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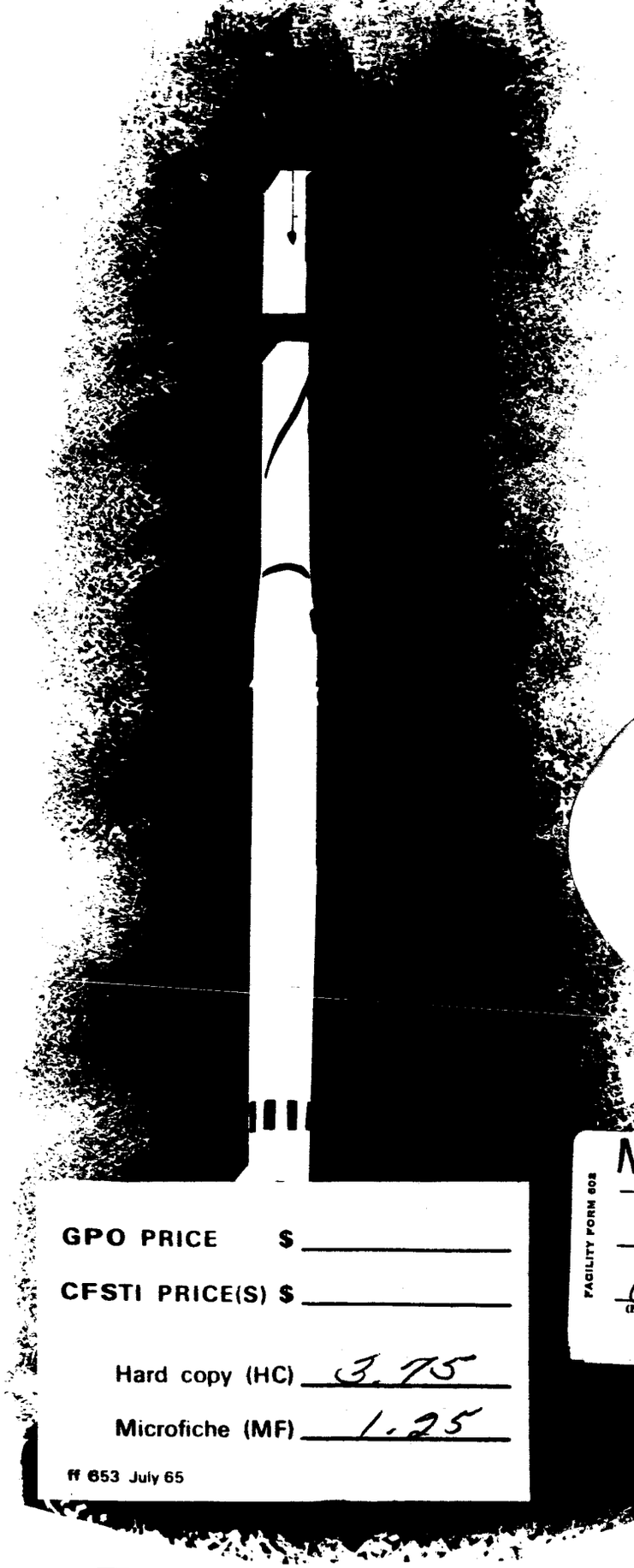

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Ling-Temco-Vought, Inc.
P. O. Box 6267
Dallas, Texas 75222

TITLE

STRUCTURAL LOAD TEST RESULTS EVALUATION ABL X-259 MOTOR LOADED AND UNLOADED CASE

SUBMITTED UNDER

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J. R. Hyden
PREPARED
J. R. Hyden

C. W. Payne
REVIEWED
C. W. Payne

H. C. Scott
H. C. Scott

R. D. Unruh FOR
APPROVED
M. D. Brinsen

REV.	DATE	REV. BY	PAGES AFFECTED	REMARKS

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LTV Aerospace Corporation
P. O. Box 6267
Dallas, Texas 75222

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REFERENCES

A. LTV AST/EIR-12430, "NASA Scout Stress Analysis Report", 11 June 1965

B. LTV Report No. 00.190 "The Buckling of Cylindrical Shells Under Compressive or Bending Loads", 29 March 1963.

C. Allegany Ballistics Laboratory Drawing No. 259-A2-3-02-0007, "Chamber Final Machining," 8 February 1962.

SECTION 1.0

INTRODUCTION

PURPOSE

The purpose of this report is to evaluate the results obtained from the Structural Load Test conducted on a loaded X-259 motor case assembled with Scout Lower "D", Upper "C" and Lower "C" Transition sections (referred to as Test A in the Test Results) and the Structural Load Test conducted on an unloaded X-259 motor case assembled with Scout Lower "D", Upper "C" and Lower "C" transition sections, (referred to as Test B). The test laboratory report for these tests is presented in Appendix I of this report.

DISCUSSION

Test A was conducted to determine the effect of internal strains from externally applied loads in the X-259 motor case and propellant system on its subsequent performance during flight. The test specimen was loaded to 115% of the motor case limit loads. Motor case limit loads equal Scout vehicle ultimate loads divided by 1.30.

The test results include displacements and strains measured at various locations on the motor case and transition sections.

Post test visual examination revealed no damage to the motor case or the transition sections and radiographic inspection of the rocket motor after the test revealed no internal damage to the chamber, case-bonding system or propellant grain.

Test B was conducted to establish the structural failing load capabilities of the X-259 unloaded motor case, the Scout Lower "D", Upper "C" and Lower "C" transition sections.

Failure occurred in the Upper "C" Transition section at approximately station 193.5. Failure occurred under the following conditions:

Loads at Station 191.95 (Aft Face of X-259 Motor)

	Loads	% of Scout Limit Design Loads	% of Motor Limit Design Loads
Bending Moment	996,205 in lbs	192%	166%
Shear	5,501 lbs	179%	155%
Torsion	138,500 in lbs	190%	165%
Axial Load	35,820 lbs	203%	176%

A sketch of the test arrangement showing stations of the various sections is shown on page 1.4.

A comparison of the running loads in the unloaded motor case and transition sections for the maximum applied test loads and the limit design loads is presented in tabular form on Page 2.2. The comparison shows that the maximum applied running load on the compression side was 193% of motor limit design at station 131.1 and 168% at station 191.95. The maximum applied running load on the tension side was 198% of motor limit design at station 131.1 and 206% at station 191.95.

Stability Analyses of the unloaded motor case and transition sections are presented on Page 3.2 through Page 3.13. The predicted compression buckling allowables for the motor case and transition sections are compared with the maximum applied test loads and the ultimate design loads.

Comparisons of the deflections and strains on the loaded and unloaded motor cases were made in order to evaluate the contribution of the solid propellant to the structural properties of the motor case. The lateral deflections at various stations of the loaded motor test for 100% motor limit loads (load point 9 of Test A) and 115% motor limit loads (load point 10 of Test A) are compared to the lateral deflections of the unloaded motor test for the load points which most closely simulate the bending moment and axial load of the loaded motor test. The load points on the unloaded motor test which give bending moments and axial loads approximately equal to those for load points 9 and 10 on the loaded motor test are load points 21 and 23 respectively. These comparisons are presented on Pages 2.3 and 2.4.

The axial strain gage values at various stations on the loaded motor case for load points 9 and 10 of test A were compared to the axial strain gage values on the unloaded motor case for load points 21 and 23 of Test B respectively. These comparisons are presented on Pages 2.5 and 2.6.

The axial strain gage values at various stations on the loaded and unloaded motor cases are plotted against running load due to bending and axial loads for the compression and tension sides of the motor cases on Pages 2.7 through 2.14.

The lateral deflection curves of the unloaded motor case show no increase in lateral deflections over the loaded motor case for the same loads. This indicates that the solid propellant does not significantly increase the lateral stiffness of the motor case.

The strain curves of the unloaded motor case show little or no increase in axial strain on the tension or compression side over the loaded motor case. This indicates that the solid propellant does not add significantly to the structural bending strength of the motor case.

CONCLUSIONS

Loading the loaded motor case to 115% motor limit loads causes no damage to the motor case or the transition sections and no internal damage to the case-bonding system or propellant grain.

The results of the unloaded motor test show that the motor case and transition sections can with-stand higher loads than the ultimate design loads.

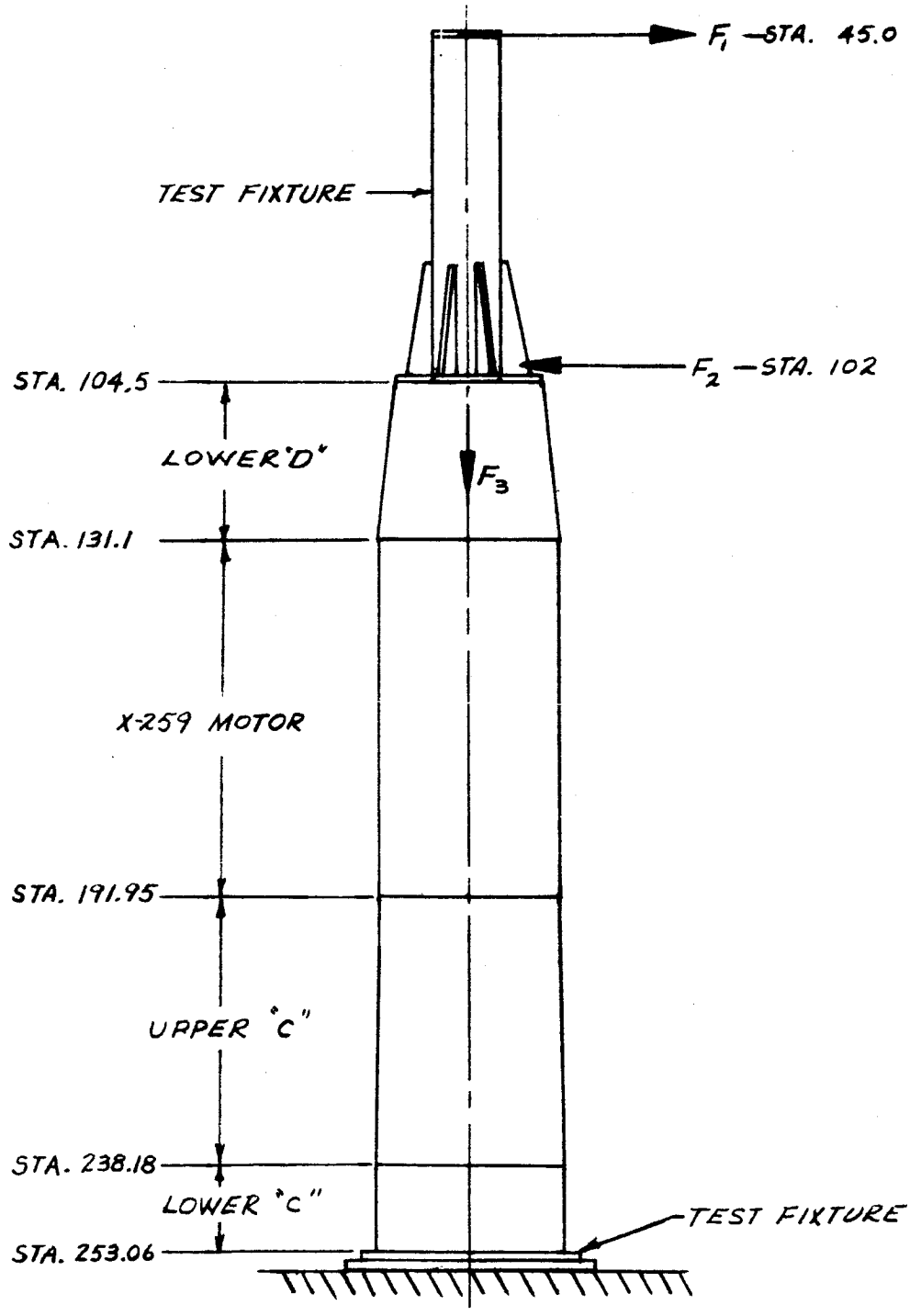
The comparisons of the deflections and strains of the loaded and unloaded motor cases indicate that the solid propellant does not significantly increase the stiffness or strength of the motor case.

The X-259 Motor, Scout Lower "D", Upper "C" and Lower "C" Transition sections and the separation diaphram were qualified for the following percent of limit design running loads on the tension and compression sides.

	Scout Station	Compression % Limit	Tension % Limit
Lower "D"	104.5	233	230
	131.1	223	229
X-259 Motor	131.1	193	198
	191.95	168	206
Upper "C"	191.95	194	237
	238.18	185	221
Lower "C"	238.18	185	221
	253.06	181	217

Limit design load on the X-259 motor equals Scout ultimate design load divided by 1.3. Limit design load on the Scout structure equals Scout ultimate design load divided by 1.5.

TEST ARRANGEMENT



SECTION 2.0

COMPARISON OF TEST RESULTS

The maximum running loads for the compression and tension sides of the unloaded motor case and transition sections were computed from the maximum applied test loads. The maximum compressive running loads for stations 104.5 through 131.1 occurred at load point 47 (ref. Test B of Appendix I). The maximum compressive running loads for stations 191.95 through 253.06 occurred at load point 55. The maximum tension running loads for all stations occurred at load point 52.

The maximum running loads applied during the test are expressed in per cent of limit design running loads on Page 2.2.

The lateral deflections and axial strains at various stations of the loaded and unloaded motor for approximately 100% and 115% of motor limit loads are compared on Pages 2.3 through 2.6. The deflections plotted are an average of the deflections measured on the tension and compression sides of the motor case. The unloaded motor test load points selected for comparison are those that give approximately the same bending moment and axial load as the 100% and 115% motor limit loads on the loaded motor test.

To evaluate the effect of the solid propellant on the strength of the motor case the axial strains measured on the compression and tension sides of the loaded and unloaded motor cases are plotted against the running loads. These comparisons are presented on Pages 2.7 through 2.14.

COMPARISON OF LIMIT DESIGN LOADS TO MAXIMUM APPLIED TEST LOADS FOR X-259 MOTOR & SCOUT LOWER "D", UPPER & LOWER "C"

BY J.R. HYDEN
DATE 4-22-66

LTV ASTRONAUTICS DIVISION
LTV Aerospace Corporation
P. O. Box 6267
Dallas, Texas 75222

MODEL SCOUT

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LIMIT DESIGN LOADS ①

	SCOUT STATION	P(AXIAL LOAD) LBS	MOMENT IN. LBS.	W_M LBS/IN	W_P LBS/IN	W_c MAX LBS/IN	W_t MAX LBS/IN
LOWER "D"	104.5	9000	266500	± 547	-115	-662	432
	131.1	10330	346700	± 479	-108	-587	371
X-259	131.1	11920	400000	± 567	-127	-694	440
	191.95	20400	600000	± 851	-217	-1068	634
UPPER "C"	191.95	17670	520000	± 710	-184	-894	526
	238.18	19700	673300	± 832	-195	-1027	637
LOWER "C"	238.18	19700	673300	± 834	-196	-1030	638
	253.06	21300	726700	± 916	-213	-1129	703

NOTES:

① LIMIT LOADS FOR X-259 MOTOR EQUAL SCOUT ULT. LOADS DEVIDED BY 1.3 LIMIT LOADS FOR SCOUT SECTIONS EQUAL SCOUT ULT. LOADS DEVIDED BY 1.5. SEE REF. A FOR DESIGN LOADS.

② MAX. APPLIED TENSION RUNNING LOAD. OCCURRED AT LOAD POINT 52.

③ SEE PAGE II-27 OF APPENDIX I FOR LOAD POINT VALUES.

④ MINUS SIGNS INDICATE COMPRESSION

MAXIMUM APPLIED TEST LOADS

		FOR COMPRESSION SIDE			FOR TENSION SIDE ②		FOR COMPRESSION		FOR TENSION				% LIMIT	
	SCOUT STATION	LOAD POINT	P(AXIAL LOAD) LBS	MOMENT IN. LBS.	P(AXIAL LOAD) LBS.	MOMENT IN. LBS.	W_M LBS/IN	W_P LBS/IN	W_M LBS/IN	W_P LBS/IN	W_c MAX. LBS/IN	W_t MAX LBS/IN	W_c % LIMIT	W_t % LIMIT
LOWER "D"	104.5	47	40588	500680	375	487659	±1026	-518	±1000	- 5	-1544	995	233	230
	131.1	47	40588	638970	375	617611	± 883	-425	± 853	- 4	-1368	849	223	229
X-259	131.1	47	40588	638970	375	617611	± 906	-431	± 876	- 4	-1337	872	193	198
	191.95	55	35821	996177	375	914887	± 1413	-381	± 1298	- 4	-1794	1294	168	206
UPPER "C"	191.95	55	35821	996177	375	914887	± 1360	-373	± 1249	-4	-1733	1245	194	237
	238.18	55	35821	1250232	375	1140739	± 1545	-355	± 1410	-4	-1900	1406	185	221
LOWER "C"	238.18	55	35821	1250232	375	1140739	± 1549	-356	± 1413	-4	-1905	1409	185	221
	253.06	55	35821	1332093	375	1213434	± 1679	-359	± 1530	-4	-2038	1526	181	217

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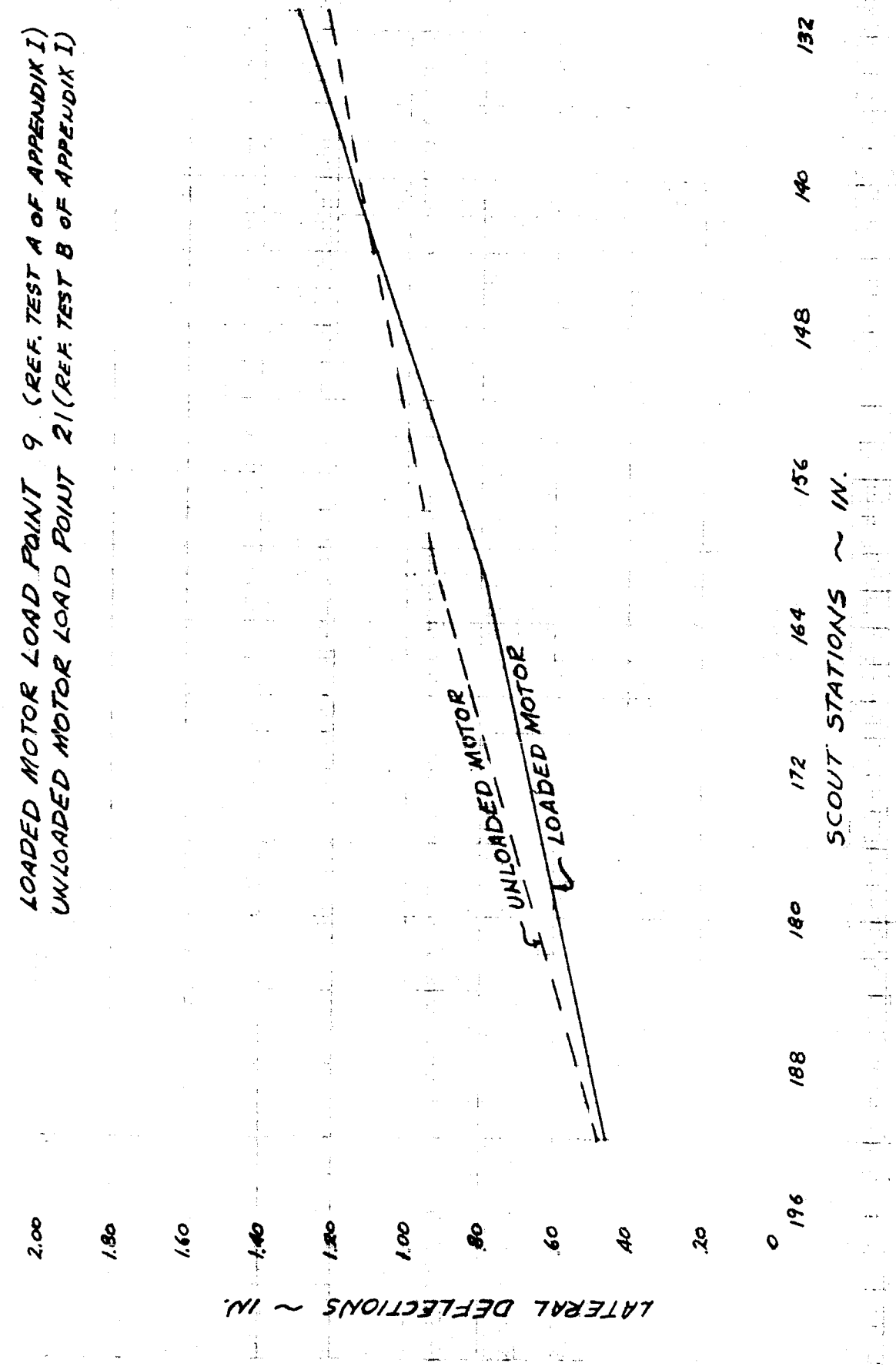
LATERAL DEFLECTION CURVES FOR 100% LIMIT
MOTOR LOADS ON LOADED AND UNLOADED MOTORS

LOADED MOTOR LOAD POINT 9 (REF. TEST A OF APPENDIX I)
UNLOADED MOTOR LOAD POINT 21 (REF. TEST B OF APPENDIX I)



LATERAL DEFLECTION CURVES FOR 115% LIMIT MOTOR LOADS ON LOADED AND UNLOADED MOTORS

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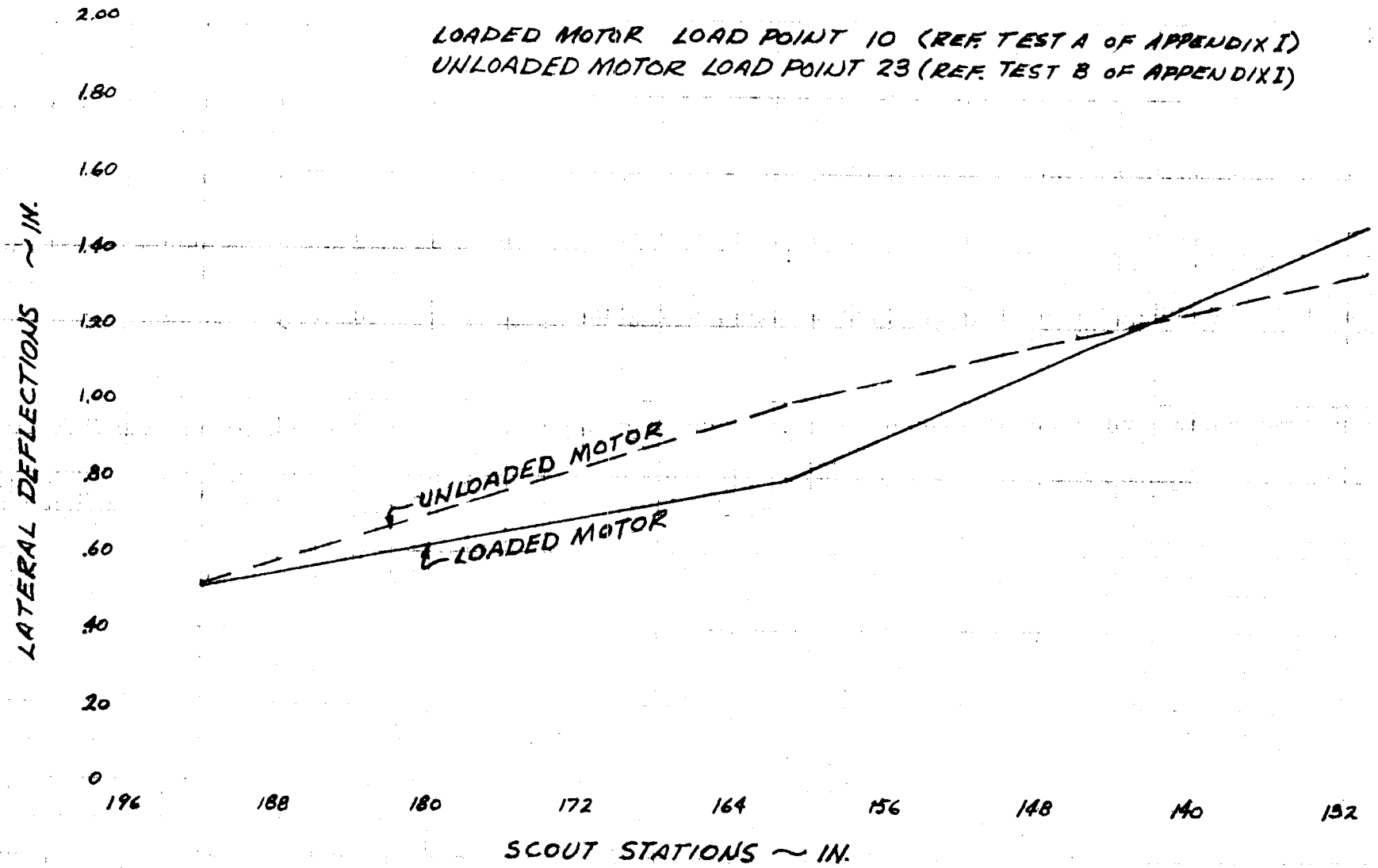
UNLOADED MOTOR LOAD POINT 23 (REF. TEST B OF APPENDIX I)



STRAINS ON THE TENSION AND COMPRESSION SIDES OF LOADED AND UNLOADED MOTORS FOR 100% LIMIT MOTOR LOADS

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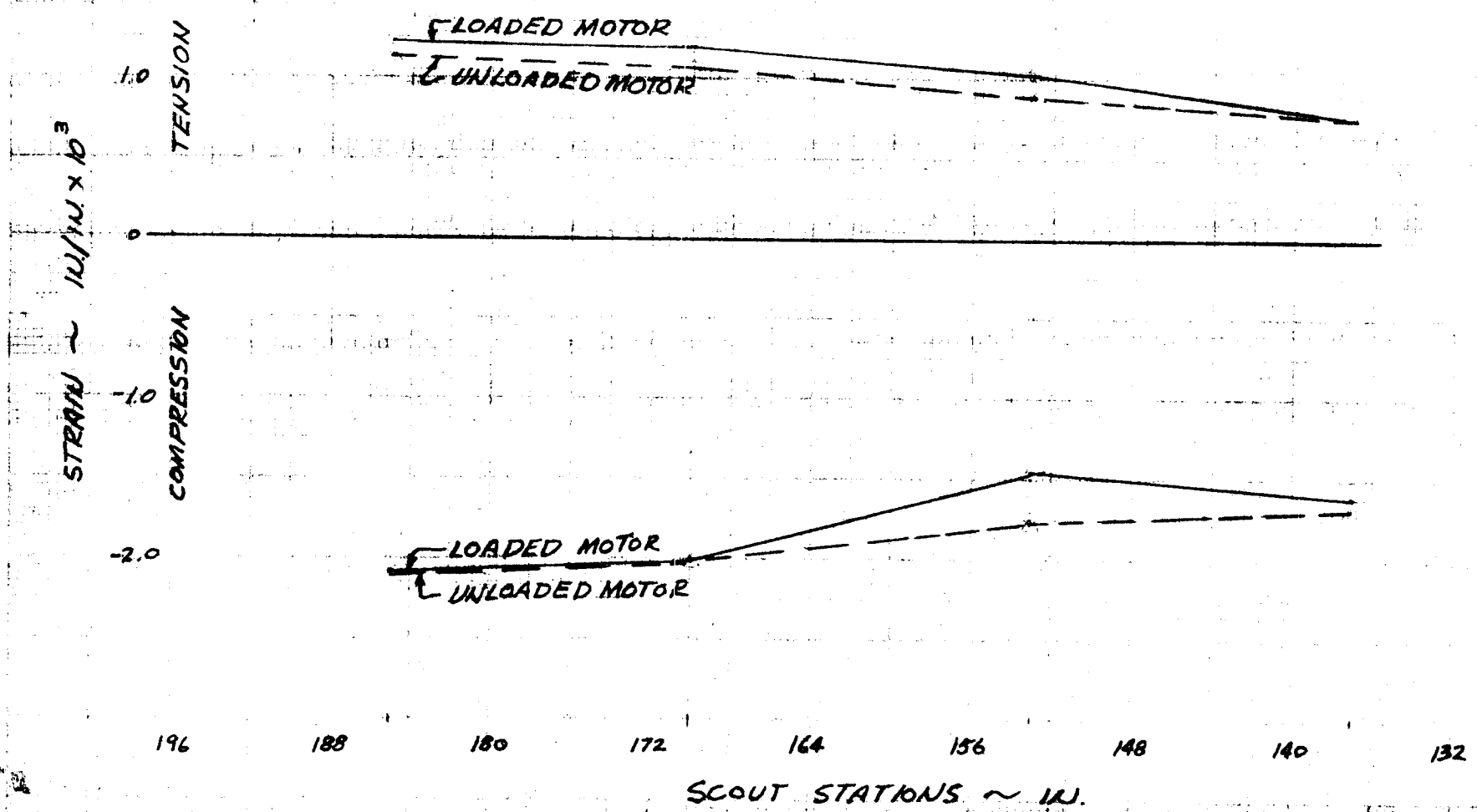
UNLOADED MOTOR LOAD POINT 21 (REF. TEST 8 OF APPENDIX I)



STRAINS ON TENSION AND COMPRESSION SIDES OF LOADED AND UNLOADED MOTORS FOR 115% LIMIT MOTOR LOADS

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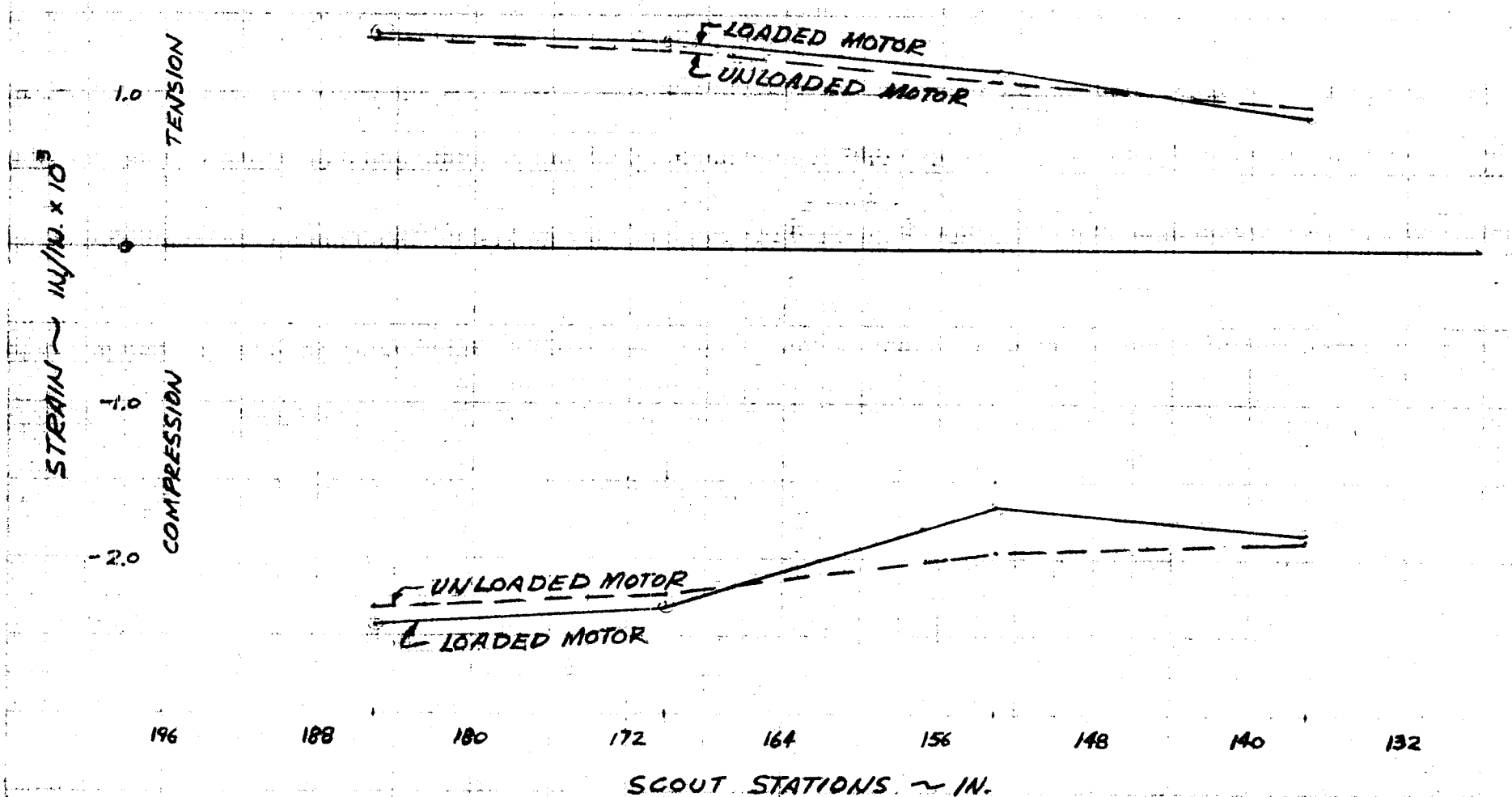
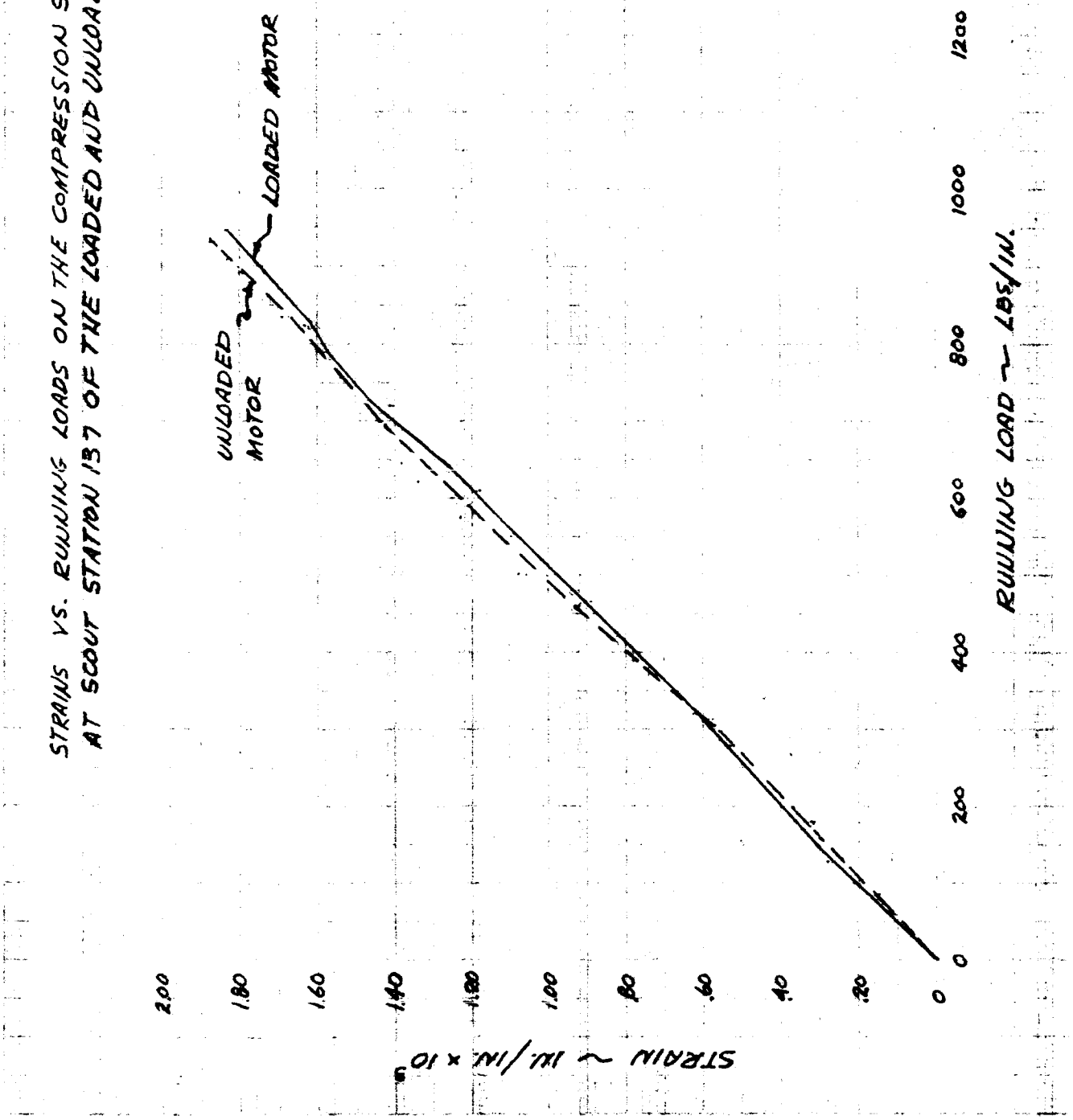
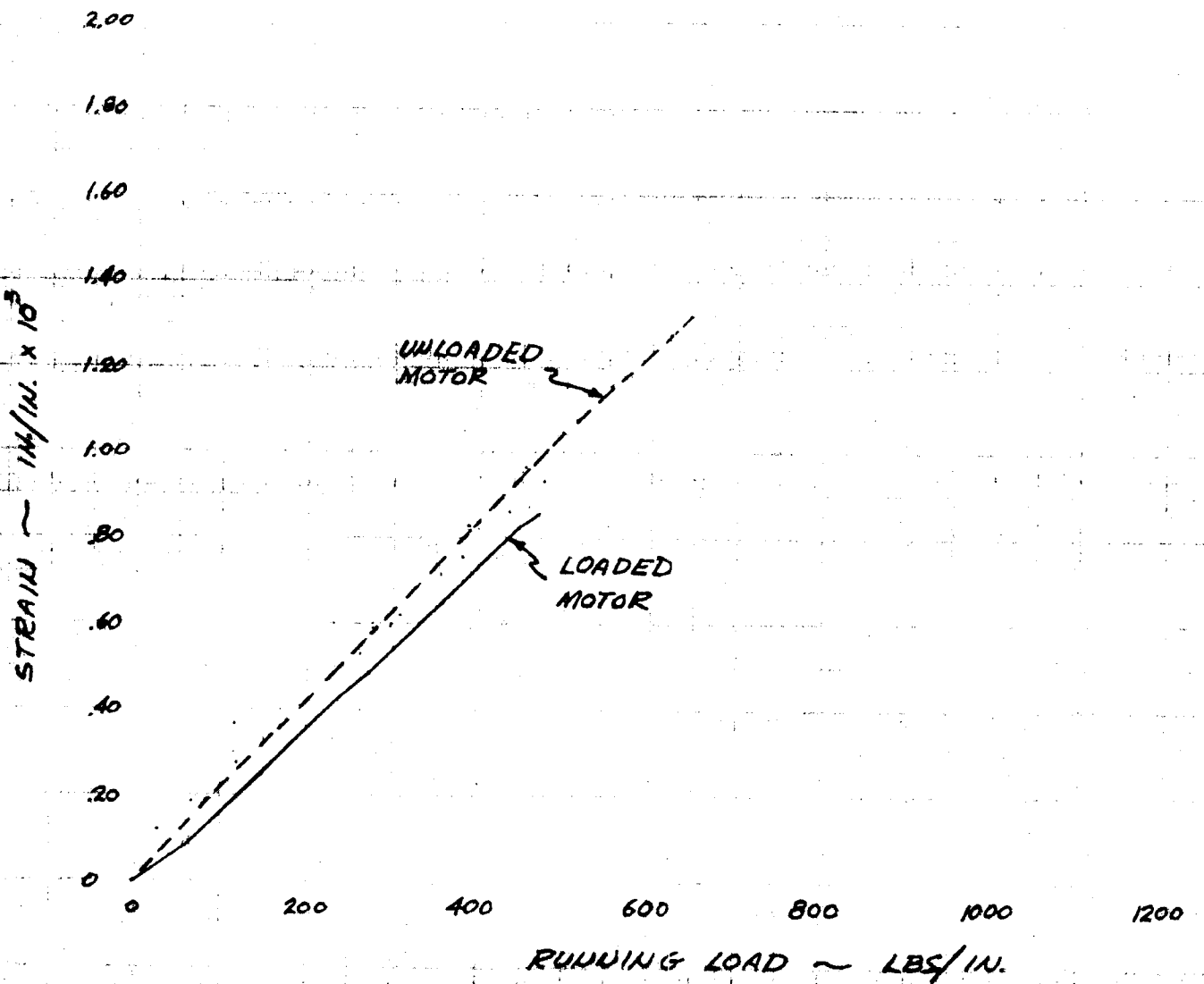
UNLOADED MOTOR LOAD POINT 28 (REF. TEST B OF APPENDIX I)



STRAINS VS. RUNNING LOADS ON THE COMPRESSION SIDE
AT SCOUT STATION 137 OF THE LOADED AND UNLOADED MOTORS



STRAINS VS. RUNNING LOADS ON THE TENSION SIDE AT SCOUT STATION 137 OF THE LOADED AND UNLOADED MOTORS



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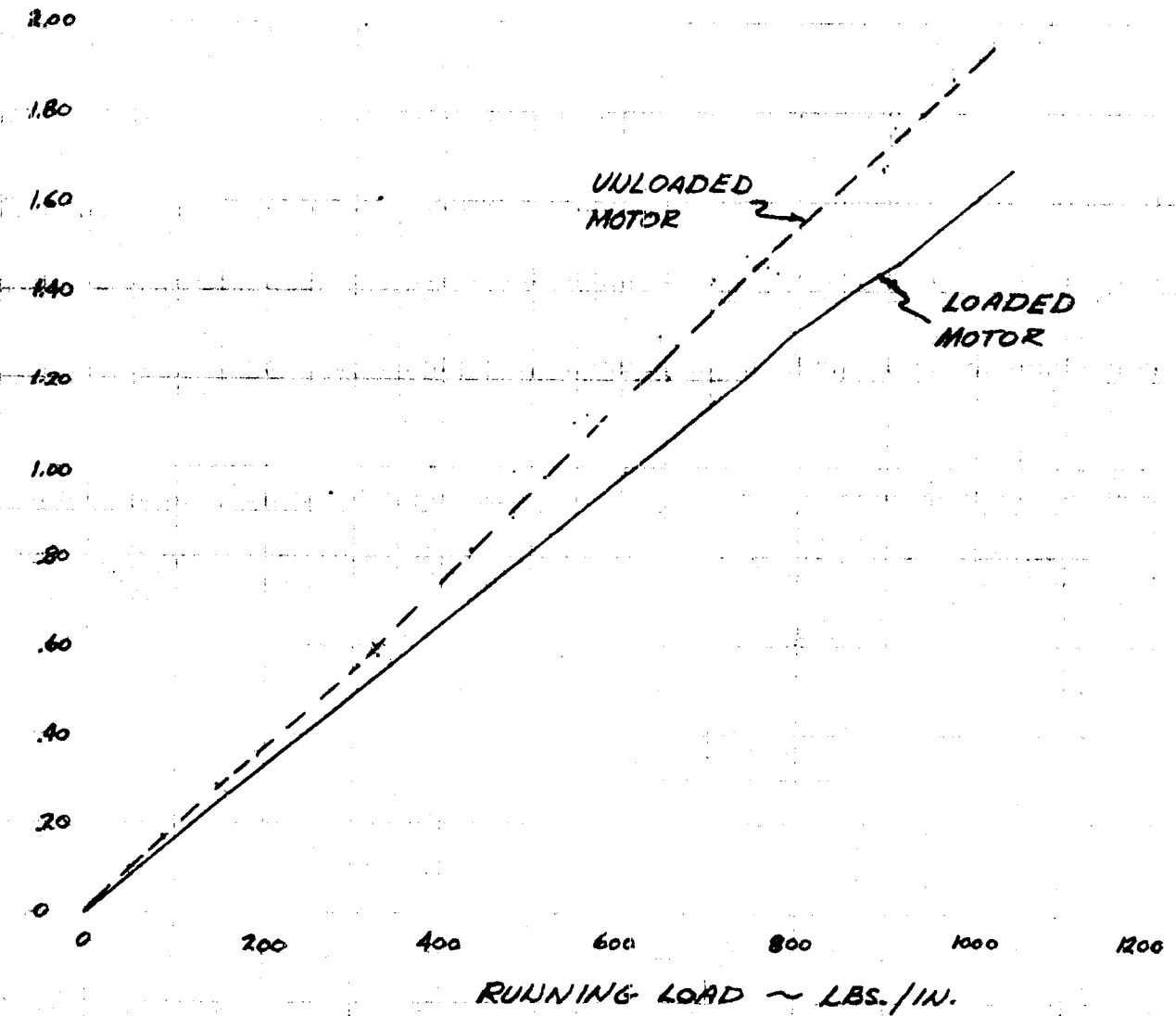
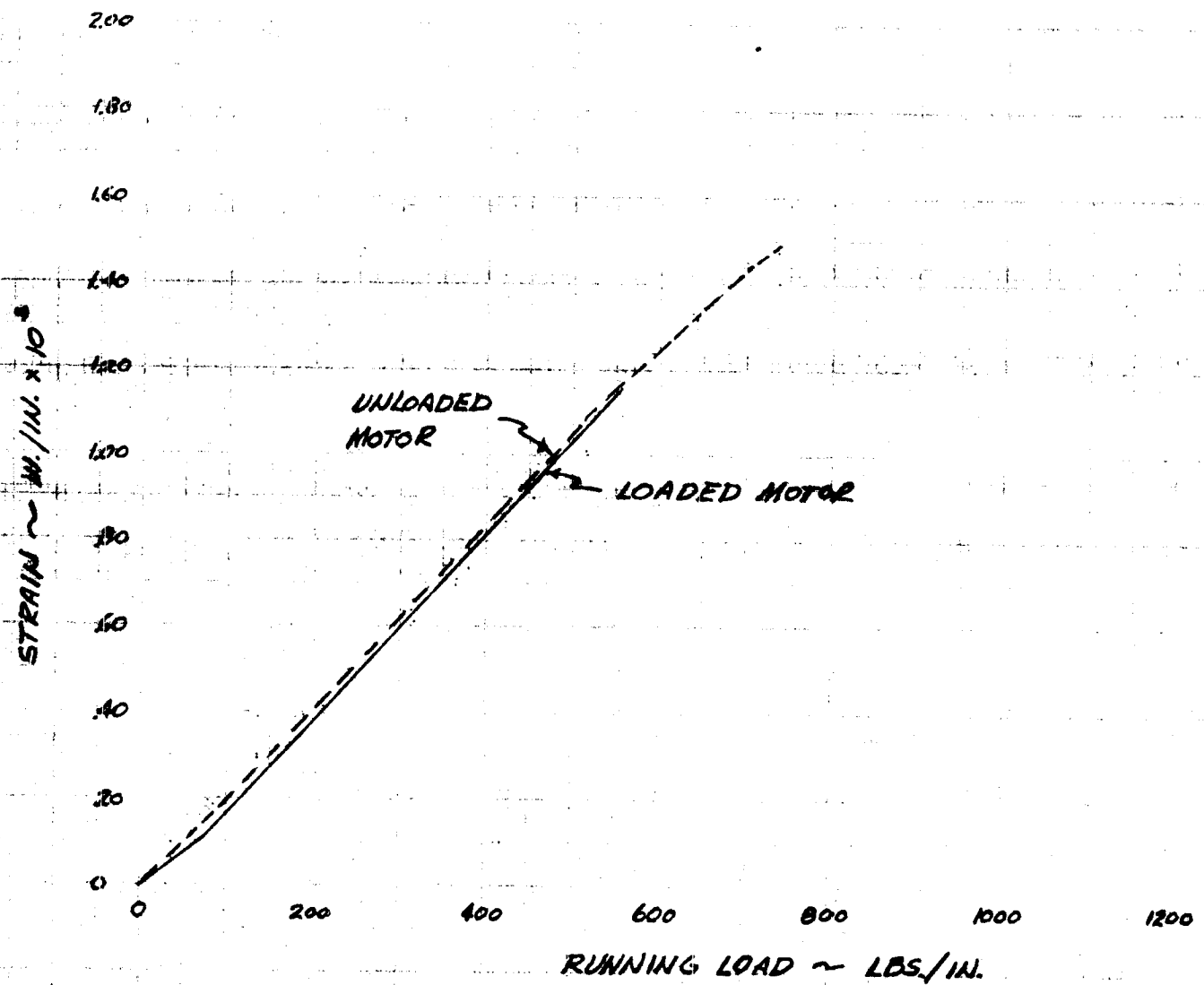
STRAINS VS. RUNNING LOADS ON THE COMPRESSION SIDE AT SCOUT STATION 153 OF THE LOADED AND UNLOADED MOTORS



STRAINS VS. RUNNING LOADS ON THE TENSION SIDE AT SCOUT STATION 153 OF THE LOADED AND UNLOADED MOTORS



J.R. HYDEN
4-22-66

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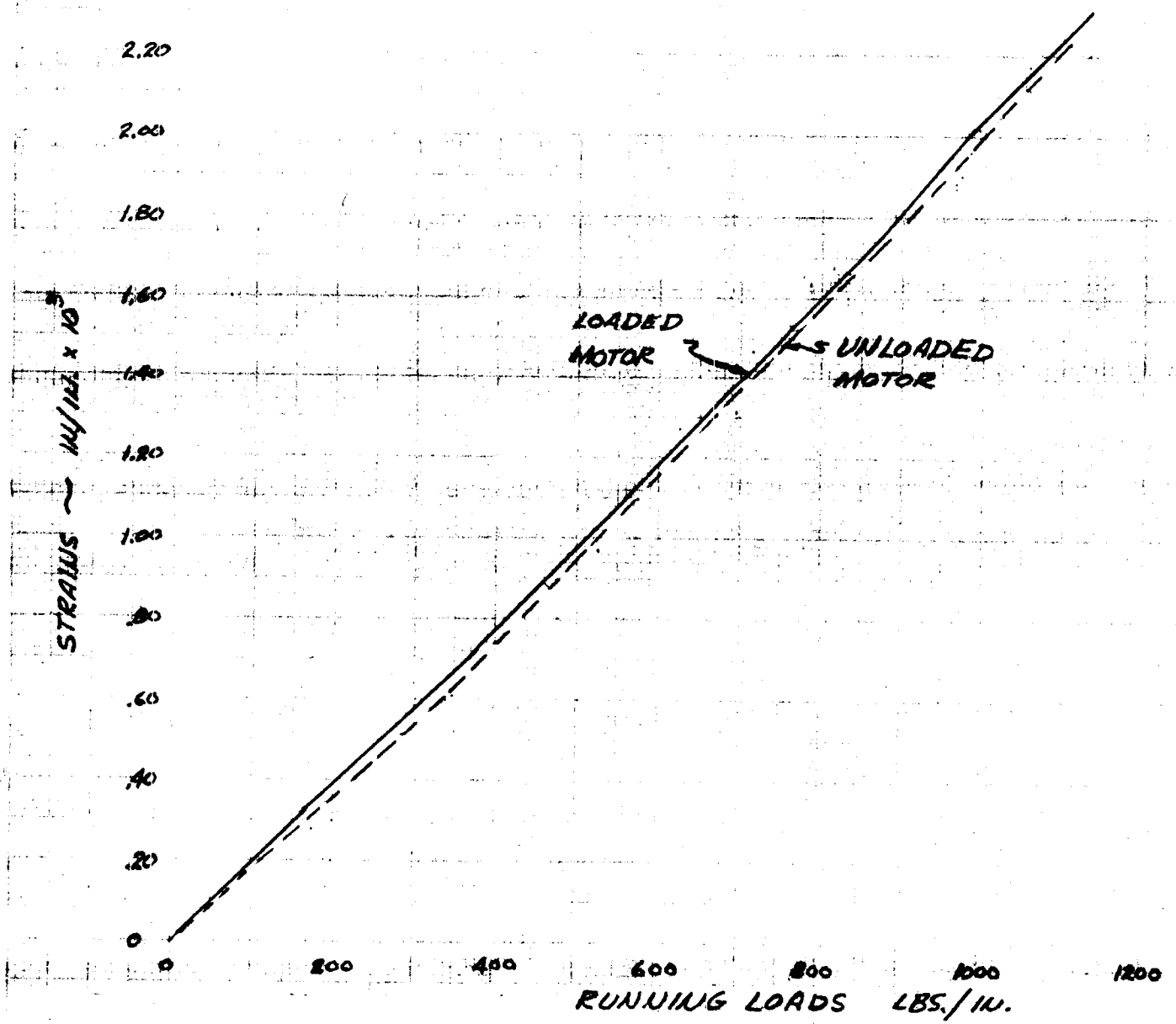
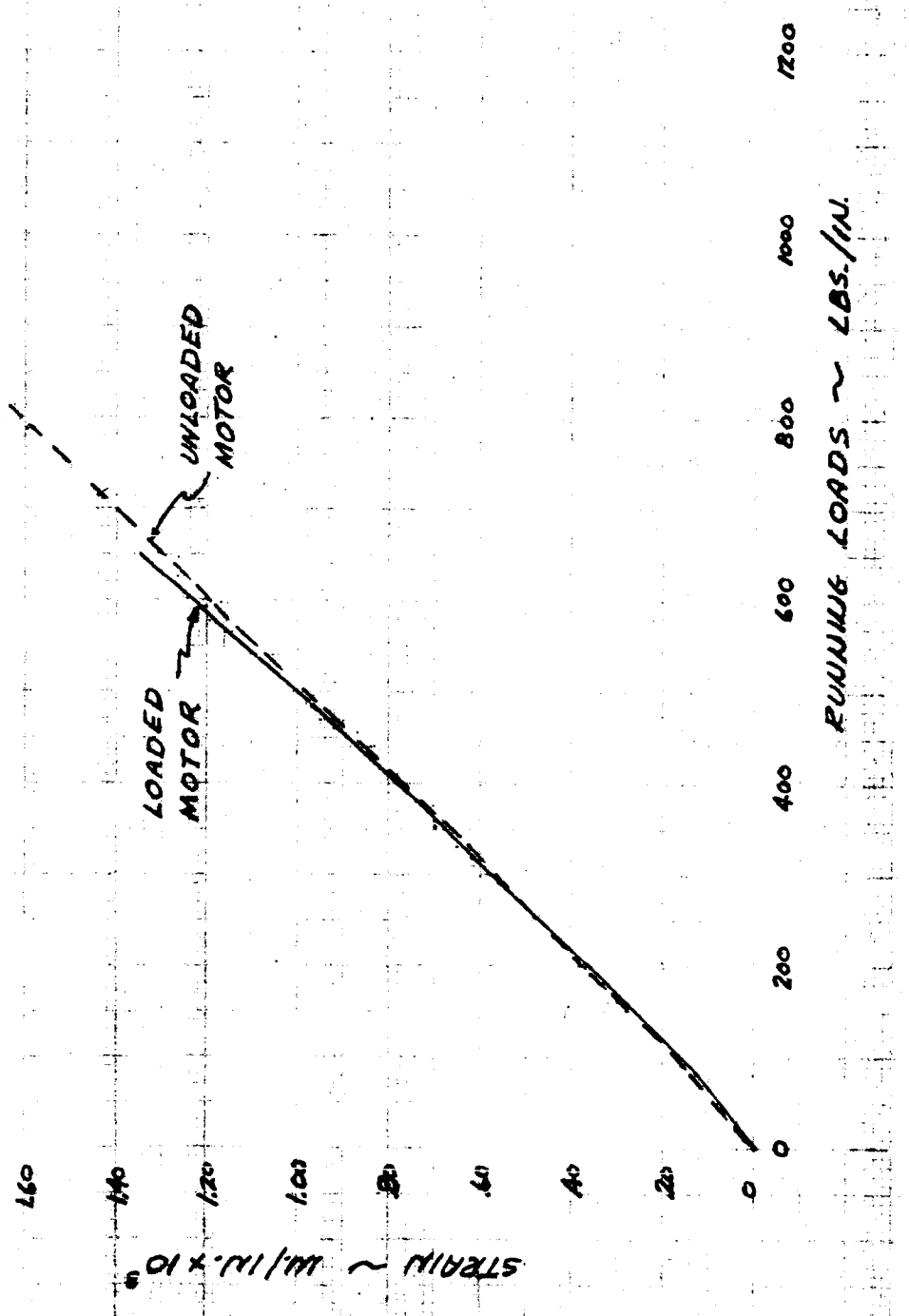
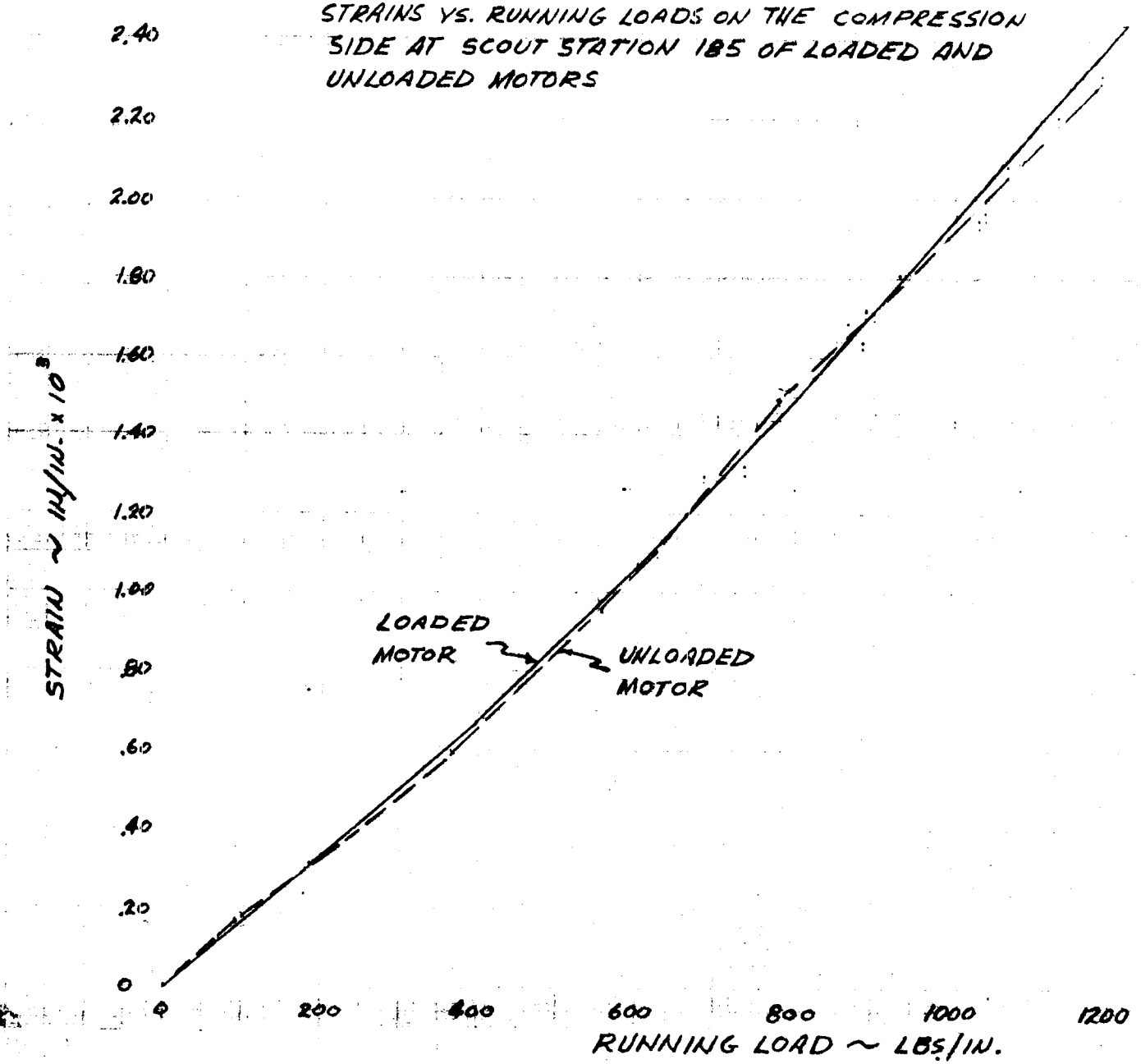
STRAINS VS. RUNNING LOADS ON THE COMPRESSION SIDE AT SCOUT STATION 170 OF THE LOADED AND UNLOADED MOTORS



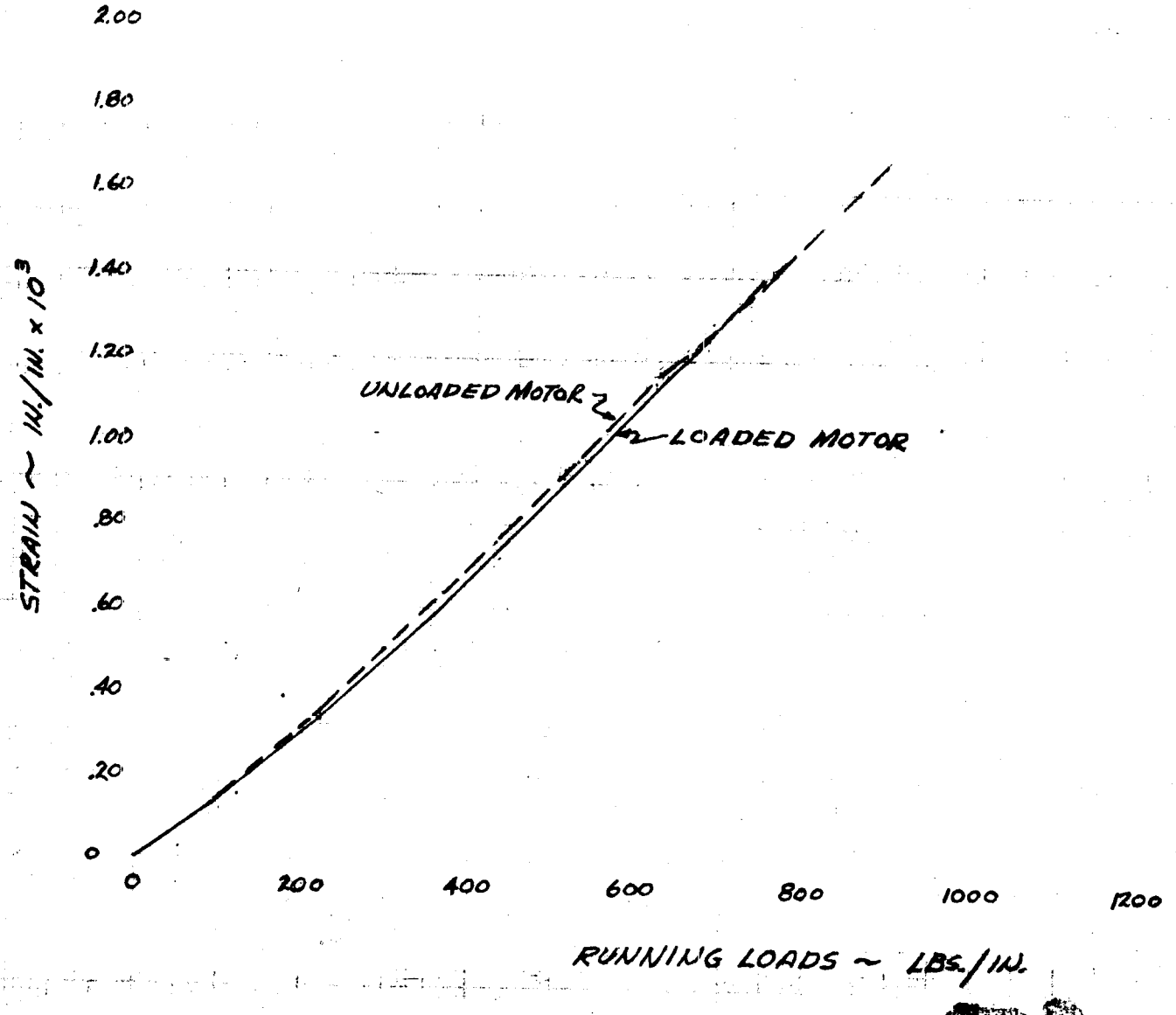
STRAINS VS. RUNNING LOADS ON THE TENSION SIDE AT SCOUT STATION 170 OF LOADED AND UNLOADED MOTORS



STRAINS VS. RUNNING LOADS ON THE COMPRESSION SIDE AT SCOUT STATION 185 OF LOADED AND UNLOADED MOTORS



STRAINS VS. RUNNING LOADS ON THE TENSION SIDE AT SCOUT STATION 185 OF THE LOADED AND UNLOADED MOTORS



SECTION 3.0

STABILITY ANALYSES

The stability analyses for the X-259 motor case and the Scout Lower "D", Upper "C" and Lower "C" transition sections are presented in this section.

