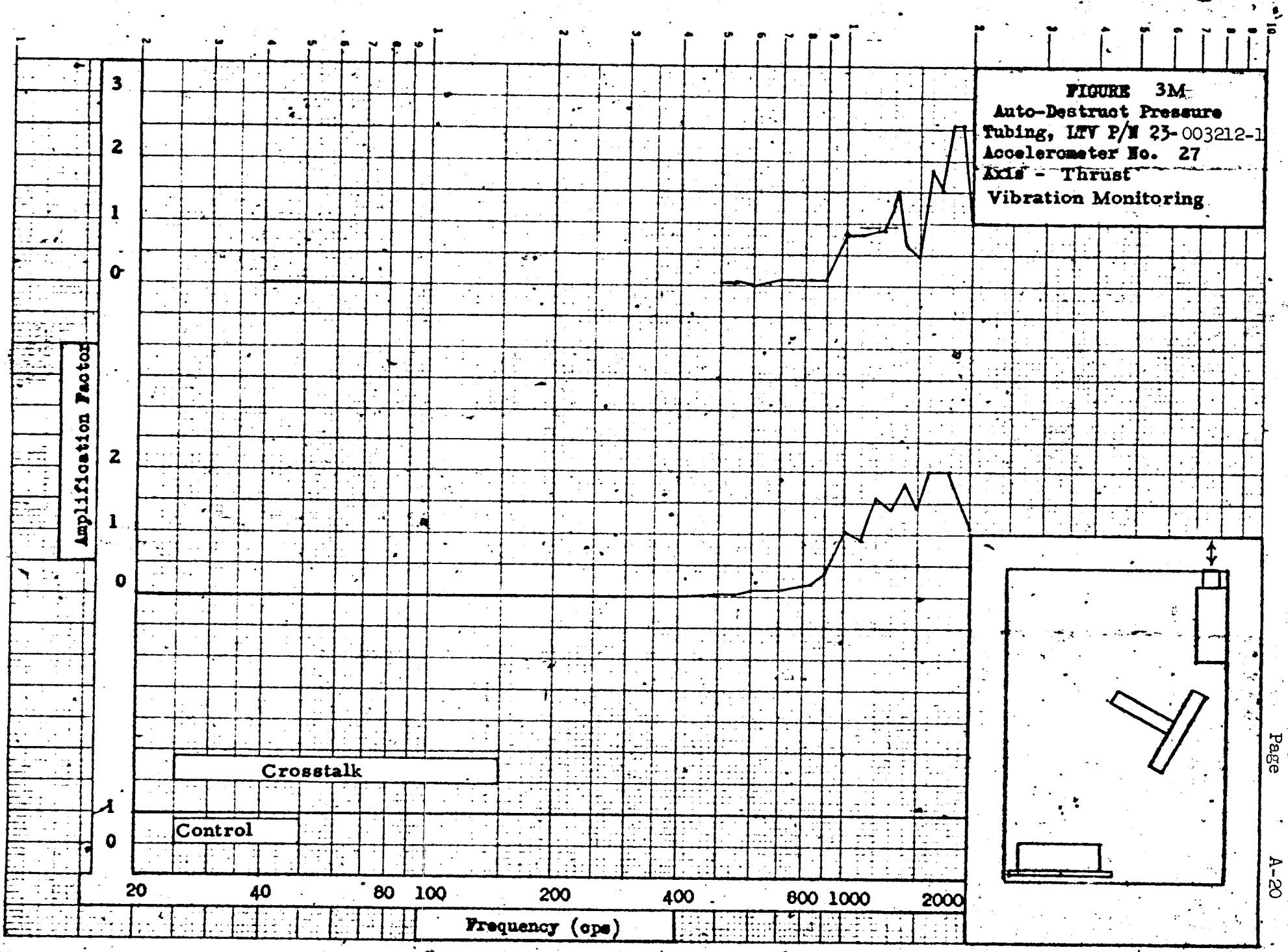
FIGURE 3K
Auto-Destruct Pressure Tubing, LTV P/N 23-003212-1
Accelerometer No. 25
Axis - Thrust
Vibration Monitoring