The predicted compression buckling allowables are compared with the maximum applied test loads and the ultimate design loads.

The method used to predict the compression buckling allowables was taken from reference B. Buckling constants for "Best fit, 75, 90 and 99 per cent probability are presented in reference B with the 90% curves being the ones normally used for design. This means that at least 90% of the time, cylindrical sections will fail at loads equal to or greater than those predicted. In this test the scout upper "C" section failed at approximately the predicted compression buckling loads.

STABILITY ANALYSIS OF UNLOADED MOTOR CASE

THE UNLOADED X-259 MOTOR CASE WITHSTOOD A TEST LOADING OF 166% MOTOR LIMIT BENDING MOMENT COMBINED WITH 176% MOTOR LIMIT AXIAL LOAD AT STATION 191.95. THE PREDICTED COMPRESSION BUCKLING ALLOWABLES FOR THE CASE ARE COMPARED WITH THE MAXIMUM APPLIED TEST LOADS (LOAD POINT 55 OF TEST B IN APPENDIX I) AND THE ULTIMATE DESIGN LOADS AT STATION 188.35 WHICH IS THE POINT OF TANGENCY OF THE AFT DOME AND CYLINDER CASE. THE COMPARISON IS PRESENTED ON PAGE 3.4 .

MAXIMUM APPLIED TEST LOADS AT STA. 188.35

SHEAR LOADS F-1 AND F-2 WERE APPLIED AT STATIONS 45.00 AND 102.00 RESPECTIVELY. THE AXIAL LOAD F-3 WAS APPLIED THROUGH THE CENTER LINE OF THE MOTOR.

F-1 = 8790 # (REF. PG. IV-28 APPENDIX I)
F-2 = 3289 #
F-3 = 35821 #

$M = 8790 \times 143.35 - 3289 \times 84.35 = 976040$ IN#

ULTIMATE DESIGN LOADS AT STA. 188.35

THE ULTIMATE DESIGN LOADS AT STA 188.35 ARE OBTAINED BY RATIOING THE LOADS AT STATIONS 131.1 AND 191.95 (REF A) TO STATION 188.35

AXIAL LOAL = 25850 #
MOMENT = 764700 IN#

PREDICTED BUCKLING ALLOWABLE LOADS

MOTOR CASE MATERIAL IS FIBERGLASS
$t = .145$ (REF. C)
$L = 54$ IN. (BETWEEN TANGENT POINTS OF DOMES AND CASE)
$E_c = 3.45 \times 10^6$ PSI
$\mu = .28$
$R = (30.11 - .145)/2 = 14.983$ (REF. C)

$L/R = 54/14.983 = 3.604$

$R/t = 14.983/.145 = 103.33$

STABILITY ANALYSIS OF UNLOADED MOTOR CASE (CONT.)

$Z = (4/R)^2(R/t)\sqrt{1-\mu^2} = (3.6614)^2(103.33)\sqrt{1-(.28)^2} = 1288$ (REF. B)

$F_{CR} = \frac{K\pi^2 E}{12(1-\mu^2)}\left(\frac{t}{L}\right)^2 = \frac{K\pi^2\, 3.45\times10^6}{12(1-.28^2)}\left(\frac{.145}{54}\right)^2 = 22.21\,K$ (REF. B)

FOR 90% PROBABILITY

$F_{CCR} = 22.21(440) = 9770$ PSI

$F_{bCR} = 22.21(680) = 15100$ PSI

FOR 99% PROBABILITY

$F_{CCR} = 22.21(235) = 5220$ PSI

$F_{bCR} = 22.21(450) = 9995$ PSI

$P_{CR} = F_{CCR} \times A$

$A = 2\pi R t = 2\pi \times 14.983 \times .145 = 13.65$ IN^2

$M_{CR} = F_{bCR} \times I/c$

$I/c = \pi R^2 t = \pi(14.983)^2 \times .145 = 102.26$ IN^3

FOR 90% PROBABILITY

$P_{CR} = 0$, $M_{CR} = 15100 \times 102.26 = 1544130$ IN #

$M_{CR} = 0$ $P_{CR} = 9770 \times 13.65 = 133360$ #

FOR 99% PROBABILITY

$P_{CR} = 0$ $M_{CR} = 9995 \times 102.26 = 1022090$ IN #

$M_{CR} = 0$ $P_{CR} = 5220 \times 13.65 = 71250$ #

TEST RUNNING LOADS

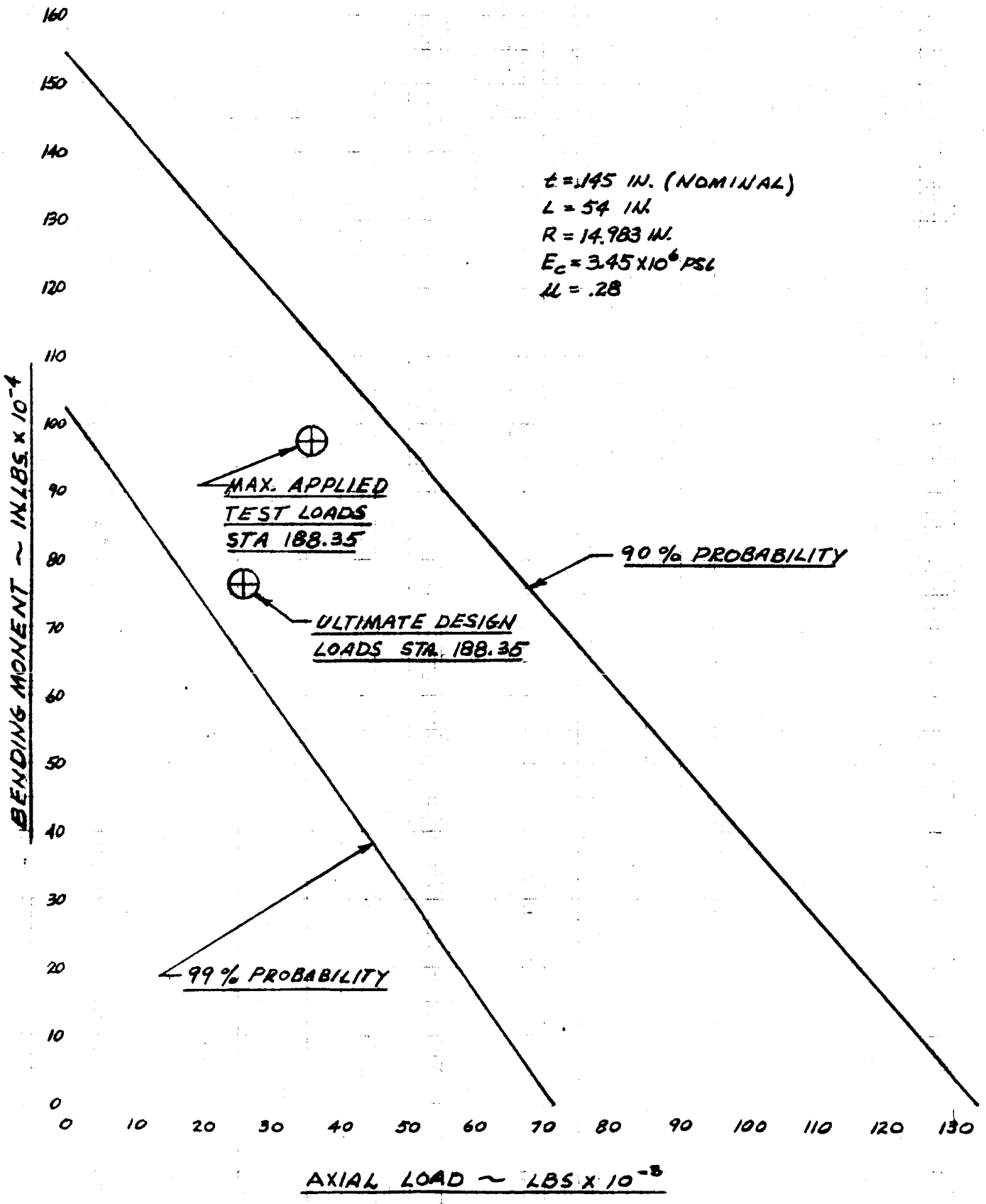
$w_M + w_P = 976040/\pi(14.983)^2 + 35821/2\pi \times 14.983 = 1765$ #/IN

ULTIMATE DESIGN RUNNING LOAD

$w_M + w_P = 764700/\pi(14.983)^2 + 25850/2\pi \times 14.983 = 1359$ #/IN

TEST RUNNING LOADS = 130% OF ULT. DESIGN LOADS
= 169% OF LIMIT MOTOR DESIGN LOADS

X-259 MOTOR CASE
BENDING-AXIAL LOAD INTERACTION CURVES



STABILITY ANALYSIS OF UPPER "C" TRANSITION SECTION

FAILURE OCCURRED IN THE UPPER "C" SECTION AT APPROXIMATE STATION 193.5 WITH A TEST LOADING OF 192% SCOUT LIMIT BENDING MOMENT COMBINED WITH 203% SCOUT LIMIT AXIAL LOAD. THE PREDICTED COMPRESSION BUCKLING ALLOWABLES FOR THE SECTION ARE COMPARED WITH THE FAILING TEST LOADS AND THE ULTIMATE DESIGN LOADS. THE COMPARISON IS PRESENTED ON PAGE 3.7 .

FAILING TEST LOADS AT STATION 193.5

F-1 = 8790 # (REF. PG. IV-28 APPENDIX I)
F-2 = 3289 #
F-3 = 35821 #

$M = 8790 \times 148.5 - 3289 \times 91.5 = 1004400$ IN #

ULTIMATE DESIGN LOADS AT STATION 193.5

THE ULTIMATE DESIGN LOADS AT STATION 193.5 ARE OBTAINED BY RATIOING THE LOADS AT STATIONS 191.95 AND 238.18 (REF. A) TO STATION 193.5.

AXIAL LOAD = 26600 #
MOMENT = 787700 IN #

PREDICTED ALLOWABLE BUCKLING LOADS.

MATERIAL IS FIBERGLASS
AVERAGE MEASURED THICKNESS = .143 IN. (REF. PG. 4.1)
L = 43.8 IN.
$E_c = 3.25 \times 10^6$ PSI (REF. PG. 4.1)

$\mu = .28$
R = 15.30 IN.

$L/R = 43.8/15.30 = 2.86$
$R/t = 15.30/.143 = 107.00$

$Z = (L/R)^2 (R/t)^2 \sqrt{1-\mu^2} = (2.86)^2 (107.0) \sqrt{1-(.28)^2} = 840$ (REF. B)

$F_{cr} = \frac{K \pi^2 E}{12(1-\mu^2)} \left(\frac{t}{L}\right)^2 = \frac{K \pi^2 3.25 \times 10^6}{12(1-.28^2)} \left(\frac{.143}{43.8}\right)^2 = 30.93\ K$ (REF. B)

STABILITY ANALYSIS OF UPPER "C" TRANSITION SECTION (CONT.)

FOR 90% PROBABILITY

$F_{ccR} = 30.93\,(275) = 8510$ PSI
$F_{bcR} = 30.93\,(440) = 13610$ PSI

FOR 99% PROBABILITY

$F_{ccR} = 30.93\,(165) = 5100$ PSI
$F_{bcR} = 30.93\,(300) = 9280$ PSI

$P_{CR} = F_{ccR} \times A$

$A = 2\pi Rt = 2\pi \times 15.30 \times .143 = 13.75$ IN^2

$M_{CR} = F_{bcR} \times I/c$

$I/c = \pi R^2 t = 105.16$ IN^3

FOR 90% PROBABILITY

$P_{cR} = 0$, $M_{cR} = 13610 \times 105.16 = 1,431,200$ IN #
$M_{cR} = 0$, $P_{cR} = 8510 \times 13.75 = 117,000$ #

FOR 99% PROBABILITY

$P_{cR} = 0$, $M_{cR} = 9280 \times 105.16 = 975,900$ IN #
$M_{cR} = 0$, $P_{cR} = 5100 \times 13.75 = 70130$ #

TEST RUNNING LOADS

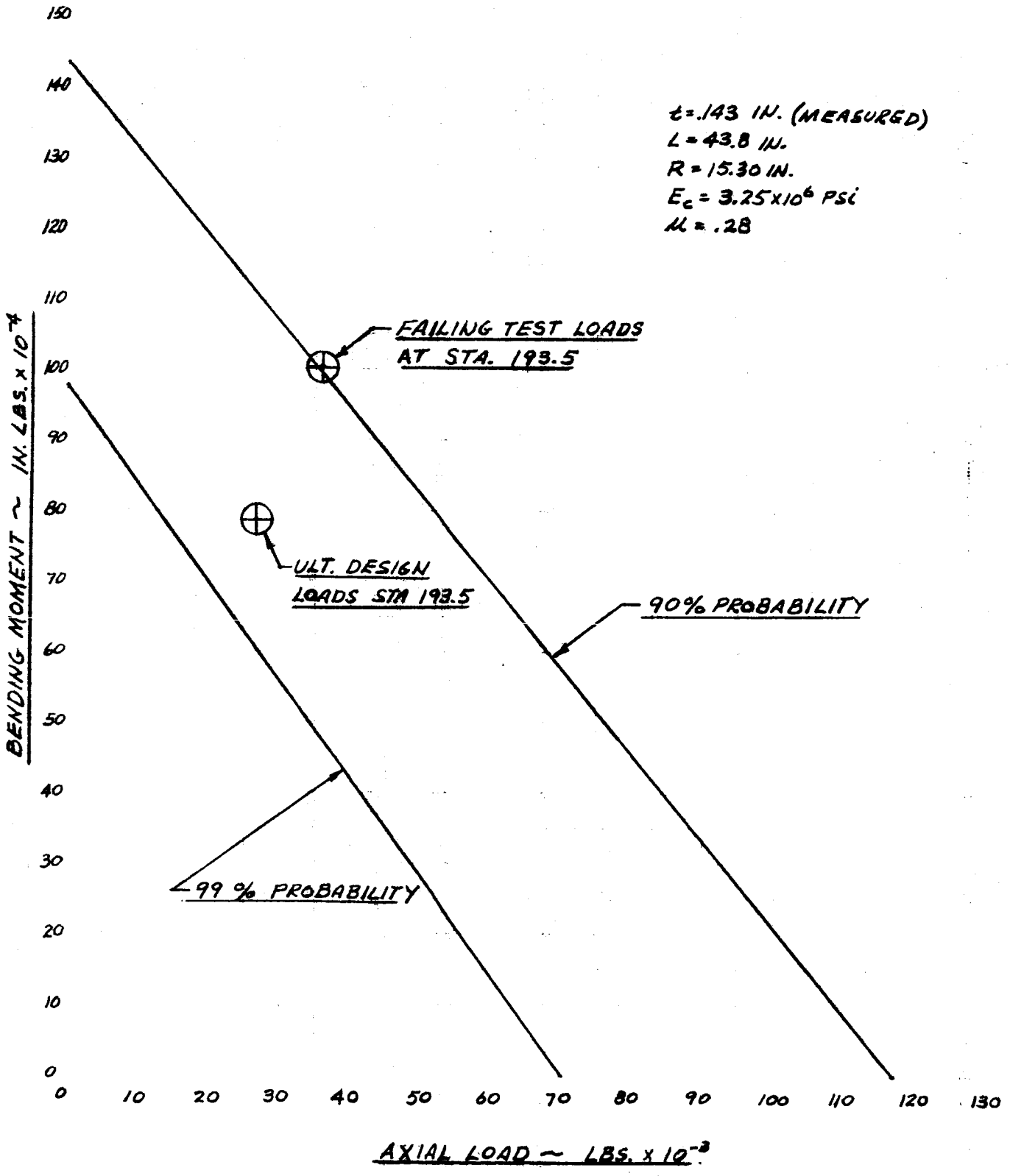
$w_M + w_p = 1004400/\pi(15.30)^2 + 35821/2\pi \times 15.30 = 1740$ #/IN

ULTIMATE DESIGN RUNNING LOADS

$w_M + w_p = 787700/\pi(15.30)^2 + 26600/2\pi \times 15.30 = 1348$ #/IN

TEST RUNNING LOADS = 129% OF ULTIMATE DESIGN LOADS
= 194% OF LIMIT STOUT DESIGN LOADS

SCOUT UPPER "C" SECTION
BENDING-AXIAL LOAD INTERACTION CURVES



STABILITY ANALYSIS OF LOWER "C" TRANSITION SECTION

THE LOWER "C" TRANSITION SECTION WITHSTOOD A TEST LOADING OF 183% SCOUT LIMIT BENDING MOMENT COMBINED WITH 168% SCOUT LIMIT AXIAL LOAD AT STATION 253.06. THE PREDICTED COMPRESSION BUCKLING ALLOWABLES FOR THE SECTION ARE COMPARED WITH THE MAXIMUM APPLIED TEST LOADS (LOAD POINT 55 OF TEST B IN APPENDIX I) AND THE ULTIMATE DESIGN LOADS THE COMPARISON IS PRESENTED ON PAGE 3.10.

MAXIMUM APPLIED TEST LOADS AT STATION 258.06

F-1 = 8790 # (REF. PG. II-28 APPENDIX I)
F-2 = 3289 #
F-3 = 35821 #

$M = 8790 \times 208.06 - 3289 \times 151.06 = 1{,}332000$ IN #

ULTIMATE DESIGN LOADS AT STATION 253.06

THE ULTIMATE DESIGN LOADES ARE FROM REF. A

AXIAL LOAD = 32000 #
MOMENT = 1090000 IN #

PREDICTED BUCKLING ALLOWABLE LOADS

MATERIAL IS FIBERGLASS
$t = .160$ IN.
$L = 14.88$ IN.
$E_c = 3.25 \times 10^6$ PSI (REF. PG. 4.1)
$\mu = .28$
$R = 15.89$

$L/R = 14.88/15.89 = .936$
$R/t = 15.89/.160 = 99.31$

$Z = (L/R)^2 (R/t)\sqrt{1-\mu^2} = (.936)^2(99.31)\sqrt{1-.28^2} = 83.53$ (REF. B)

$F_{CR} = \frac{K\pi^2 E}{12(1-\mu^2)}\left(\frac{t}{L}\right)^2 = \frac{K\pi^2 \times 3.25\times10^6}{12(1-.28^2)}\left(\frac{.16}{14.88}\right)^2 = 335K$ (REF. B)

STABILITY ANALYSIS OF LOWER "C" TRANSITION SECTION (CONT.)

FOR 90% PROBABILITY

$F_{ccR} = 335(33) = 11060$ PSI

$F_{bcR} = 335(45) = 15080$ PSI

FOR 99 % PROBABILITY

$F_{ccR} = 335(23) = 7710$ PSI

$F_{bcR} = 335(35) = 11730$ PSI

$P_{cR} = F_{ccR} \times A$

$A = 2\pi Rt = 2\pi \times 15.89 \times .160 = 15.97\ IN^2$

$M_{cR} = F_{bcR} \times I/C$

$I/C = \pi R^2 t = \pi(15.89)^2 \times .160 = 126.92\ IN^3$

FOR 90% PROBABILITY

$P_{cR} = 0$, $M_{cR} = 15080 \times 126.92 = 1914000$ IN#

$M_{cR} = 0$, $P_{cR} = 11060 \times 15.97 = 176600$ #

FOR 99 % PROBABILITY

$P_{cR} = 0$, $M_{cR} = 11730 \times 126.92 = 1488800$ IN #

$M_{cR} = 0$, $P_{cR} = 7710 \times 15.97 = 123100$ #

TEST RUNNING LOADS

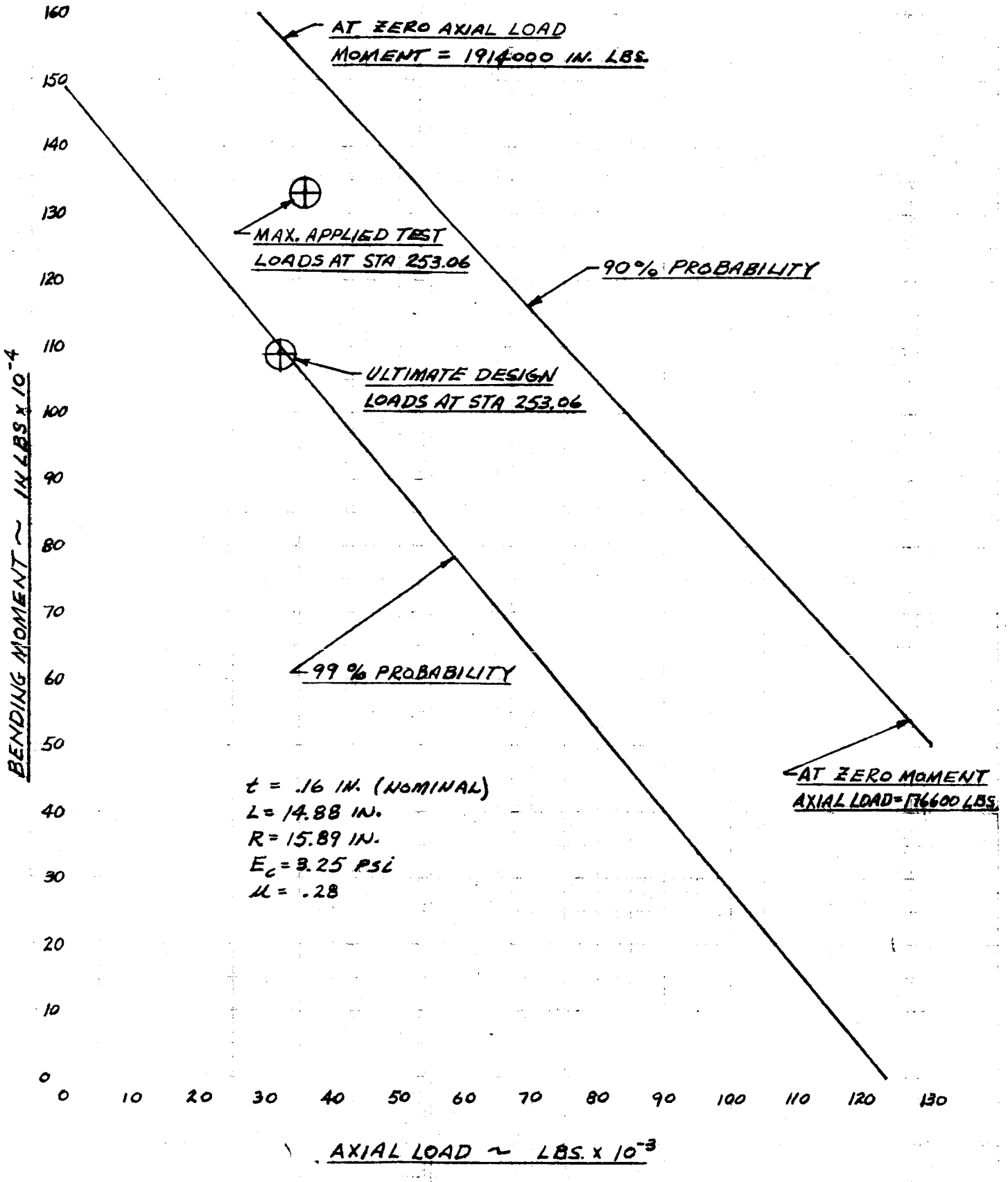
$w_M + w_P = 1332000/\pi(15.89)^2 + 35821/2\pi 15.89 = 2038$ #/IN.

ULTIMATE DESIGN RUNNING LOADS

$w_M + w_P = 1090000/\pi(15.89)^2 + 32000/2\pi 15.89 = 1695$ #/IN.

TEST RUNNING LOADS = 120 % OF ULT. DESIGN LOADS
= 180 % OF SCOUT LIMIT DESIGN LOADS

SCOUT LOWER "C" SECTION
BENDING-AXIAL LOAD INTERACTION CURVES



STABILITY ANALYSIS OF LOWER "D" TRANSITION SECTION

THE LOWER "D" TRANSITION SECTION WITHSTOOD A TEST LOADING OF 184% SCOUT LIMIT BENDING MOMENT COMBINED WITH 393 % SCOUT LIMIT AXIAL LOAD AT STATION 131.1. THESE LOADS WERE APPLIED BY LOAD POINT 47 (REF. TEST B IN APPENDIX I) WHICH PRODUCED THE MAXIMUM COMPRESSIVE RUNNING LOAD ON THE SECTION. THE PREDICTED COMPRESSION BUCKLING ALLOWABLES FOR THE SECTION ARE COMPARED WITH THE MAXIMUM APPLIED TEST LOADS AND THE ULTIMATE DESIGN LOADS. THIS COMPARISON IS PRESENTED ON PAGE 3.13. NO THERMAL EFFECT ON THE PREDICTED LOADS OR THE ULTIMATE DESIGN LOADS IS CONSIDERED IN THE COMPARISON.

MAXIMUM APPLIED TEST LOADS AT STATION 131.1

F-1 = 8556 #
F-2 = 3357 #
F-3 = 40588 #

$M = 8556 \times 86.1 - 3357 \times 29.1 = 638970$ IN #

ULTIMATE DESIGN LOADS AT STATION 131.1

THE ULTIMATE DESIGN LOADS ARE FROM REF. A

AXIAL LOAD = 15500 #
MOMENT = 520000 IN #

PREDICTED BUCKLING ALLOWABLE LOADS

MAT'L IS CRES. 15-7 STAINLESS

SKIN AREA = 4.516 IN^2
LONG. AREA = .900 IN^2

$I_{SKIN} = 520.22\ IN^4$

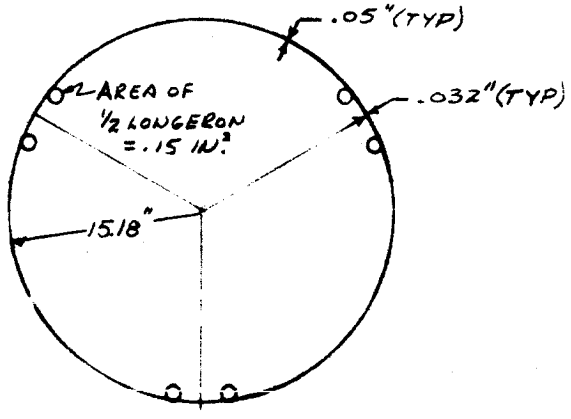
$I_{LONG} = 103.68\ IN^4$

$I_{TOTAL} = 623.9\ IN^4$

$I/C = 623.9/15.18 = 41.10\ IN^3$

SOLVE FOR AN EQUIVALENT t TO USE IN F_{CR} EQUATIONS.

$t = \frac{41.1}{\pi(15.18)^2} = .057$ IN



STABILITY ANALYSIS OF LOWER "D" TRANSITION SECTION (CONT.)

$t = .057$ IN.
$L = 26.6$ IN.
$E_c = 30 \times 10^6$ PSI
$\mu = .30$
$R = 15.18$

$L/R = 26.6/15.18 = 1.75$

$R/t = 15.18 \times .057 = 266.32$

$Z = (L/R)^2 (R/t)\sqrt{1-\mu^2} = (1.75)^2(266.32)\sqrt{1-(.30)^2} = 777$ (REF. 8)

$F_{CR} = \frac{K\pi^2 E}{12(1-\mu^2)}\left(\frac{t}{L}\right)^2 = \frac{K\pi^2 \times 30\times10^6}{12(1-.30^2)}\left(\frac{.057}{26.6}\right)^2 = 124\,K$ (REF. 8)

FOR 90% PROBABILITY

$F_{ccR} = 124(160) = 19840$ PSI

$F_{bcR} = 124(240) = 29760$ PSI

FOR 99% PROBABILITY

$F_{ccR} = 124(100) = 12400$ PSI

$F_{bcR} = 124(170) = 21080$ PSI

AREA $= 5.416$ IN^2
$I = 623.9$ IN^4

FOR 90% PROBABILITY

$P_{cR} = 0$, $M_{cR} = 29760 \times 623.9/15.18 = 1223000$ IN#

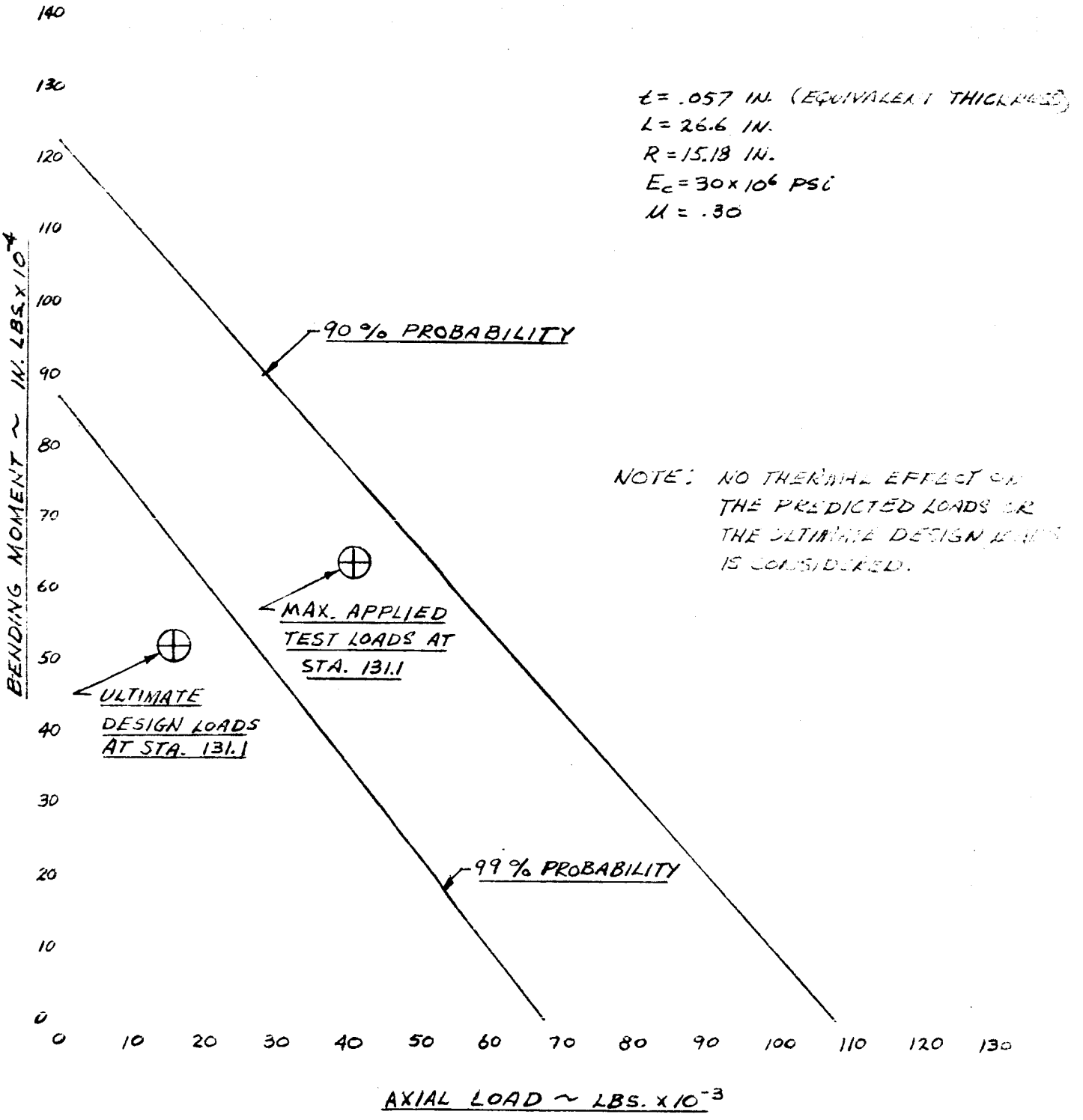
$M_{cR} = 0$, $P_{cR} = 19840 \times 5.416 = 107500$ #

FOR 99% PROBABILITY

$P_{cR} = 0$, $M_{cR} = 21080 \times 623.9/15.18 = 866400$ IN#

$M_{cR} = 0$, $P_{cR} = 12400 \times 5.416 = 67200$ #

SCOUT LOWER "D" SECTION
BENDING – AXIAL LOAD INTERACTION CURVES



SECTION 4

Results of compression tests on specimens cut from Upper "C" Transition Section.

After the Upper "C" Transition Section failure during the X-259 motor test, six specimens of the fiberglass skin were subjected to compression test by LTV Materials Test Lab. The results of these tests are presented below.

Specimen No.	Thickness (in.)	Width (in.)	Compressive Failing Load (lbs.)	Compressive Failing Stress (psi)	Modulus of Elasticity Ec x 10^6 (psi)
1	.1386	.6437	3660	41000	3.3
2	.1421	.6503	4070	44000	3.2
3	.1493	.6531	4270	43800	3.1
4	.1382	.6541	4070	45000	3.3
5	.1386	.6546	3950	43500	3.3
6	.1484	.6517	3910	40400	3.3

Average Thickness = .143 in.

Average Ec = 3.25 x 10^6 psi

SECTION 5.0

STATIC MOTOR FIRING

On 11 February 1966 at 1702 hours, X259 solid rocket motor S/N HPC 126A, which had already passed structural tests in conjunction with Vehicle "C" and "D" sections, was static fired successfully. Action time was 33.9 seconds, maximum pressure 345 psia, and maximum thrust 17.925 lb_f, with a squib delay of 1.701 seconds. This is completely compatible with previous sea level, 75° firings, and was apparently unaffected by loads applied.

The "Thermolag" external insulation bubbled as a result of the firings although case temperatures did not exceed 100°F on any of twelve thermocouples mounted directly against the glass case. Thermolag has been replaced with cork on Scout motors, because of this instability. On the basis of the thermocouple readings, no case temperature problem exists.

Complete results of this test are presented in Appendix I.

APPENDIX I

STRUCTURAL AND STATIC FIRING TESTS RESULTS DATA OF ROCKET MOTOR X-259 A2

(Contains 197 Pages)

ABL/X-154
Structural and Static Firing Tests of Rocket Motor X259 A2

Revised: April 6, 1966

S. H. Harris
D. W. Fuller

Prepared for:

Ling-Temco-Vought, Inc.
LTV Astronautic Division
Contract C-143734-AER

NAS 1-3899

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ABSTRACT

In accordance with LTV Astronautics Division Report No. 23.220, Allegany Ballistics Laboratory has completed two structural load tests and one static firing of the Rocket Motor X259 A2. The tests were made to obtain data for use in determining whether the X259 (Scout) could be safely flight tested at wind velocities above 110 knots (the current limitation) and whether heavier upper stage weights could be used with the X259.

In test A of the structural load tests, an X259 loaded motor, assembled between C and D Scout transition sections, was structurally tested to 115% of design limit loads. Post-test examination showed the structural integrity of the motor to be excellent. No adverse effects of the 43 months storage were found, indicating that the current shelf life limitation of 22 months might well be increased. In test B of the structural load tests a vertical assembly consisting of an empty X259 motor and C and D transition stages was load tested to failure. Failure occurred in the Scout upper C transition stage at bending moments and shear and torsional loads 190-193% of design values; compression load at failure was 168% of design load. The X259 chamber demonstrated excellent structural integrity.

The loaded motor of structural load test A was subsequently statically fired. All ballistic parameters were within requirements (HXS 1-21).

Complete data packages are given for the three tests. Detailed test plans for the structural load tests and static firing are included in the Appendix.

SECTION I

INTRODUCTION

This is the final report, submitted by Allegany Ballistics Laboratory in accordance with LTV Astronautics Division Report No. 23.220,[1] on two structural tests and one static firing test of the Rocket Motor X259 A2 (Antares). The general configuration of the X259 A2 is shown in Figure I-1. It is noted that the X259 A2 and A3 (Scout) differ only in external insulation and attachments. These tests were conducted to determine whether the X259 could be safely flight tested at greater wind velocities than permitted at the outset of the study and whether heavier upper stage weights could be used with the X259.

In a simulated flight load test made on an X259 A1 chamber in 1962, the forward fiberglass-to-skirt ring attachment failed at about 108% of the limit load. Another A1 chamber was subsequently reinforced by overwinding the fiberglass skirts, and this composite chamber was tested to failure at design ultimate loads (130% design limit load). This reinforcement overwind was integrated into the A2 chamber design which was accepted for flight use without further structural testing. These A1 chamber test results were the basis for the flight specification that the Scout vehicle could be exposed in flight to wind velocities up to 110 knots. The tests described in this report were made to increase this exposure range and to permit the use of heavier upper stage weights.

In test A of this study, an X259 loaded motor (HPC-126) was structurally tested to 115% of design limit load to evaluate the

effects of the Scout flight loads on the loaded motor and transition sections. The effects of these loads were evaluated by visual and nondestructive testing (NDT) inspection and by subsequent static firing test of this motor.

In Test B of this study, an inert A2 chamber (HPC-187) was tested to failure to determine the ultimate flight load capabilities of the X259 chamber and the Scout vehicle transition sections. The primary purpose of this test was to establish the ultimate strength of the A2 chamber since this chamber has not been tested previously.

This final report presents a general description of the tests and a brief discussion of the results (Section II) and complete data packages for each of the three tests (Sections III, IV and V). The test plans which were established and followed for the three tests are included in Appendix A and Appendix B.

---

(1) LTV Astronautics Division, Ling-Temco-Vought, Inc., "Structural Load Test Plan ABL X-259 Motor, Loaded and Unloaded Case," Report No. 23.220, Revision A (Unclassified), November 1965.

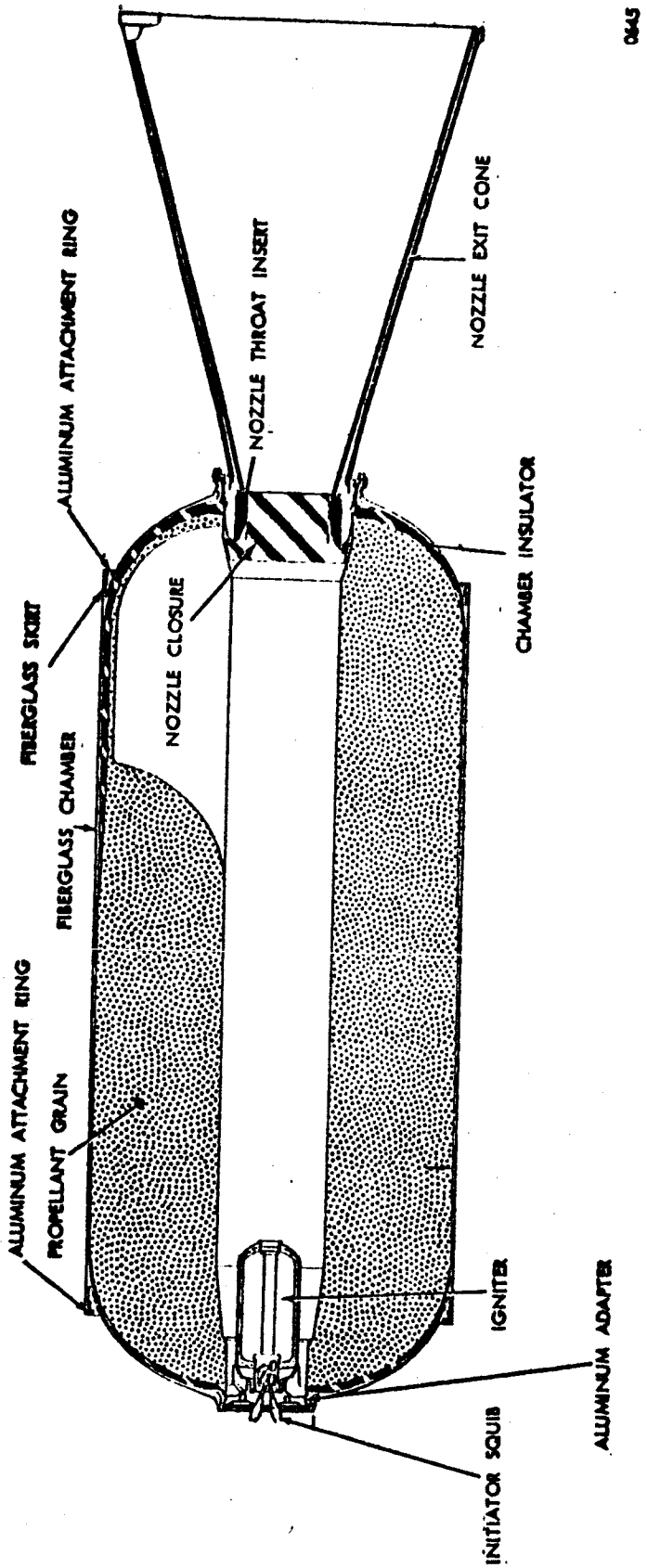


FIGURE I-1
Rocket Motor X259 A2

SECTION II

DESCRIPTION OF TESTS

In accordance with LTV report 23.220, Allegany Ballistics Laboratory conducted a structural load test program for the X259 motor (loaded and unloaded) and for adjacent Scout C and D transition sections. The general objectives of this program were to evaluate (1) the effect of internal strains (from externally applied structural loads) in a glass filament wound, solid-propellant rocket motor chamber and in the propellant system on its subsequent performance during firing and (2) the contribution of propellant grain to the structural properties of thin glass wound solid rocket motor chambers. To this end, the following steps were planned:

1. Instrument X259 cases and Scout C and D sections to measure strain and deflections.
2. Subject the propellant-loaded motor and adjacent C and D sections to 115% of the Scout X259 motor design limit flight loads.
3. Statically fire the loaded motor to determine the effect of structural loading on the performance of the motor.
4. Subject the unloaded motor case and C and D sections to failure to establish correlation between the propellant loaded and unloaded motor case.

A. TEST A - STRUCTURAL LOAD TEST OF LOADED X259 MOTOR (HPC-126)

1. Purpose

The purpose of the loaded motor test was to evaluate the effects of the application of Scout flight loads on an AEL X259 motor case prior

to ignition and firing. This condition is a design condition for both the Scout vehicle transition sections as well as for the ABL X259 motor. The condition is considered very realistic, and it could be obtained during the flight regimes of the Scout program.

The motor assigned to this test had been in storage for 43 months; its successful performance in this test would permit extension of the motor shelf life (22 months). The static test firing of this motor after application of the Scout design loads is described later in this section (II).

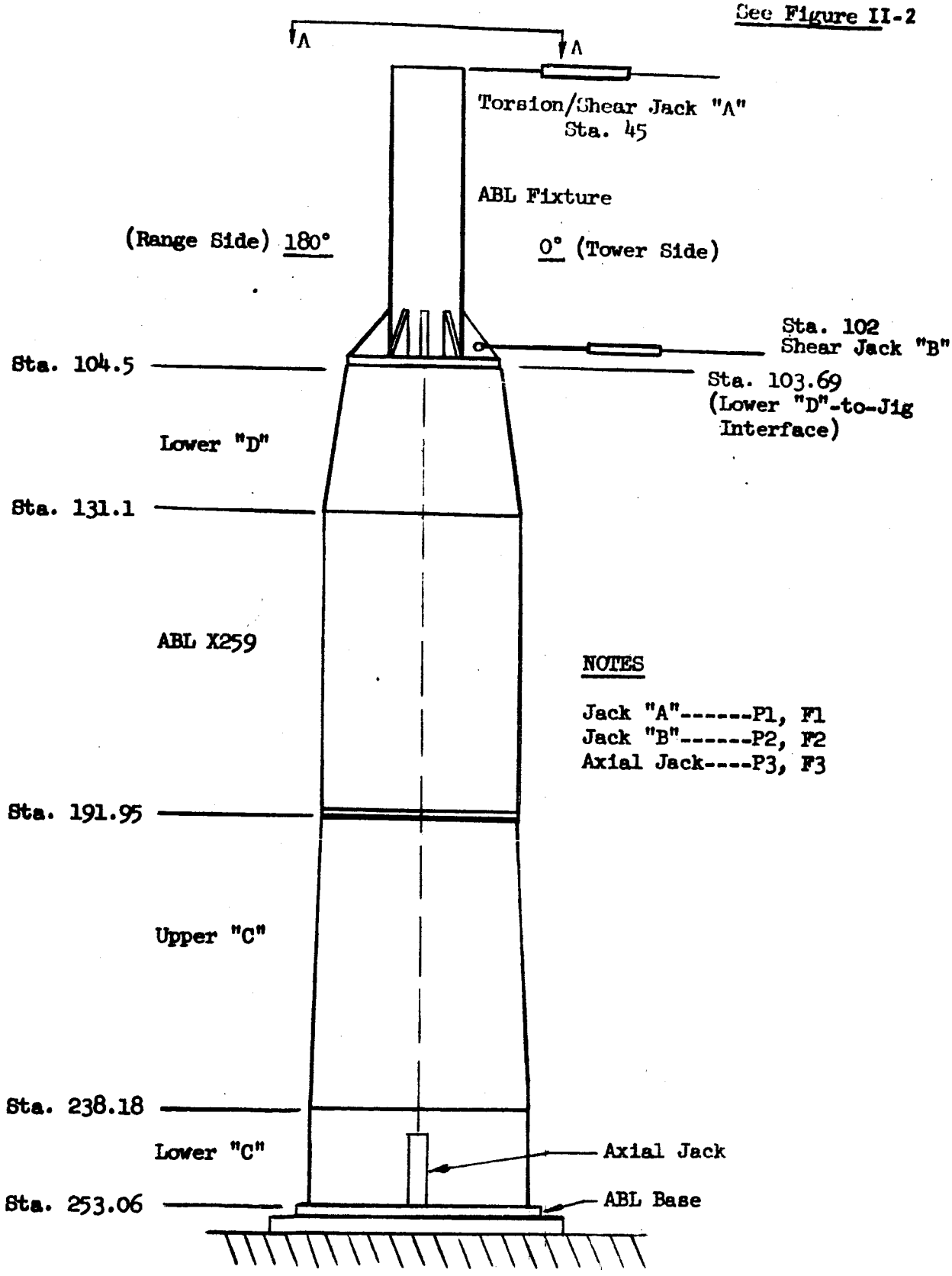
2. Test Arrangement and Procedure

The loaded X259 motor used in Structural Load Test A was that shown in Figure I-1 but modified for load testing; the nozzle and igniter were omitted to permit insertion of a rod through the motor for use in applying compression loads.

Before installation of the X259 loaded motor into the test fixture, it was inspected in accordance with ABL final inspection procedures to determine the effects of the prior storage life test and to establish the flight integrity of the motor. On the basis of this examination, HPC-126 was accepted for structural load testing.

The test arrangement for the loaded X259 structural test is shown in Figures II-1, II-2 and II-3. The X259 motor was mounted in the vertical position between Scout production transitions sections C and D (structural shells only). For this structural load test assembly, a production lower C section, fixed to the bay floor, was attached to an upper C section by a production diaphragm separation system. The upper C section was bolted to the aft skirt of the X259, and the forward skirt of the X259 was bolted to the lower D transition section. Adapters were attached to the Scout lower D section for application of the shear, axial, bending and torsional loads to motor case.

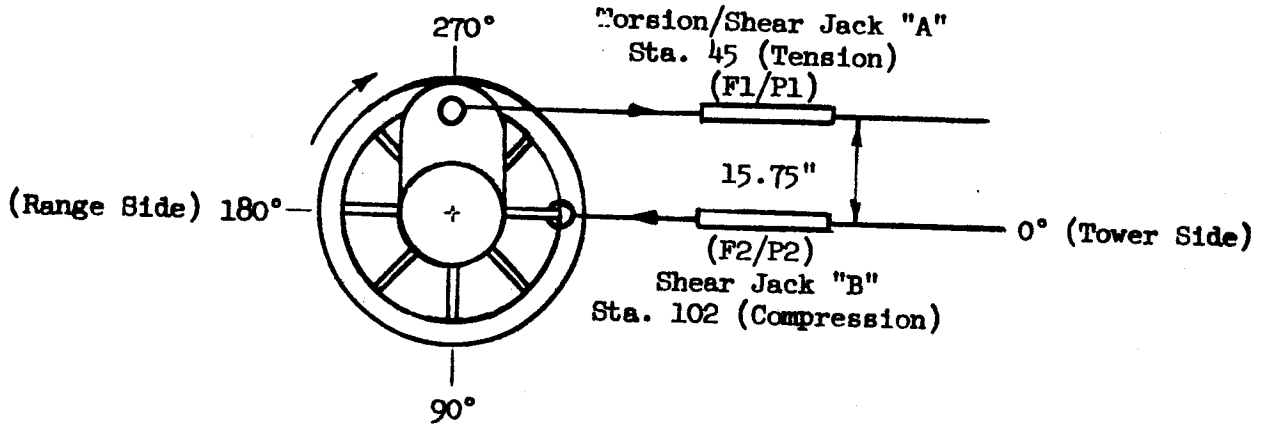
See Figure II-2



Test Arrangement

Figure II-1

See Figure II-1

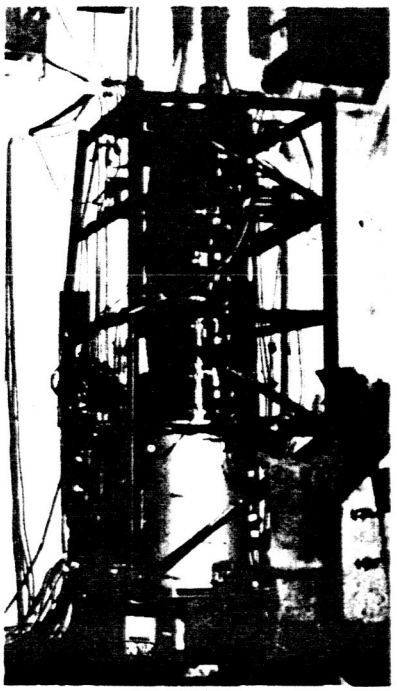


View AA

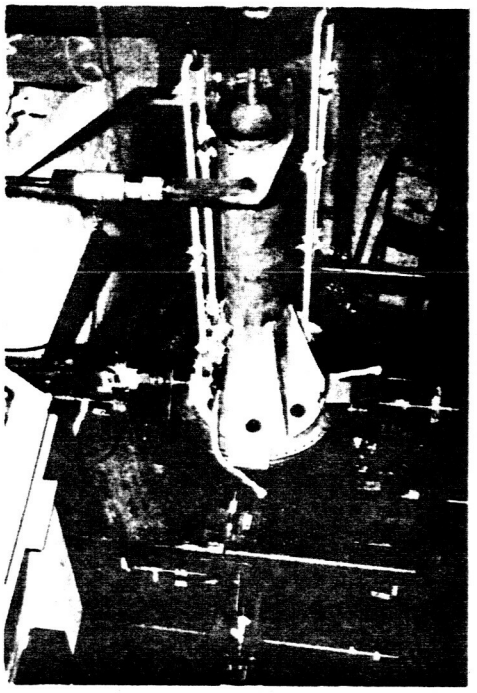
Looking Aft

Test Arrangement

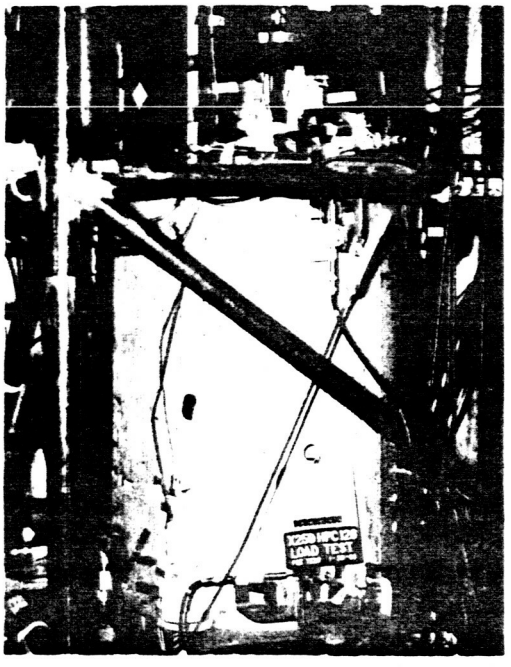
Figure II-2



(from 200°)



(from 270°)



(from 110°)

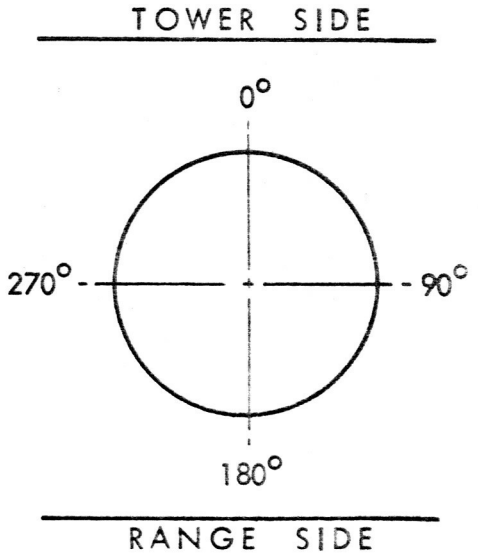


FIGURE II-3
HPC-126 Test Arrangement

G-1365

The following loads represent the Scout ultimate design loads as presented in the Scout Stress Analysis Report.

SCOUT ULTIMATE FLIGHT LOADS

Reference Report AST/E1R 12430, "Volume II - NASA Scout Stress Analysis Report," Revision E

Ultimate Loads	Station 131.10	Station 191.95
Axial Loads, lb	15,500	26,500
Shear Loads, lb	4,400	4,600
Bending Moment, in.-lb	520,000	780,000
Torsion, in.-lb	109,200	109,200

Application of the axial load to simulate exact vehicle loads during flight presents a severe physical loading problem. No simple solution exists that will allow an increase in axial load along the motor case and transition sections to simulate inertial loads that will not affect the case stability characteristics. Since the motor case wall thickness is constant over the length of the motor case, the axial loads were held constant. This type loading produced slightly higher loading on the case forward skirt but produced exact skirt loads on the aft end of the case.

Since the combination of axial loads and bending moments produces the critical load combination for the case, the shear loads used may differ slightly from flight shears in order to duplicate the torsional loads and bending moments.

Based on the above conditions, the following loads were considered as limit motor case loads.*

AEL X259 LIMIT TEST LOADS

Limit Loads	Station 131.1	Station 191.95
Axial Loads, lb	20,400	20,400
Shear Loads, lb	3,300	3,300
Bending Moment, in.-lb	400,000	600,000
Torsion, in.-lb	84,000	84,000

* NOTE: Limit motor case loads equal Scout ultimate loads divided by 1.30.

The loaded motor case was subjected to the planned structural loading profile (loads and sequence) presented in Table I of Appendix A. Simultaneous loads were applied with hydraulic cylinders (jacks) at three locations as shown in Figures II-1 and II-2. The three loads are described as Shear Load A, Shear Load B and Axial Load. Shear Load A subjected the structure to both torsional loads and bending moments.

The complete test plan for Test A is included as Appendix A.

3. Discussion of Results

Structural load test A for HPC-126 was performed at AEL on January 28, 1966. The complete data package for this test, including displacement and strain values measured at various locations on the motor and transition sections, is presented as Section III of this report. The actual applied loads were within 5% of the loads specified in Reference (1).

The X259 motor demonstrated excellent structural integrity. Post-test visual examination revealed no damage to the motor or to the transition sections, and radiographic inspection of the rocket motor after this test revealed no internal damage to the chamber, case-bonding system or propellant grain.

On the basis of the test results and visual evidence, HPC-126 was accepted for static firing to complete the history of structural load effects on an X259 motor.

B. TEST B - STRUCTURAL LOAD TEST OF EMPTY X259 MOTOR (HPC-187)

1. Purpose

The purpose of the unloaded motor test was to establish the structural failing load capabilities of the AEL X259 unloaded motor case, the Scout lower D transition section and the Scout upper and lower C transition sections.

2. Test Arrangement and Procedures

Pretest and post-test arrangements for Load Test B are shown on Figures II-4A and 4B and Figures II-5A and 5B. The test arrangement for the inert motor structural test was the same as that employed for the loaded motor structural test. That is, the X259 motor was mounted in the vertical position between Scout production transition sections C and D (structural shells only). For this structural load test assembly, a production lower C section, fixed to the bay floor, was attached to an upper C section by a production diaphragm separation system. The upper C section was bolted to the aft skirt of the X259, and the forward skirt of the X259 was bolted to the lower D transition section. Adapters were attached to the Scout lower D section for application of the shear, axial, bending and torsional loads to motor case.

Scout ultimate design loads as shown in the Scout Stress Analysis Report are presented as follows:

SCOUT ULTIMATE FLIGHT LOADS
Reference Report AST/EIR 12430, "Volume II - NASA Scout Stress Analysis Report," Revision E

Ultimate Loads	Station 104.5	Fwd. Station 131.1	Aft Station 191.95	Station 238.18	Station 253.06
Axial Load, lb	13,500	15,500	26,500	29,500	32,000
Shear Load, lb	4,400	4,400	4,600	4,800	4,700
Bending Moment, in.-lb	400,000	520,000	780,000	1,010,000	1,090,000
Torsion, in.-lb	109,200	109,200	109,200	109,200	109,200

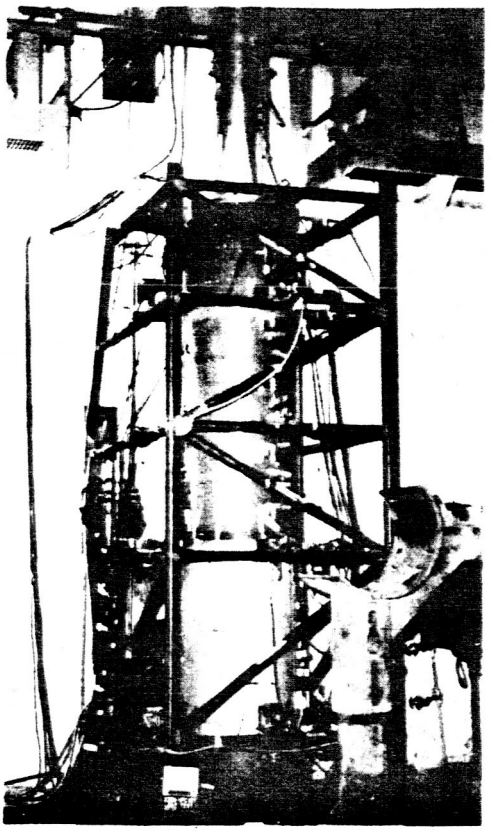


FIGURE II-4A
Pretest Condition of Unit HPC-187
(from 200°)

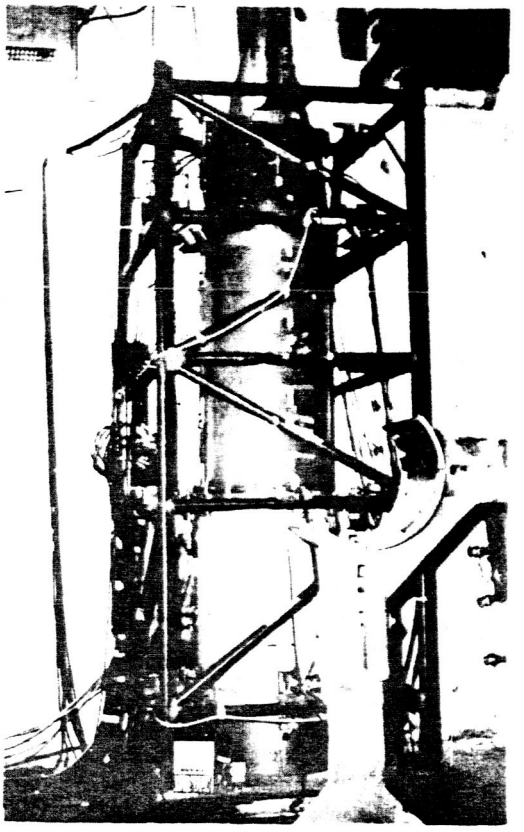
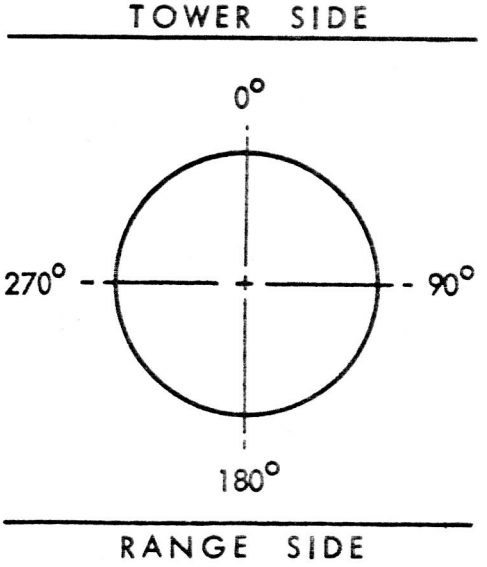
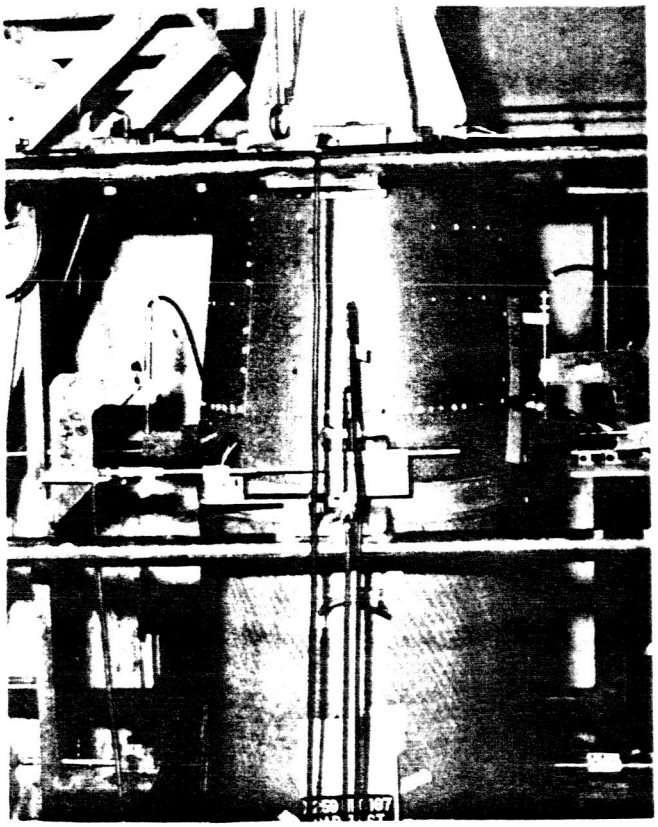


FIGURE II-4B
Post-test Condition of Unit HPC-187
(from 200°)



G-1370



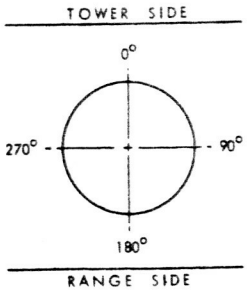


FIGURE II-5A
Pretest Condition of Unit HPC-187
(from 270°)

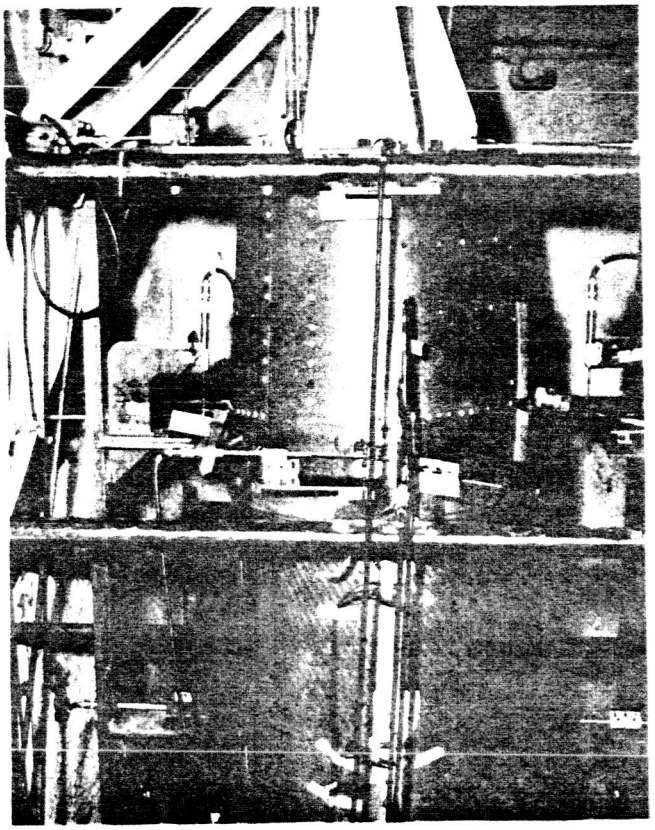


FIGURE II-5B
Post-test Condition of Unit HPC-187
(from 270°)

G-1366

As explained above for Test A, the axial load was kept at constant input load along the complete test section. Also, as in Test A, the shear loads used may differ slightly from flight shear loads in order to duplicate torsional loads and bending moments. Based on these conditions, a set of test load points were established to simulate Scout flight loads along the vehicle transition sections. Scout limit design loads are as follows:

SCOUT LIMIT FLIGHT LOADS*

Limit Loads	Station 104.5	Station 131.1	Station 191.95	Station 238.18	Station 253.06
Axial Load, lb	9,000	10,320	17,650	19,700	21,350
Shear Load, lb	2,930	2,930	3,080	3,200	3,130
Bending Moment, in.-lb	266,500	347,000	520,000	674,000	726,000
Torsion, in.-lb	73,000	73,000	73,000	73,000	73,000

*NOTE: Limit Scout flight loads equal Scout ultimate loads divided by 1.50.

3. Discussion of Results

Ultimate structural load test B for HPC-187 was performed at AEL on February 4, 1966. The complete data package for this load test to failure, including displacement and strain values measured at various locations on the chamber and transition sections, is presented as Section IV of this report.

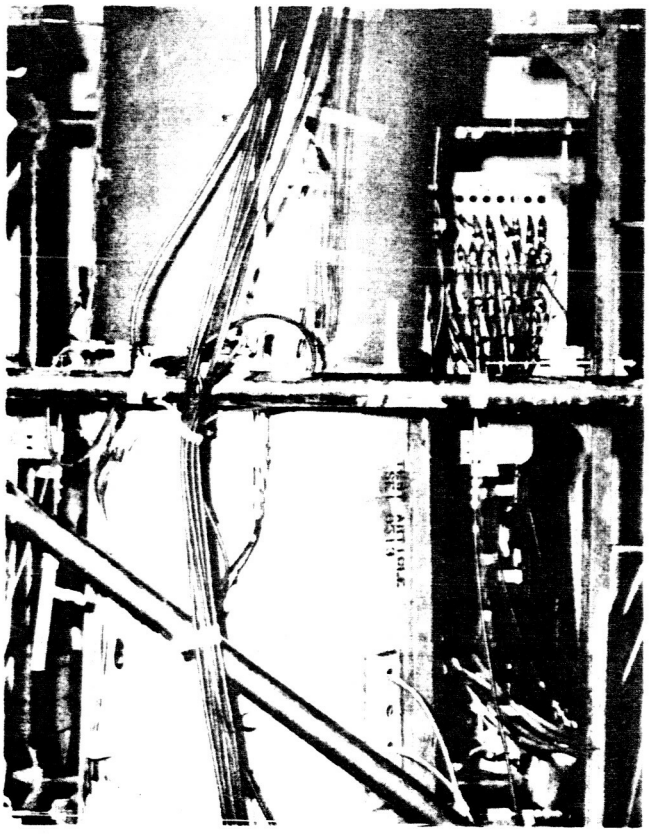
Failure occurred in the Scout upper "C" transition interstage when the axial load was being increased between load point numbers 54 and 55 (see Appendix A). The interstage failed in compression (tower side) at station 192. The area of failure is shown in Figures II-6 through II-9.

Failure occurred under the following load conditions:

a.	Bending Moment at Station 191.95	996,250 in.-lbs or 192%
b.	Shear load	5,501 lbs or 193%
c.	Torsional load	138,500 in.-lbs or 190%
d.	Compression load	35,820 lbs or 168%

The X259 chamber demonstrated excellent structural integrity during this test with no indication of failure.

The aft chamber dome was damaged after the failure occurred in the upper "C" interstage. Two holes through the fiberglass at 15^{o} and 345^{o} under the aft skirt ring were caused by collapse of the C interstage after its initial failure under compression.



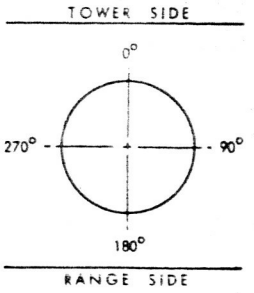


FIGURE II-6A
Post-test Condition of Unit HPC-187
(from 90°)

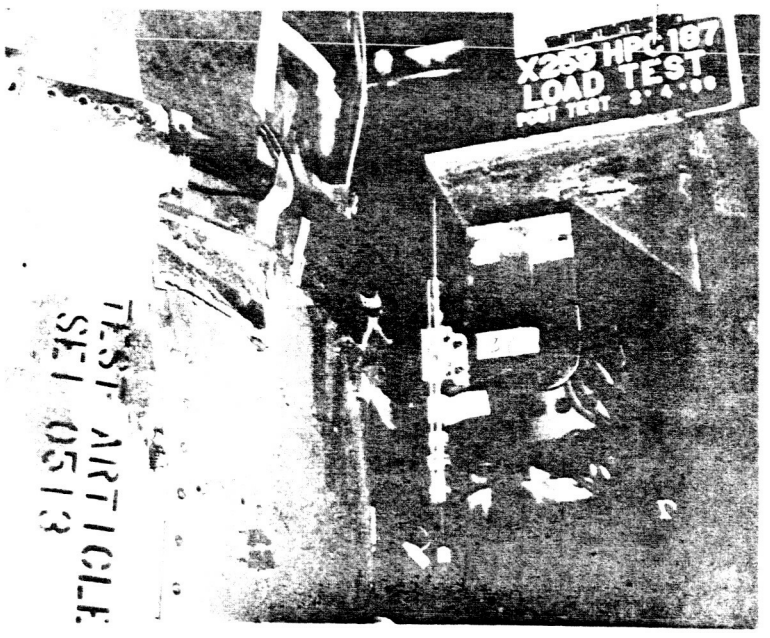


FIGURE II-6B
Post-test Condition (close-up)
of Unit HPC-187
(from 90°)

G-1367

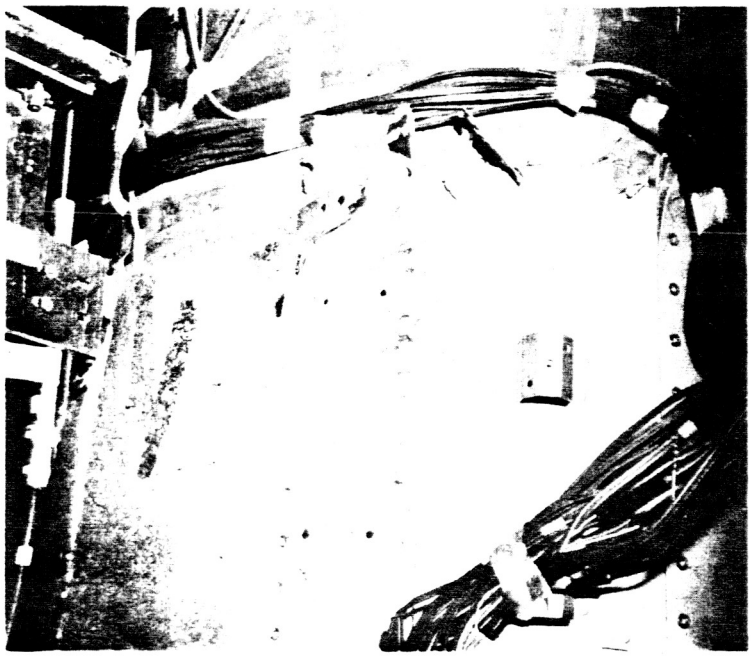
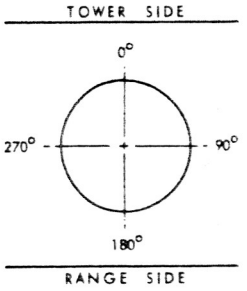


FIGURE II-7
Post-test Condition
of Unit HPC-187
(from 330°)



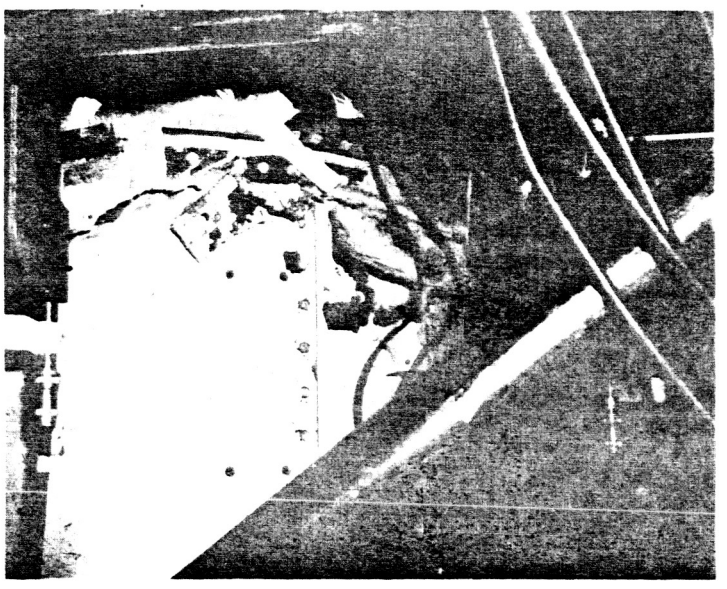


FIGURE II-8
Post-test Condition
of Unit HPC-187
(from 160°)

G-1368

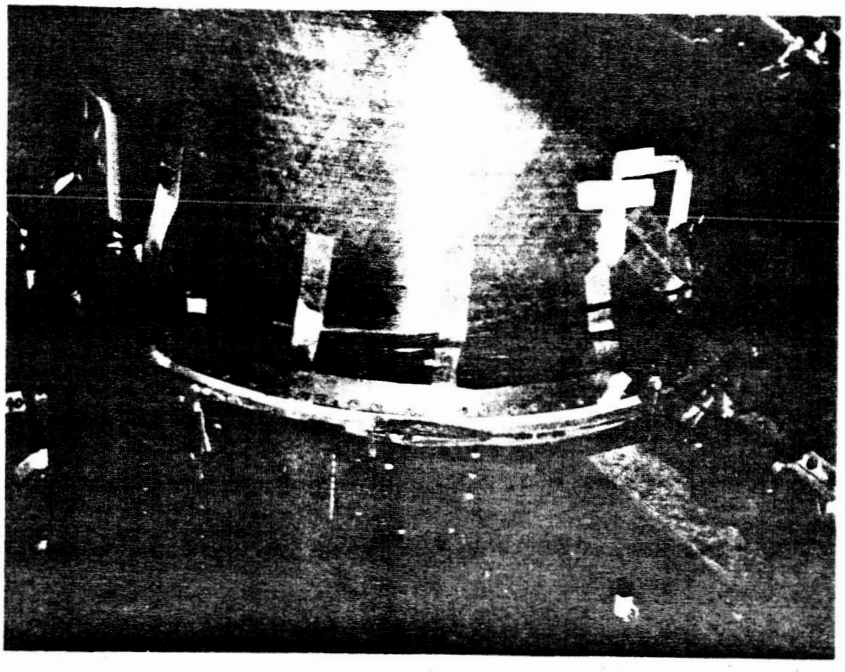
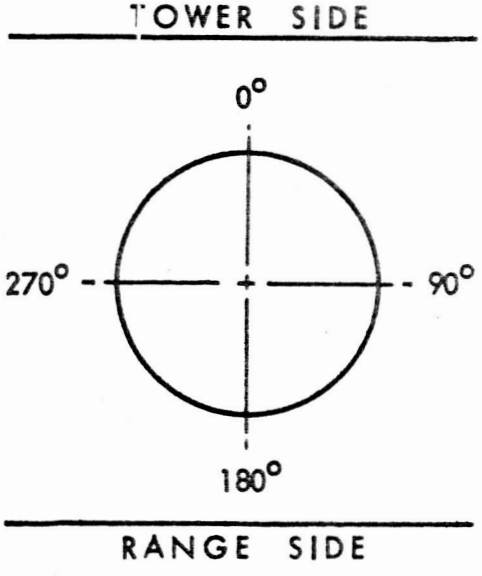


FIGURE II-9
Post-test Condition of Unit HPC-187
(from 225°)



G-1369

C. STATIC FIRING OF X259 MOTOR HPC-126

1. Purpose

Motor HPC-126 was statically fired after 43 months' storage and structural load testing (Test A). Test objectives of the firing were as follows:

(a) To evaluate the effects of Scout simulated flight loads on ballistic performance.

(b) To determine motor ballistic information.

(c) To determine the feasibility of extending the current shelf life limitation.

(d) To obtain strain gage and thermocouple data during static testing.

2. Test Arrangement and Procedure

Rocket Motor X259 A3 S/N HPC-126 was successfully statically fired at Hercules Powder Company (HPC)/Allegany Ballistics Laboratory (ABL) on February 11, 1966. The complete test plan for this static firing is included in this report as Appendix B.

The test motor was a full-scale flight-weight rocket motor and was loaded with 2556 pounds of CYI-75 propellant (casting powder lot No. ZI-169), an aluminized double-base solid propellant. It had been in storage at 50°F to 100°F for 43 months and then subjected to simulated flight loads (115% of normal flight load conditions) described as Test A in a preceding subsection (II-A).

For this static firing, the rod used for the structural load testing was removed from HPC-126, and a nozzle and X259 igniter were added to the unit. The nozzle used was shorter than that shown in Figure I-1 since the firing was made at ground level rather than altitude conditions.

The X259 igniter was a pyrogen rocket type, HPC S/N 92134A (K-50). It contained 8.0 pounds of solid propellant (EJC-75); 25 grams of boron/potassium nitrate pellets in a 2-mil conductive polyethylene bag; and two type SD60E0 squibs, S/N 0132 and 0134, both manufactured from lot number HEP-2-2. Before the firing, the igniter was subjected to a modified transportation vibration program (MIL-STD-353) and electrostatic discharge (ESD) testing. After these tests, the igniter was disassembled for visual inspection. It was found that the pellet bag had abraided at both ends during the vibration testing, and pellet dust was in the charge cup and over the external surface of the pellet liner.

Prefiring weights of the HPC-126 motor igniter and nozzle were obtained. After radiographic inspection per HXS 1-22 and visual inspection per HXD 1-117, the motor was temperature conditioned to 75°F, then taken to the firing bay and mounted on V-blocks (rollers) to permit forward and aft movements only. (See Figure II-10.) It was prepared for firing and fired according to HXS 1-21.

Forty-six channels of instrumentation were provided. Four channels were used to measure igniter and chamber pressure; two channels were used to measure thrust; specific impulse and action time were also determined. As shown in Section V, page V-4, twelve chromel-alumel thermocouples were used to record temperatures on the aft dome, aft cylinder, forward cylinder and forward dome. Thirty-two strain gages were employed at the locations shown in Section V, page V-5. Still photographs and motion pictures were taken of the firing as described in Appendix B.

HPC-126 was water quenched immediately after the end of burning to permit evaluation of the internal insulation burning pattern. Postfiring weights were measured.

3. Discussion of Results

The ballistic performance of HPC-126 was completely acceptable. Static firing data for HPC-126 are summarized in Figure II-11. The complete data package for this test is presented as Section V.

As shown below, the ballistic parameters were within the requirements of HXS 1-21.

Parameter	Test Results	Tolerance (HXS 1-21)
Action time, sec	34.0	33.7 ± 4.2
Average pressure over action time, psia	323	337 ± 25
Maximum pressure, psia	354	362 ± 20
Total impulse, lbf-sec	567,078	575,000 ± 15,000

Satisfactory ignition and a maximum igniter pressure of 882 psia were followed by normal motor performance. Maximum chamber pressure and thrust were 354 psia and 18,562 lbf, respectively. Chamber pressure and thrust versus time curves are presented in Section V. Figure II-12 shows the postfiring condition of the igniter.

Neither the prefiring vibration nor ESD tests had any detrimental effects on the igniter performance; the loose pellet dust (boron/potassium nitrate) noted above did not affect the igniter performance.

Post-firing examination indicated the exterior condition of the motor chamber to be excellent. (See Figures II-13 and II-14.) The slight blistering of the Thermo-Lag insulation found on the aft cylinder had been evident in past static firings; a review of thermocouple data indicates that the blistering is not a result of abnormally high skin temperatures.

Examination of the motor internal insulation and nozzle showed normal erosion patterns. The condition of the nozzle after firing is shown in Figure II-15.

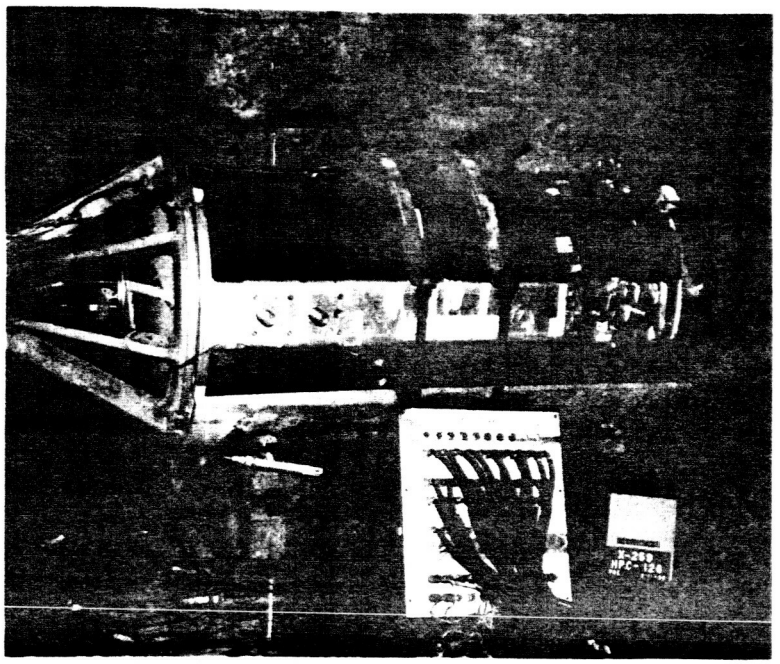


FIGURE II-10 G-1465
Prefiring Test Arrangement - HPC-126

D-195

HERCULES POWDER COMPANY
INCORPORATED
ALLEGANY BALLISTICS LABORATORY
CUMBERLAND, MARYLAND

Range Round No. X19465B

Date Fired 2-11-66

STATIC FIRING DATA SUMMARY

Contract C-143734-AER

Task 08052912 Project Eng. S. H. Harris

Purpose Evaluate effects of simulated flight loads & 43 months' storage

Loading No. X259 A3 - HPC-126A
Motor Design. X259 S/N HPC-126A
Chamber No. HPC-126A
Propellant CYI-75 Lot ZI-169
Grain No. PLX-6187 Wt. 2556
Propellant Wt. 2564 Inc. Igniter
Igniter ABL-92134A (K-50)
Circuit Resistance 1.24 ohms
Current Used 30.6 amps
Nozzle TRW-0115
Expansion Ratio 3.94
Throat Area (before firing) 34.92 in.^{2}
(after firing) 37.15 in.^{2}
K (initial) 100.5
Web Thickness 10.2 in.

Air Temperature 45 °F
Left Conditioning
Time Fired 5:02 P.M.

Conditioning: 75 ± 5 °F, 156 hrs;
45 °F, 0.25 hrs;
°F, hrs;
°F, hrs.

Round Weight (before firing) 2752 lbw
(after firing) 168 lbw

Post-Firing Inspection Inert parts in good condition.

Action Time	t_a	33.996	sec	Specific Impulse	I_{sp}	221.10	lbf-sec/lbw
Burning Time	t_b	33.348	sec	Motor Spec. Imp.	I_{sm}	206.06	lbf-sec/lbw
Ignition Time	t_i	1.772	sec	Minimum Thrust	F_{min}	15890	lbf
Prop. Ignition Time	t_{pi}	0.024	sec	Maximum Thrust	F_{max}	18562	lbf
Ignition Delay	t_d	1.748	sec	Eros. Max. Thrust	F_{me}	18240	lbf
Minimum Pressure	P_{min}	319	psia	Prog. Max. Thrust	F_{mp}	18554	lbf
Maximum Pressure	P_{max}	354	psia	Average Thrust	$\bar{F}_a$	16681	lbf
Eros. Max. Pressure	P_{me}	347	psia	Average Thrust	$\bar{F}_b$	16910	lbf
Prog. Max. Pressure	P_{mp}	354	psia	Total Impulse	I	567,078	lbf-sec
Average Pressure	$\bar{P}_a$	323	psia	Eff. Gas Velocity	v_E	7122	ft/sec
Average Pressure	$\bar{P}_b$	328	psia	Discharge Coeff.	C_d	0.00648	
Avg. Burning Rate	$\bar{r}$	0.306	in/sec	$C_F A_t$		51.64	
1st Pres. Indication	t_F	1.736	sec.	C^*		4969	

Max. Ign. Pressure Ign. P_{max} 882 psia

FIGURE II-11

FIGURE II-12 G-1466
Postfiring Condition of HPC-126 Igniter

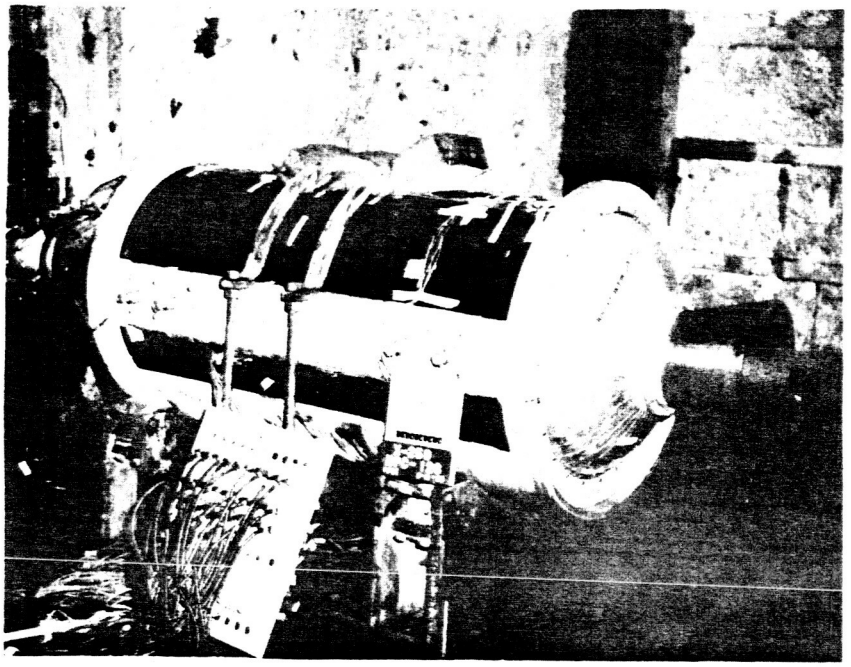


FIGURE II-13 G-1463
Postfiring View - HPC-126

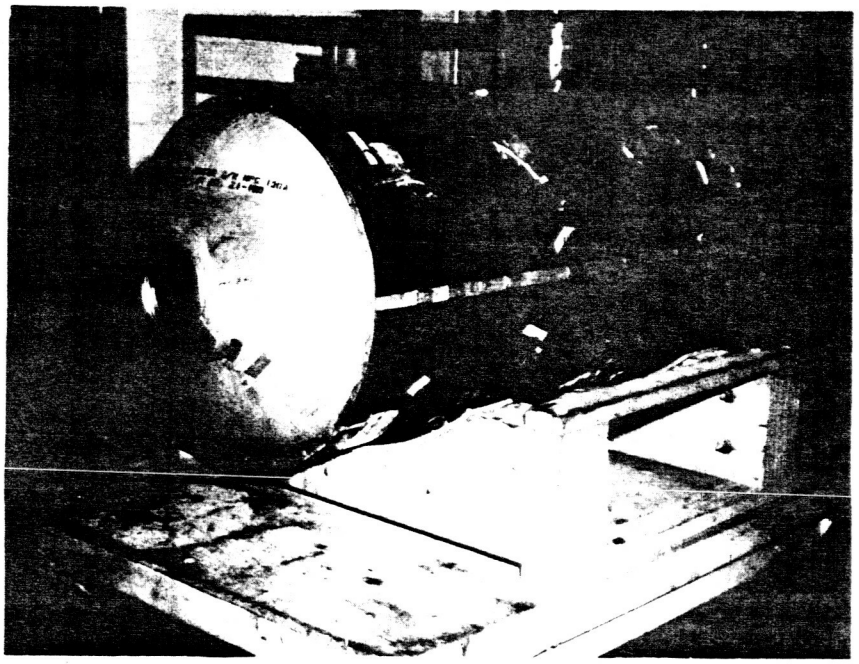


FIGURE II-14 G-1462
Postfiring Condition of HPC-126 Chamber

FIGURE II-15 G-1464
Postfiring Condition of HPC-126 Nozzle

SECTION III

Data Package
Structural Load Test
X259 Motor S/N HPC-126

Test A

HERCULES POWDER COMPANY
Allegany Ballistics Laboratory
Cumberland, Maryland

March 28, 1966

(REVISION I)

Data Package
Structural Load Test
X259 Motor S/N HPC-126

Contract: NAS 1-3899
Test A

TEST ENGINEER: D. K. Fuller

APPROVED BY: E. A. Stair

Title: Loaded Motor Case Structural Test

Specimen: HPC-126 and adjacent Scout "C" and "D" transition section.

Test Date: January 28, 1966

Test Site: ABL, X-Range, Bay 3

Test Arrangement: ABL Drawing No. 60158S42001

Test Document: ABL test plan titled, "Structural Load Test, ABL X259 Motor, Loaded and Unloaded Case", dated December 10, 1965.

Tabulated Data:

(1) Sign Convention

(a) Force gauges (F1, F2, F3)----Minus (-) indicates tension on load cell.

(b) Linear potentiometer (LP)----Minus (-) indicates movement away from the gage (extension of gauge shaft).

(c) Strain gage (SG)----Minus (-) indicates compression.

(2) Units

(a) Force gauge data are presented in pounds.

(b) Linear potentiometer data are presented in inches.

(c) Strain gauge data are presented in per cent.

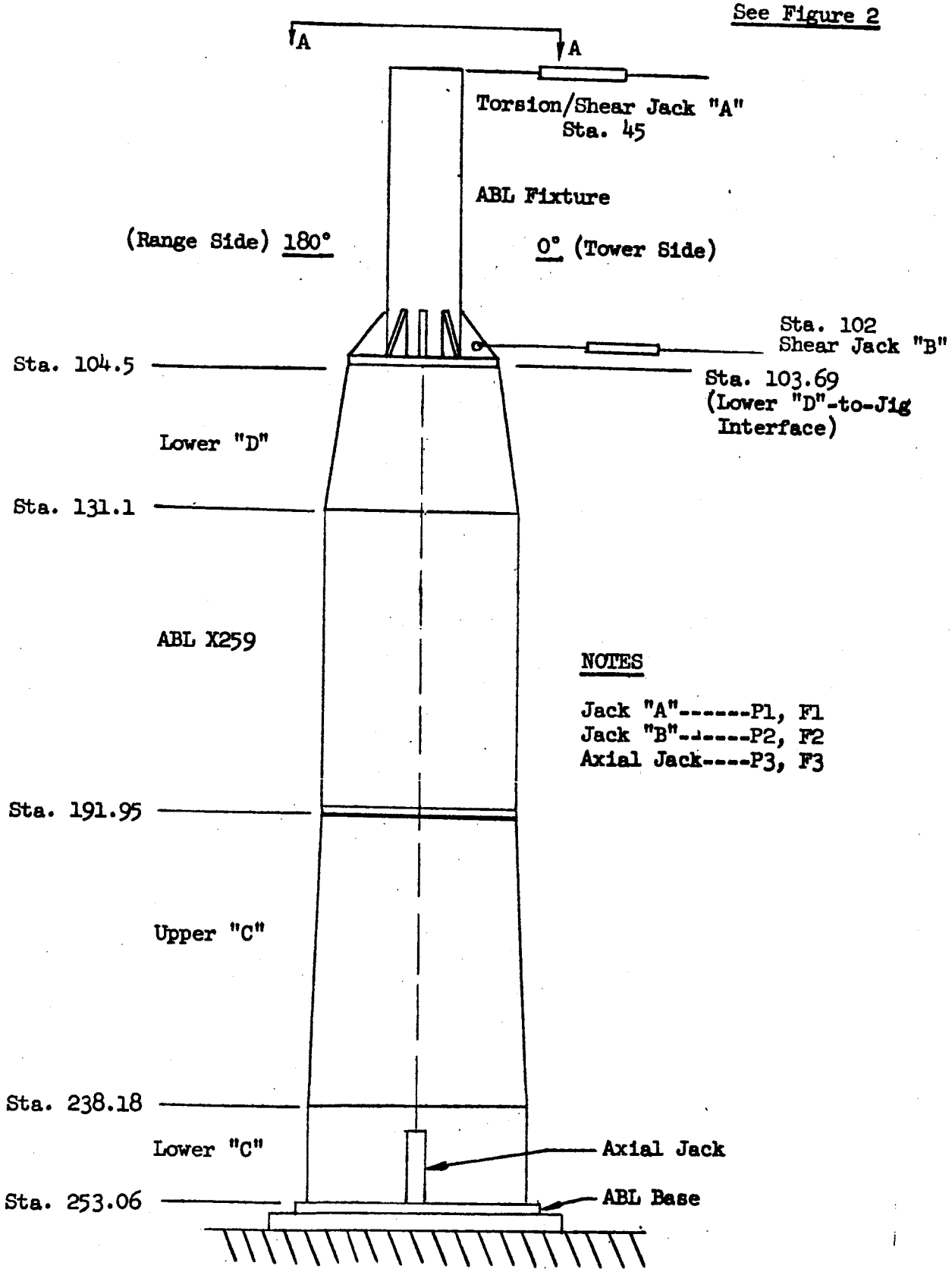
(3) Data Evaluation

(a) Load point 5 for LP-11 is questionable. Investigation of records, calibration and physical conditions will not support the elimination of this point.

(b) F2 deviated from planned program for load points 11 and 12 and thereby may affect all data at these points.

(c) LP-15 failed to follow the movement of the contact pad.

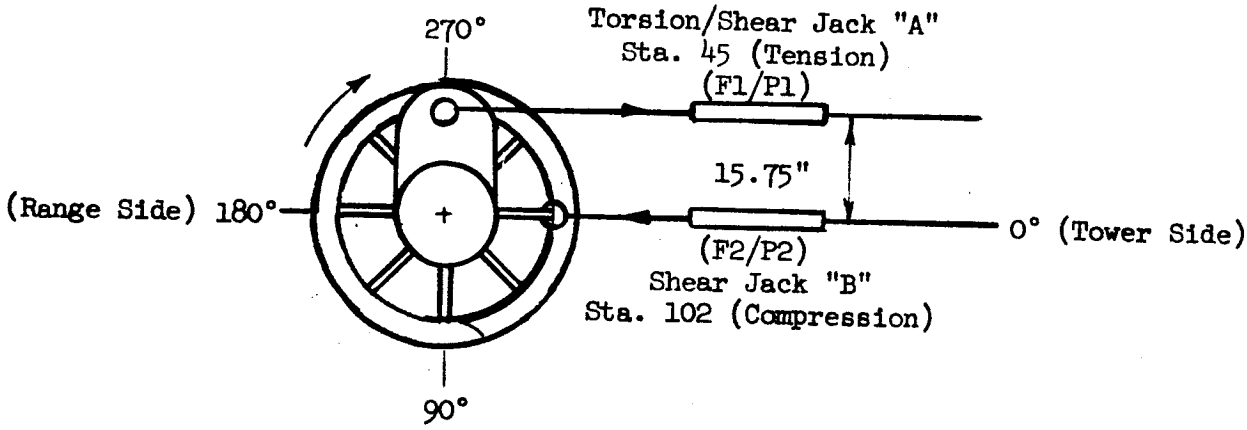
(c) LP-6 moved to the limit of its excursion at and after load point 10. The probable cause of the deviation was the failure of the LP follower to remain on its contact pad.



Test Arrangement

Figure 1

See Figure 1



View AA

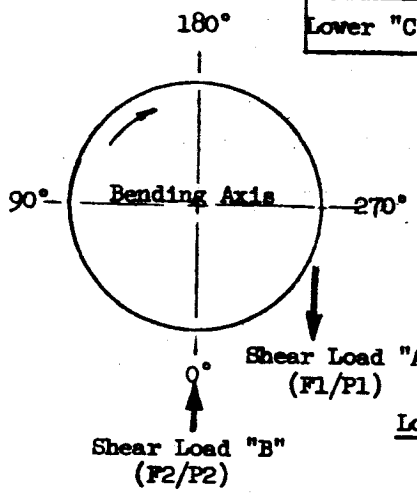
Looking Aft

Test Arrangement

Figure 2

Transition Sections "C" and "D"

Station \ Degree		0°	15°	30°	45°	60°	90°	135°	180°	225°	270°	300°	315°
Lower "D"	106	S22	---	---	---	S21	S20	----	S19	----	S24	S23	----
	129	---	S16	---	---	S15	S14	----	S13	----	S18	S17	----
Upper "C"	194	S28	---	---	S27	---	R2	S26	S25	S30	R1	----	S29
	225	---	---	---	---	---	---	S31	----	----	----	----	S32
	235	S35	---	---	S34	---	R4	----	S33	S36	R3	----	----
Lower "C"	241	S39	---	---	---	---	S38	----	S37	----	S40	----	----
	250	S43	---	---	---	---	S42	----	S41	----	S44	----	----

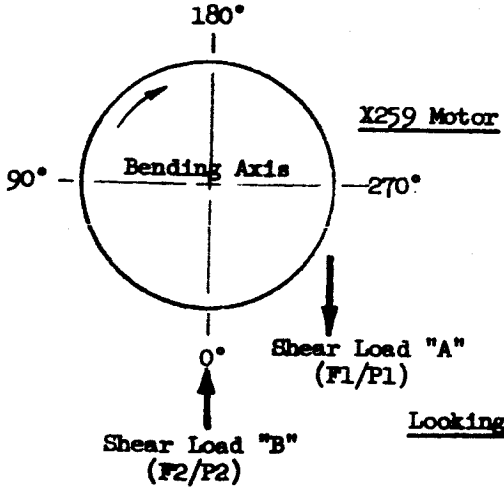


Looking Aft

NOTES:

All "S" gages are axial-oriented.
All "R" gages are 3-gage rosette type.
"C" and "D" section gages installed by LTV.

Gage locations are approximate. For exact locations, see LTV drawing AVDL-Scout-334.



X259 Motor

Looking Aft

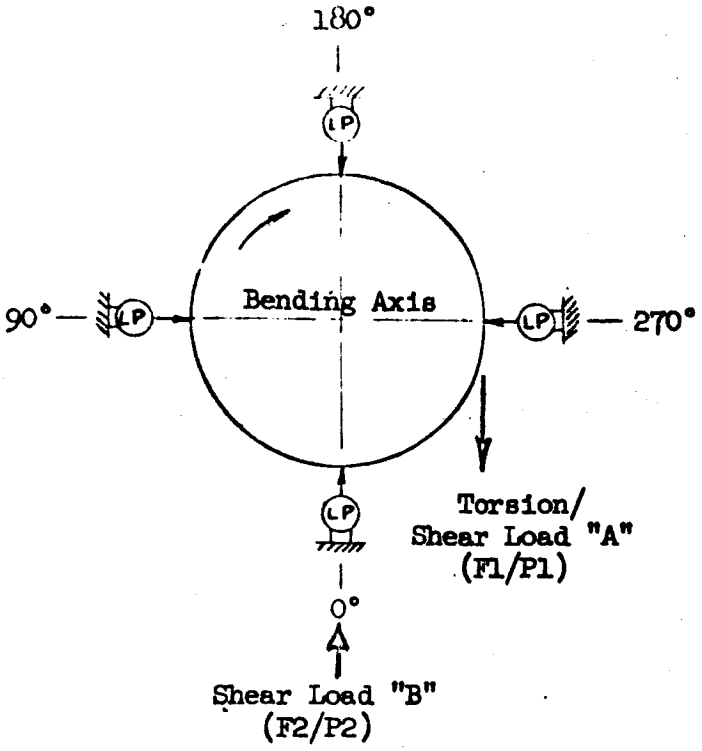
Station \ Degree	0°	90°	180°	270°
137	S49	R9	S45	R5
153	S50	R10	S46	R6
170	S51	R11	S47	R7
185	S52	R12	S48	R8

NOTES:

All "S" gages are axial-oriented.
All "R" gages are 3-gage rosette type.
Gages on motor case installed by ABL.

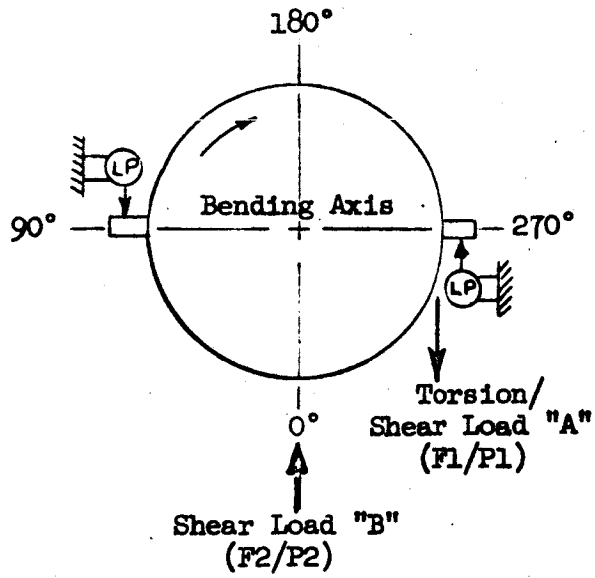
Strain Gage Locations

Figure 3



View Looking Aft (Down)

Radial LP Gage Locations				
Station \ Degree	0°	90°	180°	270°
103.69	LP1	LP2	LP3	LP4
131.1	LP5	LP6	LP7	LP8
161.35	LP9	LP10	LP11	LP12
191.95	LP13	LP14	LP15	LP16
234.5	LP17	LP18	LP19	LP20
241.5	LP21	LP22	LP23	LP24



View Looking Aft (Down)

Torsional LP Gage Locations

Station \ Degree	90°	270°
131.1	LP25	LP26
191.95	LP27	LP28
234.5	LP29	LP30
241.5	LP31	LP32

NOTE: Data from the torsional LP's reflect both torsional displacement and displacement of the entire structure in the 0°/180° directions. These LP's were 2 inches away from structure (skin).

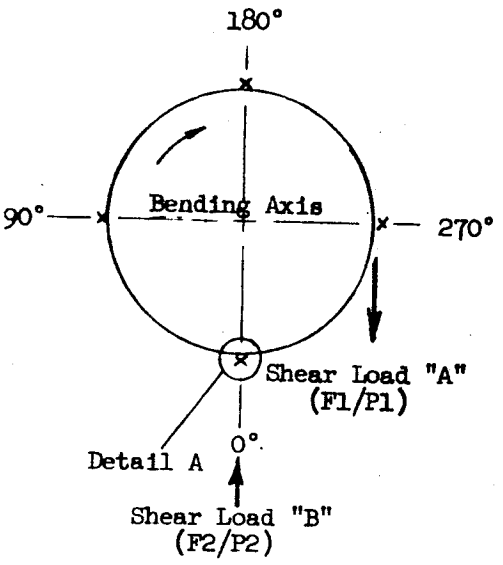
Radial and Torsional Displacement Gage Locations

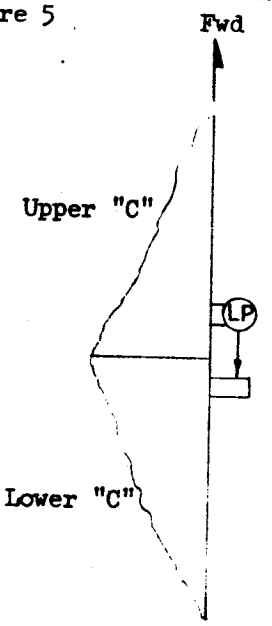
Figure 4

Longitudinal Displacement Gage Locations

Figure 5

All views looking aft (down).

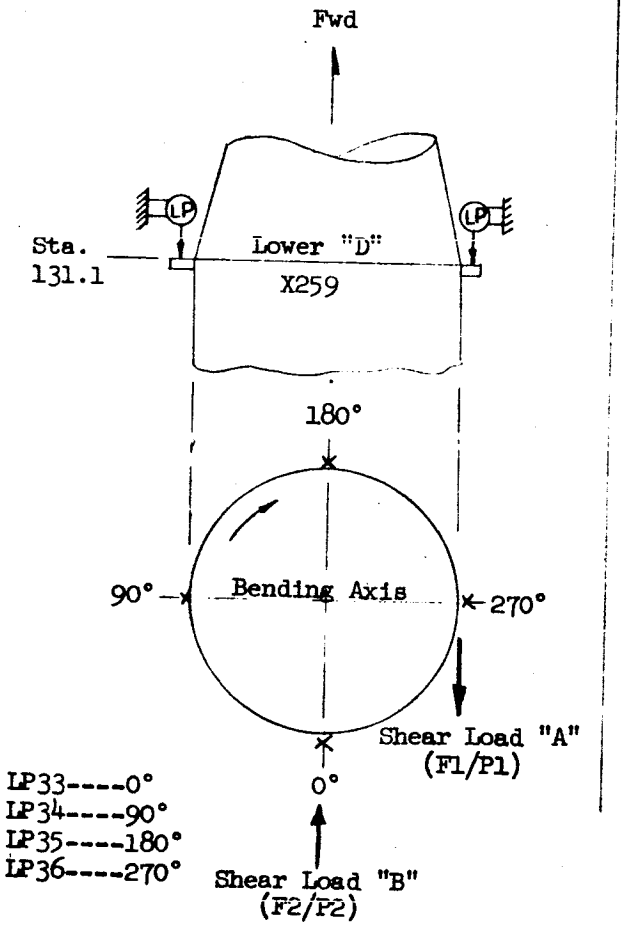




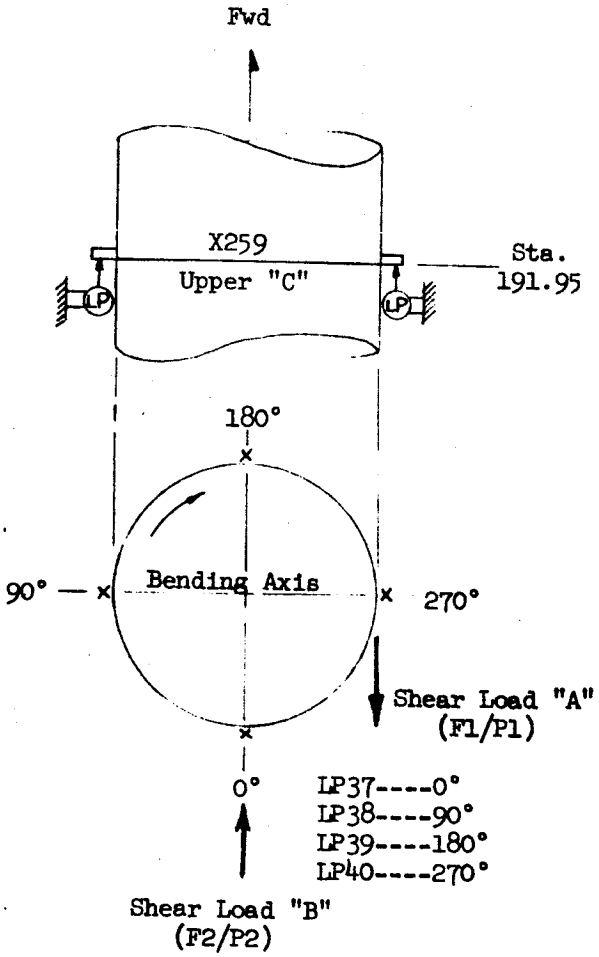
Sta. 238.18*

LP41----0°
LP42----90°
LP43----180°
LP44----270°

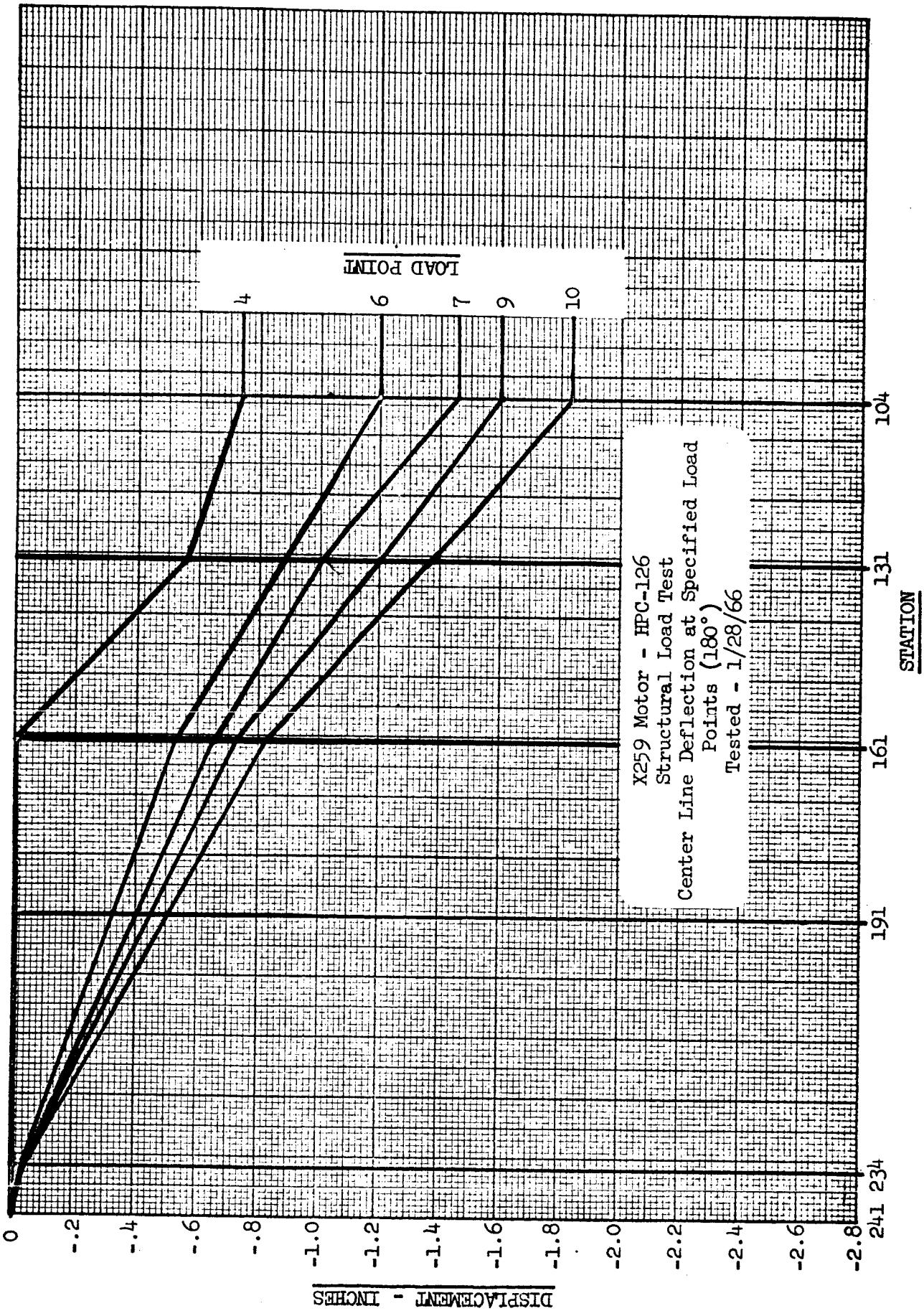
*These 4 LP's to measure gap at interface.