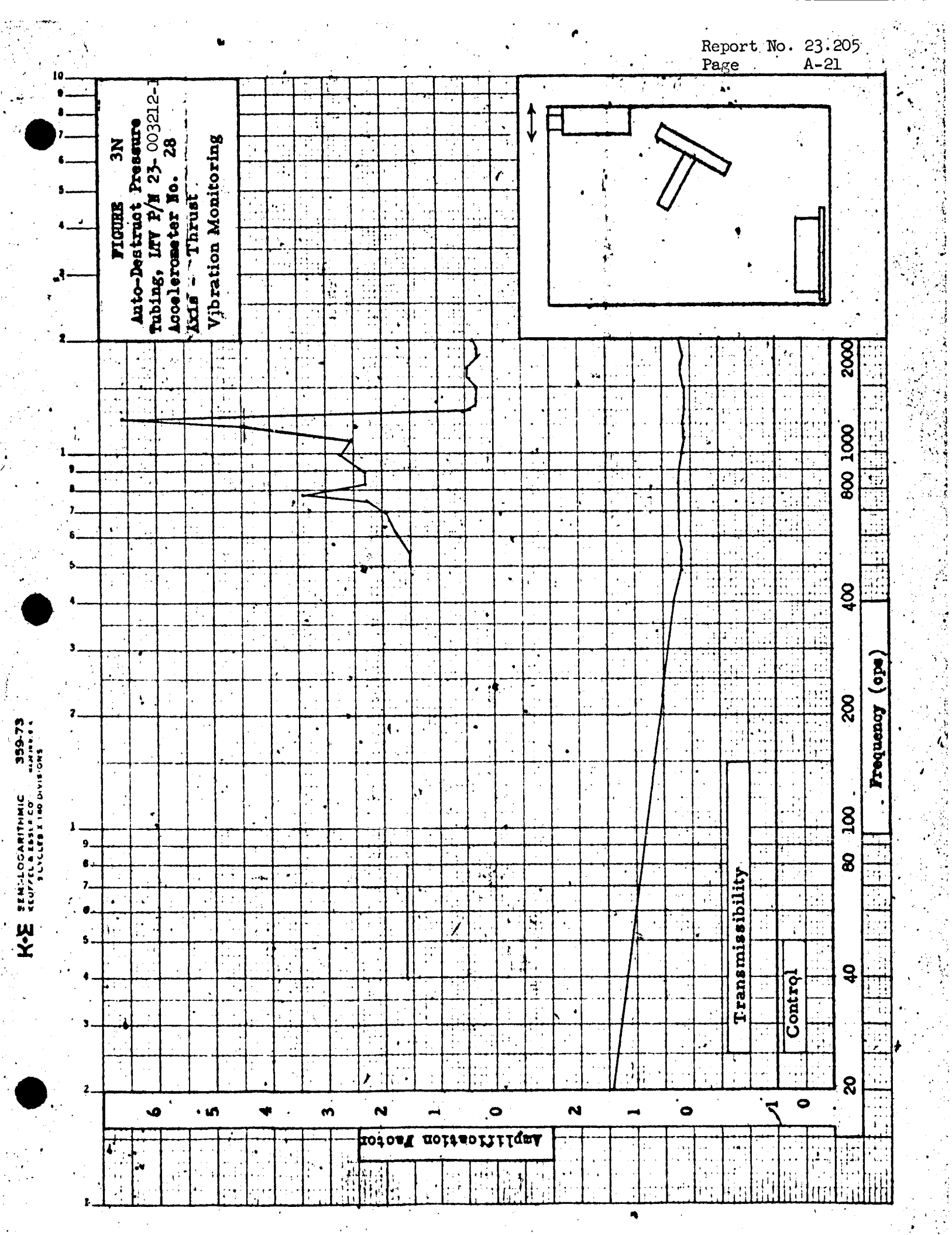


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KEUFFEL & ESSER CO
3 CYCLES X 140 DIVISIONS

FIGURE 3L
Auto-Destruct Pressure Tubing, LTV P/N 23-003212-1
Accelerometer No. 26
Axis - Thrust
Vibration Monitoring