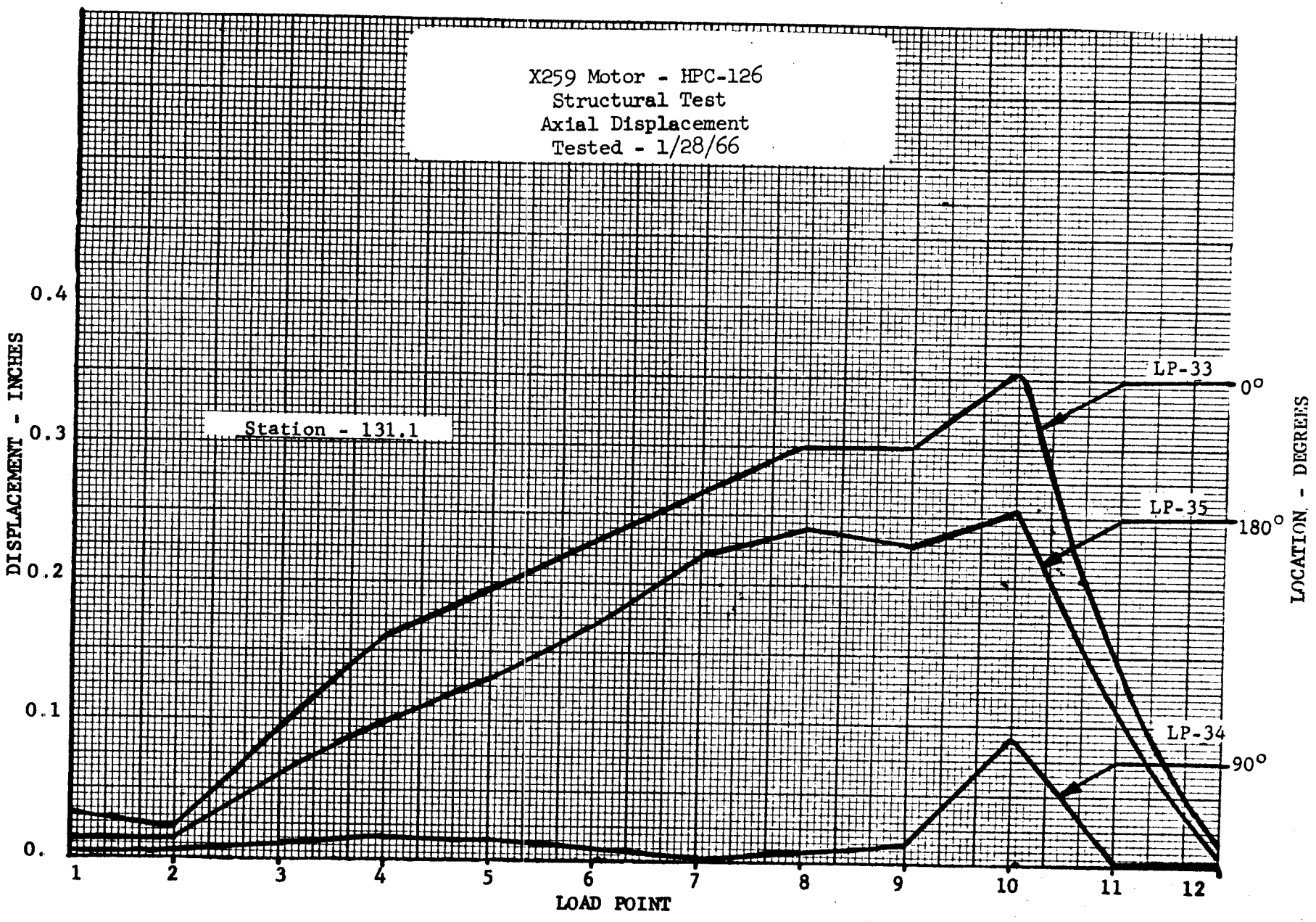


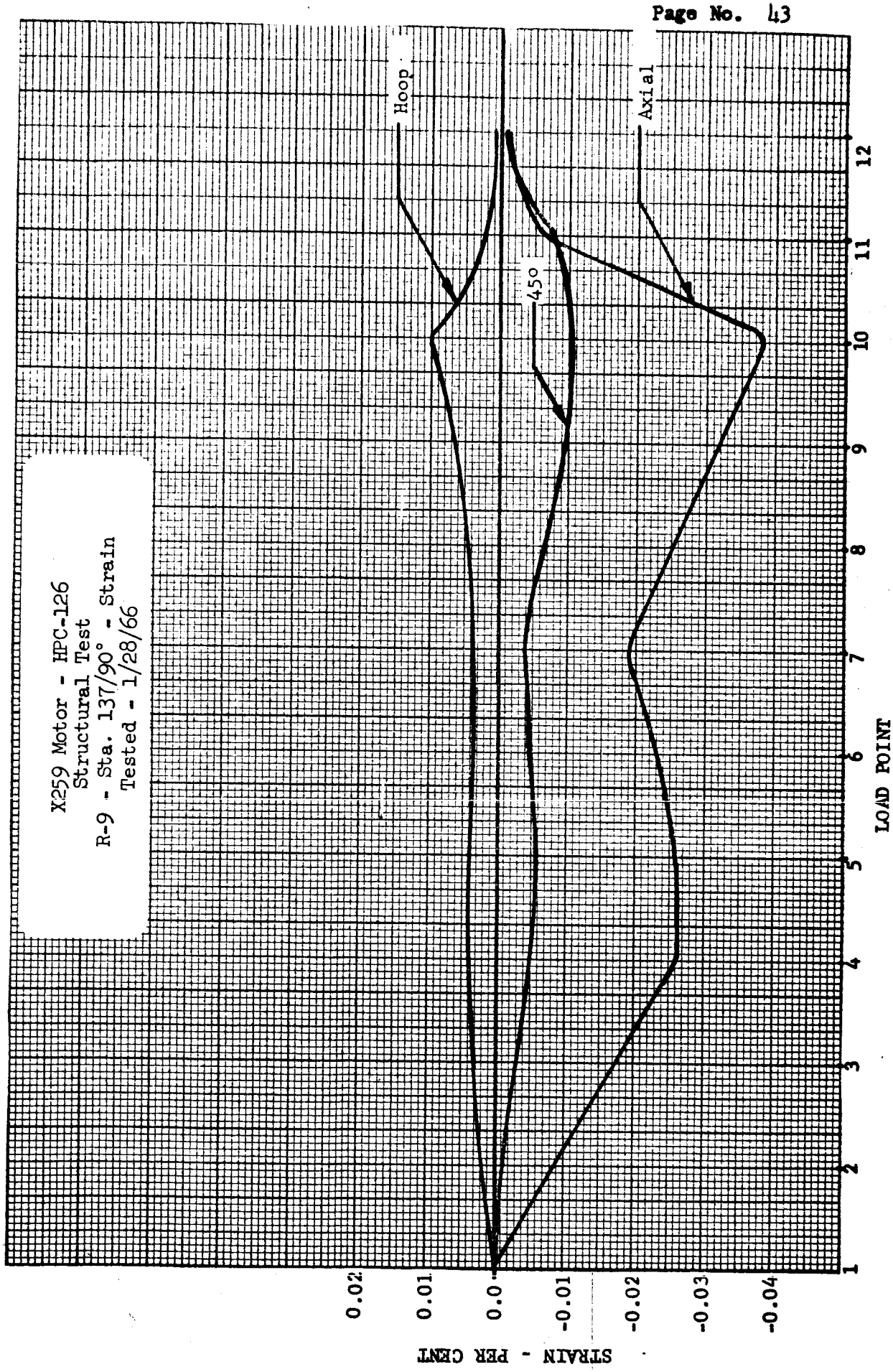
LP33----0°
LP34----90°
LP35----180°
LP36----270°

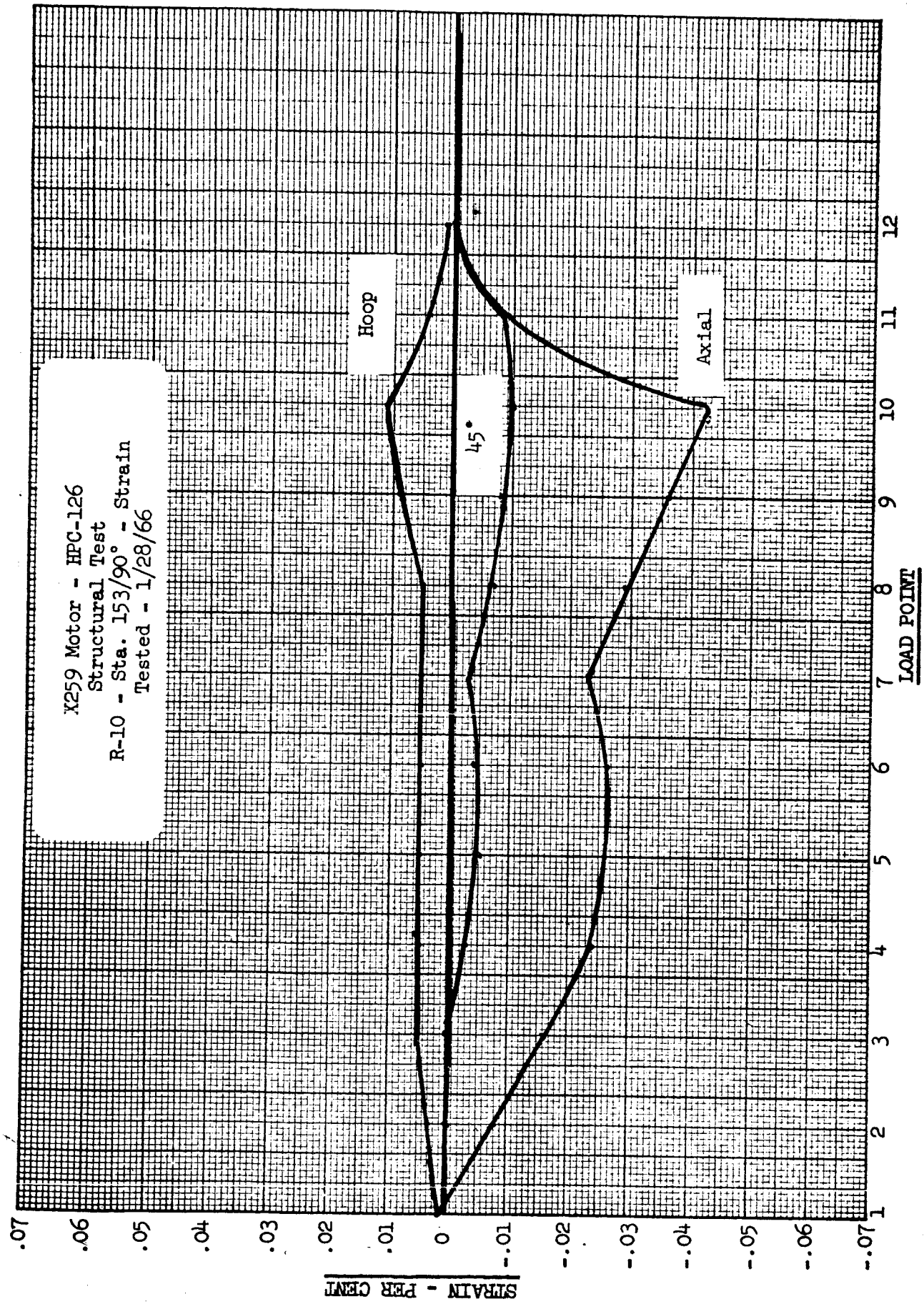


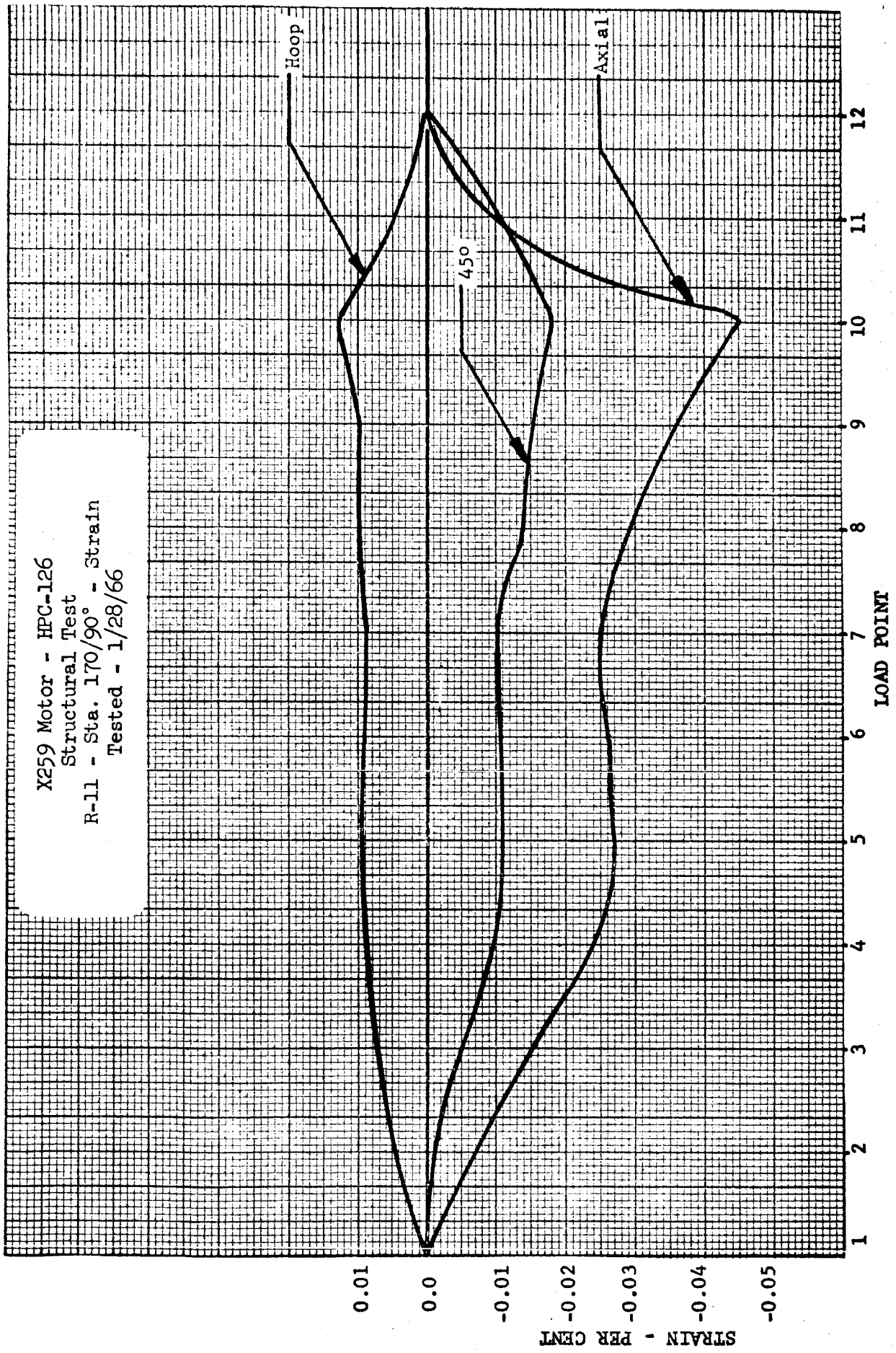
LP37----0°
LP38----90°
LP39----180°
LP40----270°

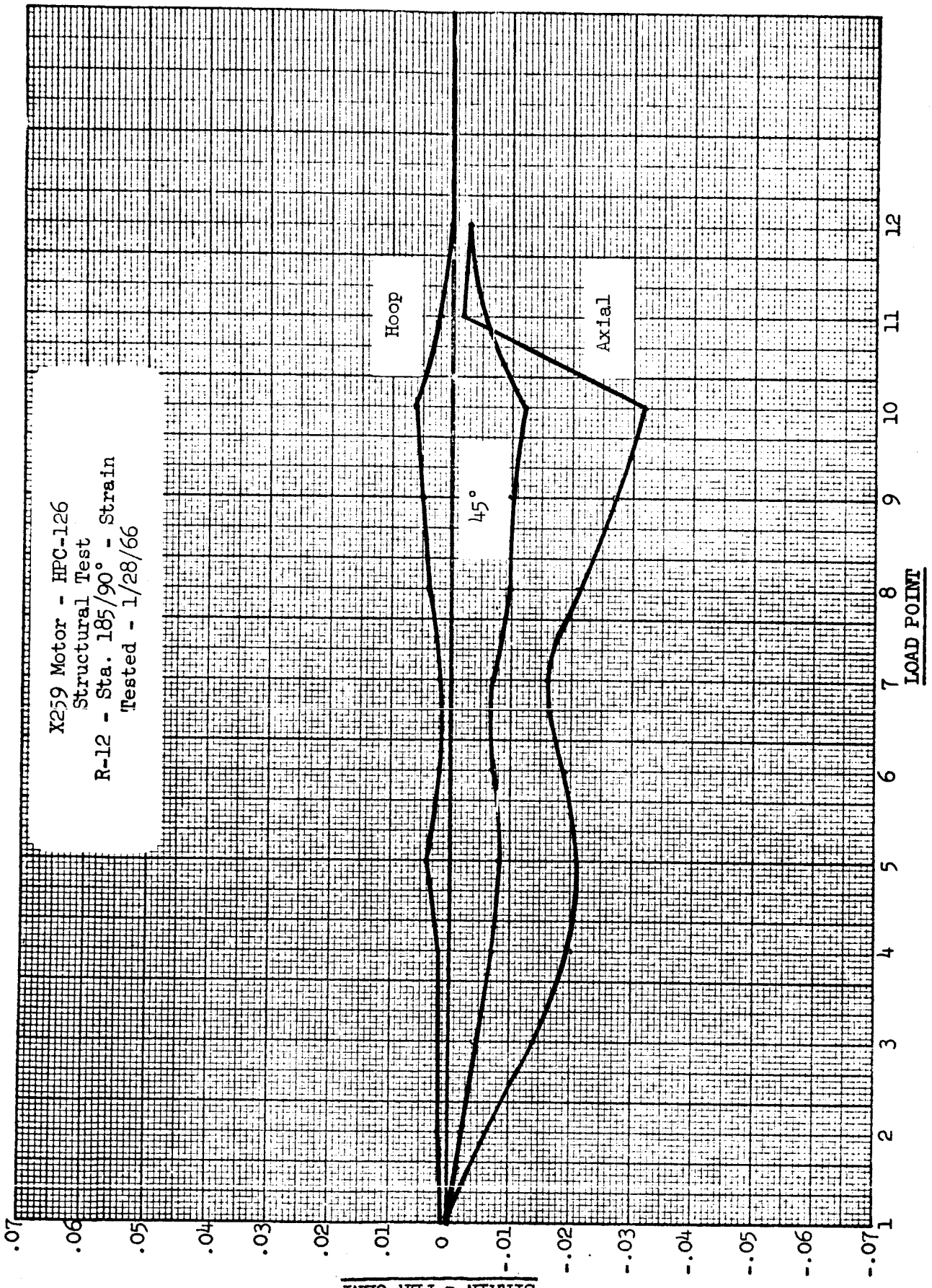

X259 Motor - HPC-126
Structural Load Test
Center Line Deflection at Specified Load Points (180°)
Tested - 1/28/66
LOAD POINT
4
6
7
9
10
STATION
104
131
161
191
241 234
DISPLACEMENT - INCHES
0
-.2
-.4
-.6
-.8
-1.0
-1.2
-1.4
-1.6
-1.8
-2.0
-2.2
-2.4
-2.6
-2.8

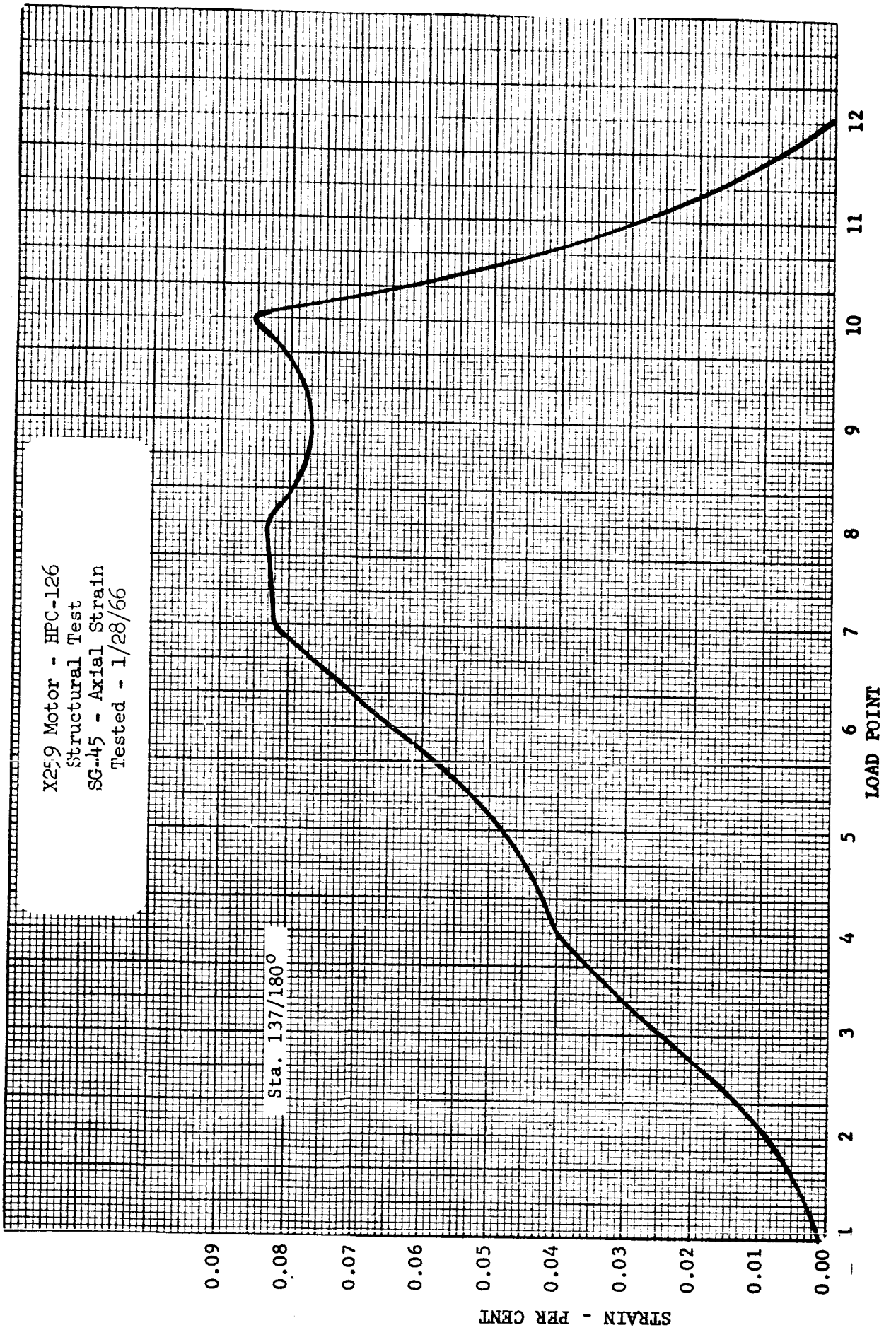

X259 Motor - HPC-126
Structural Test
Axial Displacement
Tested - 1/28/66
Station - 131.1
DISPLACEMENT - INCHES
0.4
0.3
0.2
0.1
0.
1
2
3
4
5
6
7
8
9
10
11
12
LOAD POINT
LP-33
LP-35
LP-34
0°
180°
90°
LOCATION - DEGREES

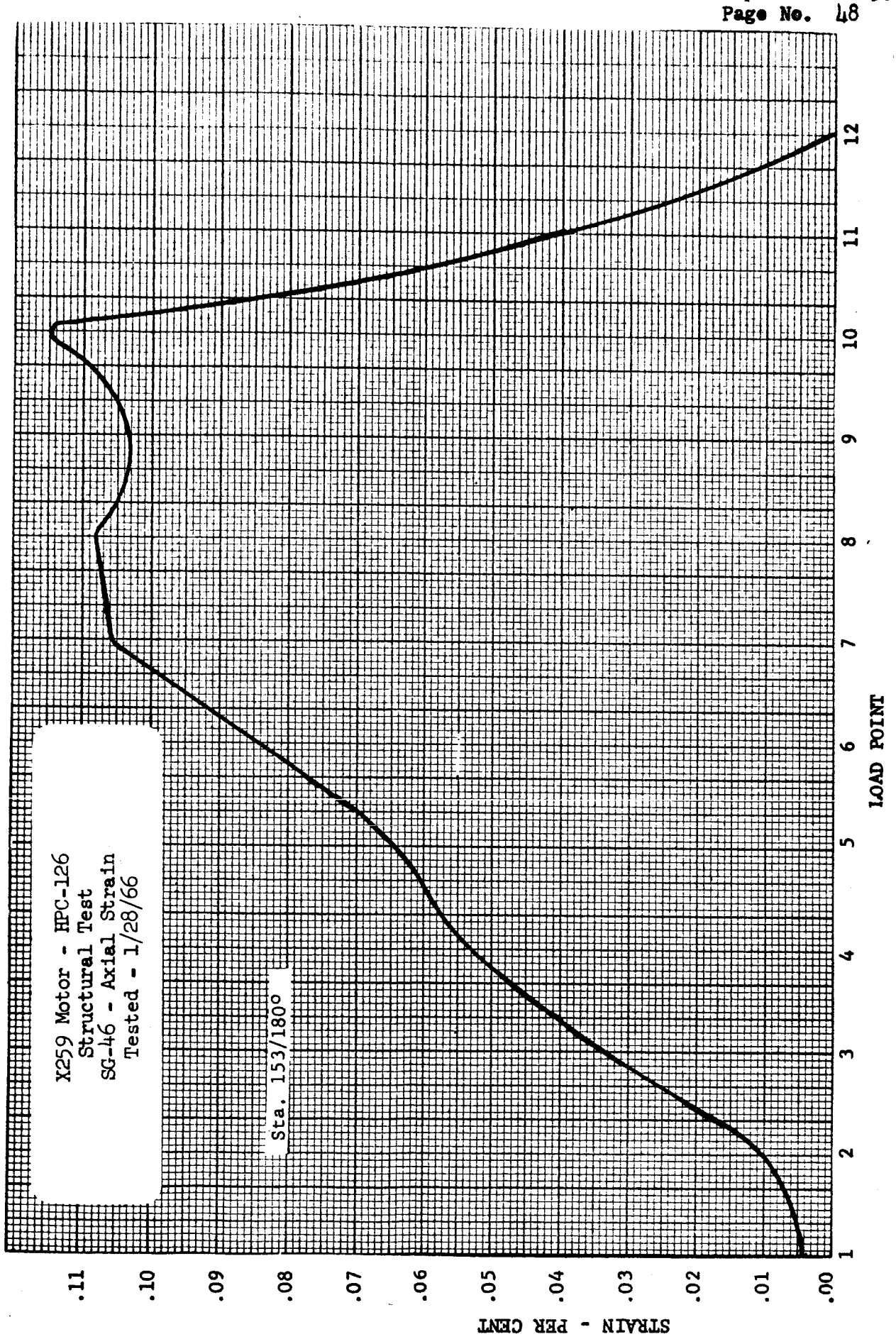

X259 Motor - HPC-126
Structural Test
R-9 - Sta. 137/90° - Strain
Tested - 1/28/66
Hoop
45°
Axial
0.02
0.01
0.0
-0.01
-0.02
-0.03
-0.04
STRAIN - PER CENT
1
2
3
4
5
6
7
8
9
10
11
12
LOAD POINT

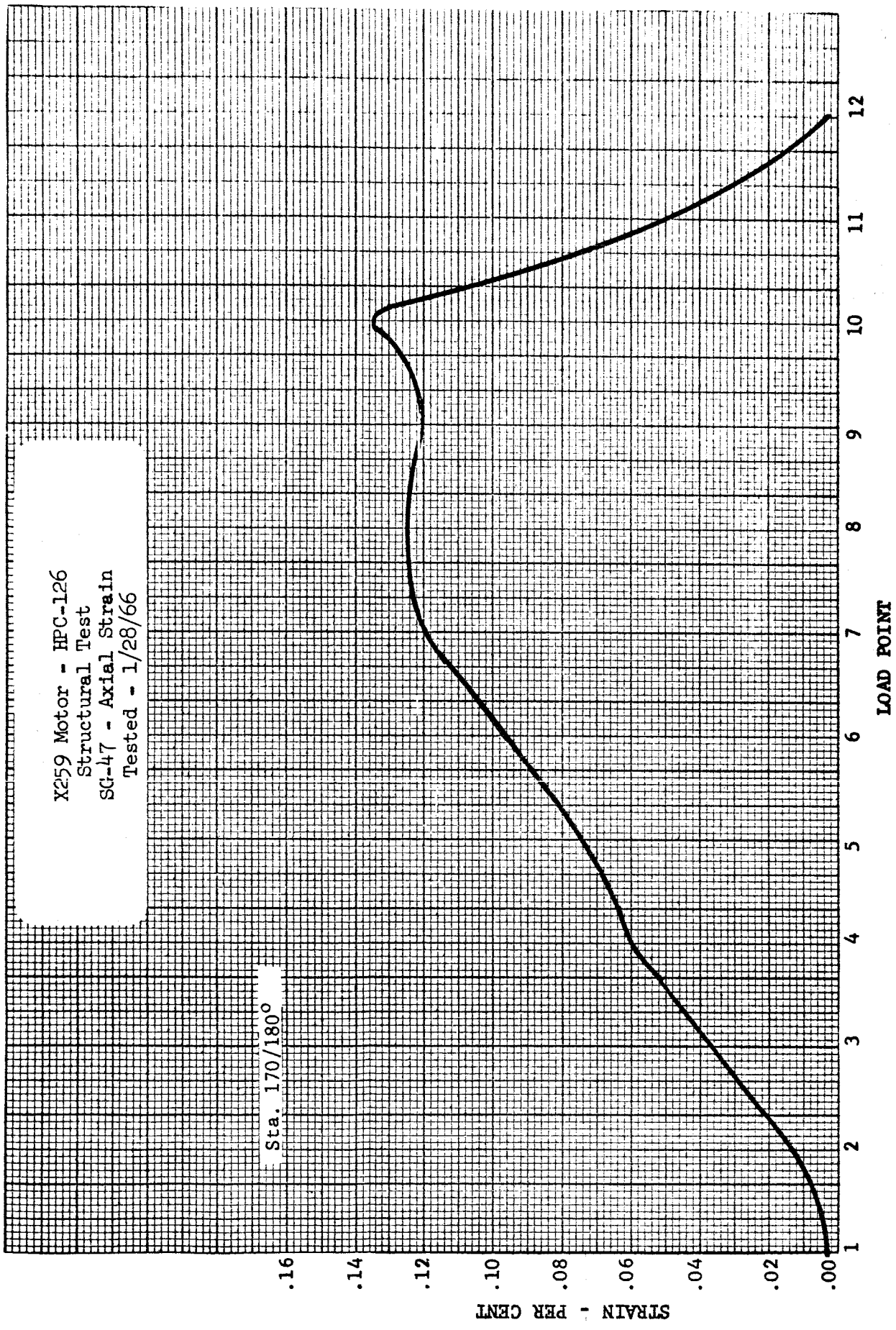

X259 Motor - HPC-126
Structural Test
R-10 - Sta. 153/90° - Strain
Tested - 1/28/66
Hoop
45°
Axial
.07
.06
.05
.04
.03
.02
.01
0
-.01
-.02
-.03
-.04
-.05
-.06
-.07
STRAIN - PER CENT
1
2
3
4
5
6
7
8
9
10
11
12
LOAD POINT


X259 Motor - HPC-126
Structural Test
R-11 - Sta. 170/90° - Strain
Tested - 1/28/66
Hoop
45°
Axial
0.01
0.0
-0.01
-0.02
-0.03
-0.04
-0.05
STRAIN - PER CENT
1
2
3
4
5
6
7
8
9
10
11
12
LOAD POINT


X259 Motor - HPC-126
Structural Test
R-12 - Sta. 185/90° - Strain
Tested - 1/28/66
Hoop
45°
Axial
.07
.06
.05
.04
.03
.02
.01
0
-.01
-.02
-.03
-.04
-.05
-.06
-.07
STRAIN - PER CENT
1
2
3
4
5
6
7
8
9
10
11
12
LOAD POINT


X259 Motor - HPC-126
Structural Test
SG-45 - Axial Strain
Tested - 1/28/66
Sta. 137/180°
STRAIN - PER CENT
0.00
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
LOAD POINT
1
2
3
4
5
6
7
8
9
10
11
12


X259 Motor - HPC-126
Structural Test
SG-46 - Axial Strain
Tested - 1/28/66
Sta. 153/180°
STRAIN - PER CENT
.00
.01
.02
.03
.04
.05
.06
.07
.08
.09
.10
.11
LOAD POINT
1
2
3
4
5
6
7
8
9
10
11
12


X259 Motor - HPC-126
Structural Test
SG-47 - Axial Strain
Tested - 1/28/66
Sta. 170/180°
STRAIN - PER CENT
.00
.02
.04
.06
.08
.10
.12
.14
.16
LOAD POINT
1
2
3
4
5
6
7
8
9
10
11
12

HERCULES POWDER CO

DATE FEBRUARY 8,1966
UNIT NO X259
LOADING NO HPC-126
ROUND NO X19453C - Structural
TYPE TEST H.S.
TESTED JANUARY 28,1966

LOAD POINT	F-1	F-2	F-3	LP-3	LP-5
1.00000	13.4841	12.247 -	50.649-	0.1595829	0.1194688-
2.00000	1056.0581-	634.2066	4046.664-	0.051144 -	0.0396753
3.00000	2212.0526-	1083.9687	8099.659-	0.4095547-	0.3015325
4.00000	3264.5873-	1440.5054	11873.028-	0.7429976-	0.5459138
5.00000	3740.8865-	1517.9996	13245.834-	0.9354924-	0.683251
6.00000	4571.7675-	1935.9827	13253.22 -	1.177923 -	0.8659664
7.00000	5336.3447-	2230.9674	13224.73 -	1.4618327-	1.0616284
8.00000	5535.5768-	2088.9651	16201.429-	1.6104322-	1.1683342
9.00000	5543.5844-	2077.0347	19134.864-	1.6088214-	1.173137
10.00000	6351.083 -	2445.6074	22590.621-	1.8379626-	1.3316296
11.00000	1173.2911-	759.6332-	3705.836-	0.8231366-	0.6281232
12.00000	12.8123-	94.8089-	70.697-	0.0620171-	0.054919

HERCULES POWDER CO

DATE FEBRUARY 8,1966
UNIT NO X259
LOADING NO HPC-126
ROUND NO X19453C - Structural
TYPE TEST H.S.
TESTED JANUARY 28,1966

LP-7	LP-8	LP-9	LP-11	LP-13	LP-1
0.1174807	.00427959-	.08048275-	0.066039	.04591967-	.00222197-
0.0290518-	.00888837-	.01540404	0.0235853-	.00179719	.00256371-
0.3073376-	.01399096-	.1755249	0.000000	.08912429	.00376001-
0.5596296-	.02139795-	.32287663	0.000000	.17432743	.00461455-
0.696479 -	.02353774-	.40618001	2.0556244	.22301494	.00119651-
0.8849335-	.02666513-	.51927803	0.5291699-	.28779546	.00205098-
1.099764 -	.03094472-	.64453714	0.6500985-	.36099011	.00290546-
1.212531 -	.03110933-	.71142306	0.7208547-	.40453112	.00222182-
1.2167358-	.03012173-	.71344992	0.7247141-	.40763536	.00017113-
1.384166 -	.03275532-	.8072929	0.8199132-	.46514544	.00222197-
0.650990 -	.02238554-	.40516659	0.3979495-	.22946849	.00307637-
0.083715 -	.00131921-	.03506445	0.0330195-	.02001416	.00085462-

HERCULES POWDER CO

DATE FEBRUARY 8,1966
UNIT NO X259
LOADING NO HPC-126
ROUND NO X19453C - Structural
TYPE TEST H.S.
TESTED JANUARY 28,1966

LP-17	LP-19	LP-21	LP-23	LP-24	LP-25
.00769148-	.01255634	.00612465-	.00327359	.00001335	0.1247692
.00120251	.00861895	.00222964-	.00016690	.00022027-	0.0106656-
.02031828	.00178897-	.00906381	.00302010-	.00418309-	0.2584523-
.03545332	.01645311-	.01863730	.00875552-	.00582055-	0.489669 -
.04479697	.02692943-	.02391304	.01124919-	.00645352-	0.618800 -
.05841160	.04025185-	.03140653	.01460178-	.00831114-	0.793641 -
.07320109	.05631193-	.03963009	.01875788-	.00932940-	0.9831473-
.07933804	.06478243-	.04414822	.02205506-	.00934316-	1.0911373-
.08066495	.06562271-	.04458901	.02163945-	.00930188-	1.0960892-
.08840525	.07696641-	.05009893	.02596180-	.00913675-	1.2496967-
.05278606	.03235056-	.02840363	.00698225-	.01091182-	0.5917548-
.00168628	.00143659-	.00112953	.00119141-	.00038367	0.0529474-

HERCULES POWDER CO

DATE FEBRUARY 8,1966
UNIT NO X259
LOADING NO HPC-126
ROUND NO X19453C - Structural
TYPE TEST H.S.
TESTED JANUARY 28,1966

LP-26	LP-27	LP-28	LP-29	LP-30	LP-3
0.1200793-	.04404954	.04399871-	.01175991	.01680416-	.00127932-
0.0542038	.00728639	.01337047	.01110201	.00766072-	.00034916-
0.3258165	.06593567-	.1106778	.00180922	.01383872	.00127643
0.5873402	.13261592-	.20187763	.01094672-	.03410257	.00491232
0.7299715	.17613181-	.25800059	.01835427-	.04629382	.00765858
0.9321479	.22155049-	.32477043	.02897177-	.06260375	.01036616
1.1404568	.28492154-	.4007015	.04024772-	.08056114	.01454357
1.2599427	.31933716-	.44312386	.04609146-	.09192866	.01787003
1.2621188	.32256362-	.44485708	.04633838-	.09291714	.01725115
1.431852	.3688096 -	.5035386	.05514514-	.10560264	.02193140
0.6486657	.19284324-	.24570306	.02428032-	.0550254	.01125579
0.0561821	.01795237-	.0185701	.00041153-	.00378917	.00058019

HERCULES POWDER CO

DATE FEBRUARY 8,1966
UNIT NO X259
LOADING NO HPC-126
ROUND NO X19453C - Structural
TYPE TEST H.S.
TESTED JANUARY 28,1966

LP-32	LP-33	LP-34	LP-35	LP-36	LP-37
.00414432	.03036939	.00407610	.01296776-	.00876357	.0101167 -
.00180545	.02227318-	.00631655-	.01319838	.00036054-	.01151735
.00508808-	.09405599-	.01183354-	.06017569	.00840598-	.04338337
.01296640-	.15964497-	.01683081-	.10081478	.01392991-	.07573776
.01776726-	.19549536-	.01619116-	.12847919	.01525085-	.0935225
.02437356-	.23351974-	.01027439-	.17403972	.00768547-	.11688278
.03118503-	.27207737-	.00279847-	.2226575	.00024039-	.13894074
.03520626-	.29960095-	.00655642-	.23645242	.00120099-	.15566735
.03565762-	.30825591-	.01511175-	.22907027	.00720512-	.16156847
.04144327-	.35546849-	.08795200-	.25457223	.01633162-	.18794035
.01906031-	.14147366-	.00231873-	.11117961	.00600244	.07602264
.00201061-	.01657157-	.00479738-	.00812782	.00072007	.00879062

HERCULES POWDER CO

DATE FEBRUARY 8,1966
UNIT NO X259
LOADING NO HPC-126
ROUND NO X19453C - Structural
TYPE TEST H.S.
TESTED JANUARY 28,1966

LP-38	LP-39	LP-40	LP-41	LP-42	LP-43
.00393083-	.00530937	.00551170-	.00518257-	.00095324-	.00524482
.00196541-	.01104926-	.00337283-	.00225898	.00004152	.00330198-
.00303001-	.04880818-	.00106900-	.00687830	.00114762	.02226173-
.00212911-	.0783889 -	.00111334	.01130938	.00204635	.03399175-
.00196541-	.09378827-	.00317384	.01340907	.00353964	.04096851-
.00081888-	.11875788-	.00032619-	.01584182	.00359495	.05090108-
.00278433-	.14738157-	.00222113-	.01768087	.00318015	.06160589-
.00188352-	.15886585-	.00172754-	.01812976	.00420333	.06675857-
.00000007	.15590777-	.00292653	.02012809	.00559983	.06548039-
.00098267-	.17261218-	.00527600	.02022946	.00554452	.06915517-
.00188352-	.09335326-	.00534717-	.01568254	.00102318	.05216595-
.00016369-	.00565513-	.00008027-	.00443107	.00113284-	.00231671-

HERCULES POWDER CO

DATE FEBRUARY 8,1966
UNIT NO X259
LOADING NO HPC-126
ROUND NO X19453C - Structural
TYPE TEST H.S.
TESTED JANUARY 28,1966

LP-44	SG-13	SG-19	SG-25	SG-33	SG-37
.00068387-	.00133255-	.00376797-	.00306614-	.0025880 -	.00324467-
.00023280-	.00147792	.00053828	.01067018	.01032978	.00184356
.00154236	.00520908	.00528494	.02619713	.03907248	.01634629
.00430697	.00801956	.00941993	.04606574	.07428655	.03141437
.00531096	.00947325	.01149965	.05680951	.09436004	.04117299
.00618399	.01274407	.01766542	.07466673	.12068513	.05488912
.00660596	.01613603	.02534817	.09325983	.14657065	.07187452
.00669326	.01591797	.02622900	.0979449	.15602131	.07801974
.00894860	.01456119	.02458969	.09343153	.15274898	.07605327
.01075287	.01591797	.02708536	.10584328	.16871986	.08546775
.00542736	.00462760	.00873484	.04010516	.09880454	.04166460
.00049472	.00016959	.00066062	.00203592	.01326022	.00673516

HERCULES POWDER CO

DATE FEBRUARY 8,1966
UNIT NO X259
LOADING NO HPC-126
ROUND NO X19453C - Structural
TYPE TEST H.S.
TESTED JANUARY 28,1966

SG-41	SG-45	SG-46	SG-47	SG-48	SG-49
.00053939	.00194748-	.00357628-	.00357115-	.00316825-	.00475288-
.00767412	.00876369	.01079388	.0127263	.01306097	.0300i481-
.02113448	.02505767	.03264174	.03668551	.03439821	.0614620 -
.03645820	.04044282	.05312411	.06025513	.05838643	.09329985-
.04611828	.04836260	.06391799	.07434497	.07312852	.10860024-
.06068194	.06478641	.08459543	.09694064	.09647016	.1260492 -
.07728060	.08231380	.10637827	.12044534	.12194553	.14590716-
.08262552	.08296296	.1089792	.12538003	.12789409	.15736618-
.07855553	.07653625	.10325715	.11953632	.12239813	.16114244-
.08983379	.08581928	.11541652	.13466503	.13836873	.18380005-
.03258436	.02823857	.04089971	.04980139	.05095073	.05130515-
.00188788	.00168782	.00175563	.00318157	.00316825	.00546907-

HERCULES POWDER CO

DATE FEBRUARY 8,1966
UNIT NO X259
LOADING NO HPC-126
ROUND NO X19453C - Structural
TYPE TEST H.S.
TESTED JANUARY 28,1966

SG-50	SG-51	SG-52
.0011026 -	.00110292-	.00116869
.0260085 -	.03269862-	.02889258-
.0561680 -	.07220947-	.06706975-
.08438172-	.11191495-	.10777907-
.09839129-	.13027548-	.12939982-
.11460607-	.15356677-	.15459155-
.13049655-	.17588488-	.18043256-
.14119831-	.19418054-	.20101447-
.14625732-	.20170642-	.20919529-
.16681766-	.23129089-	.24360668-
.04754173-	.07039288-	.0753155 -
.00227006-	.00603367-	.00467475-

HERCULES POWDER CO

DATE FEBRUARY 9,1966
UNIT NO X259
LOADING NO HPC-126
ROUND NO X19453C - Structural
TYPE TEST M.S.
TESTED JANUARY 28,1966

LOAD POINT	LP-1	LP-2	LP-6	LP-10	LP-14
1.00000	0.0020188	.00000000	0.0004376	.00041032	.00021675
2.00000	0.2200517	.00697810	0.0065652	.00041118-	.00281775-
3.00000	0.5814211	.01724000	0.0196957	.00123096	.00065025-
4.00000	0.9135176	.02750190	0.0380784	.00410321	.00108375
5.00000	1.0952117	.03365905	0.0512089	.00902706	.00151725
6.00000	1.3475646	.04104762	0.0582119	.01189930	.00281776
7.00000	1.6140493	.04515238	0.0494582-	.01148898	.00325126
8.00000	1.760414	.04925714	0.3829731-	.01230962	.00368476
9.00000	1.7614234	.04925714	0.3829731-	.01395091	.00433501
10.00000	1.9683528	.05336191	1.5025678-	.01313027	.00867003
11.00000	1.0124399	.02873333	1.5030054-	.01395091	.00606902
12.00000	0.2442776	.00082095	1.5025678-	.00410321	.00541877

HERCULES POWDER CO

DATE FEBRUARY 9,1966
UNIT NO X259
LOADING NO HPC-126
ROUND NO X19453C-Structural
TYPE TEST M.S.
TESTED JANUARY 28,1966

LP-18	LP-22	SG-2A	SG-2B	SG-2C	SG-4A
.00006869-	.00041813-	.00012358	.00062017	.00061223	.00012244
.00728161-	.00104533-	.00865099-	.00310085-	.00355095	.00257137-
.01476930-	.00515700-	.01779632-	.00620170-	.00697945	.00061223-
.01634927-	.00787488-	.02496429-	.00731800-	.00930593	.00110201-
.01669274-	.00892022-	.02595298-	.00682187-	.01004061	.00061223-
.01895966-	.01142903-	.02286333-	.00781414-	.00918349	.00330605
.02122658-	.01386816-	.01829067-	.00793817-	.00808147	.00820391
.02163874-	.01637697-	.02657090-	.00843431-	.01040795	.00502031
.02177613-	.01686480-	.03410963-	.00930255-	.01297933	.00012244
.02136397-	.01749200-	.03831154-	.01041885-	.01469358	.00318360-
.02136397-	.01428629-	.00271888-	.01686862	.00134691	.00024489-
.00151127-	.00216036-	.00135944	.00917851	.00073467-	.01040795-

HERCULES POWDER CO

DATE FEBRUARY 9,1966
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TYPE TEST M.S.
TESTED JANUARY 28,1966

SG-4B	SG-4C	SG-9A	SG-9B	SG-9C	SG-10A
.00000000	.00061159	.00000000	.00163285	.00000000	.00130491
.00197528-	.00061159	.00912399-	.00065314-	.00195162	.00750322-
.00296292-	.00159013-	.01759627-	.00261256-	.00325269	.01631136-
.00111109-	.00171245-	.02574270-	.00489856-	.00325269	.02381459-
.00111109	.00183477-	.02639441-	.00555170-	.00390323	.02642441-
.00271601	.00366954-	.02280998-	.00457199-	.00325269	.02577196-
.00530857	.00550432-	.01889970-	.00359228-	.00325269	.02348836-
.00716039	.00403650-	.02476513-	.00685799-	.00390323	.02936046-
.00641966	.00207941-	.03160812-	.00947056-	.00683066	.03588500-
.00679003	.00171245-	.03845112-	.01142998-	.00975809	.04240955-
.01493807	.00036695	.00684299-	.00849084-	.00227689	.00946059-
.00444438	.00672750	.00097757-	.00032657-	.00097581	.00097868-

HERCULES POWDER CO

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TESTED JANUARY 28,1966

SG-10B	SG-10C	SG-11A	SG-11B	SG-11C	SG-12A
.00000000	.00130085	.00000000	.00000000	.00065250	.00032386-
.00000000	.00292692	.00684962-	.00097979-	.00489382	.00647736-
.00065319-	.00487820	.01630863-	.00522557-	.00652509	.01425020-
.00326598-	.00487820	.02446294-	.00979795-	.00880888	.02007983-
.00457237-	.00487820	.02707232-	.01110434-	.00978764	.02137530-
.00359258-	.00487820	.02609380-	.01077775-	.00880888	.01910823-
.00326598-	.00487820	.02511529-	.01012455-	.00880888	.01586954-
.00653197-	.00487820	.03033405-	.01404373-	.00978764	.02105144-
.00783836-	.00910596	.03653133-	.01535013-	.01076641	.02655720-
.00979795-	.01105724	.04501182-	.01828951-	.01305019	.03206296-
.00751176-	.00357734	.00880666-	.01110434-	.00391505	.00194321-
.00000000	.00130085	.00000000	.00000000	.00000000	.00259094

HERCULES POWDER COMPANY

DATE FEBRUARY 9,1966
UNIT NO. X-259
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ROUND NO. X19453C - STRUCTURAL
TYPE TEST M.S.
TESTED JANUARY 28,1966

SG-12B	SG-12C	SG-14	SG-20	SG-22	SG-28
.00032285	.00129817	.00048769	.00434738-	.00049068	.0006081
.00193713-	.00162271	.00182883-	.00596212-	.00858701-	.02748621-
.00419713-	.00162271	.00280421-	.00745265-	.01913676-	.06689123-
.00677998-	.00227179	.00402344-	.00819791-	.03005453-	.11225566-
.00839426-	.00421904	.00390152-	.00832212-	.03434804-	.13439057-
.00677998-	.00227179	.00195076-	.00782528-	.04048162-	.16102545-
.00677998-	.00162271	.00024384-	.00683159-	.04587916-	.19301162-
.00968568-	.00356996	.00182883-	.00881897-	.04833260-	.21611951-
.01065425-	.00519267	.00365767-	.00944002-	.04968198-	.22341673-
.01162282-	.00649084	.00475497-	.01155160-	.05557022-	.26209203-
.00516569-	.00162271	.00036576	.00335369-	.01202181-	.0625129 -
.00322856	.00064908	.00170691	.00161474-	.00000000	.00729722

HERCULES POWDER COMPANY

DATE FEBRUARY 9,1966
UNIT NO. X-259
LOADING NO. HPC-126
ROUND NO. X19453C - STRUCTURAL
TYPE TEST VISICORDER
TESTED JANUARY 28,1966

LDPT	LP-4	LP-12	LP-16	LP-20
1	+.0128	+.0066	+.0000	+.0000
2	+.0128	+.0132	+.0000	+.0000
3	+.0128	+.0264	+.0000	+.0000
4	+.0257	+.0396	+.0083	+.0024
5	+.0257	+.0396	+.0083	+.0024
6	+.0386	+.0462	+.0083	+.0024
7	+.0515	+.0594	+.0167	+.0048
8	+.0515	+.0594	+.0167	+.0072
9	+.0515	+.0594	+.0167	+.0072
10	+.0515	+.0594	+.0167	+.0072
11	+.0386	+.0462	+.0167	-.0048
12	+.0257	+.0198	-.0081	-.0048

LDPT	SG-1A	SG-1B	SG-1C	SG-3A	SG-3B	SG-3C
1	+.0000	+.0056	+.0000	+.0000	+.0000	+.0050
2	-.0073	-.0085	+.0028	-.0024	-.0076	+.0075
3	-.0195	-.0198	+.0084	-.0024	-.0127	+.0050
4	-.0317	-.0396	+.0084	-.0024	-.0204	+.0075
5	-.0341	-.0480	+.0112	-.0024	-.0255	+.0075
6	-.0317	-.0537	+.0084	+.0000	-.0280	+.0000
7	-.0293	-.0565	+.0056	+.0024	-.0280	+.0025
8	-.0244	-.0593	+.0084	+.0073	-.0331	+.0000
9	-.0293	-.0650	+.0084	+.0024	-.0357	+.0025
10	-.0366	-.0706	+.0112	+.0024	-.0357	+.0075
11	-.0463	-.0848	+.0112	+.0024	-.0382	+.0025
12	-.0073	-.0367	+.0028	+.0049	-.0127	+.0175

LDPT	SG-5A	SG-5B	SG-5C	SG-6A	SG-6B	SG-6C
1	+.0000	+.0000	+.0000	+.0044	+.0041	+.0000
2	-.0066	+.0000	+.0049	-.0088	+.0041	+.0000
3	-.0132	+.0000	+.0049	-.0131	+.0082	+.0043
4	-.0198	+.0063	+.0049	-.0219	+.0082	+.0043
5	-.0198	+.0126	+.0049	-.0219	+.0124	+.0043
6	-.0198	+.0126	+.0049	-.0219	+.0165	+.0043
7	-.0198	+.0126	+.0049	-.0219	+.0165	+.0043
8	-.0264	+.0190	+.0049	-.0262	+.0165	+.0043
9	-.0264	+.0190	+.0049	-.0306	+.0165	+.0043
10	-.0330	+.0126	+.0049	-.0350	+.0165	+.0043
11	-.0132	+.0126	+.0000	-.0088	+.0082	+.0000
12	-.0066	+.0000	+.0000	-.0044	+.0000	+.0000

HERCULES POWDER COMPANY

DATE FEBRUARY 9,1966
UNIT NO. X-259
LOADING NO. HPC-126
ROUND NO. X19453C - STRUCTURAL
TYPE TEST VISICORDER
TESTED JANUARY 28,1966

LDPT	SG-7A	SG-7B	SG-7C	SG-8A	SG-8B	SG-8C
1	-.0073	+.0059	-.0076	+.0048	+.0076	+.0000
2	-.0146	+.0059	-.0076	-.0048	+.0076	+.0077
3	-.0146	+.0118	-.0076	-.0146	+.0076	+.0077
4	-.0220	+.0118	+.0000	-.0193	+.0153	+.0077
5	-.0293	+.0177	+.0000	-.0242	+.0153	+.0077
6	-.0293	+.0236	+.0000	-.0242	+.0230	+.0077
7	-.0293	+.0296	-.0076	-.0193	+.0230	+.0077
8	-.0366	+.0236	-.0076	-.0290	+.0230	+.0077
9	-.0439	+.0236	-.0000	-.0290	+.0306	+.0077
10	-.0513	+.0296	-.0000	-.0338	+.0230	+.0077
11	-.0146	+.0118	-.0076	-.0048	+.0076	+.0000
12	-.0146	+.0059	-.0076	+.0000	+.0000	+.0000

LDPT	SG-15	SG-16	SG-17	SG-18	SG-21	SG-23
1	-.0027	+.0000	-.0026	+.0000	-.0027	-.0024
2	-.0080	-.0043	-.0053	-.0026	-.0053	-.0072
3	-.0134	-.0086	-.0132	-.0026	-.0160	-.0193
4	-.0242	-.0172	-.0184	-.0052	-.0239	-.0290
5	-.0268	-.0216	-.0211	-.0052	-.0266	-.0338
6	-.0322	-.0259	-.0264	-.0026	-.0319	-.0386
7	-.0349	-.0259	-.0237	-.0026	-.0346	-.0410
8	-.0349	-.0259	-.0290	-.0026	-.0399	-.0434
9	-.0403	-.0302	-.0316	-.0052	-.0426	-.0482
10	-.0483	-.0346	-.0343	-.0026	-.0532	-.0555
11	-.0107	-.0043	-.0053	-.0000	-.0186	-.0145
12	+.0000	+.0000	+.0000	+.0000	-.0133	-.0072

LDPT	SG-24	SG-26	SG-27	SG-29	SG-30	SG-31
1	+.0000	+.0000	+.0000	+.0000	+.0000	+.0024
2	+.0000	+.0099	-.0223	-.0127	+.0062	+.0145
3	+.0000	+.0297	-.0594	-.0333	+.0219	+.0314
4	-.0028	+.0421	-.0891	-.0476	+.0344	+.0507
5	-.0028	+.0544	-.1040	-.0556	+.0563	+.0555
6	+.0028	+.0693	-.1188	-.0651	+.0626	+.0700
7	+.0055	+.0842	-.1361	-.0746	+.0720	+.0820
8	+.0055	+.0842	-.1560	-.0626	+.0720	+.0868
9	+.0055	+.0817	-.1609	-.0858	+.0720	+.0820
10	+.0055	+.0391	-.1856	-.1048	+.0751	+.0893
11	+.0055	+.0470	-.0743	-.0318	+.0375	+.0507
12	+.0055	+.0124	-.0198	+.0000	+.0000	+.0121

HERCULES POWDER COMPANY

DATE FEBRUARY 9,1966
UNIT NO. X-259
LOADING NO. HPC-126
ROUND NO. X19453C - STRUCTURAL
TYPE TEST VISICORDER
TESTED JANUARY 28,1966

LDPT	SG-32	SG-34	SG-35	SG-36	SG-38	SG-39	SG-40
1	+.0000	+.0000	+.0028	+.0000	+.0020	+.0000	+.0029
2	-.0248	-.0400	-.0140	+.0175	-.0020	-.0239	+.0029
3	-.0594	-.0999	-.0642	+.0524	+.0000	-.0638	+.0029
4	-.0941	-.1623	-.1200	+.0874	+.0000	-.1091	+.0029
5	-.1064	-.1973	-.1479	+.1099	+.0000	-.1330	+.0029
6	-.1213	-.2247	-.1814	+.1523	+.0040	-.1596	+.0058
7	-.1386	-.2522	-.2121	+.1848	+.0060	-.1916	+.0115
8	-.1560	-.2697	-.2372	+.1973	+.0060	-.2155	+.0086
9	-.1609	-.2772	-.2372	+.1973	+.0040	-.2208	+.0058
10	-.1832	-.2996	-.2819	+.2048	+.0000	-.2554	+.0029
11	-.0718	-.1598	-.0754	+.1224	+.0040	-.0718	+.0144
12	-.0124	-.0574	-.0028	+.0275	+.0060	-.0106	+.0000

LDPT	SG-42	SG-43	SG-44
1	+.0000	+.0028	+.0000
2	-.0027	-.0193	-.0032
3	-.0027	-.0470	-.0065
4	-.0027	-.0802	+.0000
5	+.0000	-.0912	+.0000
6	+.0054	-.1106	+.0032
7	+.0081	-.1299	+.0065
8	+.0054	-.1465	+.0032
9	+.0000	-.1520	+.0000
10	-.0027	-.1714	+.0000
11	-.0027	-.0636	+.0032
12	-.0081	-.0083	+.0000

HERCULES POWDER COMPANY
Allegany Ballistics Laboratory
Cumberland, Maryland

March 29, 1966

(REVISION I)

Data Package
Structural Load Test
X259 Case S/N HPC-187

Contract: NAS 1-3899
Test B

TEST ENGINEER: D. K. Fuller

APPROVED BY: E. A. Stair

SECTION IV

Data Package
Structural Load Test
X259 Case S/N HPC-187

Test B

Title: Empty Motor Case Structural Test

Specimen: X259 S/N HPC-187 and adjacent Scout "C" and "D" transition sections.

Test Date: February 4, 1966

Test Site: ABL, X-Range, Bay 3

Test Arrangement: ABL Drawing No. 60158S42001

Test Document: ABL test plan titled, "Structural Load Test, ABL X259 Motor, Loaded and Unloaded Case", dated December 10, 1965.

Tabulated Data:

(1) Sign Convention

(a) Force gauges (F1, F2, F3)-----Minus (-) indicates tension on load cell.

(b) Linear potentiometer (LP)-----Minus (-) indicates movement away from the gauge (extension of gauge shaft).

(c) Strain gauge (SG)----------Minus (-) indicates compression.

(2) Units

(a) Force gauge data are presented in pounds.

(b) Linear potentiometer data are presented in inches.

(c) Strain gauge data are presented in per cent.

(3) Data Evaluation

(a) One (1) phase of the data acquisition system failed to operate during the test, resulting in loss of data from the following gauges:

Strain Gauges	Linear Potentiometers
R10(S10A,B,C)	LP-1
R11(S11A,B,C)	LP-2
S14	LP-6
S20	LP-10
S22	LP-14
S28	LP-18
	LP-22

(b) LP-39 was deleted prior to the test due to failure of the gauge to calibrate.

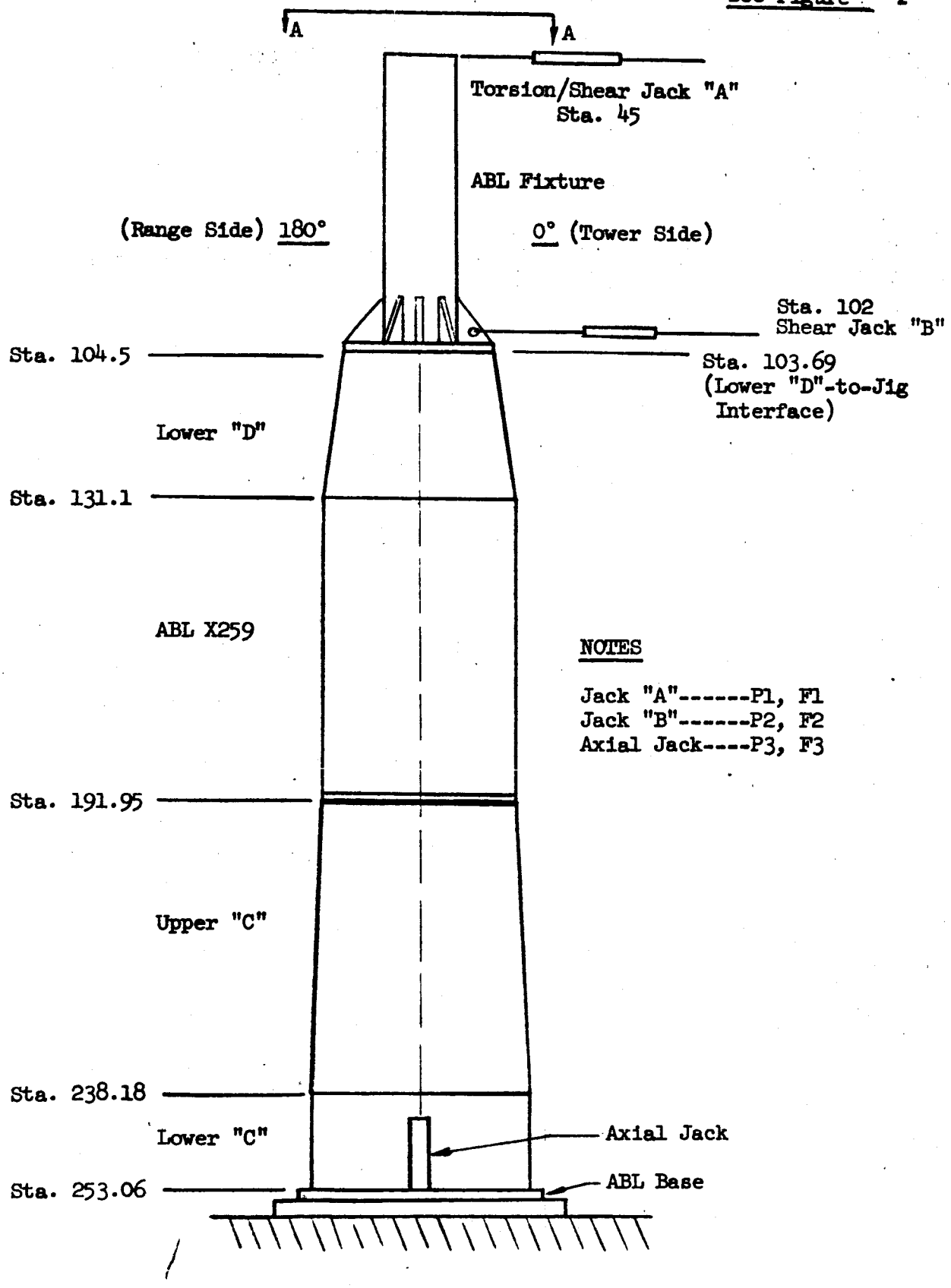
(c) During installation of the empty case strain gauges, the identifying numbers were inadvertently interchanged on the rosette gauges at 90° and 270°. The changes (below) are reflected in Figure 3.