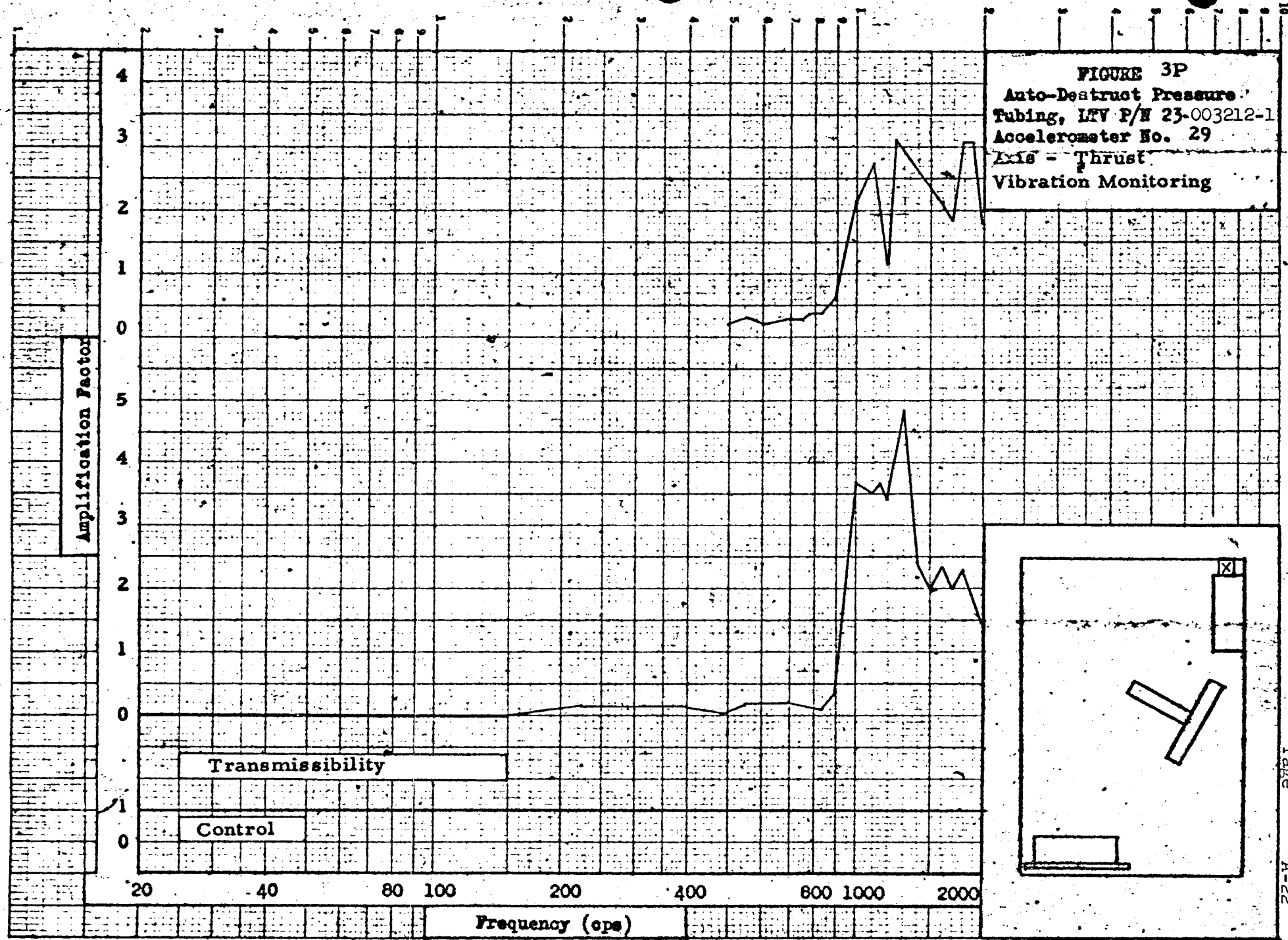



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KEUFFEL & ESSER CO.
3 CYCLES X 140 DIVISIONS
FIGURE 3M
Auto-Destruct Pressure
Tubing, LTV P/N 23-003212-1
Accelerometer No. 27
Axis - Thrust
Vibration Monitoring
Amplification Factor
3
2
1
0
2
1
0
1
0
Crosstalk
Control
20
40
80
100
200
400
800
1000
2000
Frequency (cps)


FIGURE 3N
Auto-Destruct Pressure
Tubing, LTV P/N 23-00321-
Accelerometer No. 28
Axis - Thrust
Vibration Monitoring
Amplification Factor
Transmissibility
Control
Frequency (cps)
20
40
80
100
200
400
800
1000
2000