(1) Rosettes 5, 6, 7, and 8 were actually at 90°.
(2) Rosettes 9, 10, 11, and 12 were actually at 270°.

(d) LP-7 appeared to have slipped in its holder after load point 1.

(e) The contact pad for LP-8, LP-26, and LP-36 at station 131.1 (270°) became unbonded after load point 4. The result was a loss of data.

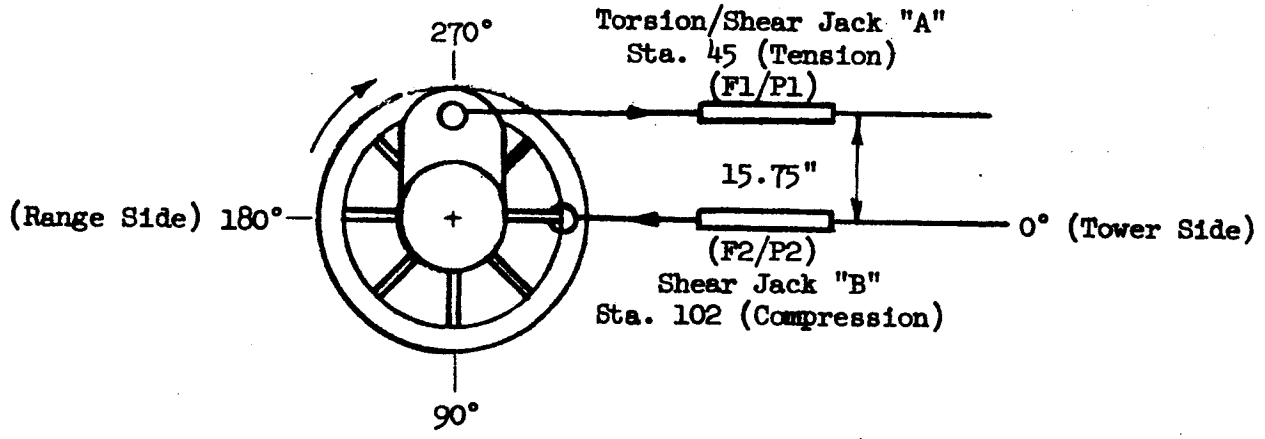
See Figure 2



Test Arrangement

Figure 1

See Figure 1



View AA

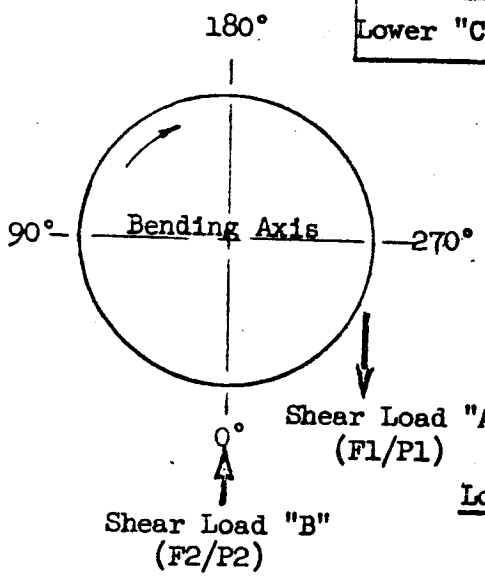
Looking Aft

Test Arrangement

Figure 2

Transition Sections "C" and "D"

Station \ Degree		0°	15°	30°	45°	60°	90°	135°	180°	225°	270°	300°	315°
Lower "D"	106	S22	---	---	---	S21	S20	----	S19	----	S24	S23	----
	129	---	S16	---	---	S15	S14	----	S13	----	S18	S17	----
Upper "C"	194	S28	---	---	S27	---	R2	S26	S25	S30	R1	----	S29
	225	---	---	---	---	---	---	S31	----	----	----	----	S32
	235	S35	---	---	S34	---	R4	----	S33	S36	R3	----	----
Lower "C"	241	S39	---	---	---	---	S38	----	S37	----	S40	----	----
	250	S43	---	---	---	---	S42	----	S41	----	S44	----	----

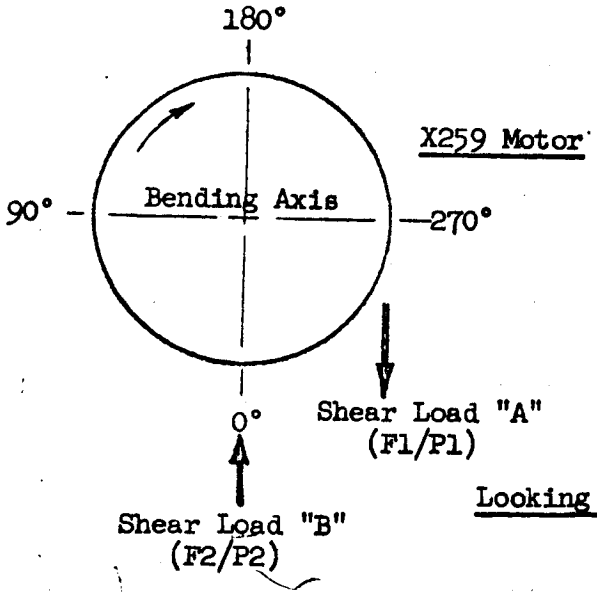


Looking Aft

NOTES:

All "S" gages are axial-oriented.
All "R" gages are 3-gage rosette type.
"C" and "D" section gages installed by LTV.

Gage locations are approximate. For exact locations, see LTV drawing AVDL-Scout-334.
Each rosette "R" has an axial gage (A), diagonal gage (B), and hoop gage (C).



X259 Motor

Looking Aft

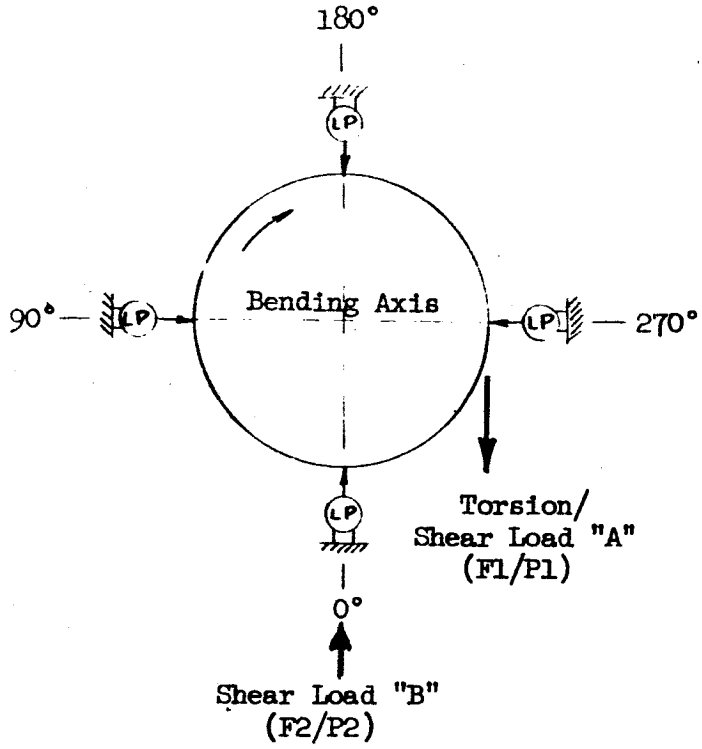
Station \ Degree	0°	90°	180°	270°
137	S49	R5	S45	R9
153	S50	R6	S46	R10
170	S51	R7	S47	R11
185	S52	R8	S48	R12

NOTES:

All "S" gages are axial-oriented.
All "R" gages are 3-gage rosette type.
Gages on motor case installed by ABL.
Each rosette "R" has an axial gage (A), diagonal gage (B), and hoop gage (C).

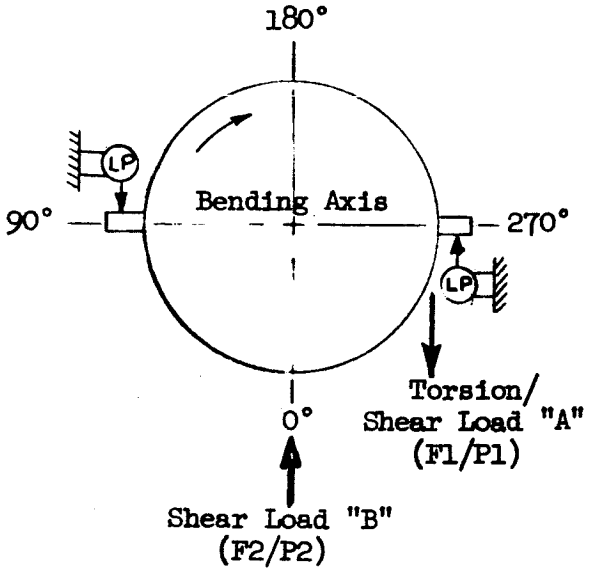
Strain Gage Locations

Figure 3



View Looking Aft (Down)

Radial LP Gage Locations				
Station \ Degree	0°	90°	180°	270°
103.69	LP1	LP2	LP3	LP4
131.1	LP5	LP6	LP7	LP8
161.35	LP9	LP10	LP11	LP12
191.95	LP13	LP14	LP15	LP16
234.5	LP17	LP18	LP19	LP20
241.5	LP21	LP22	LP23	LP24



View Looking Aft (Down)

Torsional LP Gage Locations

Station \ Degree	90°	270°
131.1	LP25	LP26
191.95	LP27	LP28
234.5	LP29	LP30
241.5	LP31	LP32

NOTE: Data from the torsional LP's reflect both torsional displacement and displacement of the entire structure in the 0°/180° directions. These LP's were 2 inches away from structure (skin).

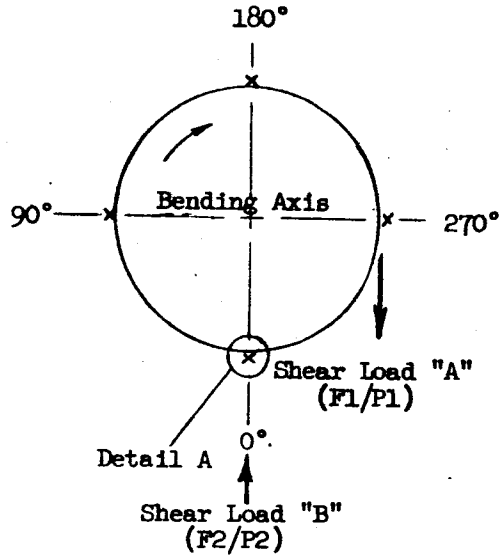
Radial and Torsional Displacement Gage Locations

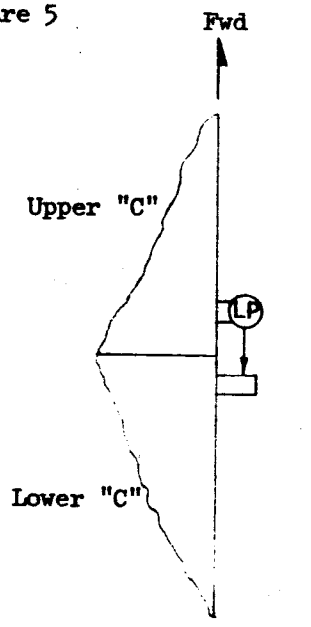
Figure 4

Longitudinal Displacement Gage Locations

Figure 5

All views looking aft (down).

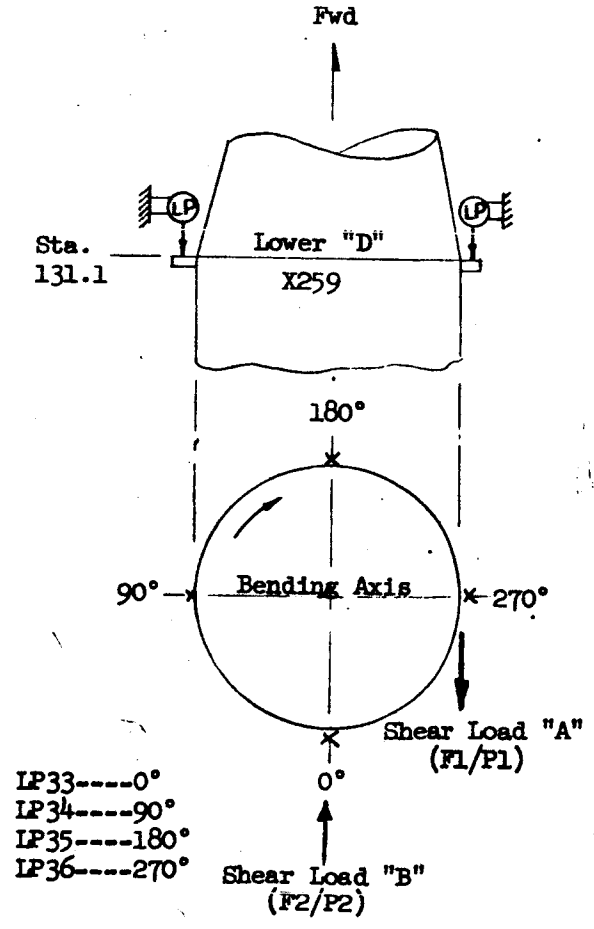




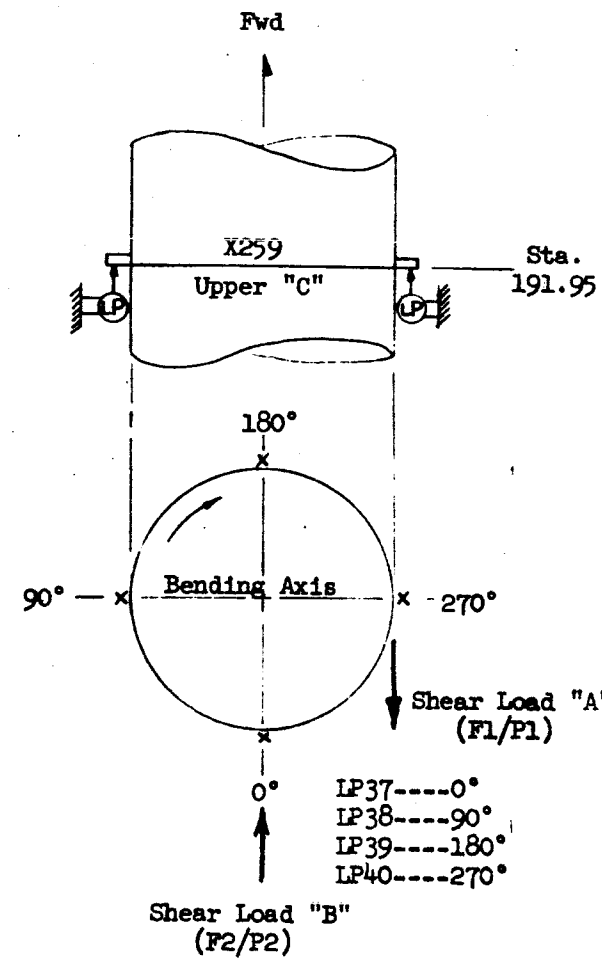
Sta. 238.18*

LP41----0°
LP42----90°
LP43----180°
LP44----270°

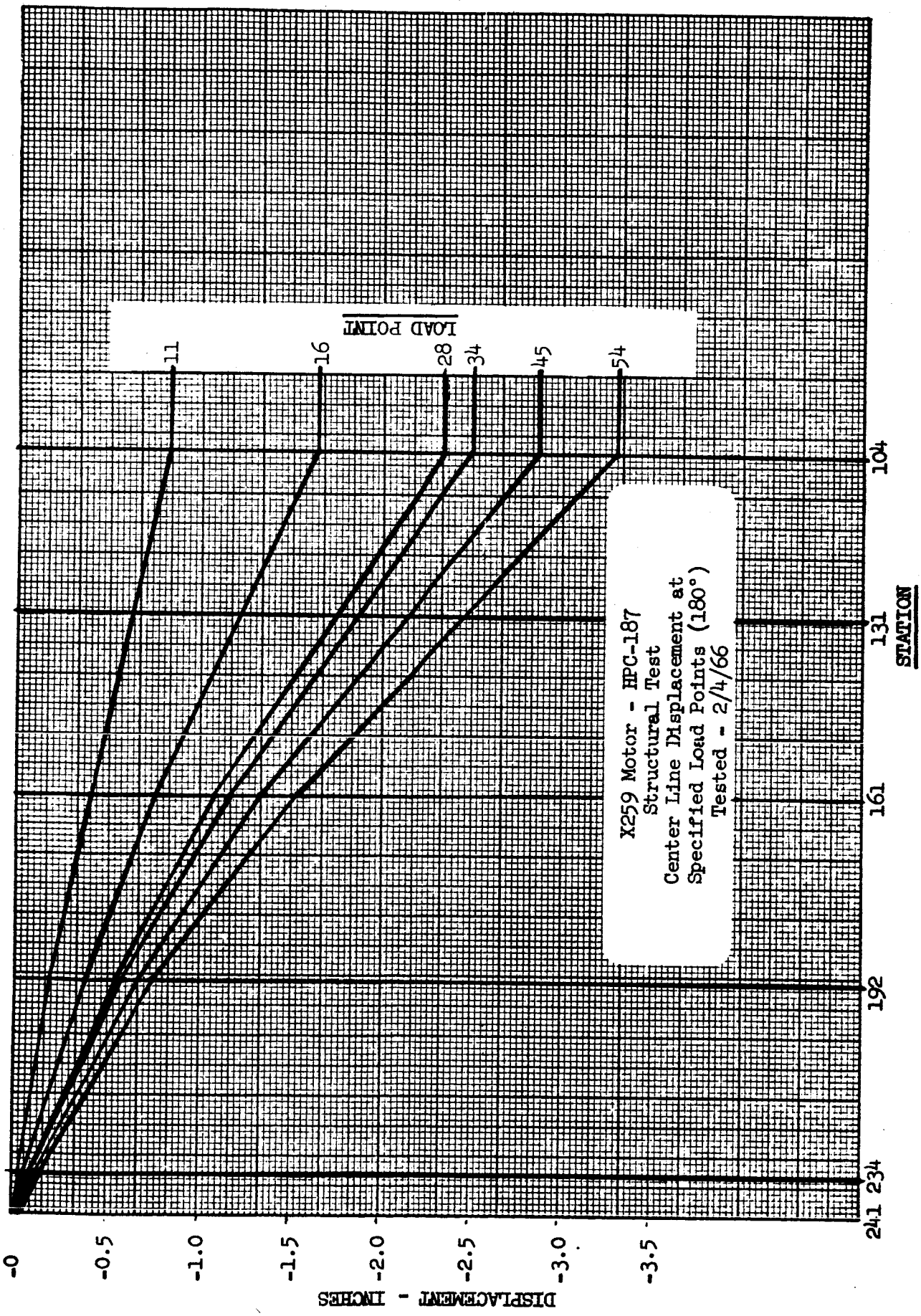
*These 4 LP's to measure gap at interface.

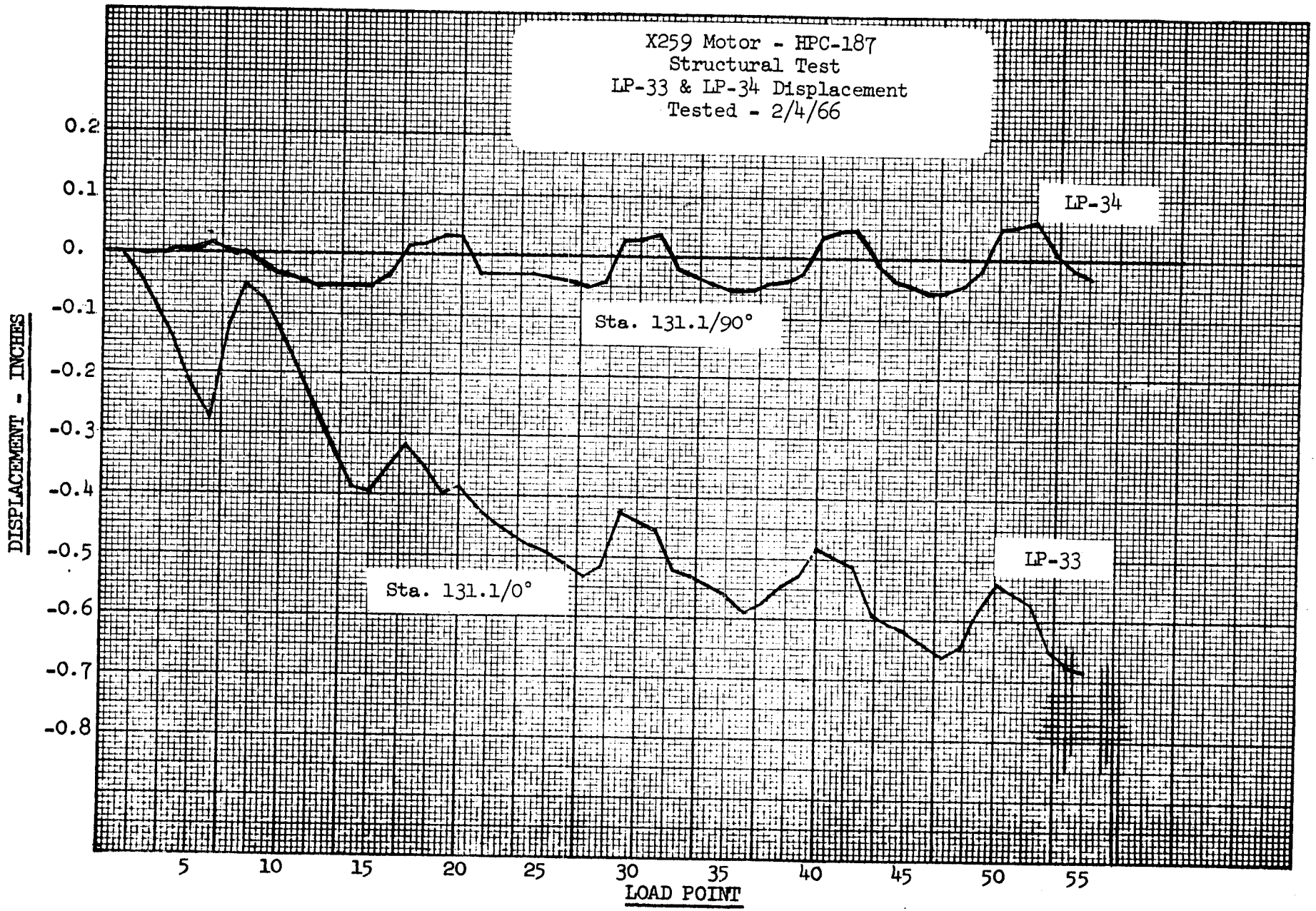


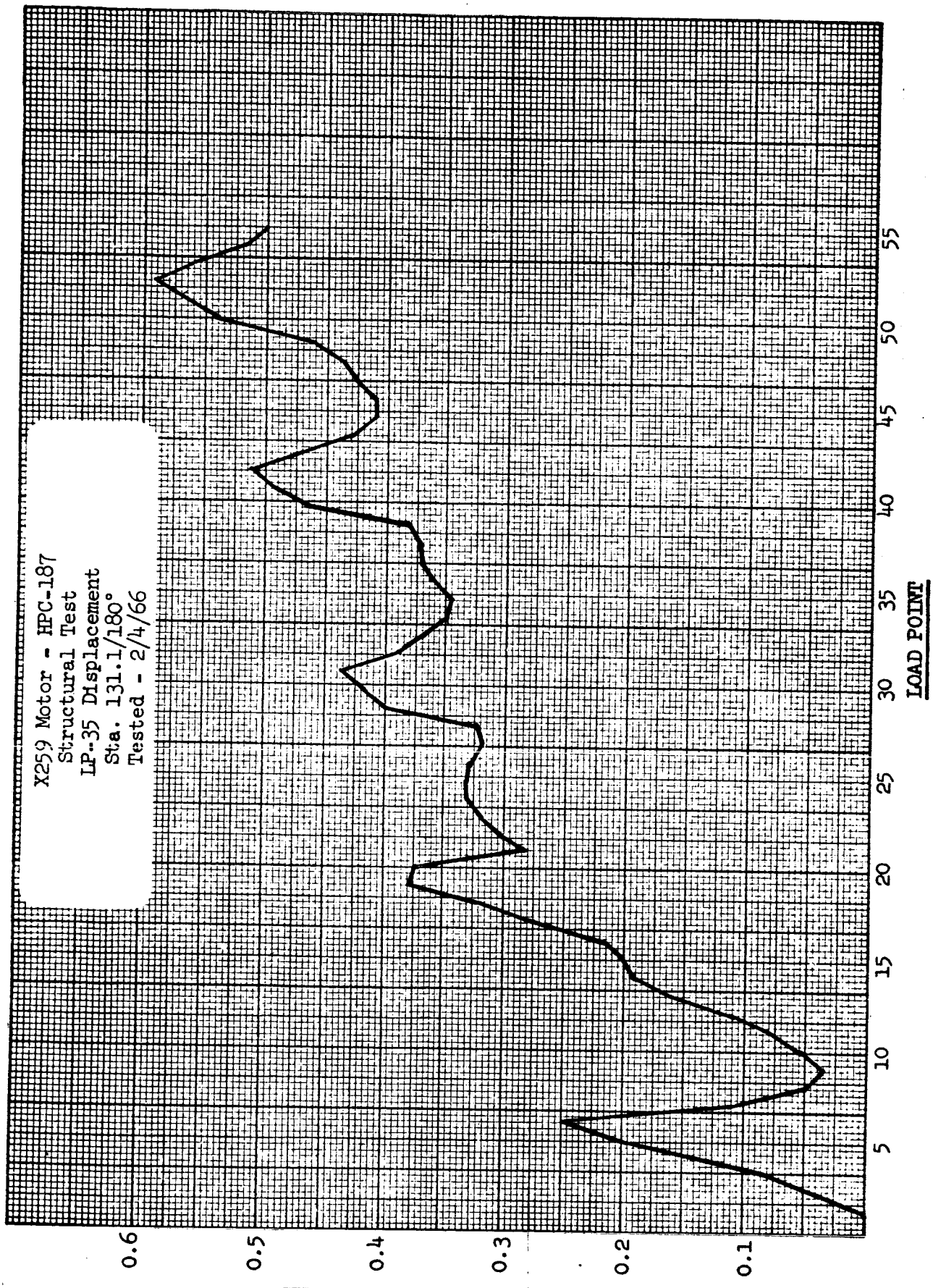
LP33----0°
LP34----90°
LP35----180°
LP36----270°

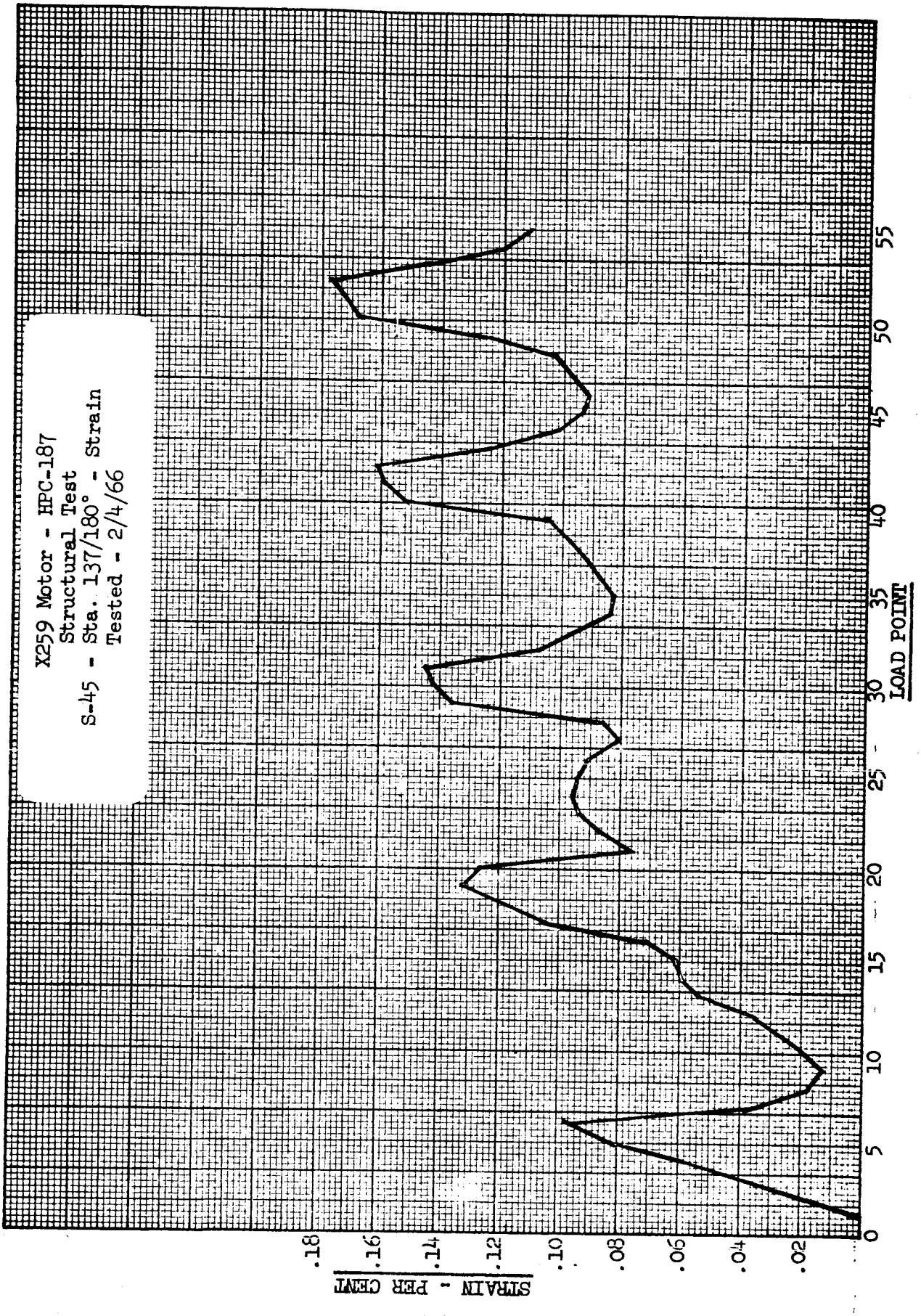


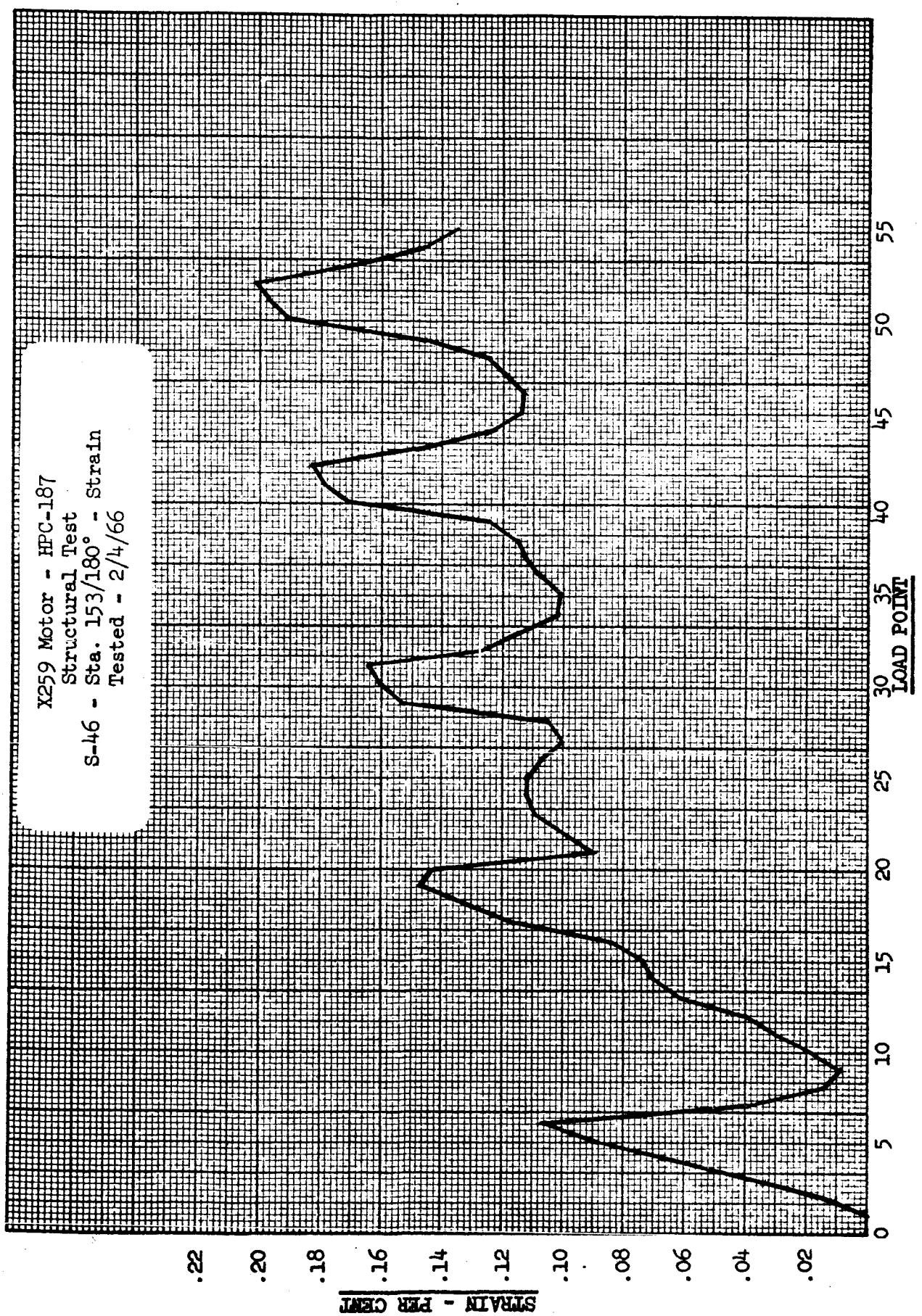
LP37----0°
LP38----90°
LP39----180°
LP40----270°

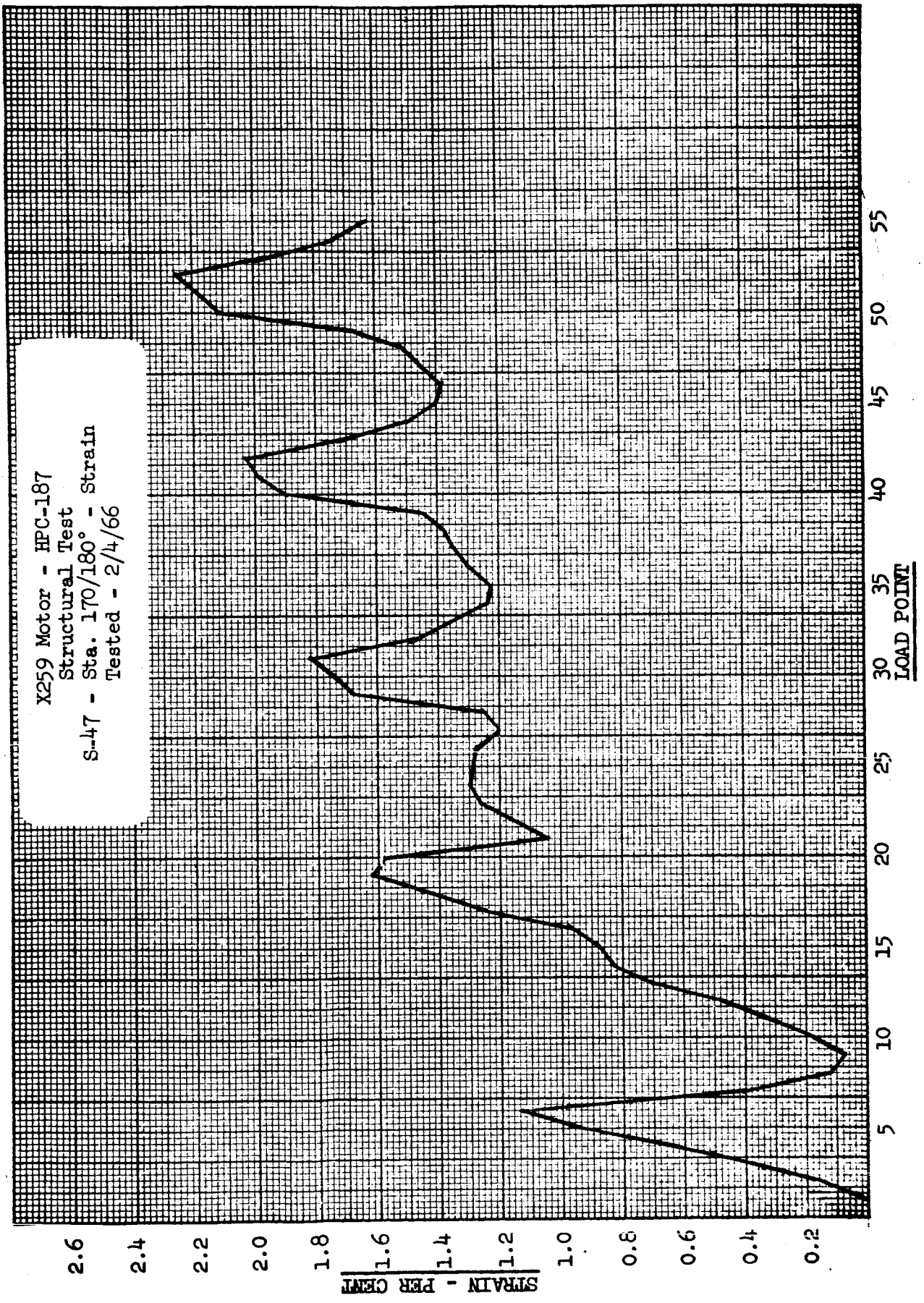

X259 Motor - HPC-187
Structural Test
Center Line Displacement at
Specified Load Points (180°)
Tested - 2/4/66
LOAD POINT
11
16
28
34
45
54
STATION
104
131
161
192
241 234
DISPLACEMENT - INCHES
-0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5

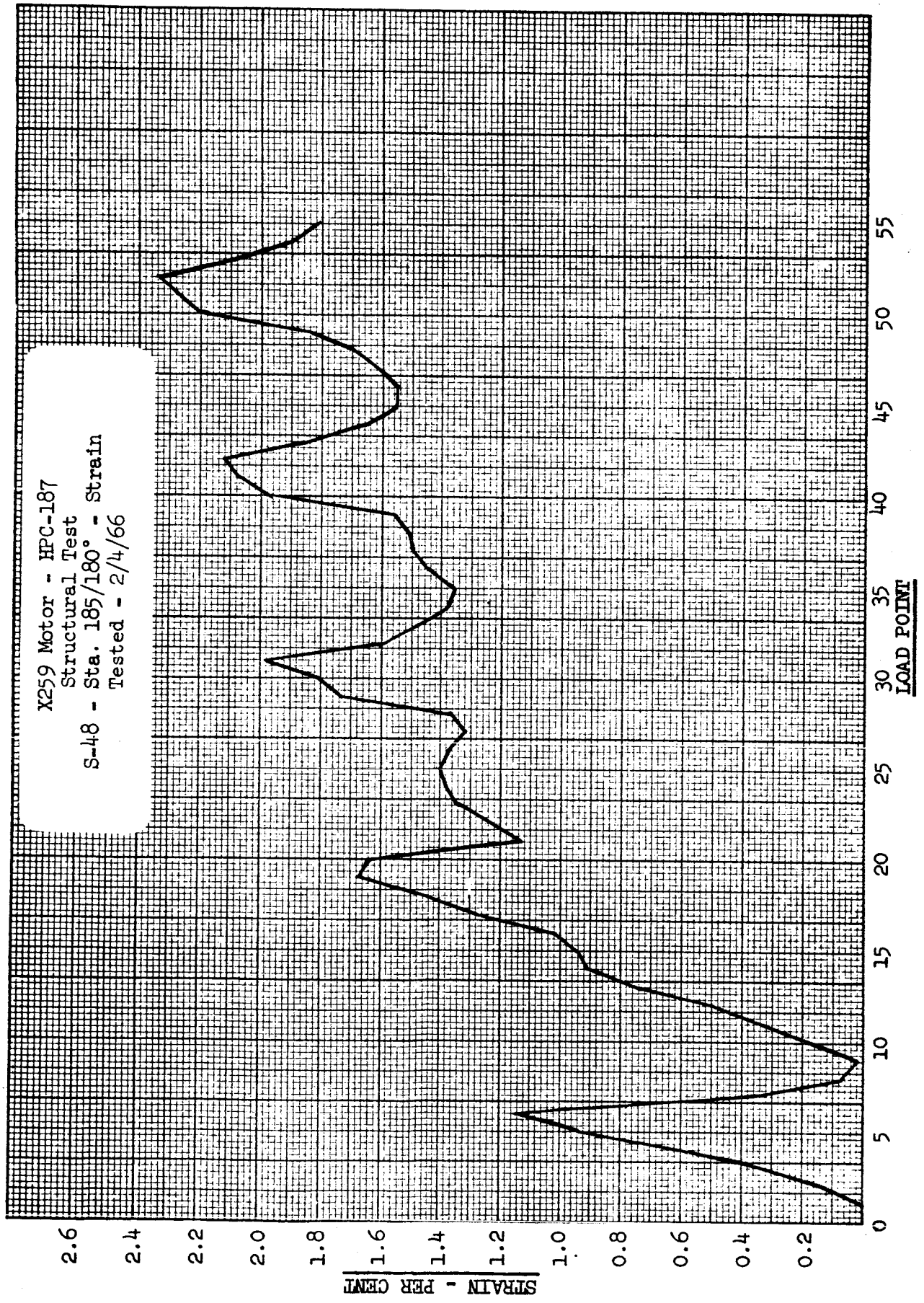

X259 Motor - HPC-187
Structural Test
LP-33 & LP-34 Displacement
Tested - 2/4/66
LP-34
Sta. 131.1/90°
LP-33
Sta. 131.1/0°
DISPLACEMENT - INCHES
0.2
0.1
0.
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
5
10
15
20
25
30
35
40
45
50
55
LOAD POINT

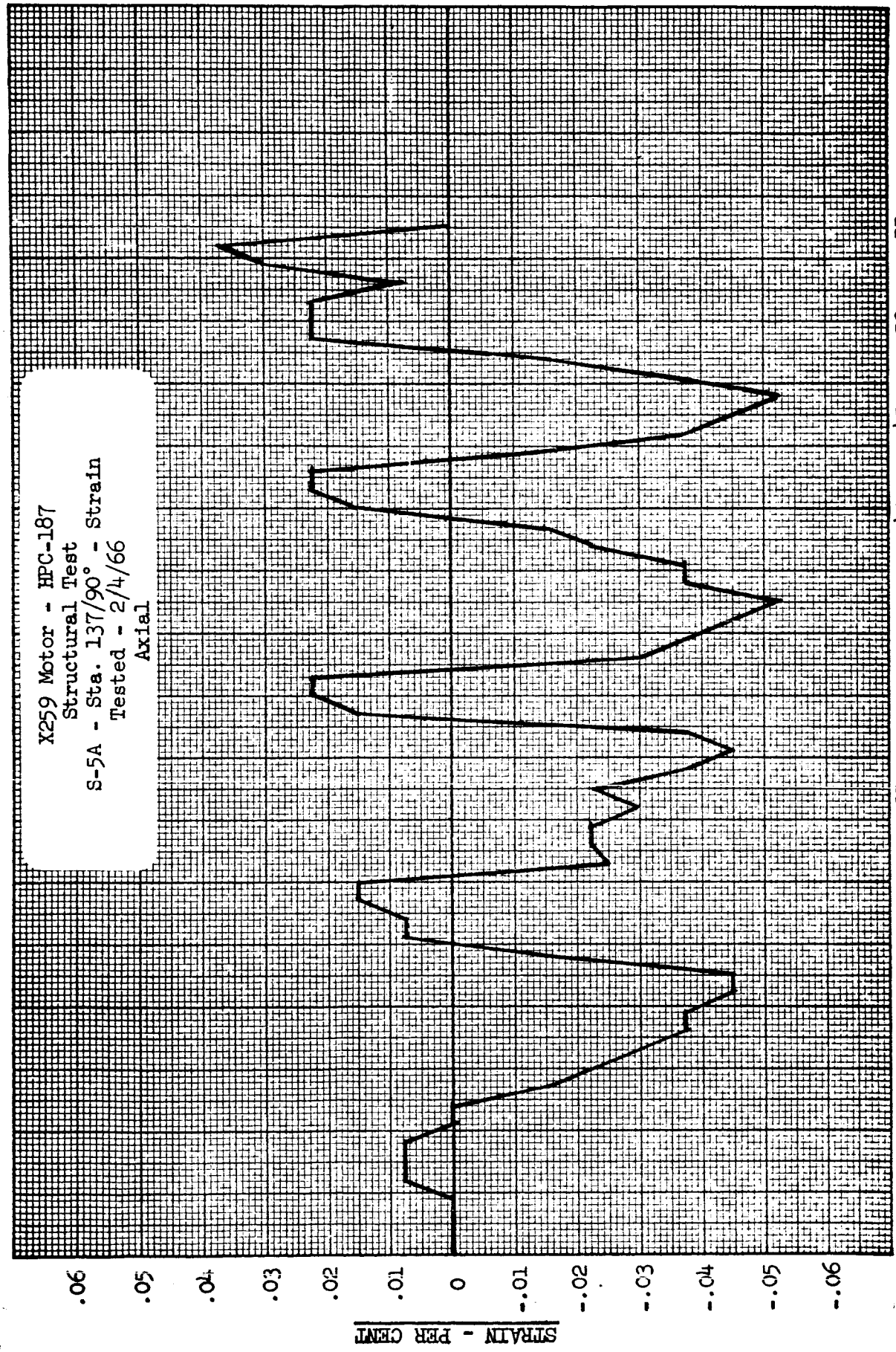

X259 Motor - HPC-187
Structural Test
LP-35 Displacement
Sta. 131.1/180°
Tested - 2/4/66
0.6
0.5
0.4
0.3
0.2
0.1
STRAIN - PER CENT
5
10
15
20
25
30
35
40
45
50
55
LOAD POINT

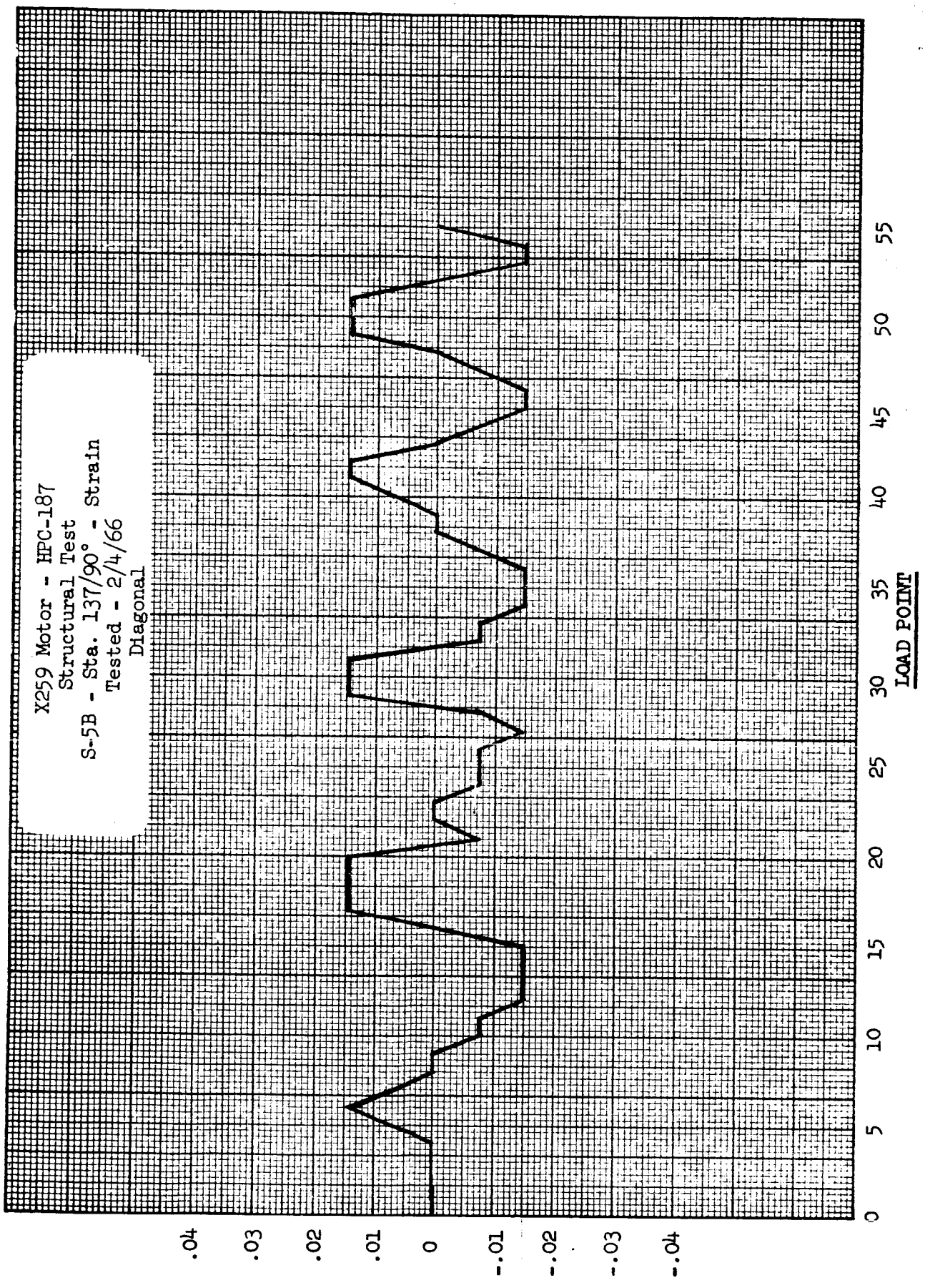

X259 Motor - HPC-187
Structural Test
S-45 - Sta. 137/180° - Strain
Tested - 2/4/66
STRAIN - PER CENT
.02
.04
.06
.08
.10
.12
.14
.16
.18
0
5
10
15
20
25
30
35
40
45
50
55
LOAD POINT

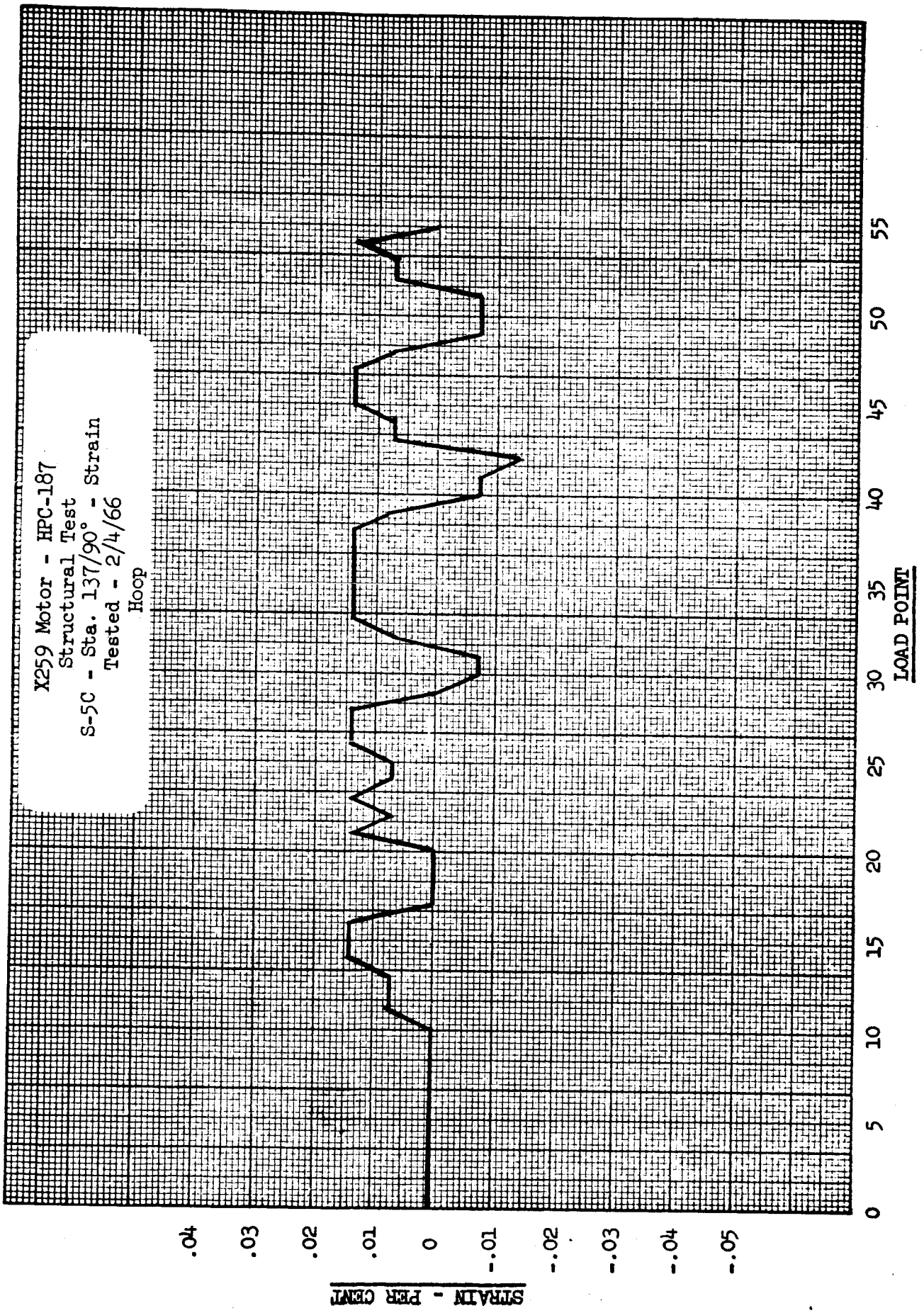

X259 Motor - HPC-187
Structural Test
S-46 - Sta. 153/180° - Strain
Tested - 2/4/66
STRAIN - PER CENT
.22
.20
.18
.16
.14
.12
.10
.08
.06
.04
.02
0
5
10
15
20
25
30
35
40
45
50
55
LOAD POINT

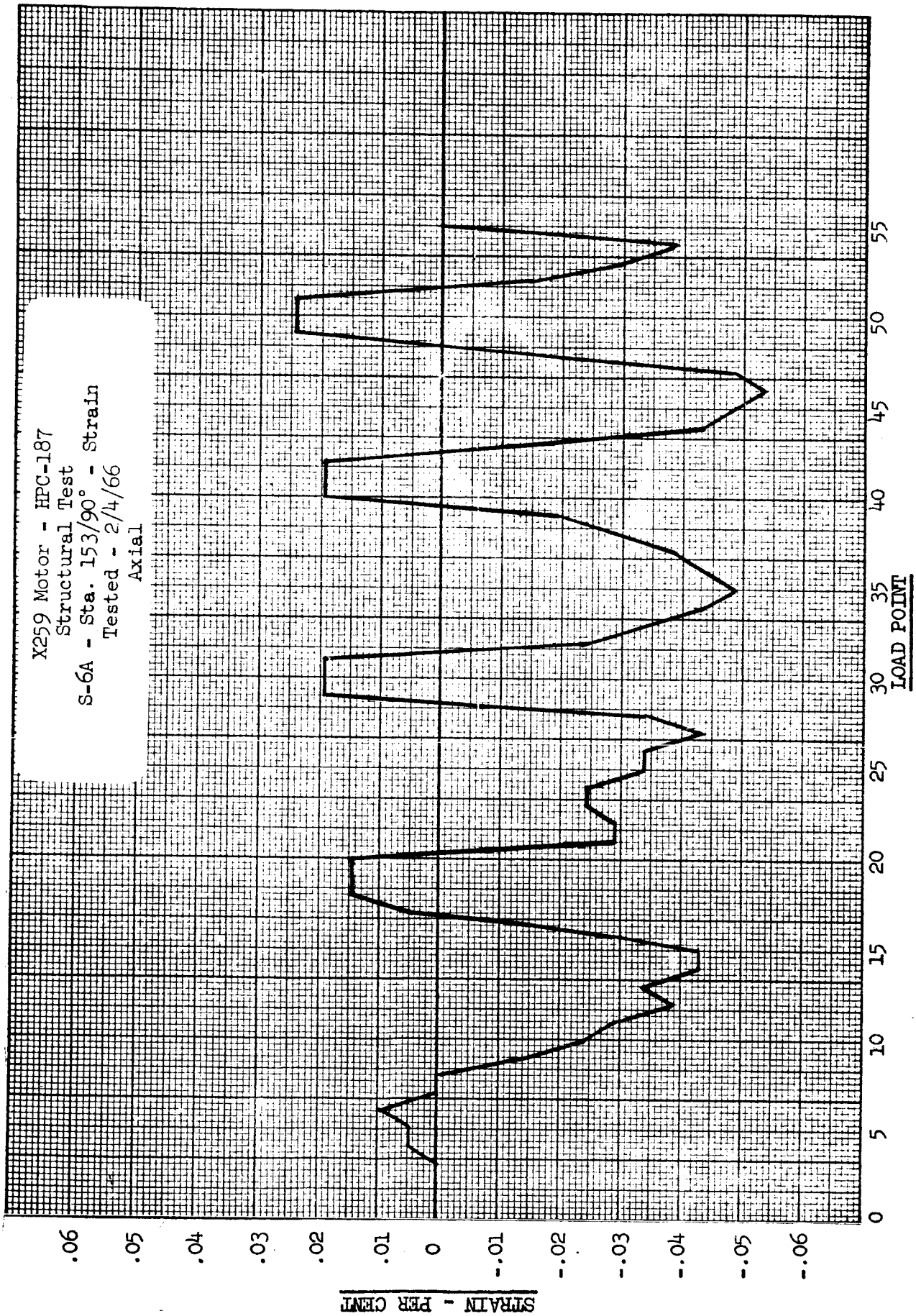

X259 Motor - HPC-187
Structural Test
S-47 - Sta. 170/180° - Strain
Tested - 2/4/66
STRAIN - PER CENT
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
5
10
15
20
25
30
35
40
45
50
55
LOAD POINT

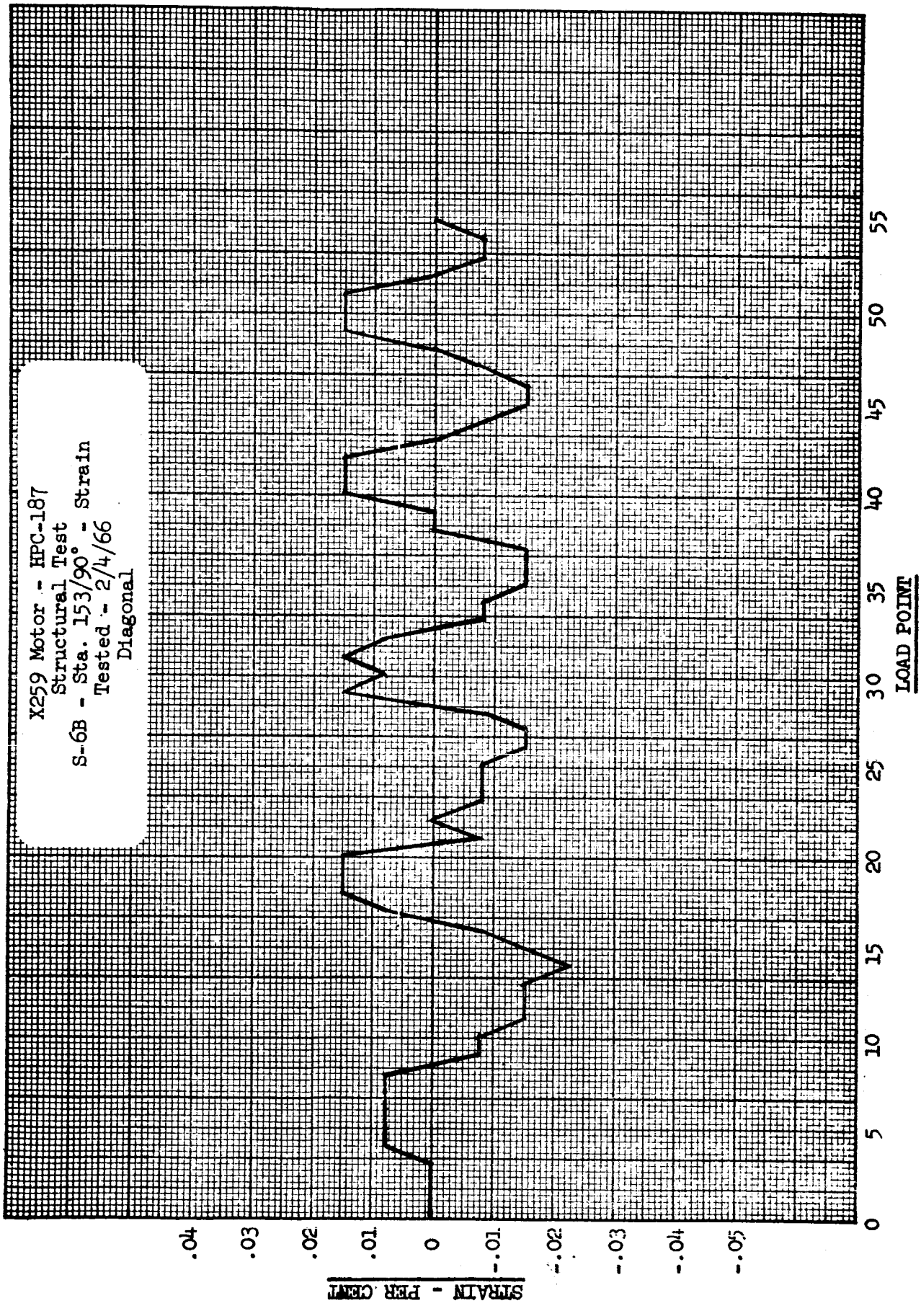

X259 Motor - HPC-187
Structural Test
S-48 - Sta. 185/180° - Strain
Tested - 2/4/66
STRAIN - PER CENT
LOAD POINT
0
5
10
15
20
25
30
35
40
45
50
55
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6

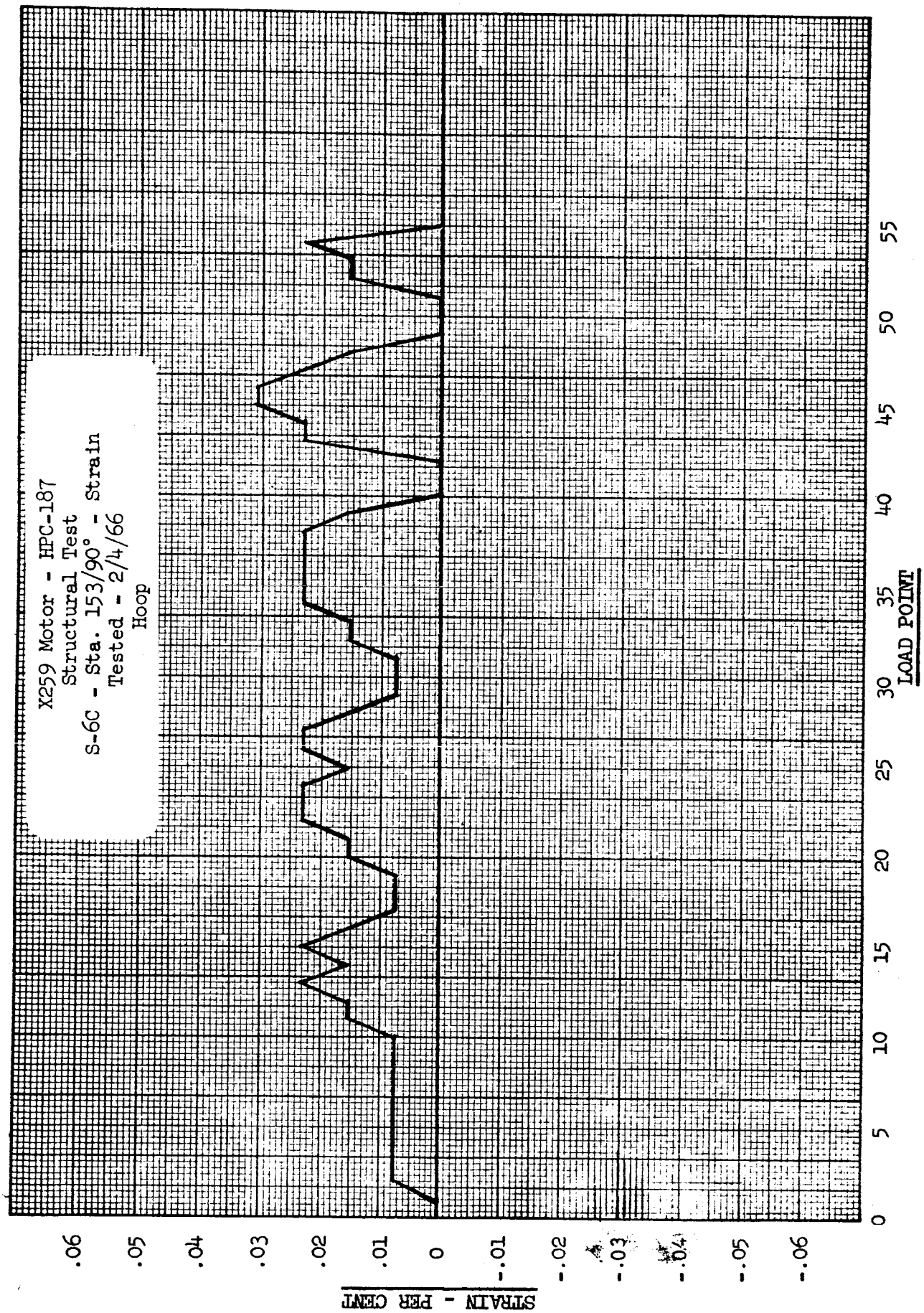

X259 Motor - HPC-187
Structural Test
S-5A - Sta. 137/90° - Strain
Tested - 2/4/66
Axial
.06
.05
.04
.03
.02
.01
0
-.01
-.02
-.03
-.04
-.05
-.06
STRAIN - PER CENT
0
5
10
15
20
25
30
35
40
45
50
55
LOAD POINT

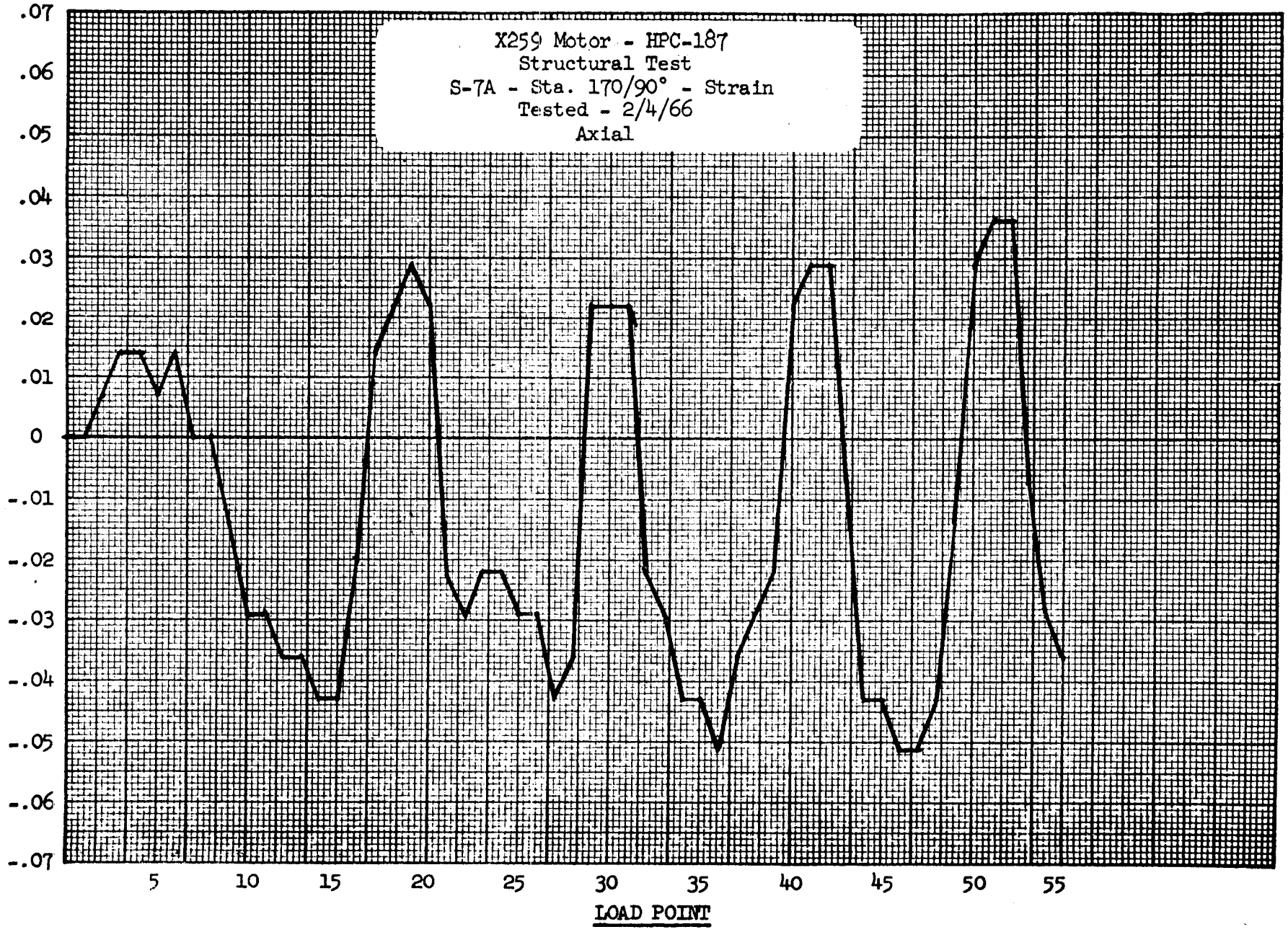

X259 Motor - HPC-187
Structural Test
S-5B - Sta. 137/90° - Strain
Tested - 2/4/66
Diagonal
.04
.03
.02
.01
0
-.01
-.02
-.03
-.04
STRAIN - PER CENT
0
5
10
15
20
25
30
35
40
45
50
55
LOAD POINT

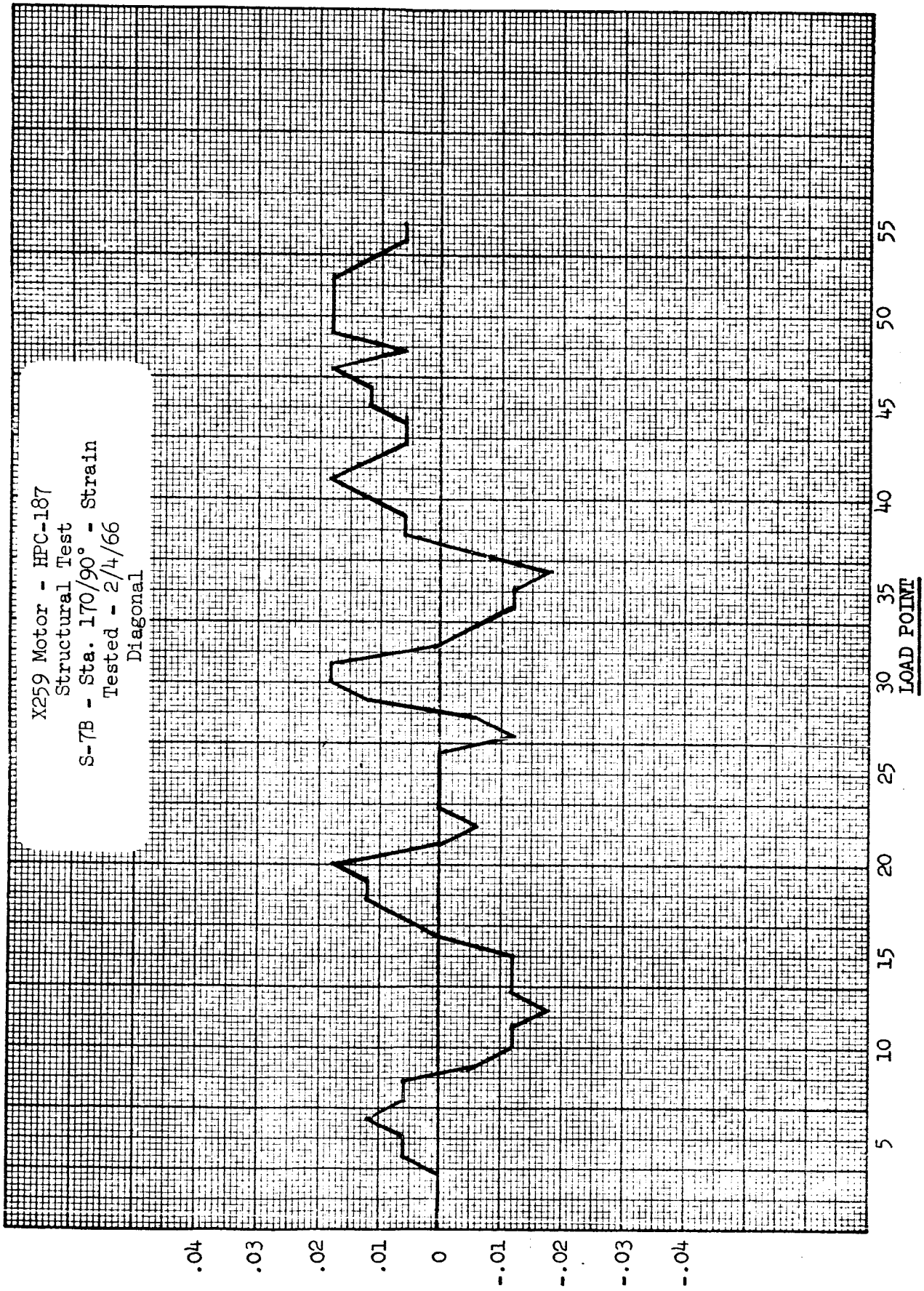

X259 Motor - HPC-187
Structural Test
S-5C - Sta. 137/90° - Strain
Tested - 2/4/66
Hoop
.04
.03
.02
.01
0
-.01
-.02
-.03
-.04
-.05
STRAIN - PER CENT
0
5
10
15
20
25
30
35
40
45
50
55
LOAD POINT

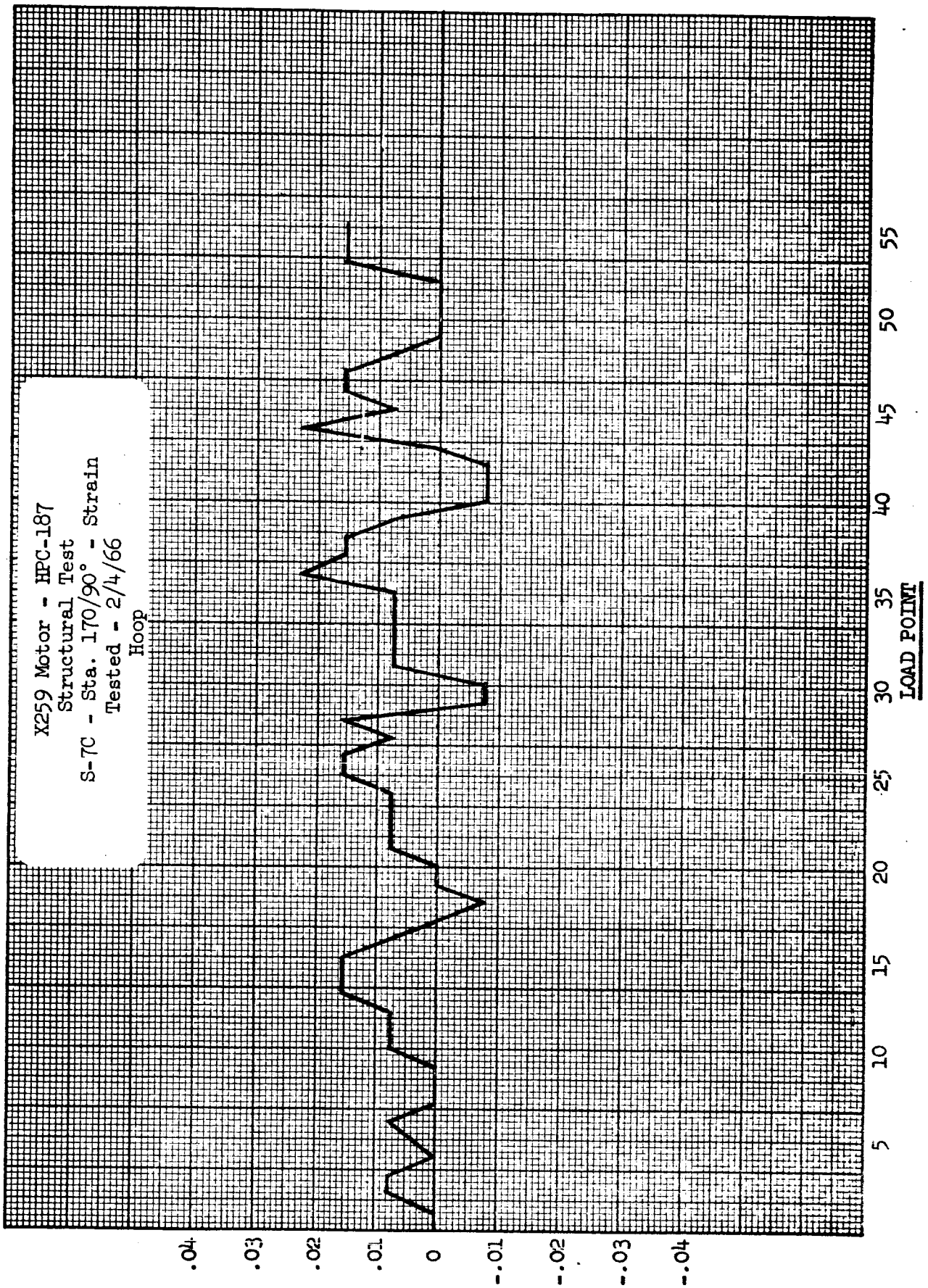

X259 Motor - HPC-187
Structural Test
S-6A - Sta. 153/90° - Strain
Tested - 2/4/66
Axial
.06
.05
.04
.03
.02
.01
0
-.01
-.02
-.03
-.04
-.05
-.06
STRAIN - PER CENT
0
5
10
15
20
25
30
35
40
45
50
55
LOAD POINT

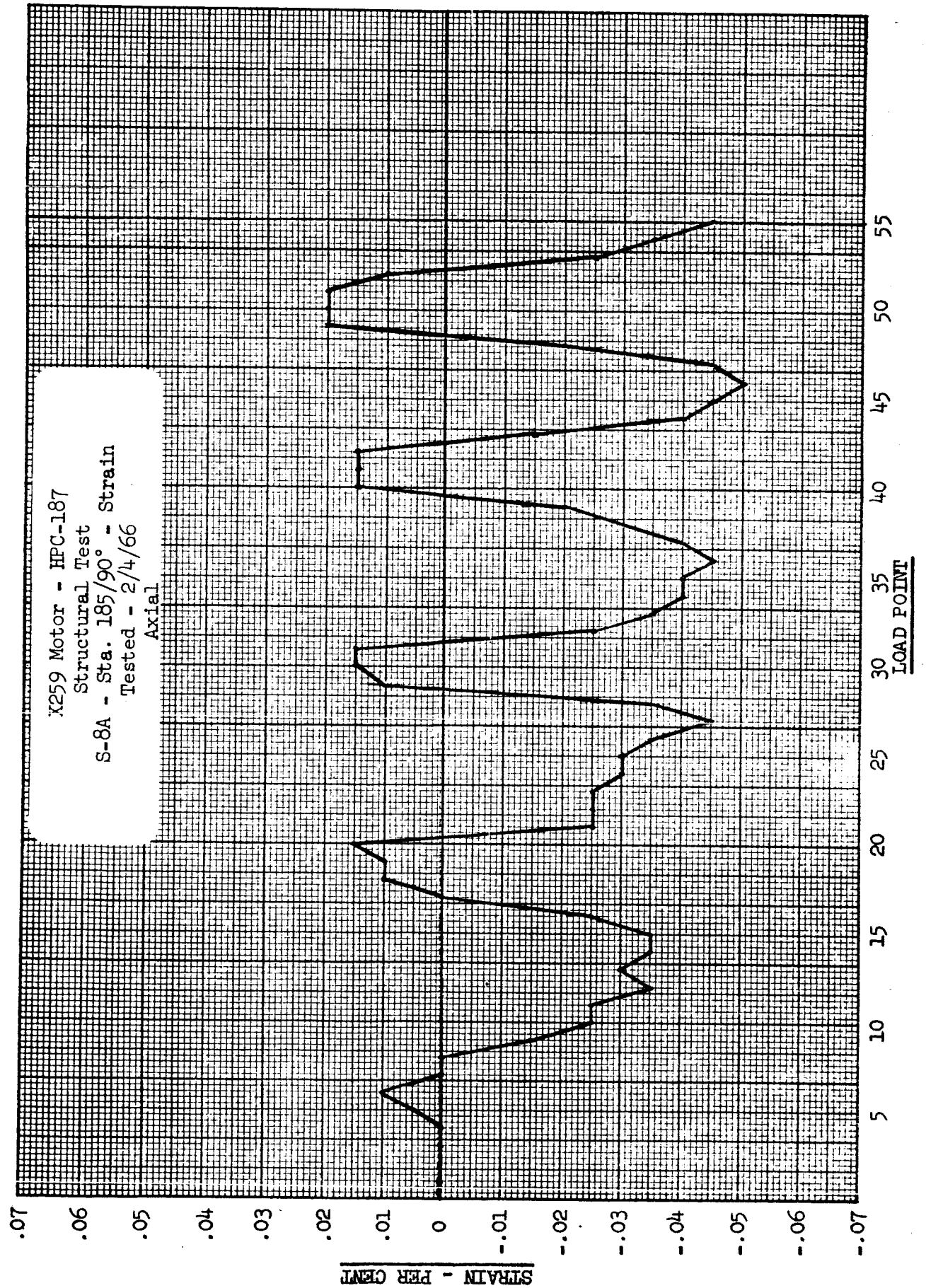

X259 Motor - HPC-187
Structural Test
S-6B - Sta. 153/90° - Strain
Tested - 2/4/66
Diagonal
STRAIN - PER CENT
.04
.03
.02
.01
0
-.01
-.02
-.03
-.04
-.05
0
5
10
15
20
25
30
35
40
45
50
55
LOAD POINT

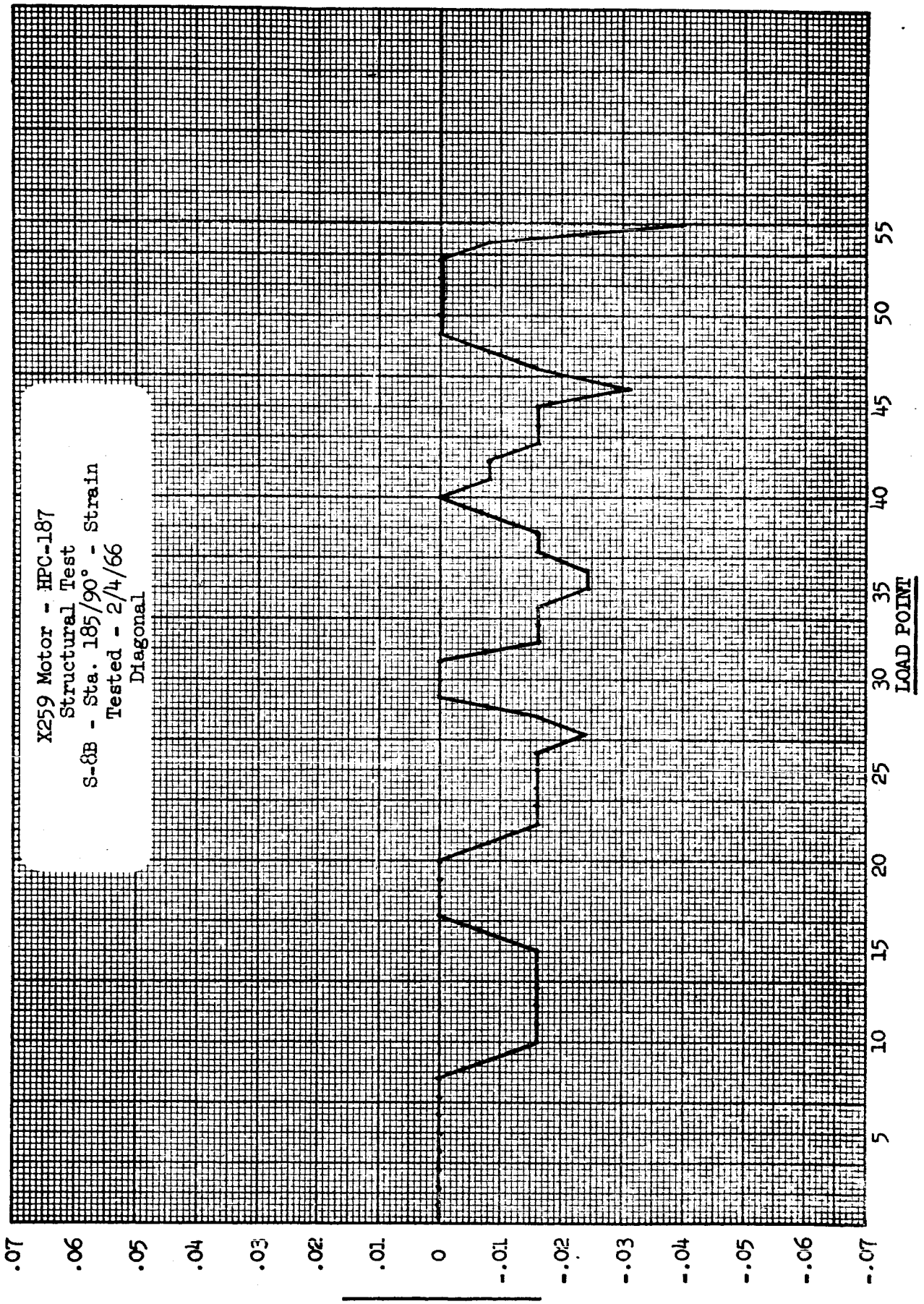

X259 Motor - HPC-187
Structural Test
S-6C - Sta. 153/90° - Strain
Tested - 2/4/66
Hoop
.06
.05
.04
.03
.02
.01
0
-.01
-.02
-.03
-.04
-.05
-.06
STRAIN - PER CENT
0
5
10
15
20
25
30
35
40
45
50
55
LOAD POINT

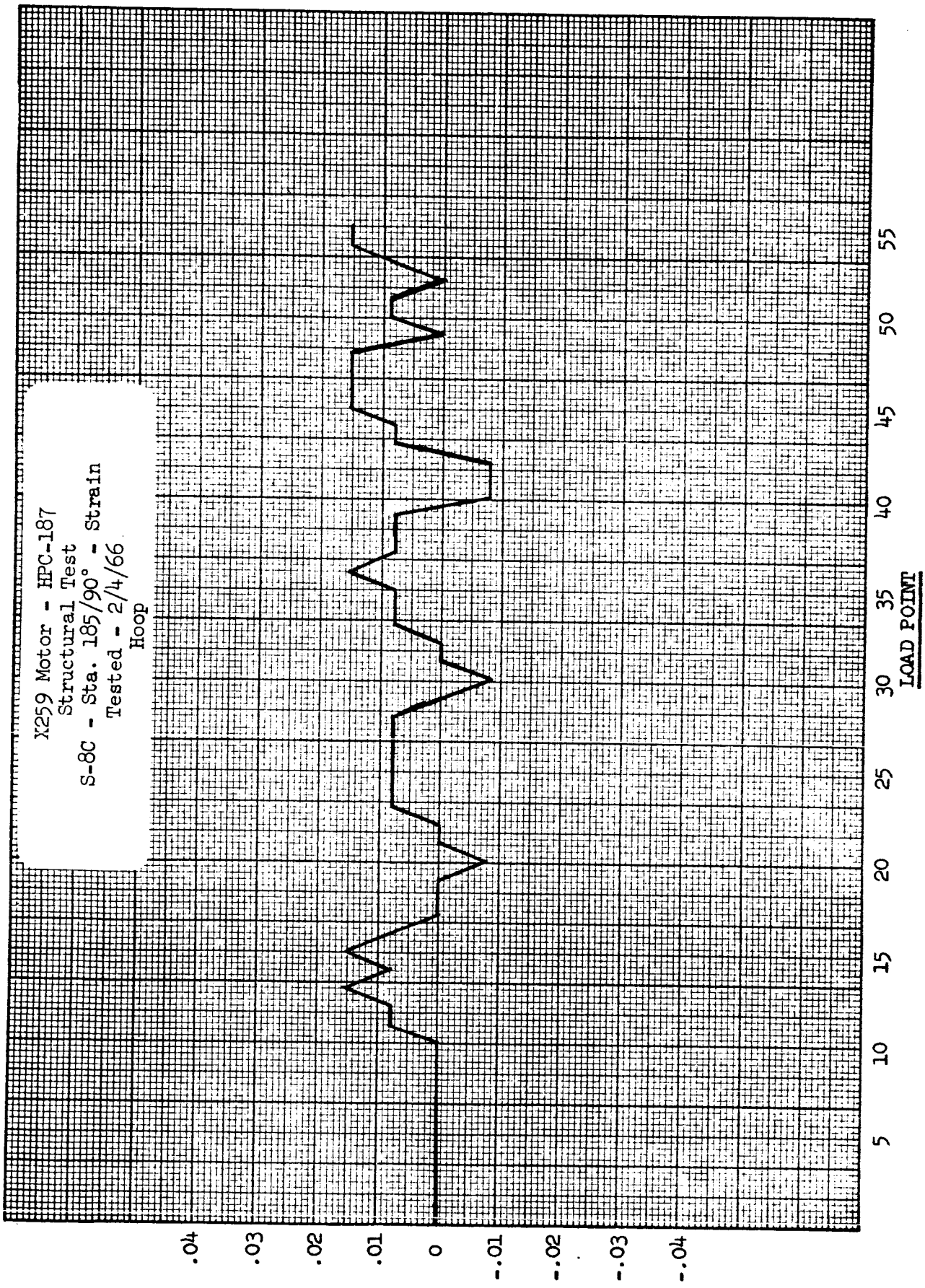

X259 Motor - HPC-187
Structural Test
S-7A - Sta. 170/90° - Strain
Tested - 2/4/66
Axial
.07
.06
.05
.04
.03
.02
.01
0
-.01
-.02
-.03
-.04
-.05
-.06
-.07
5
10
15
20
25
30
35
40
45
50
55
STRAIN - PER CENT
LOAD POINT


X259 Motor - HPC-187
Structural Test
S-7B - Sta. 170/90° - Strain
Tested - 2/4/66
Diagonal
.04
.03
.02
.01
0
-.01
-.02
-.03
-.04
STRAIN - PER CENT
5
10
15
20
25
30
35
40
45
50
55
LOAD POINT


X259 Motor - HPC-187
Structural Test
S-7C - Sta. 170/90° - Strain
Tested - 2/4/66
Hoop
.04
.03
.02
.01
0
-.01
-.02
-.03
-.04
STRAIN - PER CENT
5
10
15
20
25
30
35
40
45
50
55
LOAD POINT


X259 Motor - HPC-187
Structural Test
S-8A - Sta. 185/90° - Strain
Tested - 2/4/66
Axial
.07
.06
.05
.04
.03
.02
.01
0
-.01
-.02
-.03
-.04
-.05
-.06
-.07
STRAIN - PER CENT
5
10
15
20
25
30
35
40
45
50
55
LOAD POINT


X259 Motor - HPC-187
Structural Test
S-8B - Sta. 185/90° - Strain
Tested - 2/4/66
Diagonal
.07
.06
.05
.04
.03
.02
.01
0
-.01
-.02
-.03
-.04
-.05
-.06
-.07
STRAIN - PER CENT
5
10
15
20
25
30
35
40
45
50
55
LOAD POINT


X259 Motor - HPC-187
Structural Test
S-8C - Sta. 185/90° - Strain
Tested - 2/4/66
Hoop
.04
.03
.02
.01
0
-.01
-.02
-.03
-.04
STRAIN - PER CENT
5
10
15
20
25
30
35
40
45
50
55
LOAD POINT

HERCULES POWDER CO

DATE FEBRUARY 18,1966
UNIT NO X-259
LOADING NO HPC-187
ROUND NO X19454C
TYPE TEST STRUCTURAL
TEST FEBRUARY 4, 1966

LOAD PT.	F-1	F-2	F-3	LP-3	LP-5
1.00000	21.7438-	25.2792	23.04	0.0062334-	0.0016635
2.00000	951.7122-	813.1472	54.75 -	0.2040054-	0.0002079
3.00000	1833.175 -	1212.137	108.917	0.4952799-	0.144102
4.00000	2741.0831-	1591.2379	138.241	0.8029881-	0.363686
5.00000	3746.3044-	1982.6555	159.186	1.1713313-	0.6256897
6.00000	4141.6162-	1700.9598	309.995	1.4558893-	0.8327974
7.00000	1006.0719-	159.5541-	611.611	0.7321529-	0.3250093
8.00000	270.5438-	110.0735-	599.044	0.3717432-	0.0474102
9.00000	947.9488-	609.6497	6056.261-	0.3394424-	0.0286956
10.00000	1883.3532-	1106.175	11480.785-	0.5547815-	0.1913043
11.00000	2817.6355-	1504.0018	16316.824-	0.8250887-	0.3821927
12.00000	3702.3809-	1865.8548	20743.741-	1.0800955-	0.5682985
13.00000	4618.5002-	2236.4523	21569.988-	1.3727764-	0.7745744
14.00000	5086.4089-	2059.2734	24742.856-	1.6226805-	0.9521546
15.00000	5105.6917-	1987.4441	24250.044-	1.6633889-	0.9764836
16.00000	4679.1564-	1719.2314	16010.652-	1.6407731-	0.9800185
17.00000	4540.2744-	1868.145	86.393-	1.6583003-	0.9881282
18.00000	5321.5756-	2375.114	128.453-	1.8629729-	1.1305667
19.00000	5822.0908-	2283.2975	48.433-	2.1241849-	1.328370
20.00000	5493.8635-	1928.7315	35.798-	2.1213579-	1.3287852
21.00000	5441.4645-	2049.2797	21362.377-	1.9794441-	1.2334967
22.00000	6046.7776-	2537.931	21507.075-	2.0659493-	1.2870596
23.00000	6422.7928-	2719.9132	21517.561-	2.1631971-	1.3534884
24.00000	6614.7827-	2706.1708	22731.765-	2.2344367-	1.4084998
25.00000	6702.8129-	2670.1492	24625.42 -	2.2774066-	1.4404687
26.00000	6794.6159-	2640.7905	27583.303-	2.320942 -	1.4703617
27.00000	6864.2019-	2610.1826	32042.527-	2.3469501-	1.4907056
28.00000	6562.3836-	2311.4046	27549.681-	2.3458193-	1.4963105
29.00000	6043.0048-	2487.7508	282.765	2.2655334-	1.4278057
30.00000	6393.4494-	2693.4696	280.671	2.3588234-	1.4927815
31.00000	6575.7978-	2713.4585	80.042-	2.4232783-	1.5465474
32.00000	6939.6564-	2583.5307	21540.628-	2.5150584-	1.6183736
33.00000	6960.6159-	2575.4102	26803.674-	2.5110735-	1.6187888
34.00000	6987.025 -	2592.2758	31945.861-	2.4974148-	1.6117307
35.00000	7274.1715-	2899.1885	34570.541-	2.5093657-	1.6123535
36.00000	7659.5812-	3000.3823	36426.099-	2.6266364-	1.6947668
37.00000	7291.3583-	2595.3991	31756.733-	2.6283442-	1.699749
38.00000	7023.0755-	2589.7772	26675.488-	2.5606004-	1.6609296
39.00000	6908.6362-	2609.5579	21754.53 -	2.5429529-	1.6391326

LOAD PT.	F-1	F-2	F-3	LP-3	LP-5
40.00000	6815.9948-	2747.8143	109.501-	2.5930491-	1.6659117
41.00000	7272.9139-	3038.9025	12.634-	2.7103198-	1.7485327
42.00000	7458.1962-	3078.2556	427.476-	2.7905877-	1.8058276
43.00000	7853.4188-	2930.6294	21964.237-	2.9078584-	1.8944686
44.00000	7888.1672-	2931.254	32067.744-	2.8913494-	1.8936383
45.00000	7894.0285-	2940.4156	36234.87 -	2.8771175-	1.8867878
46.00000	8310.1718-	3342.9002	39701.475-	2.9072891-	1.9021495
47.00000	8555.9227-	3357.2671	40588.285-	3.0052045-	1.9646341
48.00000	8243.187 -	2976.4373	35974.293-	3.0069123-	1.9745984
49.00000	7775.9676-	2972.4811	21255.427-	2.9272138-	1.9187567
50.00000	7655.3947-	3033.0724	383.254-	2.9790178-	1.942422
51.00000	8017.9504-	3313.9579	23.174-	3.068394 -	2.0044915
52.00000	8341.1523-	3455.7541	374.831-	3.1782642-	2.0844137
53.00000	8764.8316-	3295.2183	21247.038-	3.3057819-	2.1859253
54.00000	8789.1137-	3277.5198	31851.297-	3.3012276-	2.1867557
55.00000	8790.3697-	3288.9718	35820.888-	3.2892729-	2.1842646

HERCULES POWDER CO

DATE FEBRUARY 18,1966
UNIT NO X-259
LOADING NO HPC-187
ROUND NO X19454C
TYPE TEST STRUCTURAL
TEST FEBRUARY 4, 1966

LOAD PT.	LP-7	LP-8	LP-9	LP-11	LP-13
1.00000	0.0472281-	.00466632-	0.000608	0.0054719-	.00040845
2.00000	1.2305803-	.00358948-	0.0861409	0.094018 -	.04272411
3.00000	1.3453827-	.01094791-	0.2247772	0.2293245-	.1086483
4.00000	1.4636154-	.0172295 -	0.3674672	0.3706003-	.18159788
5.00000	1.6097482-	.11809389	0.530223	0.5397334-	.26892497
6.00000	1.7238645-	.2284704	0.6583197	0.673050 -	.34277315
7.00000	1.4510374-	.37384434	0.3644269	0.3601539-	.1848655
8.00000	1.2980439-	.41009809	0.1870779	0.189031 -	.09092148
9.00000	1.2866094-	.43055812	0.1674175	0.1552044-	.07384817
10.00000	1.3719107-	.43181444	0.2697732	0.2576791-	.12384273
11.00000	1.4745925-	.4445571	0.3897625	0.3765697-	.18527395
12.00000	1.5743013-	.45460764	0.5024552	0.4959578-	.24580658
13.00000	1.6875028-	.46106871	0.6313626	0.6297719-	.3252097
14.00000	1.7888124-	.46699134	0.7424338	0.7471701-	.39881279
15.00000	1.8004756-	.46322239	0.7590539	0.7640834-	.41024945
16.00000	1.7977313-	.45801765	0.7655398	0.7576166-	.4116382
17.00000	1.8039059-	.46447871	0.7661479	0.7640834-	.4132720
18.00000	1.8848622-	.47434978	0.8498566	0.8571066-	.45787499
19.00000	1.9854857-	.47955452	0.971062	0.9854488-	.52865435
20.00000	1.9841136-	.4790161	0.9753184	0.9829615-	.53208822
21.00000	1.9383756-	.49084567	0.9252553	0.9257547-	.50429013
22.00000	1.9703922-	.49459989	0.9546446	0.9516221-	.52080547
23.00000	2.0040096-	.5028105	0.9941681	0.997885 -	.54484264
24.00000	2.0314524-	.50834372	1.0282191	1.0327065-	.56642705
25.00000	2.0506623-	.5088792	1.0466634	1.0486249-	.58008082
26.00000	2.0641551-	.51423394	1.0657158	1.0690204-	.59299875
27.00000	2.0758183-	.51351998	1.0782822	1.0854362-	.60616198
28.00000	2.0769617-	.51459094	1.0843627	1.0884209-	.6113128
29.00000	2.0410574-	.53547443	1.0391641	1.0451428-	.57607463
30.00000	2.0765043-	.53886577	1.075850	1.0894158-	.59577857
31.00000	2.1055479-	.53993672	1.1094956	1.1212526-	.61548251
32.00000	2.1451113-	.54475599	1.1565185	1.1660232-	.6490855
33.00000	2.1407662-	.54779034	1.1571265	1.1655257-	.65047541
34.00000	2.1387079-	.5508247	1.1563158	1.1610487-	.65423633
35.00000	2.1391654-	.55617944	1.1571265	1.1635359-	.65734317
36.00000	2.1862754-	.55885682	1.2039448	1.2187529-	.6848959?
37.00000	2.1855894-	.56064173	1.2108313	1.2172605-	.691681?
38.00000	2.1618056-	.56920932	1.192799	1.1849263-	.67802822
39.00000	2.151972 -	.5676029	1.1788138	1.1834339-	.66878944

LOAD PT.	LP-7	LP-8	LP-9	LP-11	LP-13
40.00000	2.1714106-	.57135123	1.1903668	1.1998498-	.66764482
41.00000	2.2166912-	.57313614	1.2397908	1.2515945-	.69372597
42.00000	2.2459635-	.57456406	1.2707755	1.2864816-	.71261233
43.00000	2.2917015-	.58009731	1.3305171	1.3452979-	.75381891
44.00000	2.2914728-	.58473808	1.3303146	1.3433041-	.74997624
45.00000	2.2834687-	.59134227	1.3323397	1.3358274-	.74621532
46.00000	2.2951318-	.59152076	1.3374026	1.3492854-	.7434355
47.00000	2.3305788-	.59187774	1.3738551	1.3891609-	.75741631
48.00000	2.3342379-	.59419813	1.3807406	1.3946437-	.76485639
49.00000	2.3019925-	.60651405	1.350161	1.3572605-	.7394293
50.00000	2.320059 -	.60722801	1.3598816	1.3776967-	.73893875
51.00000	2.3532191-	.60383667	1.3959291	1.4220581-	.75480002
52.00000	2.3939259-	.60722801	1.4402797	1.4694102-	.7766297
53.00000	2.4694489-	.61829448	1.5083244	1.5376969-	.82086136
54.00000	2.466405 -	.63203832	1.5081219	1.5302202-	.82511284
55.00000	2.4629263-	.63453721	1.5117671	1.5327125-	.82200599

HERCULES POWDER CO

DATE FEBRUARY 18,1966
UNIT NO X-259
LOADING NO HPC-187
ROUND NO X19454C
TYPE TEST STRUCTURAL
TEST FEBRUARY 4, 1966

LOAD PT.	LP-15	LP-17	LP-19	LP-21	LP-23
1.00000	.00411283-	.00002727	.00056999-	.00016445-	.00015646-
2.00000	.04542814-	.00801829	.00129833	.00304524	.00153853-
3.00000	.11085962-	.02225933	.00994333-	.01043887	.00500676-
4.00000	.18339509-	.03659632	.02501666-	.01714663	.00912690-
5.00000	.26583876-	.05375684	.04287666-	.02624120	.01415974-
6.00000	.3346353 -	.06839537	.05978666-	.03363483	.01903612-
7.00000	.18115173-	.04318914	.02773999-	.02145386	.00425053-
8.00000	.08992155-	.02417824	.00959499-	.01178316	.00049546
9.00000	.0738441 -	.0143644	.00721999-	.00679006	.00284238-
10.00000	.12394592-	.02234157	.01443999-	.01101499	.00565868-
11.00000	.18432983-	.03237472	.02561833-	.01698202	.00959629-
12.00000	.24284427-	.04195556	.03689166-	.02309994	.01382074-
13.00000	.30715407-	.05500413	.05028666-	.03020550	.01838420-
14.00000	.36716409-	.06596932	.06358666-	.03684468	.02284334-
15.00000	.37875481-	.06795676	.06621499-	.03802437	.02305196-
16.00000	.37651145-	.07042393	.06725999-	.03888856	.02323450-
17.00000	.38286765-	.07692081	.06887499-	.04032888	.02266081-
18.00000	.42549158-	.08559404	.07865999-	.04503391	.02532065-
19.00000	.48923769-	.0995219	.09440677-	.05222178	.02983195-
20.00000	.49110538-	.10049425	.09415393-	.05289393	.02951903-
21.00000	.45671175-	.08942865	.09644209-	.04916282	.02508596-
22.00000	.47316309-	.09130487	.08988713-	.05002701	.02625941-
23.00000	.49427777-	.09476972	.09434356-	.05197487	.02790226-
24.00000	.51368317-	.09782372	.09823109-	.05375812	.02967549-
25.00000	.52226632-	.0989741	.10056992-	.05508870	.03027525-
26.00000	.53178242-	.09965885	.10186576-	.05566482	.03105756-
27.00000	.53905945-	.09986428	.10344606-	.05635069	.03210064-
28.00000	.54111194-	.10061751	.10426781-	.05699540	.03293510-
29.00000	.52226632-	.10512318	.10120204-	.05651530	.03040564-
30.00000	.54073876-	.10842368	.10515277-	.05849059	.03220494-
31.00000	.55753189-	.11214874	.10872424-	.05971143	.03314371-
32.00000	.57768364-	.11094357	.11169519-	.06154955	.03481263-
33.00000	.57544456-	.10916322	.11109468-	.06165929	.03408248-
34.00000	.57395184-	.10720482	.11046256-	.06117918	.03353486-
35.00000	.57451161-	.1061640	.11055738-	.06090483	.03350879-
36.00000	.59484995-	.10861541	.11536148-	.06229028	.03588178-
37.00000	.60119403-	.11082031	.11703659-	.06316819	.03598609-
38.00000	.58869247-	.11028621	.11428688-	.06289384	.03507340-
39.00000	.58440089-	.11043685	.11349673-	.06281154	.03468225-

LOAD PT.	LP-15	LP-17	LP-19	LP-21	LP-23
40.00000	.59559632-	.11947559	.11697338-	.06480055	.03580355-
41.00000	.62190555-	.1238580	.12228317-	.06714621	.03765501-
42.00000	.63645959-	.12737763	.12588624-	.06840820	.03921962-
43.00000	.6614627 -	.12651484	.1299950 -	.07028747	.04049739-
44.00000	.6575443 -	.12250219	.12888879-	.06890202	.03961078-
45.00000	.65605158-	.12084509	.12926806-	.06868255	.03877632-
46.00000	.65885043-	.11995491	.12948931-	.06849050	.03859378-
47.00000	.6788156 -	.12237894	.13353486-	.07019145	.04036701-
48.00000	.67937537-	.1244195	.13524158-	.07108308	.04083639-
49.00000	.66855313-	.12552879	.13255508-	.07098705	.03974116-
50.00000	.68049491-	.1349099	.13631618-	.07340130	.04195770-
51.00000	.7019528 -	.13863495	.13919231-	.07462214	.04339193-
52.00000	.72378388-	.1426476	.14371195-	.07681691	.04472185-
53.00000	.75251878-	.14234631	.14870569-	.07825723	.04618215-
54.00000	.74804062-	.13882669	.14737824-	.07736560	.04508692-
55.00000	.74412222-	.1368409	.14668291-	.07683063	.04453931-

HERCULES POWDER CO

DATE FEBRUARY 18,1966
UNIT NO X-259
LOADING NO HPC-187
ROUND NO X19454C
TYPE TEST STRUCTURAL
TEST FEBRUARY 4, 1966

LOAD PT.	LP-24	LP-25	LP-26	LP-27	LP-28
1.00000	.00001374-	0.0013341	.00019537	.00024548-	.00016451
2.00000	.00228226-	0.105119 -	.16145827	.02547039-	.06130158
3.00000	.00364337-	0.3035289-	.38235983	.08296305-	.13768138
4.00000	.00438580-	0.5162471-	.61169725	.14528772-	.21801611
5.00000	.00664057-	0.7659765-	.67427949	.22104372-	.31408822
6.00000	.00809792-	0.968965 -	.69291683	.28508825-	.39038562
7.00000	.00841414-	0.5017479-	.30977228	.15355946-	.21134215
8.00000	.00603563-	0.2392364-	.16361627	.07125158-	.10711298
9.00000	.00119612-	0.2022254-	.11986757	.05216926-	.09285872
10.00000	.00131986-	0.3512235-	.19049328	.09295465-	.15037015
11.00000	.00360213-	0.5313186-	.24071602	.14356785-	.2182633
12.00000	.00482575-	0.7035918-	.26033428	.19450864-	.28368461
13.00000	.00614562-	0.9050541-	.2679854	.2524108 -	.36022919
14.00000	.00753423-	1.078472 -	.27720598	.30548095-	.42589769
15.00000	.00787794-	1.103464 -	.27956017	.31408028-	.43586743
16.00000	.00859287-	1.1057533-	.26308083	.3179295 -	.43421955
17.00000	.00994023-	1.105181 -	.26033428	.32489086-	.44567239
18.00000	.01073765-	1.2404569-	.29976697	.36305551-	.49560944
19.00000	.01152132-	1.4263445-	.32978291	.42185855-	.56867266
20.00000	.01176879-	1.4347246-	.32782108	.42603536-	.56735324
21.00000	.01093013-	1.3406381-	.32154324	.38926299-	.52843016
22.00000	.01095763-	1.380063 -	.32056232	.3987632 -	.54822155
23.00000	.01090263-	1.4419621-	.32370124	.41686274-	.57197123
24.00000	.01083389-	1.493005 -	.32860581	.43127686-	.59209246
25.00000	.01057267-	1.5242402-	.32821344	.4392210 -	.60347252
26.00000	.01053142-	1.5526185-	.32664398	.44790223-	.61378054
27.00000	.01076515-	1.573569 -	.32860581	.45117816-	.62095492
28.00000	.01058641-	1.5813778-	.3288020	.45183335-	.62169709
29.00000	.01227749-	1.5147172-	.32350507	.45126007-	.60512181
30.00000	.01260746-	1.573188 -	.32448597	.46706645-	.62804684
31.00000	.01275869-	1.6236596-	.32546689	.48229955-	.64726097
32.00000	.01208501-	1.6884155-	.32468216	.49180458-	.66779454
33.00000	.01219500-	1.688225 -	.32428979	.49065607-	.66556802
34.00000	.01205751-	1.6876537-	.32134705	.48975368-	.66226945
35.00000	.01165880-	1.6870823-	.32566307	.48868776-	.66350641
36.00000	.01159006-	1.7562188-	.32213179	.48860573-	.6929461
37.00000	.01189253-	1.7670749-	.32507452	.48950757-	.6949252
38.00000	.01197502-	1.7364111-	.32428979	.48901536-	.68065895
39.00000	.01227749-	1.7194602-	.32468216	.48836031-	.67529878

LOAD PT.	LP-24	LP-25	LP-26	LP-27	LP-28
40.00000	.01391357-	1.7360301-	.32468216	.48942553-	.6922864
41.00000	.01438103-	1.8129754-	.32468216	.48844206-	.72197348
42.00000	.01472474-	1.8640183-	.32409361	.48885183-	.74110516
43.00000	.01411980-	1.9466773-	.32370124	.4885241 -	.76757615
44.00000	.01253872-	1.9462964-	.32566307	.48876979-	.7614738
45.00000	.01244247-	1.9451537-	.32389743	.48877021-	.75759799
46.00000	.01249747-	1.9472487-	.32428979	.4890978 -	.76452497
47.00000	.01241498-	2.0062909-	.32448598	.48926147-	.78852203
48.00000	.01238748-	2.015052 -	.32782108	.48893401-	.7929751
49.00000	.01334988-	1.976008 -	.32507452	.48844192-	.77376095
50.00000	.01521969-	1.9916256-	.32546689	.43909753-	.79396467
51.00000	.01572839-	2.0481918-	.32487834	.48917956-	.81606505
52.00000	.01597586-	2.120566 -	.32527071	.48934377-	.84195879
53.00000	.01453226-	2.215224 -	.32546689	.4892616 -	.87370749
54.00000	.01387233-	2.2123671-	.3231127	.48852397-	.86884211
55.00000	.01398232-	2.2125575-	.32370125	.48893374-	.8642241

HERCULES POWDER CO

DATE FEBRUARY 18,1966
UNIT NO X-259
LOADING NO HPC-187
ROUND NO X19454C
TYPE TEST STRUCTURAL
TEST FEBRUARY 4, 1966

LOAD PT.	LP-29	LP-30	LP-31	LP-32	LP-33
1.00000	.00008181-	.00026829-	.00052043-	.00004103	.00012169
2.00000	.00981917	.01476971	.00051581-	.00110788-	.03486037-
3.00000	.00090765	.03141919	.00111250	.00586771-	.09099492-
4.00000	.01095592-	.04896382	.00395128	.01185851-	.15087177-
5.00000	.0247126 -	.07035752	.00771075	.01916238-	.22461956-
6.00000	.03855166-	.08834971	.01116333	.02552248-	.27611691-
7.00000	.01540418-	.05343949	.00698188	.01198161-	.12064861-
8.00000	.00140038-	.0294499	.00260861	.00455465-	.05271766-
9.00000	.00181531	.0240791	.00207154	.00237991-	.07492742-
10.00000	.00370689-	.03607389	.00318404	.00709869-	.13704152-
11.00000	.0120268 -	.05102263	.00617627	.01317157-	.2038335 -
12.00000	.02026433-	.06418109	.00797929	.01924444-	.27082887-
13.00000	.0307260 -	.08172572	.01120169	.02560455-	.33123454-
14.00000	.04085817-	.0963164	.01480771	.03155433-	.38801992-
15.00000	.04291755-	.09944936	.01534478	.03258015-	.39753839-
16.00000	.04415318-	.09998644	.01569004	.03344184-	.35755269-
17.00000	.04580069-	.10401455	.01572840	.03171846-	.3204144 -
18.00000	.05329684-	.1143981	.01634219	.03532936-	.35340361-
19.00000	.0658179 -	.13176369	.01944951	.04103294-	.39863668-
20.00000	.0661474 -	.13221126	.02044692	.04173050-	.38854873-
21.00000	.05716849-	.12460263	.01921934	.04021228-	.41926002-
22.00000	.05955737-	.12809365	.01898917	.04119707-	.44557818-
23.00000	.06334664-	.13167418	.01918098	.04337181-	.46494053-
24.00000	.06565315-	.13668693	.02102235	.04525933-	.4832046 -
25.00000	.06664165-	.13937233	.02213485	.04661342-	.49683147-
26.00000	.06845391-	.14178919	.02182795	.04735201-	.51277694-
27.00000	.06911291-	.14375849	.02263356	.04792647-	.53201726-
28.00000	.07092517-	.14456411	.02351588	.04862403-	.51485147-
29.00000	.07100754-	.14152065	.02343916	.04620309-	.42283962-
30.00000	.07454968-	.1465334	.02328571	.04804957-	.43939524-
31.00000	.07702094-	.15074053	.02466674	.04923952-	.45281872-
32.00000	.07833895-	.15575328	.02451329	.05141427-	.52164456-
33.00000	.07669144-	.15566377	.02455165	.05137324-	.53075626-
34.00000	.07545581-	.15458961	.02405295	.05092187-	.54417973-
35.00000	.07562056-	.15458961	.02462838	.05207080-	.56045062-
36.00000	.07858608-	.16148214	.02451329	.05453277-	.5913653 -
37.00000	.08064546-	.16175068	.02512708	.05502517-	.5744029 -
38.00000	.07940983-	.15906528	.02574087	.05387625-	.54784069-
39.00000	.07940983-	.1585282	.02554906	.05350695-	.52969866-

LOAD PT.	LP-29	LP-30	LP-31	LP-32	LP-33
40.00000	.03402285-	.16264581	.02635467	.05371211-	.48145548-
41.00000	.08830637-	.16909077	.02712190	.05609203-	.49980091-
42.00000	.0911895 -	.17285034	.02865638	.05695372-	.51293964-
43.00000	.09333126-	.17884773	.02988397	.05982602-	.58746029-
44.00000	.09069525-	.17786308	.03099646	.06023635-	.60767687-
45.00000	.0902010 -	.17741552	.03111155	.06015429-	.61707331-
46.00000	.08962437-	.17902676	.03122663	.06093391-	.64257792-
47.00000	.09201326-	.18439756	.03126500	.06327279-	.66303855-
48.00000	.09423739-	.1860080	.03279947	.06356002-	.64876085-
49.00000	.09415502-	.18224924	.03249258	.06183664-	.58965686-
50.00000	.09917991-	.18726199	.03233913	.06364209-	.54169843-
51.00000	.10247493-	.19218523	.03249258	.06470894-	.55581343-
52.00000	.10675844-	.19827213	.03383525	.06680162-	.5729792 -
53.00000	.10848833-	.20418002	.03694257	.07016632-	.64937101-
54.00000	.10593469-	.20310586	.03606024	.06996116-	.67300447-
55.00000	.10478144-	.20238975	.03663567	.06942773-	.68378394-

HERCULES POWDER CO

DATE FEBRUARY 18,1966
UNIT NO X-259
LOADING NO HPC-187
ROUND NO X19454C
TYPE TEST STRUCTURAL
TEST FEBRUARY 4, 1966

LOAD PT.	LP-34	LP-35	LP-36	LP-37	LP-38
1.00000	.00082581-	.00294561-	0.0016547-	.00052906-	.00123383-
2.00000	.00127626-	.03071856	0.0023442-	.01347523	.00238542-
3.00000	.00022522	.0732196	0.0075842	.03470892	.00748530-
4.00000	.00307304	.13143058	0.0180644	.05871933	.00978847-
5.00000	.00743235	.19609386	0.2021558-	.08824234	.01554639-
6.00000	.01493977	.24785254	0.2090506-	.1090677	.01957694-
7.00000	.00548042	.10856099	1.0758582-	.05324757	.01110456-
8.00000	.00217715	.0499352	1.0735107-	.02396957	.00641597-
9.00000	.01959437-	.03618899	1.0851103-	.02980884	.00690951-
10.00000	.03340803-	.05161841	1.1080332-	.05341091	.01316097-
11.00000	.04466917-	.07826922	1.1490459-	.08011637	.01735603-
12.00000	.05472912-	.11081127	1.181497 -	.10747517	.02155109-
13.00000	.05367808-	.16144781	1.1973773-	.14112241	.02089304-
14.00000	.05698134-	.19342878	1.227619 -	.17476965	.02253816-
15.00000	.05555493-	.20072269	1.2299665-	.17836304	.01965920-
16.00000	.03438400-	.21601183	1.2292761-	.16574533	.00830786-
17.00000	.01336321	.27590602	1.2190575-	.14291911	.01834310-
18.00000	.01869348	.32289561	1.2400471-	.15680268	.02352523-
19.00000	.02897865	.37717911	1.2666984-	.17917973	.03043474-
20.00000	.03002969	.37339188	1.2704269-	.1795064	.03125730-
21.00000	.03032999-	.28067512	1.3154442-	.19739171	.00131610-
22.00000	.02995462-	.30003203	1.3307722-	.20760021	.00164512-
23.00000	.03055521-	.31840705	1.3380909-	.21686954	.00139835-
24.00000	.03085551-	.33047005	1.3494143-	.22920141	.00172738-
25.00000	.03490952-	.33229353	1.3640518-	.2383074	.00378378-
26.00000	.04076531-	.32920765	1.3831082-	.24887384	.00682725-
27.00000	.05247689-	.31980973	1.3960887-	.2615927	.01307871-
28.00000	.04369320-	.32471909	1.3994028-	.25833145	.00674500-
29.00000	.02702672	.39892056	1.3833844-	.20163844	.02303169-
30.00000	.03063029	.41771639	1.4028551-	.20853939	.03158632-
31.00000	.03400863	.43468875	1.4116928-	.21580785	.03413626-
32.00000	.01779259-	.38966291	1.4622337-	.2579238	.01036426-
33.00000	.03048014-	.3703060	1.4728662-	.26676993	.00370152-
34.00000	.04481932-	.34912562	1.4827979-	.27577912	.00830140-
35.00000	.05352793-	.3453384	1.4896927-	.28486984	.01365451-
36.00000	.05638075-	.35978595	1.5085845-	.29820019	.01529963-
37.00000	.04662110-	.37044627	1.5070676-	.29575425	.00740304-
38.00000	.03626085-	.37226974	1.4990696-	.2827908	.00411280-
39.00000	.02582553-	.38040526	1.4891411-	.27251787	.00370152-