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KEUFFEL & ESSER CO. MADE IN U.S.A.
3 CYCLES X 140 DIVISIONS

FIGURE 3P
Auto-Destruct Pressure Tubing, LTV P/N 23-003212-1
Accelerometer No. 29
Axis - Thrust
Vibration Monitoring



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3 CYCLES X 140 DIVISIONS

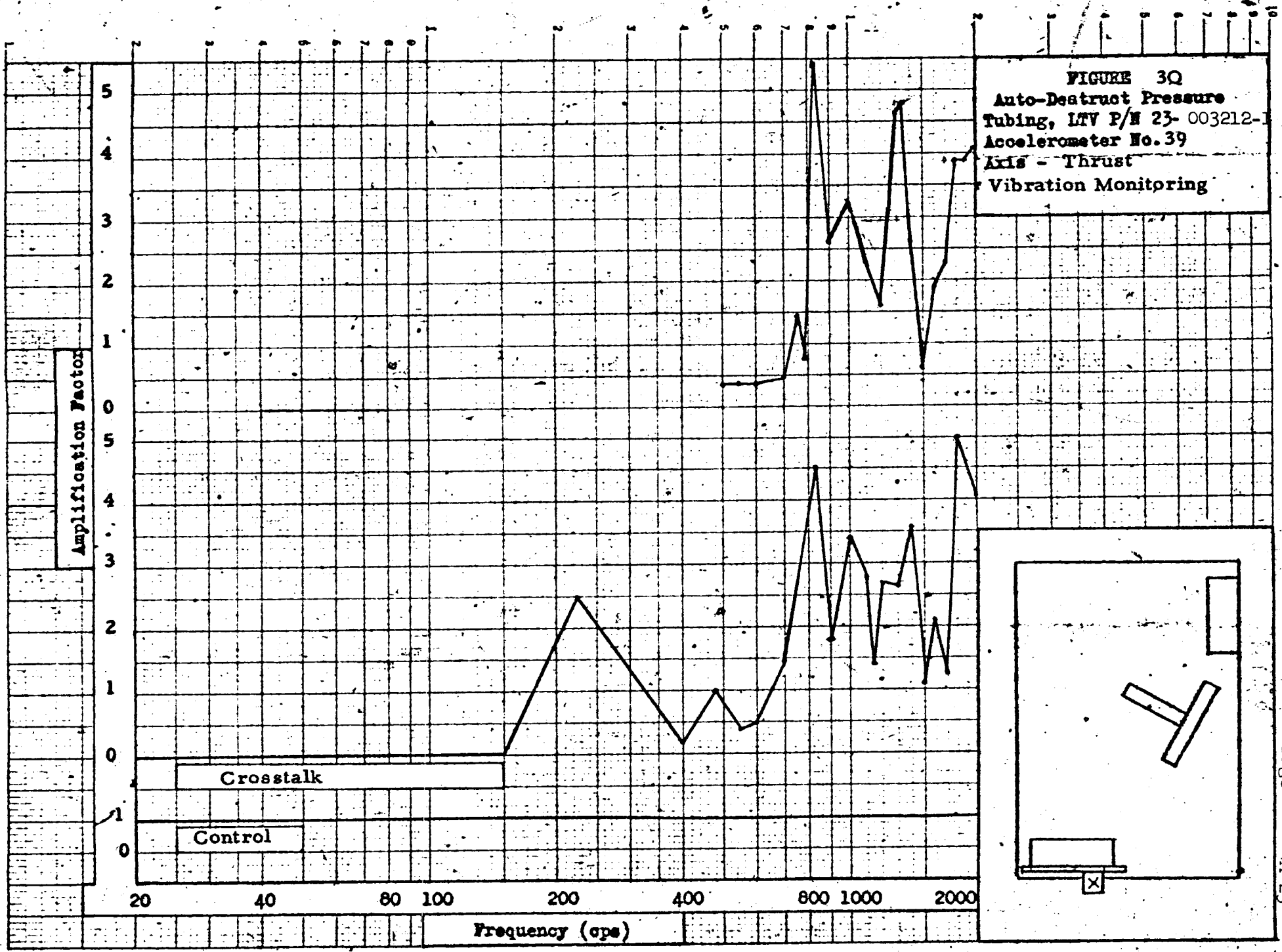
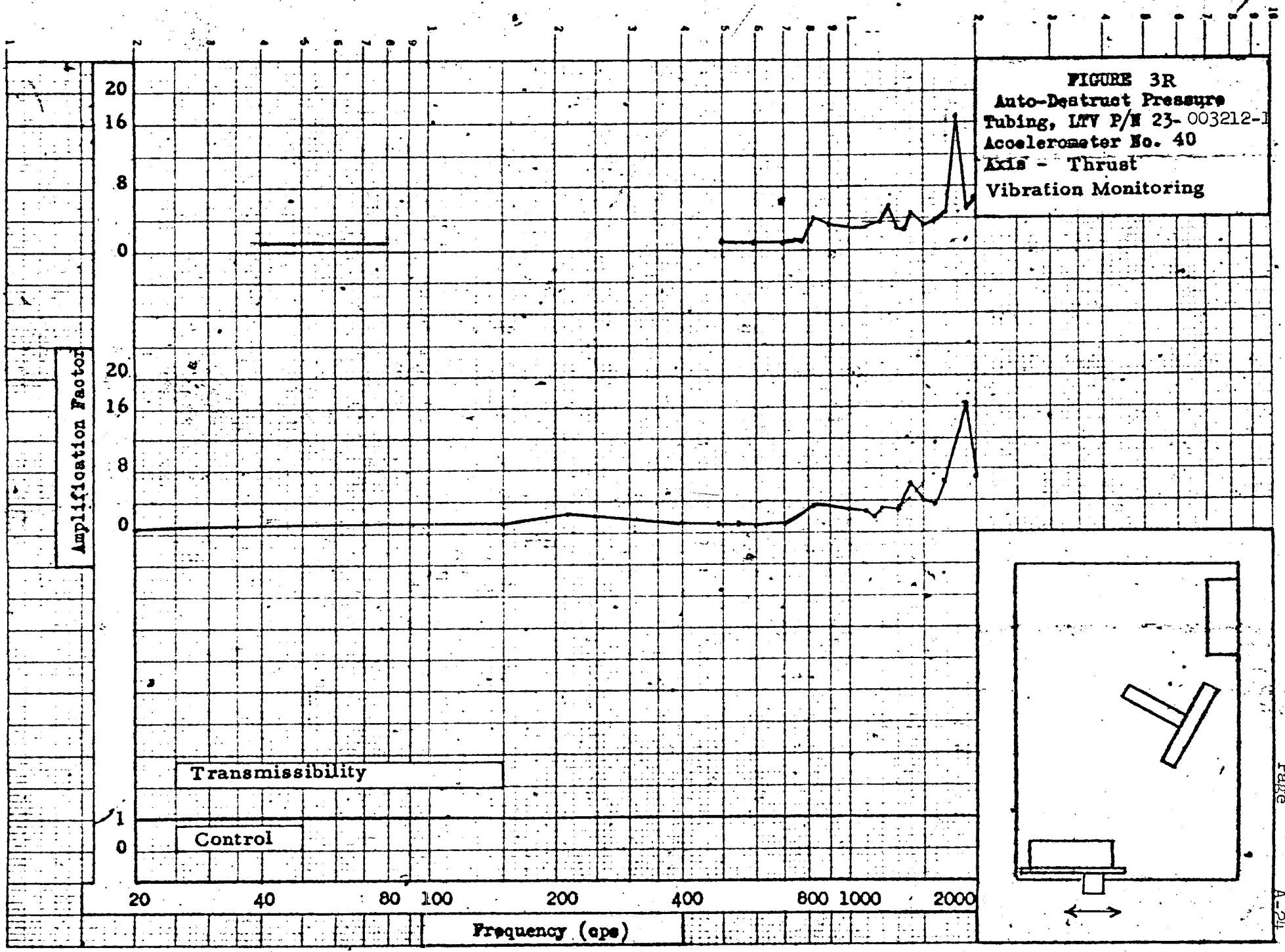
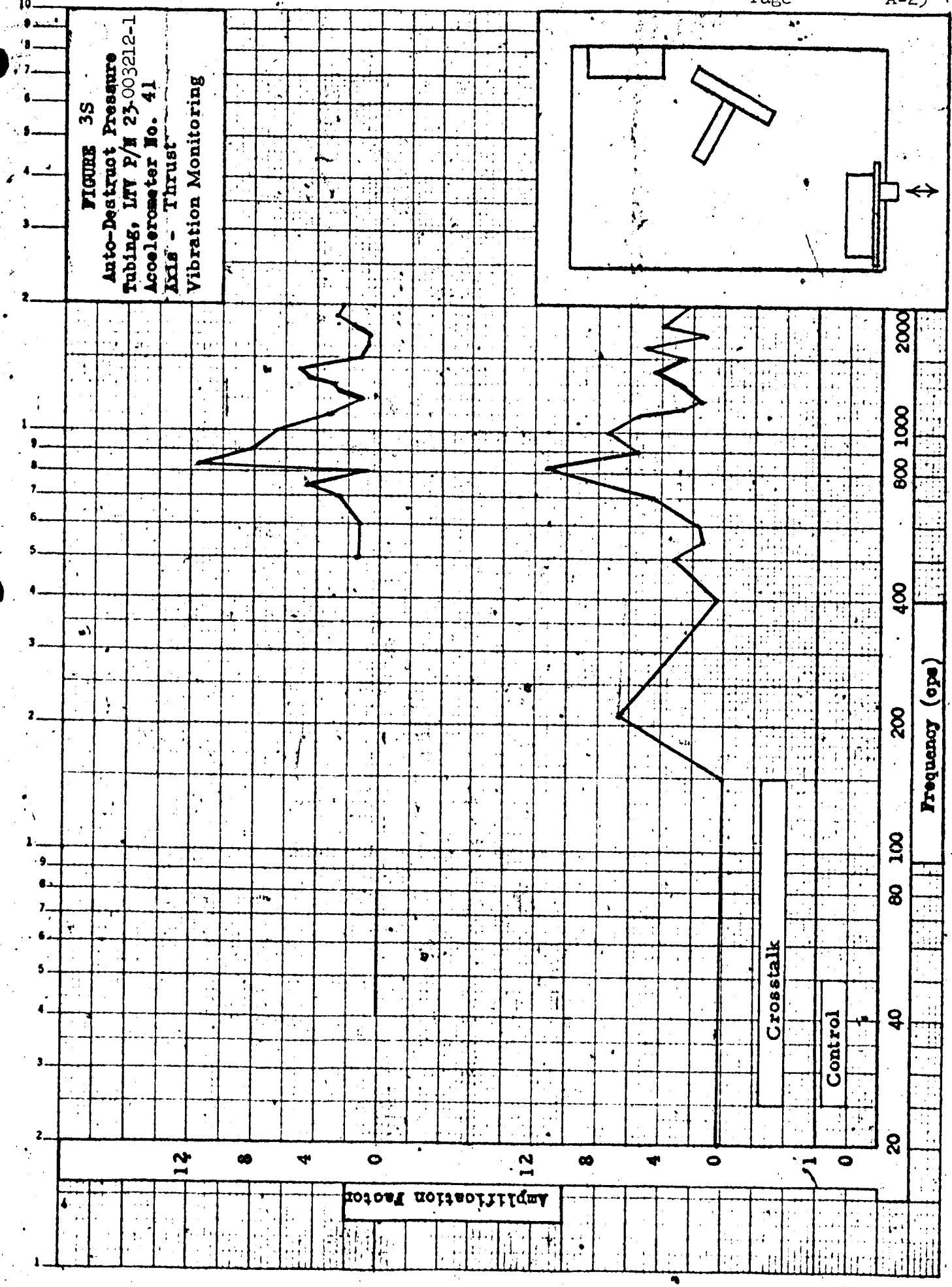