LOAD PT.	LP-34	LP-35	LP-36	LP-37	LP-38
40.00000	.03798756	.46400464	1.4848663-	.23781739	.03413626-
41.00000	.04451902	.49375343	1.5040339-	.24597948	.03701522-
42.00000	.04842288	.51119658	1.5160309-	.25303192	.04145705-
43.00000	.00427923-	.47003614	1.5681556-	.29481664	.01974145-
44.00000	.03430892-	.42893779	1.5925633-	.29787406	.00041128
45.00000	.04602051-	.41014195	1.599596 -	.29909703	.00855463
46.00000	.05337778-	.41140436	1.6135235-	.30219521	.01365450
47.00000	.05450389-	.4254311	1.6285541-	.30443732	.01348999
48.00000	.04339291-	.43595116	1.6358627-	.3025621	.00616920
49.00000	.01298784-	.46049796	1.6213836-	.26860437	.01110456-
50.00000	.05225167	.54369146	1.6027676-	.23826657	.04170382-
51.00000	.05585523	.56774611	1.6169709-	.2402266	.04499406-
52.00000	.06276206	.59250412	1.6350353-	.24671326	.04820205-
53.00000	.01231217	.55916521	1.7104645-	.28796802	.02911864-
54.00000	.01629111-	.51893345	1.7490755-	.30435579	.01094005-
55.00000	.02957925-	.50050561	1.7613482-	.30745397	.00361926-

HERCULES POWDER CO

DATE FEBRUARY 18,1966
UNIT NO X-259
LOADING NO HPC-187
ROUND NO X19454C
TYPE TEST STRUCTURAL
TEST FEBRUARY 4, 1966

LOAD PT.	LP-40	LP-41	LP-42	LP-43	LP-44
1.00000	.00041114-	.00004080	.00015187	.00048886-	.00008633
2.00000	.00333030-	.00222054	.00004151	.01354868-	.00096268-
3.00000	.00501601-	.00675698	.00004161	.02743259-	.00138051
4.00000	.00822296-	.01110270	.00191869	.04180536-	.00235838
5.00000	.01249891-	.01516233	.00226377	.05622004-	.00322120
6.00000	.01661039-	.01796866	.00302297	.06552254-	.00440040
7.00000	.01036094-	.01532581	.00222236	.05293763-	.00349443
8.00000	.00579719-	.00918186	.00202911	.03463993-	.00264599
9.00000	.00415260	.00874593	.00421007	.02118902-	.00227210
10.00000	.00818185	.01219253	.00425148	.02575646-	.00448668
11.00000	.01286894	.01555740	.00543859	.03355044-	.00661498
12.00000	.01554141	.01855445	.00646005	.04093936-	.00713267
13.00000	.01488357	.02081586	.00655667	.05205766-	.00916031
14.00000	.01615813	.02284568	.00666710	.05926501-	.00911717
15.00000	.01537695	.02324074	.00663949	.05997736-	.00920345
16.00000	.00526270	.02299553	.00676372	.06353912-	.00911717
17.00000	.01434908-	.02296828	.00455516	.07307907-	.00519132
18.00000	.01763826-	.02266858	.00421007	.07967184-	.00534950
19.00000	.02236647-	.02313176	.00353370	.0912476 -	.00483181
20.00000	.02355880-	.02332248	.00346468	.09162634-	.00458734
21.00000	.00049337	.02392189	.00661188	.08518781-	.00916031
22.00000	.00106898	.02434420	.00673612	.08492129-	.01032512
23.00000	.00135679	.02491636	.00662569	.08678692-	.01038264
24.00000	.00193239	.02544766	.00756433	.08762856-	.01100100
25.00000	.00324807	.02559751	.00796463	.0880073 -	.01127423
26.00000	.00723621	.02584272	.00882045	.08799327-	.01134613
27.00000	.01262225	.02619692	.00894468	.08783897-	.01340252
28.00000	.00966198	.02625141	.00895848	.08789508-	.01301425
29.00000	.01973512-	.02641489	.00440332	.09624132-	.00657184
30.00000	.02150306-	.02633315	.00445853	.09957982-	.00647117
31.00000	.02265427-	.02633315	.00432050	.10228709-	.00639927
32.00000	.00172682-	.02576099	.00806126	.10228709-	.01028198
33.00000	.00234354	.02550215	.00893088	.09979023-	.01164812
34.00000	.00933307	.02548853	.00894468	.09858388-	.01320120
35.00000	.01340344	.02557026	.00928977	.09779835-	.01366137
36.00000	.01467800	.02561113	.01046307	.09775627-	.01389146
37.00000	.01175884	.02645576	.00951063	.09866805-	.01358947
38.00000	.00690729	.02640126	.00905511	.09899067-	.01308616
39.00000	.00152125	.02659199	.00803365	.09960788-	.01174878

LOAD PT.	LP-40	LP-41	LP-42	LP-43	LP-44
40.00000	.02244870-	.02675546	.00448614	.10878173-	.00631299
41.00000	.02516228-	.02671459	.00440332	.1142103 -	.00629861
42.00000	.02767029-	.02660561	.00454136	.11736644-	.00641365
43.00000	.01015536-	.02585635	.00897229	.11660897-	.01144679
44.00000	.00287804	.02559751	.01013178	.11395781-	.01364699
45.00000	.00970310	.02529781	.01031123	.11196593-	.01481180
46.00000	.01360901	.02527056	.01127748	.11136276-	.01593347
47.00000	.01406127	.02492999	.01119466	.11147497-	.01591909
48.00000	.00999090	.02516158	.01119466	.11252702-	.01584719
49.00000	.00402925-	.02621054	.00897229	.11339672-	.01229523
50.00000	.02734137-	.02622417	.00456896	.12346832-	.00681630
51.00000	.02968491-	.02596533	.00440332	.12778873-	.00626985
52.00000	.03285076-	.02610156	.00447234	.13177248-	.00652870
53.00000	.01496580-	.02563838	.00893088	.13201095-	.01108728
54.00000	.00308361-	.02492999	.01112564	.12872856-	.01366137
55.00000	.00131567	.02448043	.01111183	.12721361-	.01504189

DATE FEBRUARY 18,1966
UNIT NO X-259
LOADING NO HPC-187
ROUND NO X19454C
TYPE TEST STRUCTURAL
TEST FEBRUARY 4, 1966

LOAD PT.	S-13	S-19	S-25	S-33	S-37
1.00000	.00019084	.00033424	.00012902	.0002316	.0000473
2.00000	.00467557	.00635070	.01037317	.01140022	.0091151
3.00000	.00963740	.01401451	.02931324	.02900238	.0234151
4.00000	.01450381	.02430456	.05364633	.04812285	.0397277
5.00000	.01987117	.03648071	.08166938	.07275042	.0611541
6.00000	.02244750	.04201967	.10166741	.09297746	.0789582
7.00000	.00815839	.02466268	.03682218	.03201327	.0361526
8.00000	.00367366	.01809711	.00962486	.00947016	.0143947
9.00000	.00248091	.01606775	.0052640	.00409173	.0079550
10.00000	.00341125	.01718986	.01635968	.01392217	.0152234
11.00000	.00524809	.01900435	.03119693	.02462757	.0247883
12.00000	.00710877	.02103371	.04569873	.03541018	.0346374
13.00000	.01078243	.02588030	.06711597	.05424757	.0503343
14.00000	.01195133	.02747991	.08130813	.06899324	.0625746
15.00000	.01245228	.02783803	.0844304	.07241588	.0653447
16.00000	.01502861	.03118051	.09152647	.08054787	.0725658
17.00000	.02268605	.04703338	.11196317	.10190721	.0902041
18.00000	.02502384	.05534182	.12256858	.11642127	.1025865
19.00000	.02719464	.06114340	.14088936	.13718872	.1204852
20.00000	.02600189	.05942441	.13768967	.13572187	.1198460
21.00000	.01378816	.04326116	.09658404	.09331201	.0906066
22.00000	.01593510	.04598289	.10509933	.1005433	.0951286
23.00000	.01743796	.04827487	.11369204	.1089069	.1013080
24.00000	.01767651	.04856137	.11823352	.11364198	.1045042
25.00000	.01753338	.04808388	.11900764	.11449121	.1055459
26.00000	.01610209	.04674689	.11769164	.11356478	.1048356
27.00000	.01409827	.04433553	.1134856	.10885543	.1015921
28.00000	.01521945	.04540990	.11745941	.11392506	.1056880
29.00000	.02647899	.06510662	.14566308	.14326198	.1269960
30.00000	.02769559	.06847297	.15309461	.1503646	.1327492
31.00000	.02829197	.06976221	.15794575	.15582025	.1371292
32.00000	.01870228	.05651169	.13552214	.13410062	.1222609
33.00000	.01595896	.05221422	.12747132	.1259429	.1164841
34.00000	.01307251	.04794063	.11911086	.11683301	.1105651
35.00000	.01242843	.04755863	.11730458	.11356478	.1079608
36.00000	.01326335	.04868075	.12445227	.12061593	.1127670
37.00000	.01438453	.04965961	.12948403	.12630318	.1169102
38.00000	.01564884	.05159347	.13005172	.12717814	.1175495
39.00000	.01767651	.05417195	.13397391	.13155294	.1207930

LOAD PT.	S-13	S-19	S-25	S-33	S-37
.00000	.02919846	.07336730	.16705453	.1683013	.14506058
41 .00000	.03077288	.07733052	.17634394	.17895524	.1523290
42 .00000	.03139311	.07861976	.18091123	.18441088	.15628283
43 .00000	.02213739	.06508274	.15915853	.16616537	.1427167
44 .00000	.01669846	.05655943	.14274724	.1493867	.13097358
45 .00000	.01433682	.05300209	.13570277	.14133192	.12562289
46 .00000	.01376430	.05278721	.13451579	.13834676	.12330268
47 .00000	.01462308	.05374221	.14130222	.14426561	.12739856
48 .00000	.01562499	.05491207	.14674685	.15121383	.13229941
49 .00000	.02130247	.06274301	.15755869	.16315447	.14058589
50 .00000	.03282441	.08155637	.19027805	.1999543	.16464033
51 .00000	.03377861	.08458847	.19698707	.2074172	.1702041
52 .00000	.03466124	.08666558	.20462503	.21583227	.17635976
53 .00000	.02578720	.07417905	.18676872	.19815291	.16407211
54 .00000	.01989502	.06508274	.16958331	.18078237	.15235268
55 .00000	.01753338	.06128665	.16248724	.17272758	.14723874

HERCULES POWDER CO

DATE FEBRUARY 18,1966
UNIT NO X-259
LOADING NO HPC-187
ROUND NO X19454C
TYPE TEST STRUCTURAL
TEST FEBRUARY 4, 1966

LOAD PT.	S-41	S-45	S-46	S-47	S-48
1.00000	.00019084	.00037553	.00012537	.00050044	.00049818
2.00000	.00789445	.0183387	.01662708	.01520081	.01266134
3.00000	.02253854	.03767883	.03908932	.03834608	.03355568
4.00000	.03889986	.05883405	.0621790	.0640561	.06124847
5.00000	.0613907	.08230509	.08897056	.09314407	.09324486
6.00000	.08061406	.09557404	.10572313	.1144127	.11538662
7.00000	.02559138	.03586374	.03896383	.04009761	.03835825
8.00000	.00601028	.01708691	.01474477	.01194796	.00717268
9.00000	.00357754	.01195458	.0099135	.00694358	.00218299
10.00000	.01144815	.01840129	.01832116	.01832855	.01559279
11.00000	.02146528	.02728899	.0303052	.03315403	.03262011
12.00000	.03193557	.03642704	.03996773	.0477293	.0497098
13.00000	.04886929	.05282547	.06104962	.07037413	.07472063
14.00000	.06196311	.0591470	.06995922	.08351063	.0905629
15.00000	.0648967	.06114986	.07328464	.08663837	.09368146
16.00000	.07159864	.07147712	.0835746	.0961467	.10222631
17.00000	.08984413	.10346031	.11569938	.1256100	.12829745
18.00000	.10343881	.11785588	.1318245	.14312534	.14451394
19.00000	.1220659	.1313126	.14751043	.16207944	.16678044
20.00000	.12037253	.12624286	.14242819	.15782571	.16266395
21.00000	.08106721	.07554543	.08903331	.10434138	.11289177
22.00000	.08767375	.08549715	.09938602	.11528846	.12318301
23.00000	.09540125	.09300788	.1085466	.12567256	.13391085
24.00000	.09988511	.09544887	.11174652	.12986373	.13827683
25.00000	.10098222	.09419708	.11124457	.12955095	.13958662
26.00000	.10021901	.09031653	.10710349	.12804964	.1374660
27.00000	.09578286	.08149142	.0995115	.1196673	.13210209
28.00000	.10088682	.08681152	.10459374	.12510956	.13634333
29.00000	.12612046	.13631975	.15334559	.16814725	.17283044
30.00000	.13246464	.14220316	.16037289	.17634193	.18131292
31.00000	.1374255	.14545781	.16407477	.18165909	.18773715
32.00000	.11767745	.10721568	.12661678	.14750418	.15867219
33.00000	.11011689	.09632512	.11494645	.13643198	.14838095
34.00000	.10222244	.08468348	.10246046	.12467168	.13777786
35.00000	.0989788	.08305616	.1010801	.12304526	.1359691
36.00000	.10591924	.08750001	.10660154	.13023906	.14488817
37.00000	.11109476	.09200645	.11212299	.13524344	.14981549
38.00000	.11183412	.09707619	.11526017	.13793329	.15137477
39.00000	.11565017	.10452433	.12373057	.14531476	.15642683

LOAD PT.	S-41	S-45	S-46	S-47	S-48
40.00000	.14551076	.15152898	.17066285	.18979121	.19715519
41.00000	.15340522	.15941525	.18013715	.19942465	.20732169
42.00000	.15819913	.16166847	.18289787	.2033656	.21218664
43.00000	.14002519	.12530402	.14744769	.17102477	.18493045
44.00000	.12485639	.10277183	.12366782	.14881782	.1647222
45.00000	.1178444	.09357118	.11394255	.13955972	.1564892
46.00000	.11536396	.09213163	.11318963	.13893417	.15511704
47.00000	.12139809	.09645029	.11839736	.14487688	.16241446
48.00000	.12755147	.10227111	.12454624	.15088213	.16852683
49.00000	.13787866	.12355151	.14487519	.16908558	.18268509
50.00000	.16726225	.16761446	.19042712	.21143516	.21967118
51.00000	.17310557	.17237126	.19594856	.21837875	.22715571
52.00000	.17985522	.17700288	.20140726	.22475934	.23426602
53.00000	.16397091	.14301682	.16846682	.19554625	.21056499
54.00000	.1485636	.12017168	.14481245	.17383974	.19035674
55.00000	.14183781	.11140917	.13496169	.16339309	.18212374

DATE FEBRUARY 18,1966
UNIT NO X-259
LOADING NO HPC-187
ROUND NO X19454C
TYPE TEST STRUCTURAL
TEST FEBRUARY 4, 1966

LOAD PT.	S-49	S-50	S-51	S-52
1.00000	.00050256	.00031325	.0004415 -	.00012611-
2.00000	.01519556-	.01653528-	.01687913-	.01624193-
3.00000	.03221964-	.03501958-	.03697035-	.03575744-
4.00000	.05201801-	.05539005-	.05951786-	.05678382-
5.00000	.07768023-	.08185907-	.08848951-	.08731614-
6.00000	.09230833-	.09770276-	.10914756-	.10872024-
7.00000	.02686021-	.02854379-	.03275056-	.03009164-
8.00000	.00598995-	.00496687-	.00655011-	.00232926-
9.00000	.03039113-	.02722348-	.02796394-	.02379632-
10.00000	.05889069-	.05821928-	.06140731-	.05867242-
11.00000	.08896657-	.08864922-	.09642523-	.09524825-
12.00000	.11916854-	.12052522-	.13005754-	.12993548-
13.00000	.14022796-	.14303332-	.15909218-	.1622305 -
14.00000	.16172874-	.16617015-	.18686718-	.19244805-
15.00000	.16235926-	.16711322-	.18674122-	.19458847-
16.00000	.13966049-	.14422789-	.16406775-	.16972193-
17.00000	.10643201-	.11090584-	.12690845-	.12848756-
18.00000	.12244725-	.12932727-	.14592897-	.14812897-
19.00000	.13650788-	.14649127-	.16646106-	.17091805-
20.00000	.13297696-	.14183876-	.16186338-	.16682609-
21.00000	.16746648-	.17578953-	.19940057-	.20699025-
22.00000	.1783745 -	.18647773-	.21124116-	.21876251-
23.00000	.18638212-	.19515404-	.22138124-	.22921275-
24.00000	.19262428-	.20257291-	.23089151-	.24029252-
25.00000	.1974793 -	.20854573-	.23832336-	.24816167-
26.00000	.20567608-	.21690768-	.24865239-	.26012279-
27.00000	.21349454-	.22715578-	.26074491-	.27359478-
28.00000	.20208211-	.21495865-	.24934519-	.26194843-
29.00000	.13890386-	.14982348-	.17420783-	.1808017 -
30.00000	.1459657 -	.15661363-	.1833402 -	.18992993-
31.00000	.15195565-	.16415825-	.19033119-	.19691774-
32.00000	.20012749-	.21439281-	.24682592-	.25854896-
33.00000	.20870258-	.22369784-	.2583516 -	.27120256-
34.00000	.21910618-	.23375732-	.26956237-	.28297482-
35.00000	.22629413-	.23966727-	.27793896-	.29248075-
36.00000	.23468006-	.25199014-	.29374741-	.31004471-
37.00000	.2226371 -	.24054748-	.27989139-	.29757997-
38.00000	.20819816-	.22357209-	.26213051-	.27812742-
39.00000	.19691183-	.21269527-	.24940817-	.26320749-

LOAD PT.	S-49	S-50	S-51	S-52
40.00000	.15580184-	.17119989-	.20122705-	.21145993-
41.00000	.16387251-	.18069353-	.21313062-	.22178426-
42.00000	.16910584-	.18716932-	.21949179-	.22952751-
43.00000	.21734072-	.23815835-	.2781279 -	.29298438-
44.00000	.23638247-	.25569958-	.29903788-	.31709547-
45.00000	.24136359-	.26248973-	.30691061-	.32590892-
46.00000	.25233466-	.27418388-	.31963295-	.33843662-
47.00000	.25725273-	.28122552-	.32851339-	.34989411-
48.00000	.24584029-	.26909127-	.31837331-	.33736641-
49.00000	.21015278-	.23212266-	.27611248-	.29418049-
50.00000	.17093435-	.19245055-	.2312694 -	.24218111-
51.00000	.17623073-	.20056101-	.23807144-	.25049094-
52.00000	.18474277-	.2077284 -	.24890432-	.2613189 -
53.00000	.23285155-	.25909465-	.30565097-	.32383147-
54.00000	.25164109-	.27864778-	.32800954-	.34706122-
55.00000	.25901819-	.28367752-	.33399282-	.3554340 -

UNIT NUMBER X-259 HPC-187
HERCULES POWDER COMPANY
RANGE ROUND NUMBER X19454C
TESTED FEBRUARY 4, 1966
TYPE TEST STRUCTURAL

LOAD PT	LP-4	LP-12
1	+.0000	+.0000
2	+.0102	+.0100
3	+.0306	+.0249
4	+.0408	+.0349
5	+.0510	+.0398
6	+.0611	+.0498
7	+.0408	+.0349
8	+.0408	+.0249
9	+.0204	+.0100
10	+.0204	+.0199
11	+.0306	+.0299
12	+.0408	+.0398
13	+.0510	+.0498
14	+.0510	+.0498
15	+.0510	+.0498
16	+.0611	+.0548
17	+.0611	+.0543
18	+.0713	+.0548
19	+.0815	+.0648
20	+.0815	+.0648
21	+.0713	+.0648
22	+.0713	+.0648
23	+.0713	+.0698
24	+.0815	+.0698
25	+.0815	+.0698
26	+.0815	+.0747
27	+.0815	+.0747
28	+.0815	+.0747
29	+.0917	+.0747
30	+.1019	+.0747
31	+.1019	+.0747
32	+.1019	+.0747
33	+.1019	+.0747
34	+.0917	+.0747
35	+.0917	+.0747
36	+.0917	+.0747
37	+.0917	+.0747
38	+.0917	+.0747
39	+.0917	+.0747
40	+.1121	+.0747
41	+.1121	+.0747
42	+.1121	+.0847
43	+.1121	+.0847
44	+.1011	+.0847
45	+.1019	+.0847
46	+.1019	+.0847
47	+.1019	+.0847
48	+.1019	+.0847
49	+.1121	+.0847
50	+.1223	+.0847
51	+.1223	+.0847
52	+.1223	+.0897
53	+.1223	+.0897
54	+.1223	+.0897
55	+.1223	+.0897

UNIT NUMBER X-259 HPC-187
HERCULES POWDER COMPANY
RANGE ROUND NUMBER X19454C
TESTED FEBRUARY 4, 1966
TYPE TEST STRUCTURAL

LOAD PT	LP-16	LP-20
1	+.0000	+.0000
2	+.0000	+.0000
3	+.0000	+.0000
4	+.0000	+.0000
5	+.0000	+.0000
6	+.0000	+.0000
7	+.0000	+.0000
8	+.0000	+.0000
9	+.0000	+.0000
10	+.0000	+.0000
11	+.0000	+.0030
12	+.0000	+.0030
13	+.0000	+.0060
14	+.0000	+.0060
15	+.0000	+.0060
16	+.0000	+.0090
17	+.0000	+.0090
18	+.0100	+.0090
19	+.0100	+.0090
20	+.0100	+.0090
21	+.0100	+.0090
22	+.0100	+.0090
23	+.0100	+.0090
24	+.0100	+.0090
25	+.0100	+.0090
26	+.0100	+.0090
27	+.0100	+.0090
28	+.0100	+.0090
29	+.0100	+.0090
30	+.0100	+.0090
31	+.0100	+.0090
32	+.0100	+.0120
33	+.0100	+.0120
34	+.0100	+.0120
35	+.0100	+.0160
36	+.0100	+.0160
37	+.0100	+.0160
38	+.0200	+.0160
39	+.0100	+.0100
39	+.0200	+.0160
40	+.0200	+.0160
41	+.0200	+.0160
42	+.0200	+.0160
43	+.0200	+.0160
44	+.0200	+.0160
45	+.0200	+.0160
46	+.0200	+.0160
47	+.0200	+.0160
48	+.0200	+.0160
49	+.0200	+.0160
50	+.0200	+.0120
51	+.0200	+.0120
52	+.0200	+.0120
53	+.0200	+.0160
54	+.0100	+.0190
55	+.0100	+.0190

UNIT NO. X-259(HPC-187)
RANGE ROUND NO. X-19454C
TESTED February 4,1966
TYPE TEST STRUCTURAL

LOAD PT	S-26	S-27	S-29	S-30	S-31	S-32	S-34	S-36
1	+.0000	+.0000	+.0000	+.0000	+.0000	+.0000	+.0000	+.0000
2	+.0124	-.0099	-.0156	+.0125	+.0097	-.0125	-.0126	+.0136
3	+.0248	-.0298	-.0311	+.0250	+.0244	-.0299	-.0454	+.0542
4	+.0397	-.0496	-.0518	+.0407	+.0438	-.0525	-.0833	+.1017
5	+.0596	-.0719	-.0752	+.0595	+.0658	-.0749	-.1186	+.1491
6	+.0720	-.0868	-.0855	+.0720	+.0804	-.0899	-.1464	+.1830
7	+.0298	-.0372	-.0389	+.0344	+.0365	-.0375	-.0808	+.0813
8	+.0149	-.0198	-.0181	+.0219	+.0170	-.0175	-.0378	+.0399
9	+.0124	-.0372	-.0337	+.0156	+.0097	-.0349	-.0656	+.0136
10	+.0149	-.0620	-.0596	+.0188	+.0170	-.0625	-.1085	+.0339
11	+.0248	-.0893	-.0855	+.0250	+.0244	-.0845	-.1539	+.0542
12	+.0323	-.1165	-.1114	+.0313	+.0341	-.1175	-.1918	+.0746
13	+.0447	-.1364	-.1322	+.0626	+.0487	-.1374	-.2195	+.1084
14	+.0522	-.1562	-.1555	+.0532	+.0609	-.1599	-.2549	+.1356
15	+.0522	-.1587	-.1555	+.0501	+.0609	-.1624	-.2549	+.1356
16	+.0596	-.1388	-.1348	+.0595	+.0682	-.1374	-.2271	+.1559
17	+.0795	-.1066	-.1011	+.0814	+.0852	-.1075	-.1792	+.2033
18	+.0894	-.1190	-.1141	+.0908	+.0998	-.1199	-.1943	+.2304
19	+.1043	-.1314	-.1270	+.1002	+.1144	-.1324	-.2094	+.2643
20	+.1018	-.1289	-.1244	+.0939	+.1120	-.1324	-.2094	+.2576
21	+.0695	-.1661	-.1581	+.0626	+.0779	-.1649	-.2574	+.2030
22	+.0769	-.1736	-.1685	+.0689	+.0828	-.1749	-.2575	+.2033
23	+.0820	-.1811	-.1763	+.0783	+.0901	-.1799	-.2776	+.2101
24	+.0844	-.1909	-.1840	+.0814	+.0901	-.1899	-.2877	+.2169
25	+.0844	-.1984	-.1970	+.0783	+.0901	-.1974	-.2952	+.2169
26	+.0820	-.2108	-.2074	+.0783	+.0901	-.2049	-.3079	+.2169
27	+.0745	-.2256	-.2229	+.0689	+.0852	-.2199	-.3154	+.2033
28	+.0795	-.2083	-.2099	+.0689	+.0852	-.2024	-.3003	+.2237
29	+.1093	-.1438	-.1426	+.1002	+.0901	-.1424	-.2195	+.2779
30	+.1142	-.1537	-.1504	+.1064	+.1242	-.1474	-.2271	+.2914
31	+.1167	-.1562	-.1581	+.1064	+.1242	-.1524	-.2322	+.2914
32	+.0944	-.2108	-.2048	+.0845	+.1023	-.2024	-.2952	+.2372
33	+.0869	-.2232	-.2229	+.0783	+.0925	-.2124	-.3079	+.2237
34	+.0795	-.2331	-.2307	+.0751	+.0877	-.2224	-.3205	+.2101
35	+.0795	-.2455	-.2437	+.0720	+.0877	-.2324	-.3255	+.2033
36	+.0820	-.2579	-.2618	+.0751	+.0901	-.2399	-.3205	+.2169
37	+.0844	-.2430	-.2463	+.0814	+.0949	-.2274	-.3154	+.2237
38	+.0894	-.2281	-.2307	+.0814	+.0974	-.2149	-.2978	+.2304
39	+.0944	-.2132	-.2152	+.0845	+.1023	-.1999	-.2826	+.2372
40	+.1217	-.1661	-.1685	+.1127	+.1315	-.1574	-.2296	+.2982
41	+.1292	-.1760	-.1763	+.1190	+.1388	-.1674	-.2397	+.3050
42	+.1316	-.1785	-.1815	+.1190	+.1412	-.1724	-.2448	+.3050
43	+.1093	-.2380	-.2411	+.1002	+.1193	-.2249	-.3028	+.2711
44	+.0969	-.2653	-.2670	+.0877	+.1071	-.2449	-.3280	+.2372
45	+.0894	-.2752	-.2800	+.0845	+.1023	-.2499	-.3331	+.2304
46	+.0894	-.2951	-.3007	+.0814	+.0998	-.2624	-.3407	+.2304
47	+.0944	-.3075	-.3137	+.0845	+.1023	-.2699	-.3432	+.2372
48	+.0993	-.2926	-.3007	+.0908	+.1071	-.2574	-.3306	+.2440
49	+.1118	-.2430	-.2540	+.1002	+.1218	-.2199	-.2927	+.2643
50	+.1366	-.1959	-.2048	+.1252	+.1485	-.1799	-.2448	+.3186
51	+.1440	-.2008	-.2048	+.1284	+.1534	-.1824	-.2498	+.3186
52	+.1465	-.2108	-.2203	+.1315	+.1583	-.1924	-.2599	+.3321
53	+.1267	-.2678	-.2774	+.1158	+.1388	-.2399	-.3154	+.3050
54	+.1142	-.3025	-.3059	+.1002	+.1242	-.2624	-.3356	+.2643
55	+.1093	-.3521	-.3214	+.1002	+.1193	-.2724	-.3381	+.2576

UNIT NO. X-259(HPC-187)
RANGE ROUND NO. X-19454C
TESTED February 4, 1966
TYPE TEST STRUCTURAL

LOAD PT	S-4B	S-4C	S-9A	S-9B
1	+.0000	+.0000	+.0000	+.0000
2	+.0035	+.0000	+.0000	+.0000
3	+.0035	+.0000	+.0000	-.0084
4	+.0000	-.0063	+.0000	-.0168
5	+.0000	-.0095	+.0000	-.0251
6	+.0035	-.0126	+.0000	-.0251
7	+.0035	-.0032	+.0000	-.0168
8	+.0000	+.0000	+.0000	-.0084
9	-.0034	+.0034	-.0081	-.0084
10	-.0034	+.0034	-.0163	-.0168
11	-.0034	+.0034	-.0244	-.0251
12	-.0034	+.0034	-.0244	-.0335
13	-.0034	+.0000	-.0326	-.0335
14	+.0000	+.0000	-.0326	-.0419
15	+.0000	+.0000	-.0326	-.0419
16	+.0035	-.0032	-.0163	-.0335
17	+.0070	-.0095	+.0074	-.0251
18	+.0070	-.0158	+.0148	-.0251
19	+.0140	-.0158	+.0148	-.0335
20	+.0140	-.0189	+.0074	-.0335
21	+.0070	-.0032	-.0244	-.0419
22	+.0070	-.0063	-.0244	-.0419
23	+.0035	-.0063	-.0244	-.0419
24	+.0035	-.0032	-.0244	-.0419
25	+.0070	-.0032	-.0326	-.0419
26	+.0070	-.0032	-.0326	-.0503
27	+.0035	-.0032	-.0326	-.0503
28	+.0070	-.0032	-.0326	-.0503
29	+.0140	-.0126	+.0163	-.0335
30	+.0174	-.0158	+.0163	-.0335
31	+.0174	-.0158	+.0163	-.0335
32	+.0105	-.0063	-.0244	-.0503
33	+.0105	-.0032	-.0326	-.0503
34	+.0070	+.0000	-.0407	-.0586
35	+.0070	+.0034	-.0407	-.0586
36	+.0070	+.0034	-.0407	-.0586
37	+.0105	+.0000	-.0326	-.0586
38	+.0105	+.0000	-.0163	-.0503
39	+.0105	-.0063	-.0163	-.0419
40	+.0174	-.0158	+.0148	-.0335
41	+.0174	-.0158	+.0222	-.0335
42	+.0174	-.0158	+.0222	-.0419
43	+.0105	-.0095	-.0163	-.0503
44	+.0105	-.0032	-.0326	-.0586
45	+.0105	+.0000	-.0407	-.0586
46	+.0070	+.0034	-.0488	-.0670
47	+.0070	+.0034	-.0488	-.0670
48	+.0105	+.0000	-.0407	-.0586
49	+.0140	-.0063	-.0407	-.0503
50	+.0209	-.0189	-.0163	-.0419
51	+.0209	-.0189	+.0222	-.0419
52	+.0209	-.0158	+.0222	-.0419
53	+.0140	-.0095	-.0081	-.0586
54	+.0105	-.0032	-.0326	-.0586
55	+.0070	+.0000	-.0326	-.0586

UNIT NO. X-259(HPC-187)
RANGE ROUND NO. X-19454C
TESTED February 4, 1966
TYPE TEST STRUCTURAL

LOAD PT	S-15	S-16	S-17	S-18	S-21	S-23	S-24	S-1A
1	+.0000	+.0000	+.0000	+.0000	+.0000	-.0024	-.0028	+.0000
2	-.0027	+.0000	+.0000	+.0000	-.0026	-.0048	-.0028	+.0000
3	-.0081	-.0044	+.0000	+.0026	-.0079	-.0120	+.0028	+.0000
4	-.0081	-.0088	-.0026	+.0026	-.0132	-.0168	+.0055	+.0024
5	-.0136	-.0088	-.0052	+.0026	-.0185	-.0216	+.0083	+.0073
6	-.0136	-.0132	-.0078	+.0053	-.0185	-.0216	+.0083	+.0122
7	-.0054	+.0000	+.0000	+.0026	-.0079	-.0072	+.0055	+.0024
8	-.0027	+.0044	+.0026	+.0026	-.0079	-.0024	+.0000	+.0024
9	-.0109	+.0000	-.0026	+.0000	-.0132	-.0120	-.0028	-.0171
10	-.0163	-.0044	-.0078	-.0026	-.0238	-.0239	-.0055	-.0293
11	-.0244	-.0175	-.0183	-.0026	-.0317	-.0335	-.0055	-.0416
12	-.0299	-.0219	-.0209	-.0053	-.0396	-.0431	-.0083	-.0513
13	-.0363	-.0263	-.0236	-.0026	-.0475	-.0479	-.0083	-.0513
14	-.0407	-.0307	-.0262	-.0026	-.0502	-.0527	-.0083	-.0538
15	-.0407	-.0307	-.0262	-.0026	-.0528	-.0527	-.0083	-.0538
16	-.0326	-.0263	-.0209	+.0000	-.0422	-.0431	-.0055	-.0318
17	-.0190	-.0175	-.0078	+.0026	-.0290	-.0264	+.0083	+.0098
18	-.0217	-.0175	-.0105	+.0026	-.0317	-.0312	+.0055	+.0147
19	-.0244	-.0219	-.0131	+.0053	-.0317	-.0312	+.0055	+.0220
20	-.0217	-.0219	-.0131	+.0053	-.0290	-.0288	+.0055	+.0220
21	-.0407	-.0307	-.0262	+.0026	-.0502	-.0503	+.0028	-.0318
22	-.0462	-.0351	-.0288	+.0026	-.0528	-.0551	+.0028	-.0342
23	-.0462	-.0351	-.0288	+.0026	-.0554	-.0551	+.0028	-.0318
24	-.0489	-.0395	-.0288	+.0026	-.0581	-.0575	+.0028	-.0391
25	-.0516	-.0395	-.0314	+.0026	-.0607	-.0599	+.0028	-.0416
26	-.0543	-.0439	-.0340	+.0053	-.0634	-.0623	+.0055	-.0489
27	-.0570	-.0439	-.0366	+.0053	-.0739	-.0671	+.0083	-.0611
28	-.0516	-.0395	-.0340	+.0026	-.0660	-.0623	+.0055	-.0440
29	-.0272	-.0263	-.0131	+.0053	-.0396	-.0359	+.0055	+.0220
30	-.0299	-.0307	-.0131	+.0053	-.0422	-.0359	+.0055	+.0244
31	-.0299	-.0307	-.0157	+.0053	-.0396	-.0359	+.0055	+.0220
32	-.0516	-.0395	-.0314	-.0026	-.0607	-.0551	-.0028	-.0269
33	-.0543	-.0439	-.0340	-.0053	-.0713	-.0623	-.0028	-.0440
34	-.0597	-.0439	-.0366	-.0053	-.0739	-.0671	-.0055	-.0562
35	-.0625	-.0482	-.0445	-.0053	-.0792	-.0719	-.0083	-.0611
36	-.0679	-.0482	-.0445	-.0053	-.0845	-.0743	-.0083	-.0636
37	-.0597	-.0482	-.0393	-.0026	-.0792	-.0695	-.0083	-.0489
38	-.0570	-.0439	-.0340	+.0000	-.0739	-.0647	-.0028	-.0367
39	-.0516	-.0395	-.0314	+.0000	-.0686	-.0599	+.0000	-.0244
40	-.0326	-.0307	-.0157	+.0053	-.0475	-.0383	+.0055	+.0416
41	-.0353	-.0351	-.0209	+.0053	-.0475	-.0431	+.0055	+.0416
42	-.0353	-.0351	-.0209	+.0053	-.0475	-.0431	+.0055	+.0342
43	-.0570	-.0439	-.0340	+.0000	-.0686	-.0623	+.0000	-.0220
44	-.0679	-.0482	-.0419	-.0026	-.0818	-.0719	-.0055	-.0464
45	-.0706	-.0526	-.0445	-.0053	-.0871	-.0743	-.0083	-.0562
46	-.0760	-.0570	-.0497	-.0079	-.0924	-.0791	-.0110	-.0660
47	-.0788	-.0570	-.0497	-.0079	-.0924	-.0791	-.0110	-.0611
48	-.0706	-.0526	-.0445	+.0026	-.0871	-.0743	-.0055	-.0513
49	-.0570	-.0439	-.0340	+.0000	-.0766	-.0647	+.0000	-.0122
50	-.0407	-.0351	-.0236	+.0053	-.0528	-.0431	+.0055	+.0367
51	-.0407	-.0395	-.0236	+.0053	-.0528	-.0431	+.0055	+.0391
52	-.0407	-.0395	-.0236	+.0079	-.0554	-.0455	+.0055	+.0367
53	-.0625	-.0482	-.0393	+.0000	-.0766	-.0671	+.0000	-.0073
54	-.0706	-.0570	-.0445	-.0026	-.0871	-.0743	-.0028	-.0367
55	-.0760	-.0614	-.0471	-.0053	-.0871	-.0767	-.0028	-.0464

UNIT NO. X-259(HPC-187)
RANGE ROUND NO. X-19454C
TESTED February 4, 1966
TYPE TEST STRUCTURAL

LOAD PT	S-1B	S-1C	S-3A	S-3B	S-3C	S-3S
1	-.0026	+.0000	-.0025	-.0026	+.0000	+.0000
2	-.0051	-.0028	+.0025	-.0051	-.0025	-.0252
3	-.0128	-.0028	+.0074	-.0103	-.0100	-.0559
4	-.0204	-.0057	+.0124	-.0154	-.0176	-.0867
5	-.0281	-.0028	+.0198	-.0257	-.0200	-.1296
6	-.0332	-.0085	+.0223	-.0283	-.0226	-.1649
7	-.0153	-.0028	+.0099	-.0154	-.0176	-.0559
8	-.0051	-.0028	+.0050	-.0077	-.0100	-.0224
9	-.0153	+.0057	-.0050	-.0077	+.0000	-.0503
10	-.0281	+.0085	-.0074	-.0154	+.0025	-.0894
11	-.0408	+.0113	-.0074	-.0232	+.0000	-.1342
12	-.0536	+.0142	-.0124	-.0283	+.0000	-.1845
13	-.0587	+.0142	-.0074	-.0360	+.0025	-.2236
14	-.0689	+.0226	-.0074	-.0412	+.0000	-.2684
15	-.0714	+.0198	-.0074	-.0412	+.0000	-.2684
16	-.0561	+.0085	+.0050	-.0334	+.0075	-.2376
17	-.0383	-.0057	+.0223	-.0334	+.0200	-.1873
18	-.0408	-.0085	+.0248	-.0386	+.0226	-.2180
19	-.0434	-.0113	+.0596	-.0437	+.0276	-.2544
20	-.0434	-.0085	+.0596	-.0437	+.0276	-.2488
21	-.0638	+.0085	+.0000	-.0463	+.0075	-.2935
22	-.0689	+.0085	+.0000	-.0489	+.0125	-.3103
23	-.0714	+.0085	+.0025	-.0515	-.0100	-.3243
24	-.0740	+.0085	+.0000	-.0540	-.0100	-.3411
25	-.0766	+.0113	+.0000	-.0540	-.0075	-.3522
26	-.0791	+.0142	-.0050	-.0540	-.0050	-.3718
27	-.0842	+.0226	-.0074	-.0540	-.0025	-.3858
28	-.0791	+.0113	+.0000	-.0489	-.0025	-.3690
29	-.0485	-.0142	+.0273	-.0437	-.0226	-.2656
30	-.0510	-.0142	+.0596	-.0463	-.0251	-.2852
31	-.0536	-.0142	+.0596	-.0489	-.0251	-.2963
32	-.0740	+.0057	+.0050	-.0540	-.0075	-.3774
33	-.0817	+.0113	-.0025	-.0540	-.0050	-.3942
34	-.0842	+.0142	-.0074	-.0540	-.0025	-.4082
35	-.0893	+.0170	-.0099	-.0540	+.0000	-.4221
36	-.0944	+.0170	-.0099	-.0592	+.0000	-.4529
37	-.0893	+.0113	-.0050	-.0540	-.0025	-.4333
38	-.0817	+.0085	+.0025	-.0515	-.0050	-.4054
39	-.0740	+.0057	+.0099	-.0489	-.0075	-.3858
40	-.0561	-.0142	+.0322	-.0489	-.0226	-.3215
41	-.0561	-.0170	+.0347	-.0515	-.0276	-.3438
42	-.0561	-.0170	+.0347	-.0540	-.0301	-.3494
43	-.0791	+.0028	+.0074	-.0592	-.0125	-.4417
44	-.0919	+.0113	-.0025	-.0618	-.0050	-.4780
45	-.0944	+.0142	-.0050	-.0592	-.0025	-.4892
46	-.0970	+.0170	-.0099	-.0592	+.0025	-.5144
47	-.0995	+.0142	-.0124	-.0643	+.0000	-.5312
48	-.0944	+.0113	-.0050	-.0592	-.0025	-.5172
49	-.0766	+.0000	+.0149	-.0540	-.0125	-.4529
50	-.0587	-.0170	+.0372	-.0540	-.0276	-.3886
51	-.0587	-.0198	+.0397	-.0540	-.0301	-.3998
52	-.0612	-.0198	+.0372	-.0592	-.0301	-.4249
53	-.0817	-.0028	+.0174	-.0643	-.0176	-.5116
54	-.0919	+.0085	+.0025	-.0669	-.0075	-.5507
55	-.0944	+.0113	+.0000	-.0669	-.0050	-.5647

UNIT NO. X-259(HPC-187)
RANGE ROUND NO. X-19454C
TESTED February 4, 1966
TYPE TEST STRUCTURAL

LOAD PT	S-5A	S-5B	S-5C	S-6A	S-6B	S-6C
1	+.0000	+.0000	+.0000	+.0000	+.0000	+.0000
2	+.0000	+.0000	+.0000	+.0000	+.0000	+.0077
3	+.0000	+.0000	+.0000	+.0000	+.0000	+.0077
4	+.0075	+.0000	+.0000	+.0048	+.0076	+.0077
5	+.0075	+.0073	+.0000	+.0048	+.0076	+.0077
6	+.0078	+.0146	+.0000	+.0097	+.0076	+.0077
7	+.0000	+.0073	+.0000	+.0000	+.0076	+.0077
8	+.0000	+.0000	+.0000	+.0000	+.0076	+.0077
9	-.0150	+.0000	+.0000	-.0145	-.0076	+.0077
10	-.0224	-.0073	+.0000	-.0242	-.0076	+.0077
11	-.0299	-.0073	+.0071	-.0291	-.0152	+.0154
12	-.0374	-.0146	+.0071	-.0388	-.0152	+.0154
13	-.0374	-.0146	+.0071	-.0339	-.0152	+.0232
14	-.0449	-.0146	+.0142	-.0436	-.0228	+.0154
15	-.0449	-.0146	+.0142	-.0436	-.0152	+.0232
16	-.0150	+.0000	+.0142	-.0242	-.0076	+.0154
17	+.0075	+.0146	+.0000	+.0048	+.0076	+.0077
18	+.0075	+.0146	+.0000	+.0145	+.0152	+.0077
19	+.0150	+.0146	+.0000	+.0145	+.0152	+.0077
20	+.0150	+.0146	+.0000	+.0145	+.0152	+.0154
21	-.0249	-.0073	+.0142	-.0291	-.0076	+.0154
22	-.0224	+.0000	+.0071	-.0291	+.0000	+.0232
23	-.0224	+.0000	+.0142	-.0242	-.0076	+.0232
24	-.0299	-.0073	+.0071	-.0242	-.0076	+.0232
25	-.0224	-.0073	+.0071	-.0339	-.0076	+.0154
26	-.0374	-.0073	+.0142	-.0339	-.0152	+.0232
27	-.0449	-.0146	+.0142	-.0436	-.0152	+.0232
28	-.0374	-.0073	+.0142	-.0339	-.0076	+.0154
29	+.0150	+.0146	+.0000	+.0194	+.0152	+.0077
30	+.0224	+.0146	-.0071	+.0194	+.0076	+.0077
31	+.0224	+.0146	-.0071	+.0194	+.0152	+.0077
32	-.0299	-.0073	+.0071	-.0242	+.0076	+.0154
33	-.0374	-.0073	+.0142	-.0339	-.0076	+.0154
34	-.0449	-.0146	+.0142	-.0436	-.0076	+.0232
35	-.0524	-.0146	+.0142	-.0485	-.0152	+.0232
36	-.0374	-.0146	+.0142	-.0436	-.0152	+.0232
37	-.0374	-.0073	+.0142	-.0388	-.0152	+.0232
38	-.0224	+.0000	+.0142	-.0291	+.0000	+.0232
39	-.0150	+.0000	+.0071	-.0194	+.0000	+.0154
40	+.0150	+.0073	-.0071	+.0194	+.0152	+.0000
41	+.0224	+.0146	-.0071	+.0194	+.0152	+.0000
42	+.0224	+.0146	-.0142	+.0194	+.0152	+.0000
43	-.0150	+.0000	+.0071	-.0194	+.0000	+.0232
44	-.0374	-.0073	+.0071	-.0436	-.0076	+.0232
45	-.0449	-.0146	+.0142	-.0485	-.0152	+.0309
46	-.0524	-.0146	+.0142	-.0533	-.0152	+.0309
47	-.0374	-.0073	+.0142	-.0485	-.0076	+.0232
48	-.0150	+.0000	+.0071	-.0145	+.0000	+.0154
49	+.0224	+.0146	-.0071	+.0242	+.0152	+.0000
50	+.0224	+.0146	-.0071	+.0242	+.0152	+.0000
51	+.0224	+.0146	-.0071	+.0242	+.0152	+.0000
52	+.0075	+.0000	+.0071	-.0145	+.0000	+.0154
53	+.0299	-.0146	+.0071	-.0291	-.0076	+.0154
54	+.0374	-.0146	+.0142	-.0388	-.0076	+.0232
55	+.0000	+.0000	+.0000	+.0000	+.0000	+.0000

UNIT NO. X-259(HPC-187)
RANGE ROUND NO. X-19454C
TESTED FEBRUARY 4, 1966
TYPE TEST STRUCTURAL

LOAD PT	S-2A	S-2B	S-2C	S-4A
1	+.0000	+.0000	+.0000	+.0000
2	+.0000	+.0000	+.0000	+.0000
3	+.0038	+.0000	+.0035	+.0069
4	+.0076	+.0000	+.0035	+.0138
5	+.0114	+.0000	+.0070	+.0207
6	+.0114	+.0037	+.0070	+.0276
7	+.0076	+.0073	+.0070	+.0138
8	+.0076	+.0073	+.0035	+.0069
9	-.0076	-.0037	+.0035	-.0034
10	-.0153	-.0037	+.0070	-.0068
11	-.0191	-.0037	+.0104	-.0068
12	-.0267	-.0037	+.0104	-.0068
13	-.0229	-.0037	+.0139	-.0034
14	-.0306	-.0037	+.0139	-.0034
15	-.0306	-.0037	+.0139	-.0034
16	-.0115	-.0037	+.0139	+.0069
17	+.0152	+.0037	+.0104	+.0241
18	+.0152	+.0073	-.0034	+.0276
19	+.0152	+.0073	-.0069	+.0344
20	+.0190	+.0110	-.0103	+.0344
21	-.0191	-.0037	+.0104	+.0103
22	-.0191	-.0037	+.0104	+.0103
23	-.0191	-.0037	+.0104	+.0103
24	-.0191	-.0037	+.0104	+.0103
25	-.0229	-.0037	+.0104	+.0069
26	-.0306	-.0073	+.0104	+.0069
27	-.0382	-.0073	+.0174	+.0000
28	-.0229	-.0037	+.0139	+.0034
29	+.0190	+.0110	-.0069	+.0344
30	+.0190	+.0110	-.0069	+.0344
31	+.0190	+.0110	-.0069	+.0344
32	-.0153	-.0037	+.0070	+.0138
33	-.0229	-.0037	+.0104	+.0069
34	-.0306	-.0073	+.0139	+.0000
35	-.0382	-.0073	+.0174	+.0000
36	-.0382	-.0073	+.0209	-.0034
37	-.0267	-.0037	+.0174	+.0000
38	-.0191	-.0037	+.0139	+.0069
39	-.0115	+.0000	+.0104	+.0103
40	+.0190	+.0110	-.0069	+.0413
41	+.0190	+.0110	-.0069	+.0413
42	+.0190	+.0110	-.0069	+.0448
43	-.0153	-.0037	+.0070	+.0207
44	-.0267	-.0073	+.0139	+.0069
45	-.0306	-.0073	+.0209	+.0000
46	-.0382	-.0110	+.0209	-.0068
47	-.0382	-.0110	+.0209	-.0034
48	-.0306	-.0110	+.0174	+.0000
49	-.0038	+.0000	+.0070	+.0172
50	+.0228	+.0110	-.0103	+.0413
51	+.0228	+.0110	-.0103	+.0448
52	+.0266	+.0110	-.0103	+.0448
53	-.0038	-.0037	+.0035	+.0241
54	-.0229	-.0073	+.0104	+.0103
55	-.0306	-.0110	+.0139	+.0069

UNIT NO. X-259(HPC-187)
RANGE ROUND NO. X-19454C
TESTED February 4, 1966
TYPE TEST STRUCTURAL

LOAD PT	S-7A	S-7B	S-7C	S-8A	S-8B	S-8C
1	+.0000	+.0000	+.0000	+.0000	+.0000	+.0000
2	+.0072	+.0000	+.0076	+.0000	+.0000	+.0000
3	+.0144	+.0000	+.0076	+.0000	+.0000	+.0000
4	+.0144	+.0060	+.0000	+.0000	+.0000	+.0000
5	+.0072	+.0060	+.0000	+.0050	+.0000	+.0000
6	+.0144	+.0120	+.0076	+.0100	+.0000	+.0000
7	+.0000	+.0060	+.0000	+.0000	+.0000	+.0000
8	+.0000	+.0060	+.0000	+.0000	+.0000	+.0000
9	-.0144	-.0060	+.0000	-.0149	-.0078	+.0000
10	-.0288	-.0120	+.0076	-.0249	-.0157	+.0000
11	-.0288	-.0120	+.0076	-.0249	-.0157	+.0077
12	-.0360	-.0180	+.0076	-.0349	-.0157	+.0077
13	-.0360	-.0120	+.0152	-.0299	-.0157	+.0153
14	-.0433	-.0120	+.0152	-.0349	-.0157	+.0077
15	-.0433	-.0120	+.0152	-.0349	-.0157	+.0153
16	-.0216	+.0000	+.0076	-.0249	-.0078	+.0077
17	+.0144	+.0060	+.0000	+.0000	+.0000	+.0000
18	+.0216	+.0120	-.0076	+.0100	+.0000	+.0000
19	+.0288	+.0120	+.0000	+.0100	+.0000	+.0000
20	+.0216	+.0180	+.0000	+.0149	+.0000	-.0077
21	-.0216	+.0000	+.0076	-.0249	-.0078	+.0000
22	-.0288	-.0060	+.0076	-.0249	-.0157	+.0000
23	-.0216	+.0000	+.0076	-.0249	-.0157	+.0077
24	-.0216	+.0000	+.0076	-.0299	-.0157	+.0077
25	-.0288	+.0000	+.0152	-.0299	-.0157	+.0077
26	-.0288	+.0000	+.0152	-.0349	-.0157	+.0077
27	-.0433	-.0120	+.0076	-.0448	-.0235	+.0077
28	-.0360	-.0060	+.0152	-.0349	-.0157	+.0077
29	+.0216	+.0120	-.0076	+.0100	+.0000	+.0000
30	+.0216	+.0180	-.0076	+.0149	+.0000	-.0077
31	+.0216	+.0180	+.0076	+.0149	+.0000	+.0000
32	-.0216	+.0000	+.0076	-.0249	-.0157	+.0000
33	-.0288	-.0060	+.0076	-.0349	-.0157	+.0077
34	-.0433	-.0120	+.0076	-.0399	-.0157	+.0077
35	-.0433	-.0120	+.0076	-.0399	-.0235	+.0077
36	-.0505	-.0180	+.0227	-.0448	-.0235	+.0152
37	-.0360	-.0060	+.0152	-.0399	-.0157	+.0077
38	-.0288	+.0060	+.0152	-.0299	-.0157	+.0077
39	-.0216	+.0060	+.0076	-.0199	-.0078	+.0077
40	+.0216	+.0120	-.0076	+.0149	+.0000	-.0077
41	+.0288	+.0180	-.0076	+.0149	-.0078	-.0077
42	+.0288	+.0120	-.0076	+.0149	-.0078	-.0077
43	-.0072	+.0060	+.0000	-.0149	-.0157	+.0077
44	-.0433	+.0060	+.0227	-.0399	-.0157	+.0077
45	-.0433	+.0120	+.0076	-.0448	-.0157	+.0153
46	-.0505	+.0120	+.0152	-.0498	-.0313	+.0153
47	-.0505	+.0180	+.0152	-.0399	-.0157	+.0153
48	-.0433	+.0060	+.0076	-.0199	-.0078	+.0153
49	-.0144	+.0180	+.0000	+.0199	+.0000	+.0000
50	+.0288	+.0180	+.0000	+.0199	+.0000	+.0077
51	+.0360	+.0180	+.0000	+.0199	+.0000	+.0077
52	+.0360	+.0180	+.0000	+.0100	+.0000	+.0000
53	-.0072	+.0120	+.0152	-.0249	+.0000	+.0077
54	-.0288	+.0060	+.0152	-.0349	-.0078	+.0153
55	-.0360	+.0060	+.0152	-.0448	-.0392	+.0153

UNIT NO. X-259(HPC-187)
RANGE ROUND NO. X-19454C
TESTED February 4, 1966
TYPE TEST STRUCTURAL

LOAD PT	S-9C	S-12A	S-12B	S-12C
1	+.0000	+.0000	+.0000	+.0000
2	+.0000	+.0000	+.0000	+.0000
3	+.0000	+.0000	-.0080	+.0000
4	+.0082	+.0000	-.0160	+.0086
5	+.0082	+.0000	-.0160	+.0086
6	+.0082	+.0081	-.0160	+.0086
7	+.0082	+.0081	-.0080	+.0086
8	+.0082	+.0163	+.0000	+.0171
9	+.0082	+.0000	-.0080	+.0171
10	+.0082	-.0168	-.0160	+.0171
11	+.0163	-.0253	-.0240	+.0171
12	+.0245	-.0253	-.0319	+.0171
13	+.0245	-.0253	-.0400	+.0171
14	+.0163	-.0337	-.0480	+.0086
15	+.0163	-.0337	-.0480	+.0086
16	+.0163	-.0168	-.0400	+.0086
17	+.0082	+.0000	-.0319	+.0000
18	+.0082	+.0081	-.0319	+.0000
19	+.0082	+.0163	-.0319	+.0000
20	+.0082	+.0163	-.0319	+.0000
21	+.0163	-.0168	-.0400	+.0086
22	+.0163	-.0253	-.0560	+.0086
23	+.0163	-.0253	-.0560	+.0086
24	+.0163	-.0253	-.0560	+.0171
25	+.0163	-.0253	-.0560	+.0171
26	+.0163	-.0337	-.0560	+.0171
27	+.0245	-.0337	-.0560	+.0171
28	+.0245	-.0337	-.0640	+.0171
29	+.0082	+.0163	-.0320	+.0000
30	+.0082	+.0244	-.0320	+.0086
31	+.0082	+.0244	-.0320	+.0086
32	+.0082	-.0168	-.0400	+.0171
33	+.0163	-.0253	-.0560	+.0171
34	+.0163	-.0337	-.0560	+.0171
35	+.0245	-.0421	-.0640	+.0171
36	+.0245	-.0421	-.0640	+.0171
37	+.0245	-.0421	-.0640	+.0171
38	+.0245	-.0253	-.0640	+.0171
39	+.0163	-.0253	-.0560	+.0086
40	+.0163	+.0244	-.0320	+.0086
41	+.0082	+.0244	-.0320	+.0086
42	+.0082	+.0326	-.0320	+.0086
43	+.0163	-.0168	-.0560	+.0086
44	+.0245	-.0337	-.0640	+.0086
45	+.0245	-.0421	-.0719	+.0086
46	+.0245	-.0506	-.0799	+.0086
47	+.0326	-.0506	-.0799	+.0171
48	+.0326	-.0421	-.0799	+.0171
49	+.0245	-.0168	-.0560	+.0086
50	+.0082	+.0244	-.0400	+.0086
51	+.0082	+.0326	-.0400	+.0086
52	+.0000	+.0326	-.0400	+.0086
53	+.0082	+.0081	-.0640	+.0086
54	+.0163	-.0253	-.0640	+.0086
55	+.0245	-.0253	-.0719	+.0086

UNIT NO. X-259(HPC-187)
RANGE ROUND NO. X-19454C
TESTED February 4, 1966
TYPE TEST STRUCTURAL

LOAD PT	S-38	S-39	S-40	S-42	S-43	S-44
1	+.0000	+.0000	+.0000	+.0026	+.0000	+.0000
2	+.0000	-.0118	+.0025	+.0052	-.0132	+.0027
3	+.0058	-.0378	+.0102	+.0078	-.0317	+.0054
4	+.0078	-.0637	+.0127	+.0130	-.0528	+.0054
5	+.0116	-.0968	+.0204	+.0156	-.0792	+.0054
6	+.0155	-.1251	+.0255	+.0156	-.0950	+.0081
7	+.0039	-.0307	+.0127	+.0000	-.0396	+.0000
8	+.0019	-.0047	+.0051	+.0000	-.0132	-.0027
9	-.0039	-.0260	-.0025	-.0078	-.0211	-.0054
10	-.0078	-.0614	-.0076	-.0078	-.0449	-.0054
11	-.0116	-.0991	-.0076	-.0104	-.0713	-.0054
12	-.0136	-.1393	-.0102	-.0156	-.0950	-.0054
13	-.0058	-.1723	-.0051	-.0078	-.1188	-.0027
14	-.0058	-.2124	-.0051	-.0078	-.1452	-.0027
15	-.0058	-.2101	-.0051	-.0078	-.1452	-.0054
16	+.0039	-.1818	+.0102	+.0026	-.1294	+.0000
17	+.0155	-.1369	+.0280	+.0156	-.1241	+.0081
18	+.0174	-.0566	+.0306	+.0181	-.1214	+.0108
19	+.0213	-.1888	+.0382	+.0207	-.1426	+.0108
20	+.0213	-.1865	+.0382	+.0181	-.1426	+.0108
21	+.0000	-.2148	+.0076	-.0052	-.1584	-.0054
22	+.0000	-.2266	+.0076	-.0026	-.1637	-.0027
23	+.0019	-.2384	+.0102	-.0026	-.1716	+.0000
24	+.0000	-.2549	+.0076	-.0026	-.1822	+.0027
25	+.0000	-.2620	+.0051	-.0078	-.1901	+.0054
26	-.0019	-.2714	+.0000	-.0078	-.1954	-.0054
27	-.0058	-.2903	-.0051	-.0130	-.2059	-.0054
28	+.0000	-.2738	-.0051	-.0026	-.1954	+.0000
29	+.0213	-.1936	+.0382	+.0181	-.1505	+.0108
30	+.0232	-.2101	+.0407	+.0207	-.1610	+.0108
31	+.0232	-.2148	+.0407	+.0207	-.1637	+.0108
32	+.0039	-.2762	+.0127	-.0026	-.2007	-.0027
33	-.0019	-.2903	+.0051	-.0078	-.2086	-.0081
34	-.0058	-.2998	+.0000	-.0104	-.2165	-.0054
35	-.0078	-.3069	-.0051	-.0104	-.2323	-.0081
36	-.0058	-.3257	+.0025	-.0078	-.2271	+.0000
37	-.0039	-.3126	+.0051	-.0078	-.2244	+.0000
38	+.0000	-.2903	+.0102	-.0026	-.2112	+.0054
39	+.0039	-.2762	+.0153	+.0026	-.2033	+.0054
40	+.0232	-.2266	+.0433	+.0181	-.1716	+.0108
41	+.0252	-.2431	+.0458	+.0233	-.1848	+.0161
42	+.0252	-.2502	+.0458	+.0207	-.1901	+.0161
43	+.0078	-.3163	+.0204	+.0026	-.2323	+.0000
44	-.0039	-.3376	+.0051	-.0052	-.2455	-.0027
45	-.0078	-.3446	+.0000	-.0104	-.2482	-.0054
46	-.0097	-.3730	-.0051	-.0104	-.2587	-.0054
47	-.0097	-.3588	+.0051	-.0078	-.2640	+.0000
48	+.0078	-.3116	+.0229	+.0078	-.2323	+.0054
49	+.0271	-.2620	+.0484	+.0207	-.2033	+.0161
50	+.0291	-.2738	+.0509	+.0233	-.2139	+.0161
51	+.0291	-.2903	+.0535	+.0233	-.2244	+.0161
52	+.0097	-.3541	+.0255	+.0026	-.2640	-.0027
53	+.0000	-.3777	+.0102	-.0078	-.2772	-.0054
54	+.0000	-.3824	+.0076	-.0078	-.2799	-.0054
55	+.0000	+.0000	+.0000	+.0000	+.0000	+.0000

SECTION V

Data Package
Static Firing
X259 Motor S/N HPC-126

HERCULES POWDER COMPANY
Allegany Ballistics Laboratory
Cumberland, Maryland

March 28, 1966

(REVISION I)

Data Package
Static Firing
X259 Motor S/N HPC-126

Contract: NAS 1-3899

TEST ENGINEER: W. L. Fuller

APPROVED BY: E. A. Stur

Title: Static Firing of Structural Test Motor

Specimen: X259 S/N HPC-126

Test Date: February 11, 1966

Test Site: ABL, X-Range, Bay 2

Test Arrangement: ABL 259 SK-1222 (Modified)

Test Document: ABL test plan titled, "Static Firing, ABL X259 Motor S/N HPC-126", dated January 13, 1966.