FIGURE 3Q
Auto-Destruct Pressure Tubing, LTV P/N 23-003212-1
Accelerometer No. 39
Axis - Thrust
Vibration Monitoring


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3 CYCLES X 140 DIVISIONS
FIGURE 3R
Auto-Destruct Pressure
Tubing, LTV P/N 23-003212-1
Accelerometer No. 40
Axis - Thrust
Vibration Monitoring
Amplification Factor
20
16
8
0
20
16
8
0
Transmissibility
1
0
Control
20
40
80
100
200
400
800
1000
2000
Frequency (cps)



K·E SEMI-LOGARITHMIC 359-73
KEUFFEL & ESSER CO
3 CYCLES X 140 DIVISIONS

FINAL CORRECTED INFORMATION
APPENDIX B

Under the basic contract NAS1-3899, Task Order 17 CCN #1, the Contractor was required to provide final corrected information (FCI) drawings.

All drawings relative to the Tunnel Mounted Destruct Module have been revised to include the final corrected information.

A list of these drawings and their applicable revision letter are presented on page B-2. Drawings identified by an asterisk (*) have not been final released into the Scout drawing system since no vehicle effectivity now exists. However, these drawings are complete and need only a vehicle effectivity assignment.

DESTRUCT MODULE - DRAWING LIST

23-003208	Rev. A*	MOD. ACCUM. DESTRUCT MODULE
23-002972	Rev. A	DESTRUCT SYS. INSTL. - 1ST, 2ND AND 3RD STAGES
23-000127	Rev. F	BOOSTER UNION ASSEMBLY
23-002141	Rev. B	CLAMP
23-003146	Rev. A	DESTRUCT SYS. 1ST STAGE
23-000129	Rev. E	CHARGE - RETAINER CAP
23-003147	N.C.	DESTRUCT SYS. - 1ST STAGE
23-000129	Rev. E	CHARGE - RETAINER CAP
23-003148	N.C.*	DESTRUCT SYS. 2ND STAGE
23-000129	Rev. E	CHARGE - RETAINER CAP
23-002973	Rev. A*	MODULE INSTL. - DESTRUCT TUNNEL - LOWER "B" AND "C"
23-002942	Rev. A	WIRING DIAGRAM
23-002962	Rev. A	BRACKET ASSY. - COMPONENTS
23-002963	Rev. A	BULKHEAD - TUNNEL SUPPORT
23-002965	Rev. A	SUPPORT BRACKET - EXPLOSIVE INITIATOR
23-002964	Rev. A	PRESSURE SWITCH ASSY.
23-000356	Rev. H	PRESSURE SWITCH ASSY.
23-002966	Rev. A*	TUNNEL COVER
23-003247	Rev. A	TUNNEL INSTL. - 1ST STEP
23-002968	N.C.	SWITCH ASSY. - LANYARD RELEASE
23-002969	N.C.	COVER ASSY. - ARMING HOLE
23-000423	Rev. B	PLUG ASSY. - SAFE ARM UNIT
23-003125	Rev. B*	BUNDLE INSTL.
23-003293	Rev. A*	BATTERY ASSY.
23-003294	N.C.	CASE
23-003295	N.C.	COVER
23-003311	N.C.	ADAPTER - PRESSURE SWITCH
23-003145	Rev. A*	WIRING DIAGRAM
23-003158	Rev. A*	LANYARD INSTL. - TRANS SECT "B"
23-003201	Rev. A	CLIP - LANYARD
23-001358	Rev. G*	SWITCH INSTL.
23-003200	Rev. A	TUNNEL MOD. - GUIDANCE
23-003153	Rev. A	TUNNEL COVER - LWR. "B" - GUIDANCE
23-003247	Rev. A*	TUNNEL INSTL. - 1ST STEP
23-003152	Rev. A*	TUNNEL COVER - LWR "C" - GUIDANCE
23-002949	Rev. C*	MOD. INSTL. - BLAST SHIELD
23-003247	Rev. A*	TUNNEL INSTL. - 1ST STEP
23-003212	Rev. B	HEADCAP - PRESSURE SYS. INSTL. - 1ST STG. MOTOR
23-000323	Rev. E*	FITTING - MANIFOLD ASSY.
23-003189	Rev. A*	FITTINGS - MOTOR - PRESSURE TRANSDUCER
23-003190	N.C.	PLATE ASSY. - MOTOR - PRESSURE TRANSDUCER
23-003213	N.C.*	HEADCAP - PRESSURE SYS. INSTL. - 2ND STG. MOTOR
23-000323	Rev. E*	FITTING - MANIFOLD ASSY.
23-003189	Rev. A*	FITTINGS - MOTOR - PRESSURE TRANSDUCER
23-003191	Rev. A	PLATE ASSY. - MOTOR - PRESSURE TRANSDUCER
23-003214	Rev. A*	LANYARD INSTL. - TRANS "C"
23-003201	Rev. A	CLIP - LANYARD
23-001358	Rev. G*	SWITCH INSTL.

*THIS REVISION NOT RELEASED