Data: Thermocouples TC-8 and TC-12 did not deviate from ambient and were not plotted.

Each strain gage rosette "R" has an axial gage (A), a diagonal gage (B), and a hoop gage (C).

Weight Breakdown (lbs.):

Item	Pre-Fire Wt.	Post-Fire Wt.
Nozzle and Closure	28.9	23.5
Propellant	2556.0	--
Chamber	146.0	133.0
Igniter Grain	8.0	--
Igniter Inert	13.1	11.5
TOTAL	2752.0	168.0

Dimensions:

Item	Pre-Fire	Post-Fire
Nozzle Throat Diameter	6.670 in.	6.879 in.
Nozzle Exit Diameter	13.218 in.	13.122 in.

D-195

HERCULES POWDER COMPANY
INCORPORATED

ALLEGANY BALLISTICS LABORATORY
CUMBERLAND, MARYLAND

Range Round No. X19465B

Date Fired 2-11-66

STATIC FIRING DATA SUMMARY

Contract C-143734-AER

Task 08052912 Project Eng. S. H. Harris

Purpose Evaluate effects of simulated flight loads & 43 months' storage

Loading No. X259 A3 - HPC-126A
Motor Design. X259 S/N HPC-126A
Chamber No. HPC-126A
Propellant CYI-75 Lot ZI-169
Grain No. PLX-6187 Wt. 2556
Propellant Wt. 2564 Inc. Igniter
Igniter ABL-92134A (K-50)
Circuit Resistance 1.24 ohms
Current Used 30.6 amps
Nozzle TRW-0115
Expansion Ratio 3.94
Throat Area (before firing) 34.92 in.^{2}
(after firing) 37.15 in.^{2}
K (initial) 100.5
Web Thickness 10.2 in.

Air Temperature 45 °F
Left Conditioning
Time Fired 5:02 P.M.

Conditioning: 75 ± 5 °F, 156 hrs;
45 °F, 0.25 hrs;
____ °F, ____ hrs;
____ °F, ____ hrs.

Round Weight (before firing) 2752 lbw
(after firing) 168 lbw

Post-Firing Inspection Inert parts in good condition.

Action Time	t_a	33.996	sec
Burning Time	t_b	33.348	sec
Ignition Time	t_i	1.772	sec
Prop. Ignition Time	t_{pi}	0.024	sec
Ignition Delay	t_d	1.748	sec
Minimum Pressure	P_{min}	319	psia
Maximum Pressure	P_{max}	354	psia
Eros. Max. Pressure	P_{me}	347	psia
Prog. Max. Pressure	P_{mp}	354	psia
Average Pressure	$\bar{P}_a$	323	psia
Average Pressure	$\bar{P}_b$	328	psia
Avg. Burning Rate	$\bar{r}$	0.306	in/sec
1st Pres. Indication	t_F	1.736	sec.

Specific Impulse	I_{sp}	221.10	lbf-sec/lbw
Motor Spec. Imp.	I_{sm}	206.06	lbf-sec/lbw
Minimum Thrust	F_{min}	15890	lbf
Maximum Thrust	F_{max}	18562	lbf
Eros. Max. Thrust	F_{me}	18240	lbf
Prog. Max. Thrust	F_{mp}	18554	lbf
Average Thrust	$\bar{F}_a$	16681	lbf
Average Thrust	$\bar{F}_b$	16910	lbf
Total Impulse	I	567,078	lbf-sec
Eff. Gas Velocity	v_E	7122	ft/sec
Discharge Coeff.	C_d	0.00648	
$C_F A_t$		51.64	
C^*		4969	

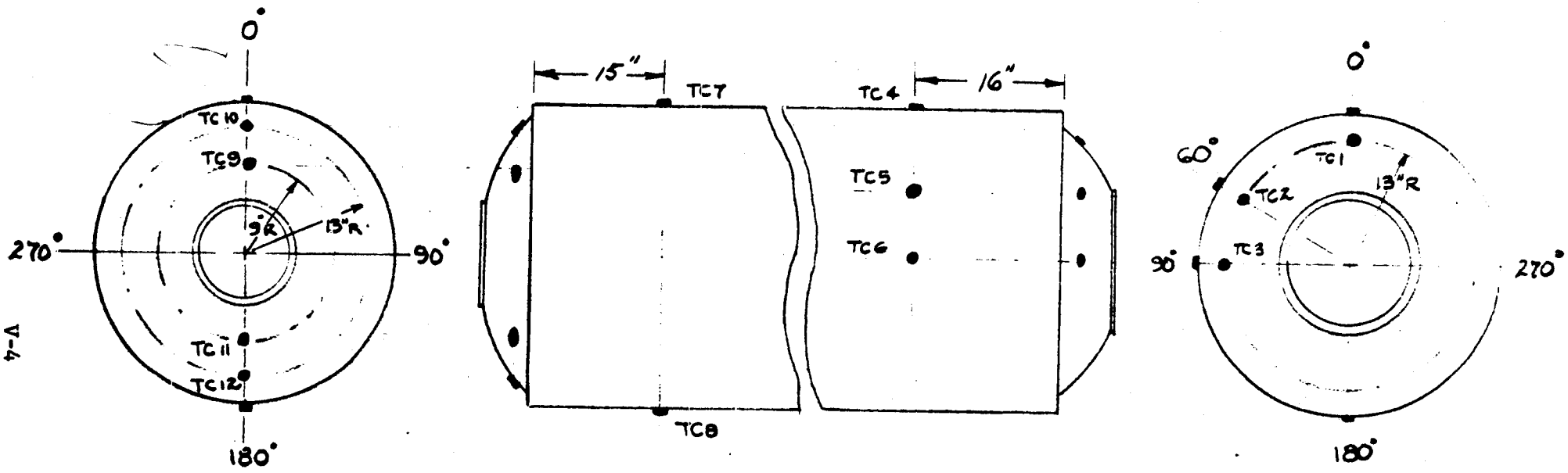
Max. Ign. Pressure Ign. P_{max} 882 psia

Tabulation of X259 Rocket Motor Performance

Motor S/N HPC-126A Model A3T
Statically Fired at HPC/ABL

Time sec.	Chamber Pressure psia	Sea Level Thrust lbs.	Impulse lbs-sec.	Weight Expended lbs.
0.1	347	18,240	1,950	9
2.0	326	16,410	33,032	150
5.0	326	16,297	81,517	371
7.0	336	17,205	115,002	524
10.0	348	17,950	168,004	765
12.0	353	18,304	204,023	930
14.0	354	18,222	240,492	1,096
16.0	352	18,405	277,414	1,264
19.0	343	18,041	331,661	1,511
21.0	334	17,307	366,606	1,670
24.0	325	16,972	418,017	1,905
27.0	318	16,766	468,588	2,135
29.0	307	16,159	501,196	2,283
30.0	298	15,581	517,189	2,356
31.0	287	15,007	532,624	2,427
32.0	273	14,184	547,003	2,492
33.0	237	12,156	560,454	2,553
34.0	0	0	567,163	2,584

Total propellant weight (including igniter charge) 2564 lbs.



FWD DOME

AFT DOME

V-4

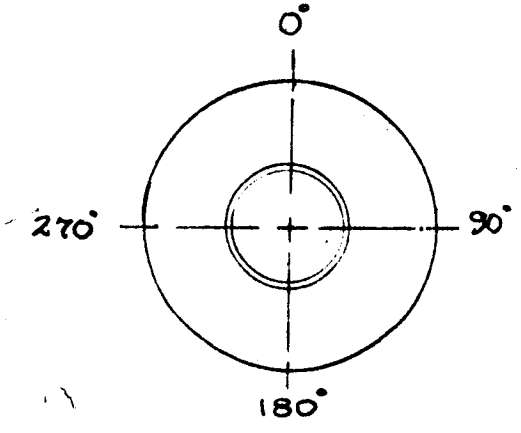
NOTE

All thermocouples are chromel-alumel.

THERMOCOUPLE LOCATIONS

HPC-126 STATIC FIRING

FIGURE 1



X259 MOTOR
LOOKING AFT

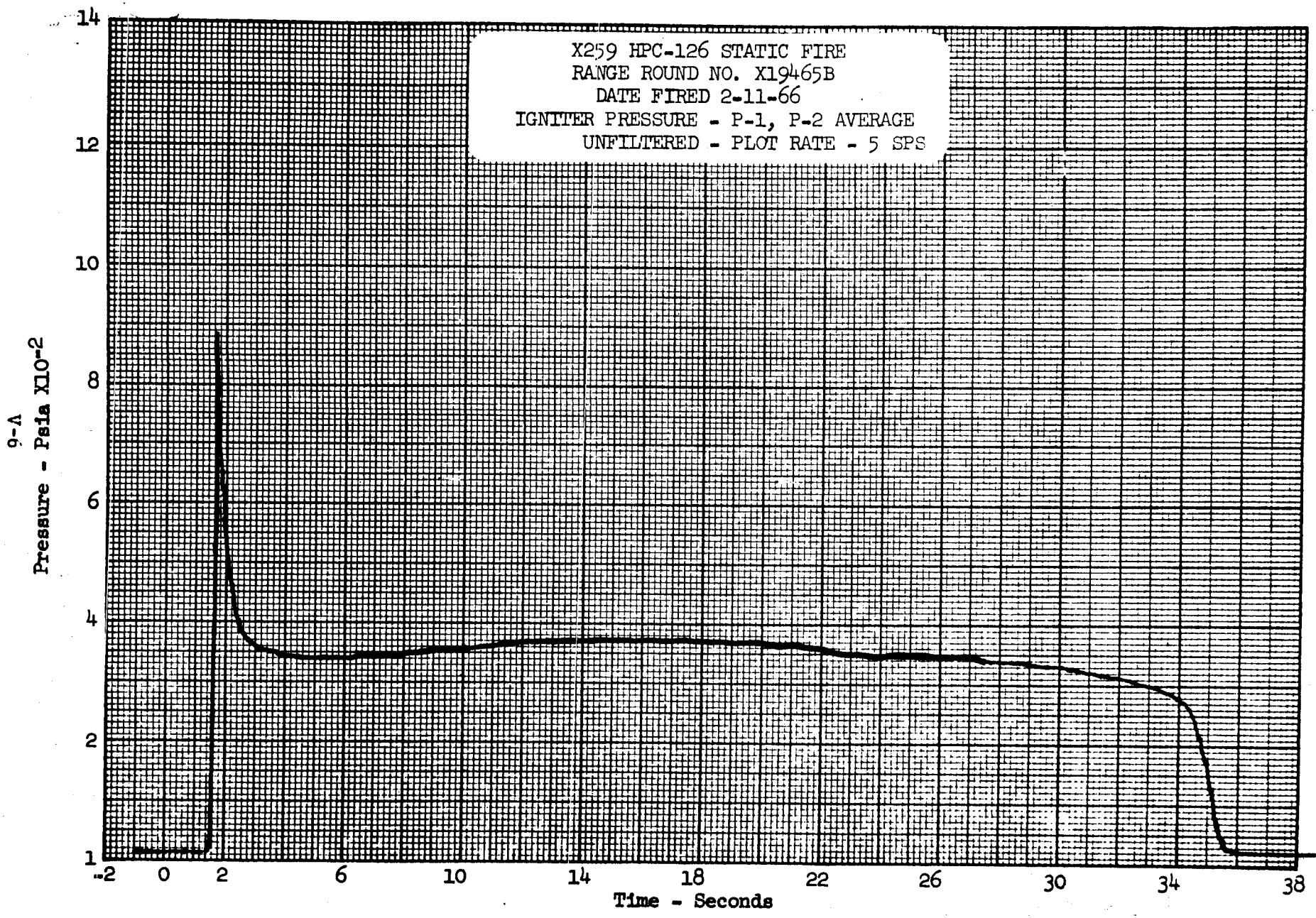
SCOUT STATION	AZIMUTH			
	0°	90°	180°	270°
137	S49	R9	S45	R5
153	S50	R10	S46	R6
170	S51	R11	S47	R7
185	S52	R12	S48	R8

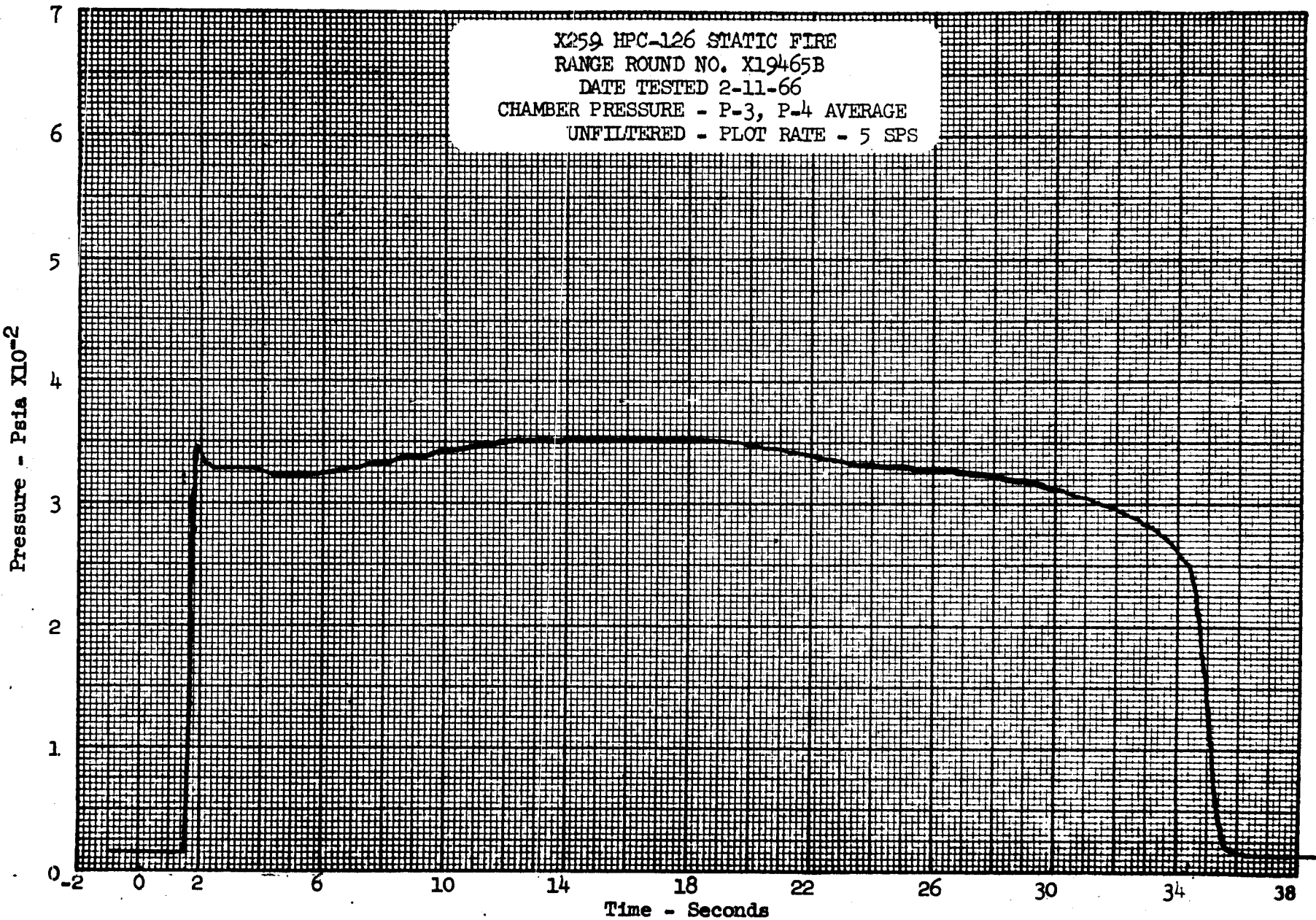
NOTES:
ALL "S" GAGES ARE AXIAL-ORIENTED.
ALL "R" GAGES ARE 3-GAGE ROSETTE TYPE.
ALL GAGES INSTALLED BY ABL FOR LTV STRUCTURAL LOAD TEST.
ALL GAGES TO BE INSTALLED ON GLASS CASE AFTER INSULATION REMOVAL.

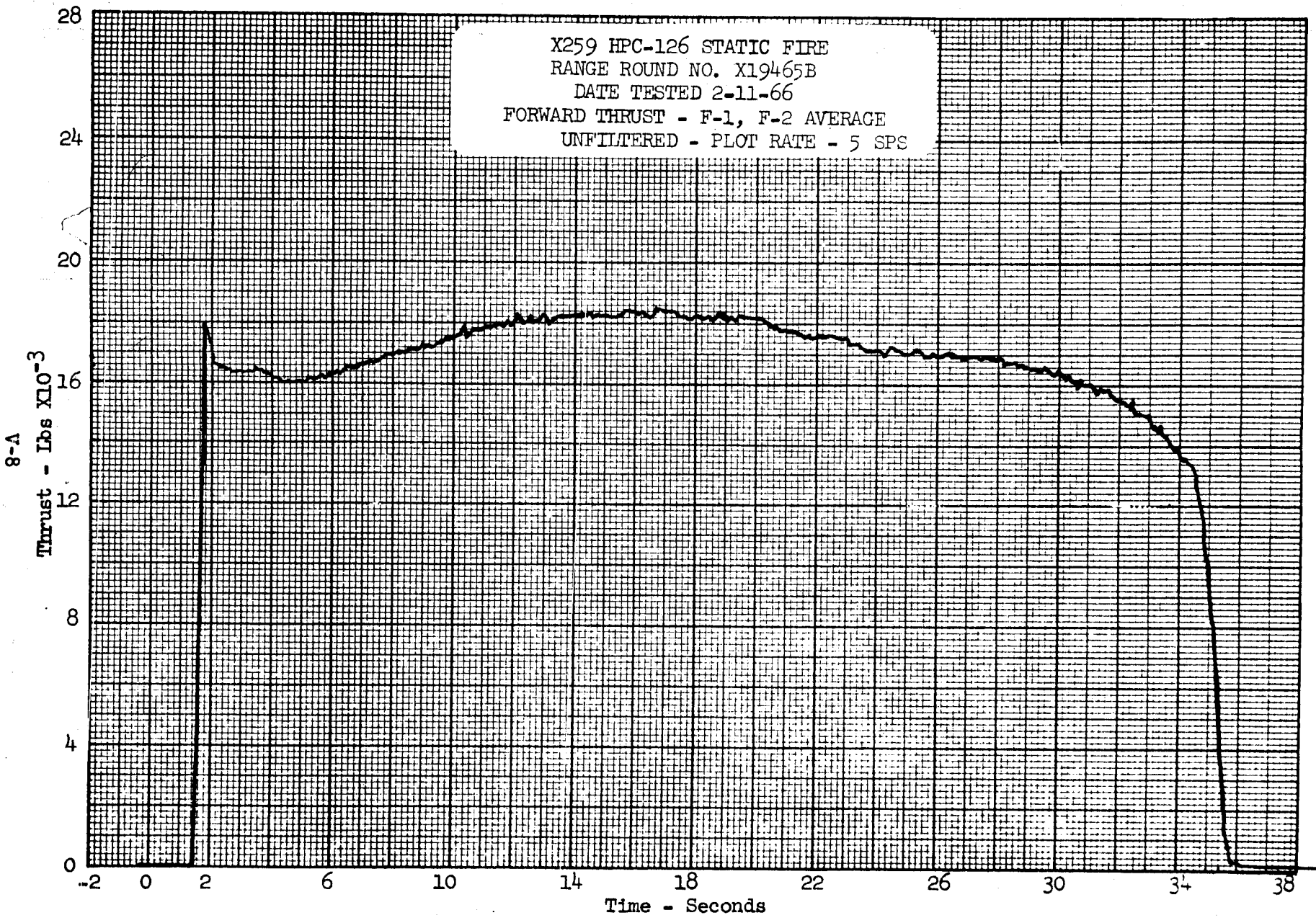
STRAIN GAGE LOCATIONS

HPC-126 STATIC FIRING

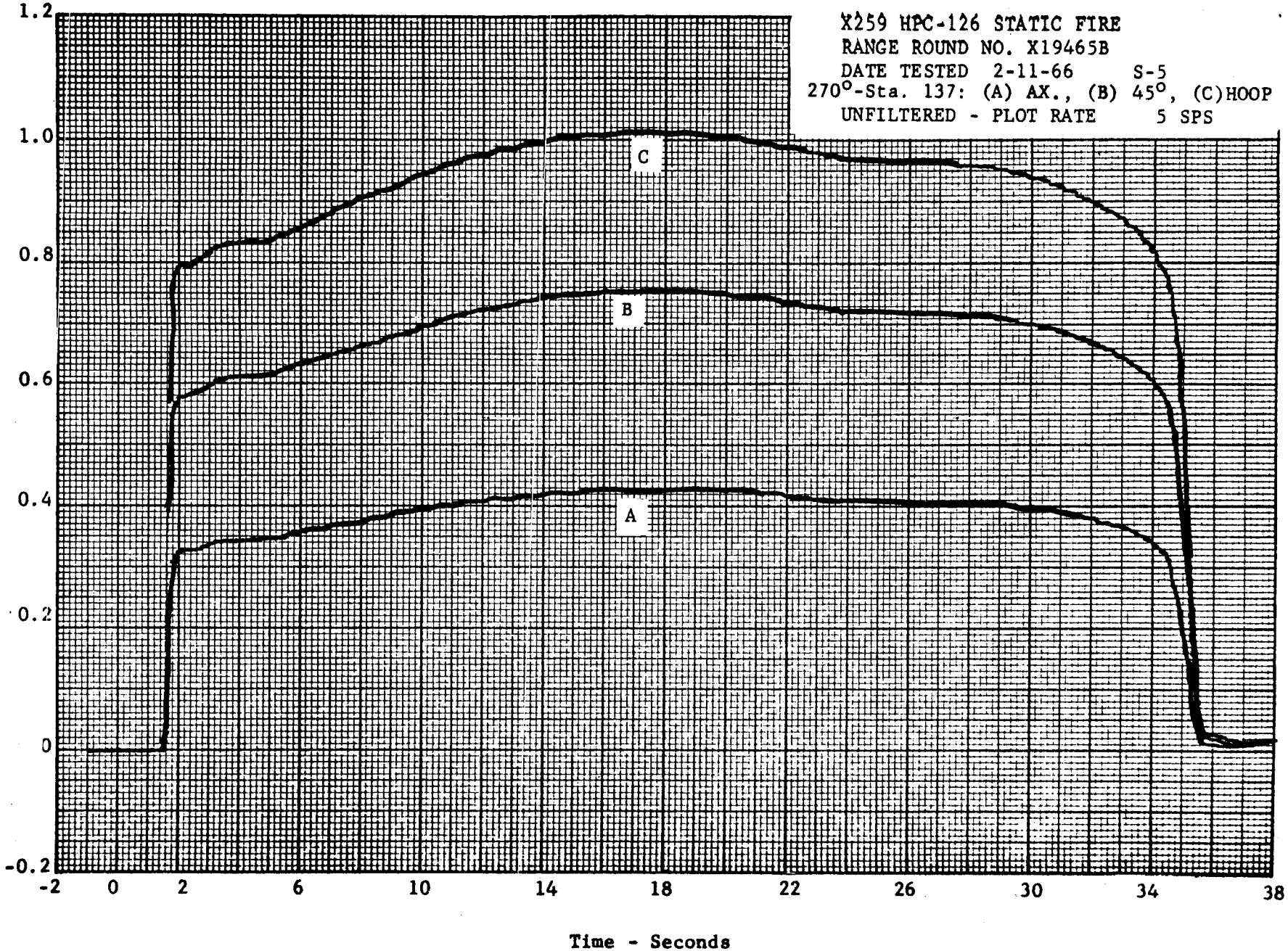
FIGURE 2

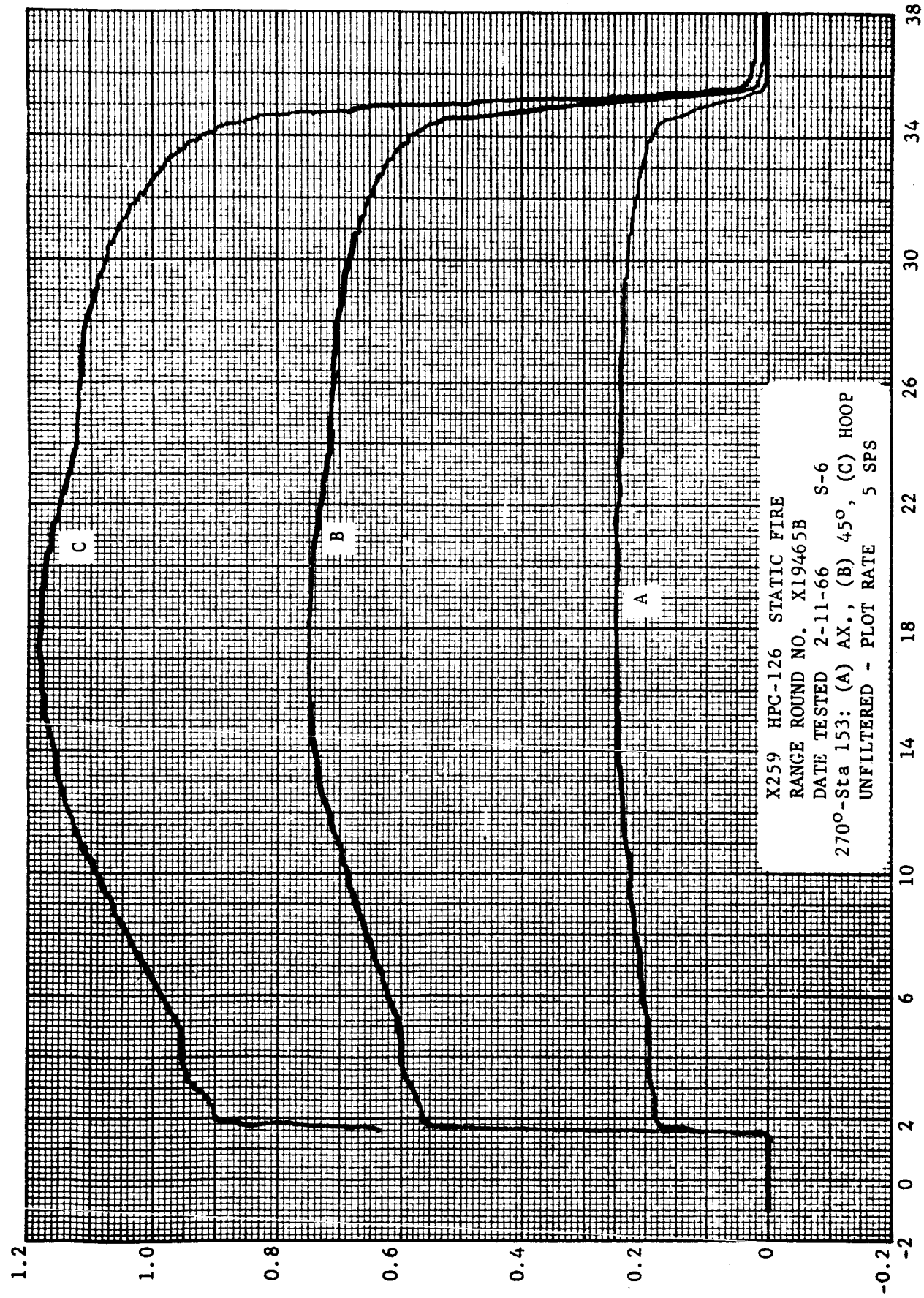

X259 HPC-126 STATIC FIRE
RANGE ROUND NO. X19465B
DATE FIRED 2-11-66
IGNITER PRESSURE - P-1, P-2 AVERAGE
UNFILTERED - PLOT RATE - 5 SPS
Pressure - Psia X10-2
Time - Seconds
14
12
10
8
6
4
2
1
-2
0
2
6
10
14
18
22
26
30
34
38

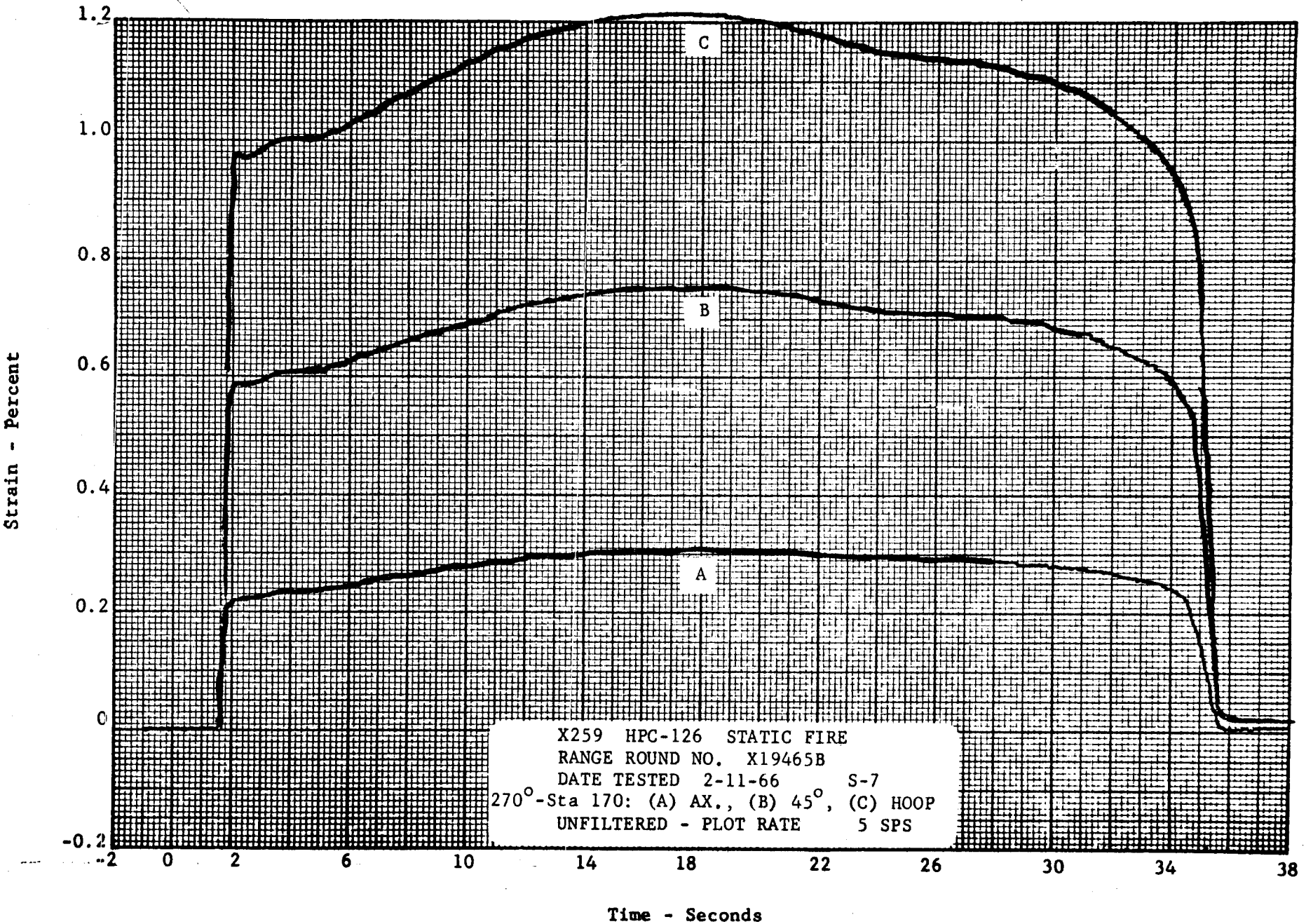

X259 HPC-126 STATIC FIRE
RANGE ROUND NO. X19465B
DATE TESTED 2-11-66
CHAMBER PRESSURE - P-3, P-4 AVERAGE
UNFILTERED - PLOT RATE - 5 SPS
Pressure - Psia X10^2
Time - Seconds
0
1
2
3
4
5
6
7
-2
0
2
6
10
14
18
22
26
30
34
38

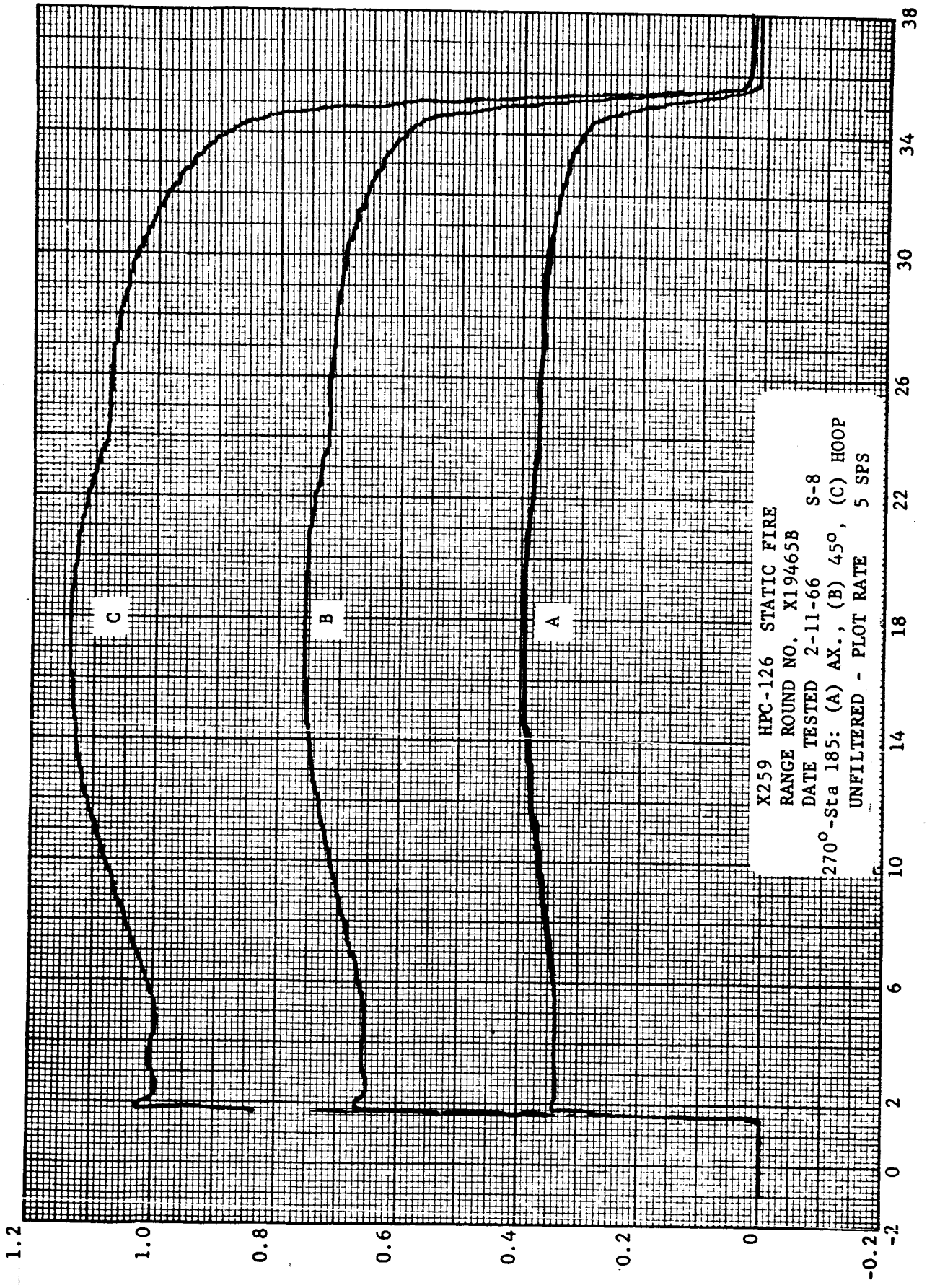

X259 HPC-126 STATIC FIRE
RANGE ROUND NO. X19465B
DATE TESTED 2-11-66
FORWARD THRUST - F-1, F-2 AVERAGE
UNFILTERED - PLOT RATE - 5 SPS
Thrust - Lbs X10-3
28
24
20
16
12
8
4
0
-2
0
2
6
10
14
18
22
26
30
34
38
Time - Seconds

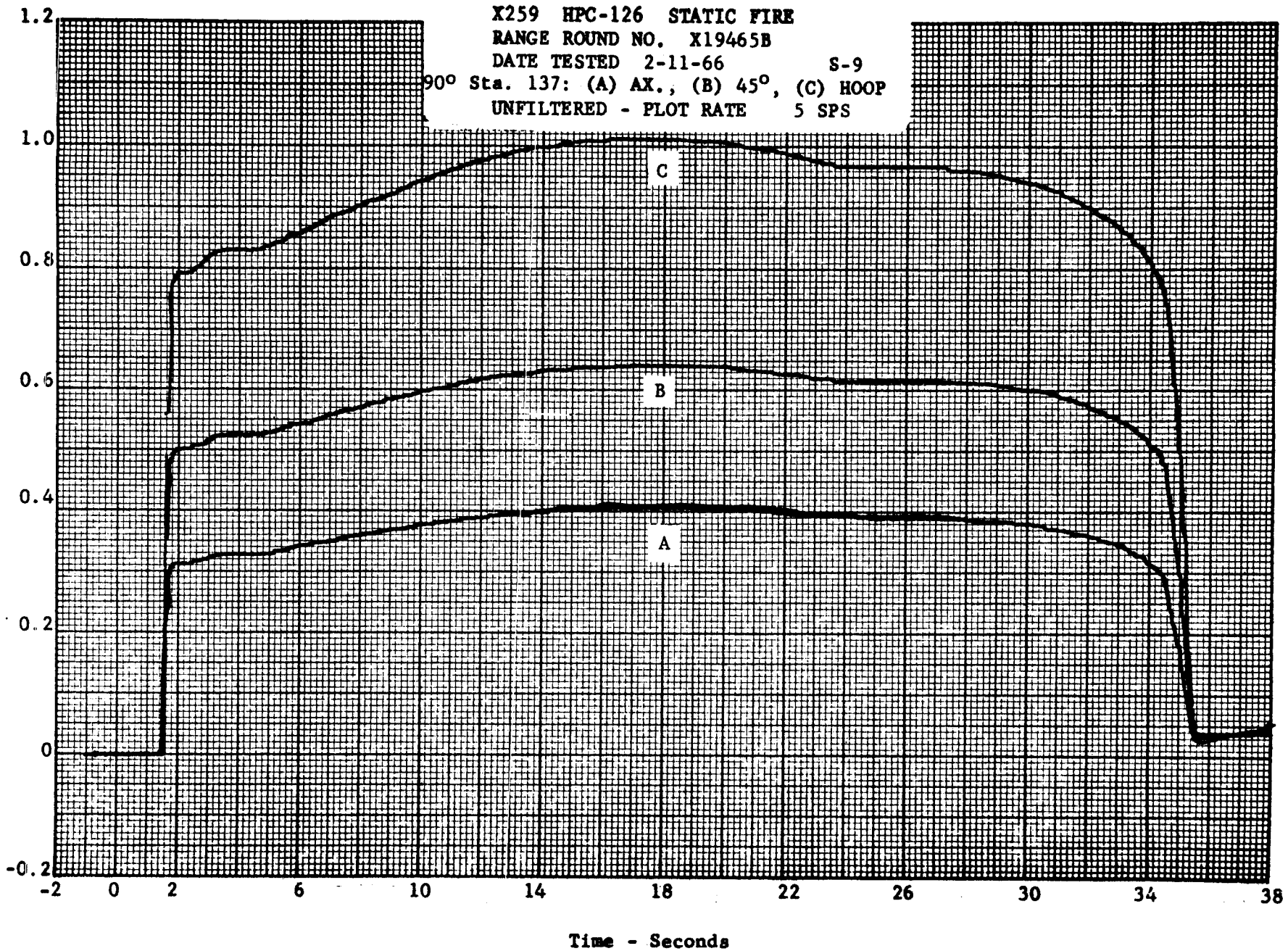
8-A

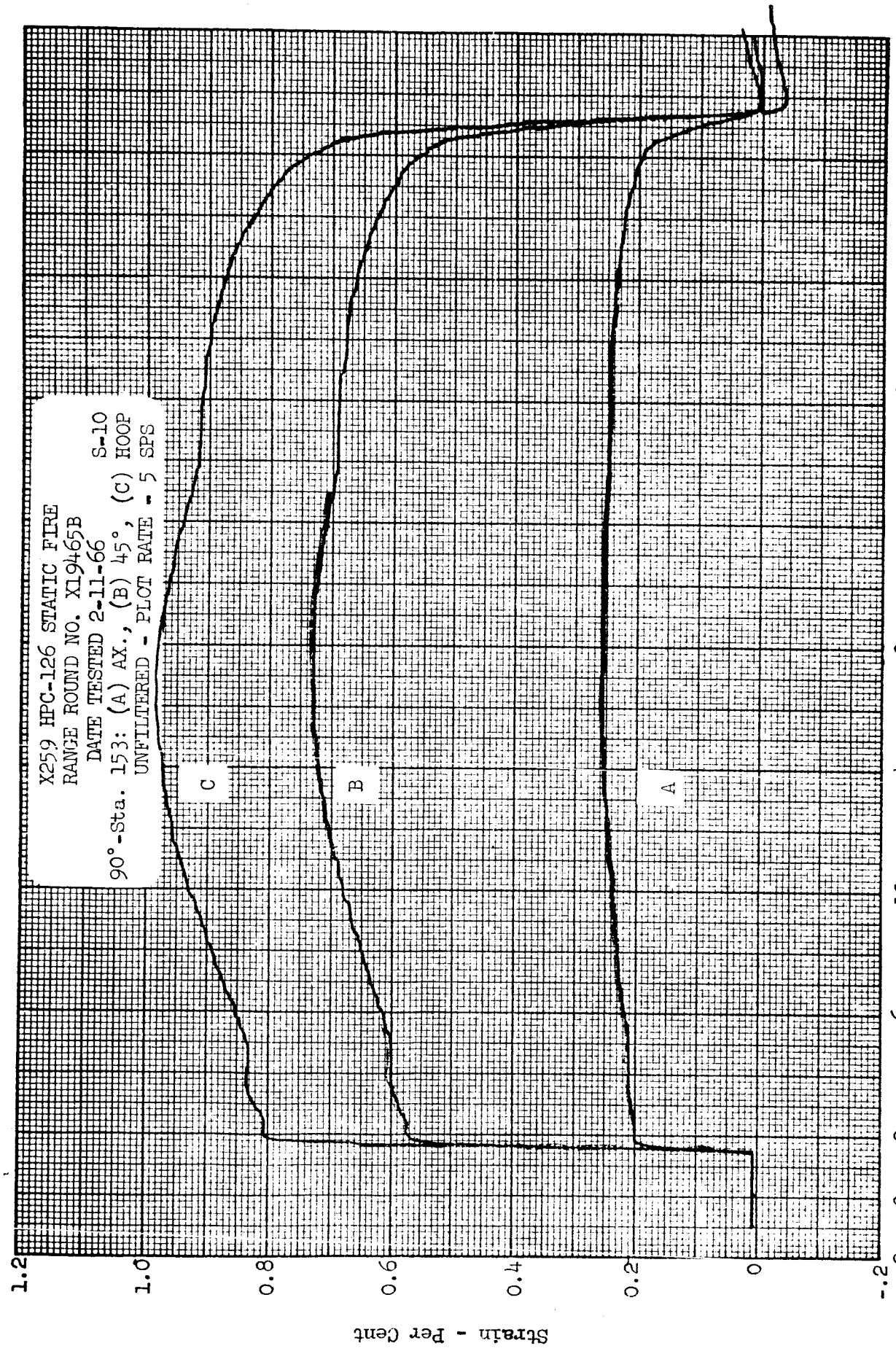

X259 HPC-126 STATIC FIRE
RANGE ROUND NO. X19465B
DATE TESTED 2-11-66 S-5
270°-Sta. 137: (A) AX., (B) 45°, (C)HOOP
UNFILTERED - PLOT RATE 5 SPS
C
B
A
1.2
1.0
0.8
0.6
0.4
0.2
0
-0.2
-2
0
2
6
10
14
18
22
26
30
34
38
Strain - Percent
Time - Seconds

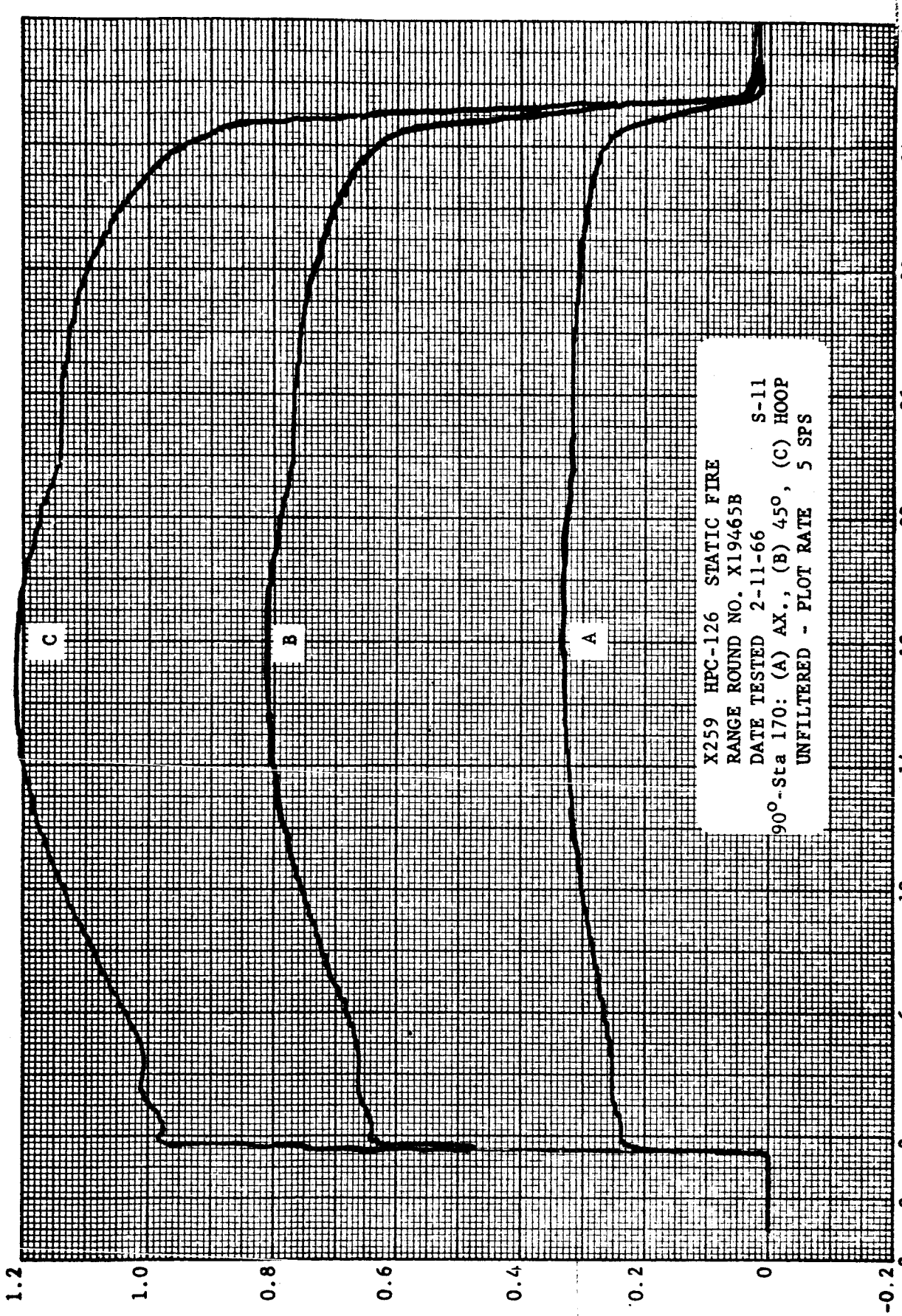

X259 HPC-126 STATIC FIRE
RANGE ROUND NO. X19465B
DATE TESTED 2-11-66 S-6
270°-Sta 153: (A) AX., (B) 45°, (C) HOOP
UNFILTERED - PLOT RATE 5 SPS
A
B
C
1.2
1.0
0.8
0.6
0.4
0.2
0
-0.2
-2
0
2
6
10
14
18
22
26
30
34
38
Strain - Percent
Time - Seconds

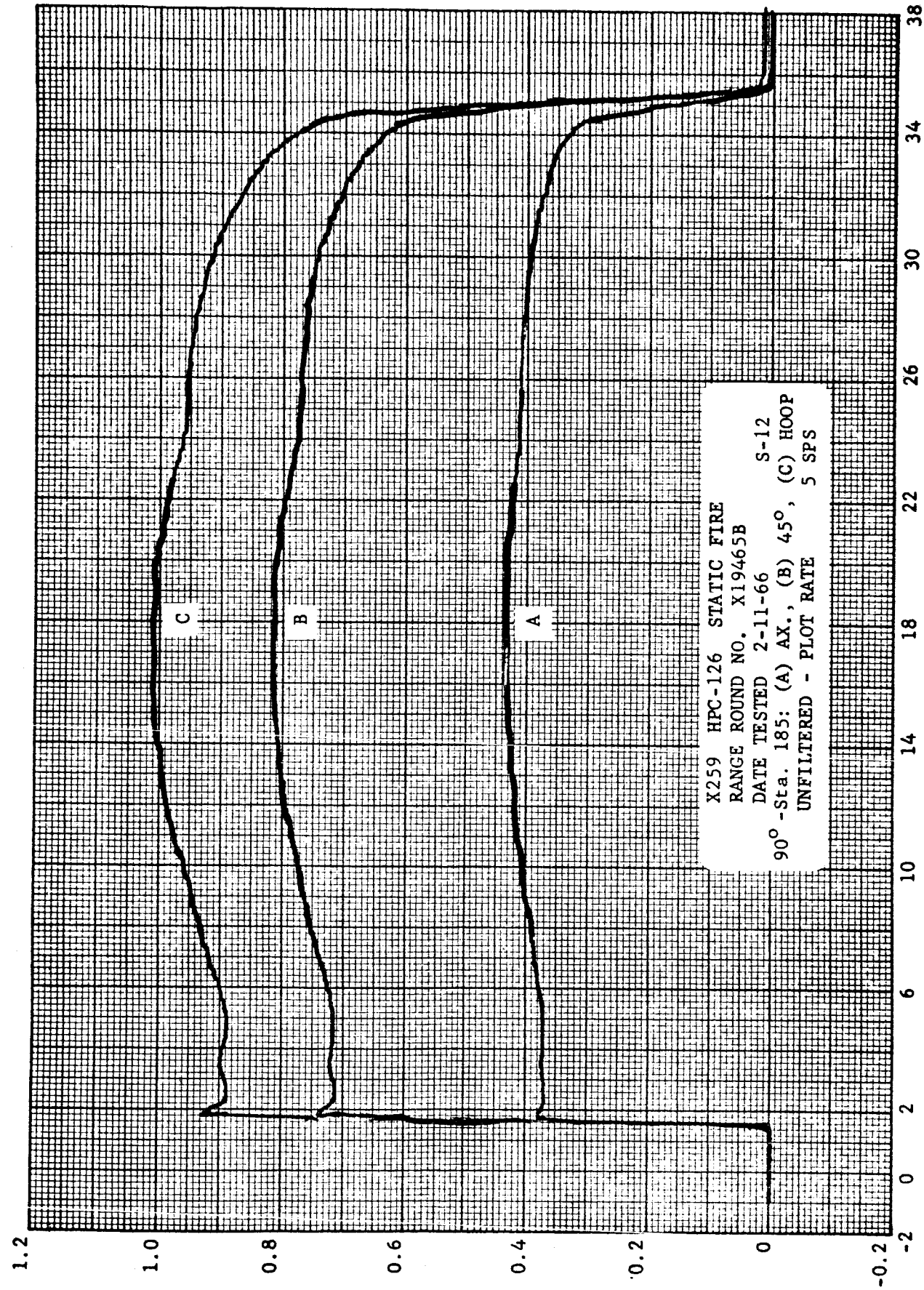

1.2
1.0
0.8
0.6
0.4
0.2
0
-0.2
-2
0
2
6
10
14
18
22
26
30
34
38
C
B
A
X259 HPC-126 STATIC FIRE
RANGE ROUND NO. X19465B
DATE TESTED 2-11-66 S-7
270°-Sta 170: (A) AX., (B) 45°, (C) HOOP
UNFILTERED - PLOT RATE 5 SPS
Strain - Percent
Time - Seconds

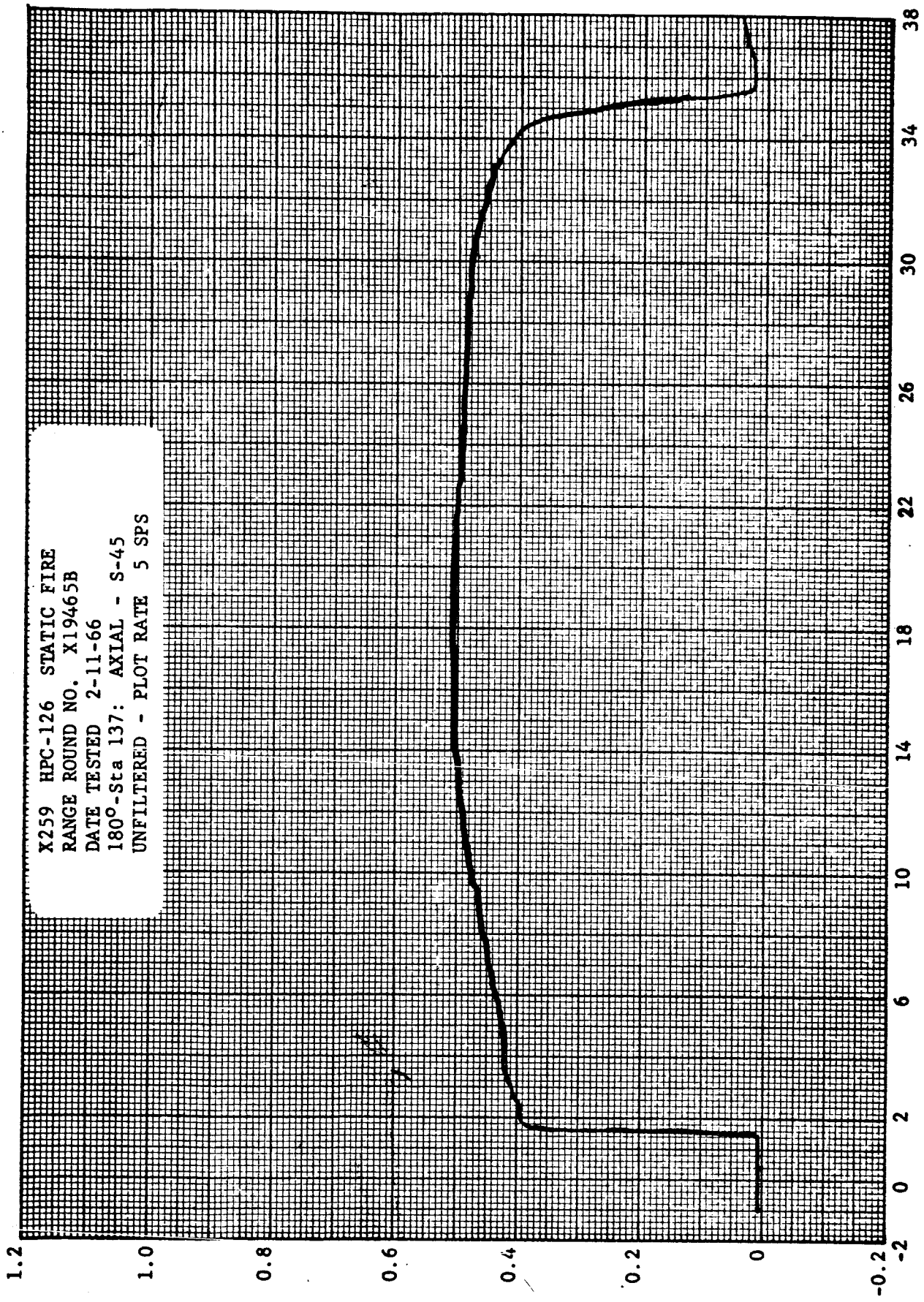

X259 HPC-126 STATIC FIRE
RANGE ROUND NO. X19465B
DATE TESTED 2-11-66 S-8
270°-Sta 185: (A) AX., (B) 45°, (C) HOOP
UNFILTERED - PLOT RATE 5 SPS
A
B
C
1.2
1.0
0.8
0.6
0.4
0.2
0
-0.2
-2
0
2
6
10
14
18
22
26
30
34
38
Strain - Percent
Time - Seconds

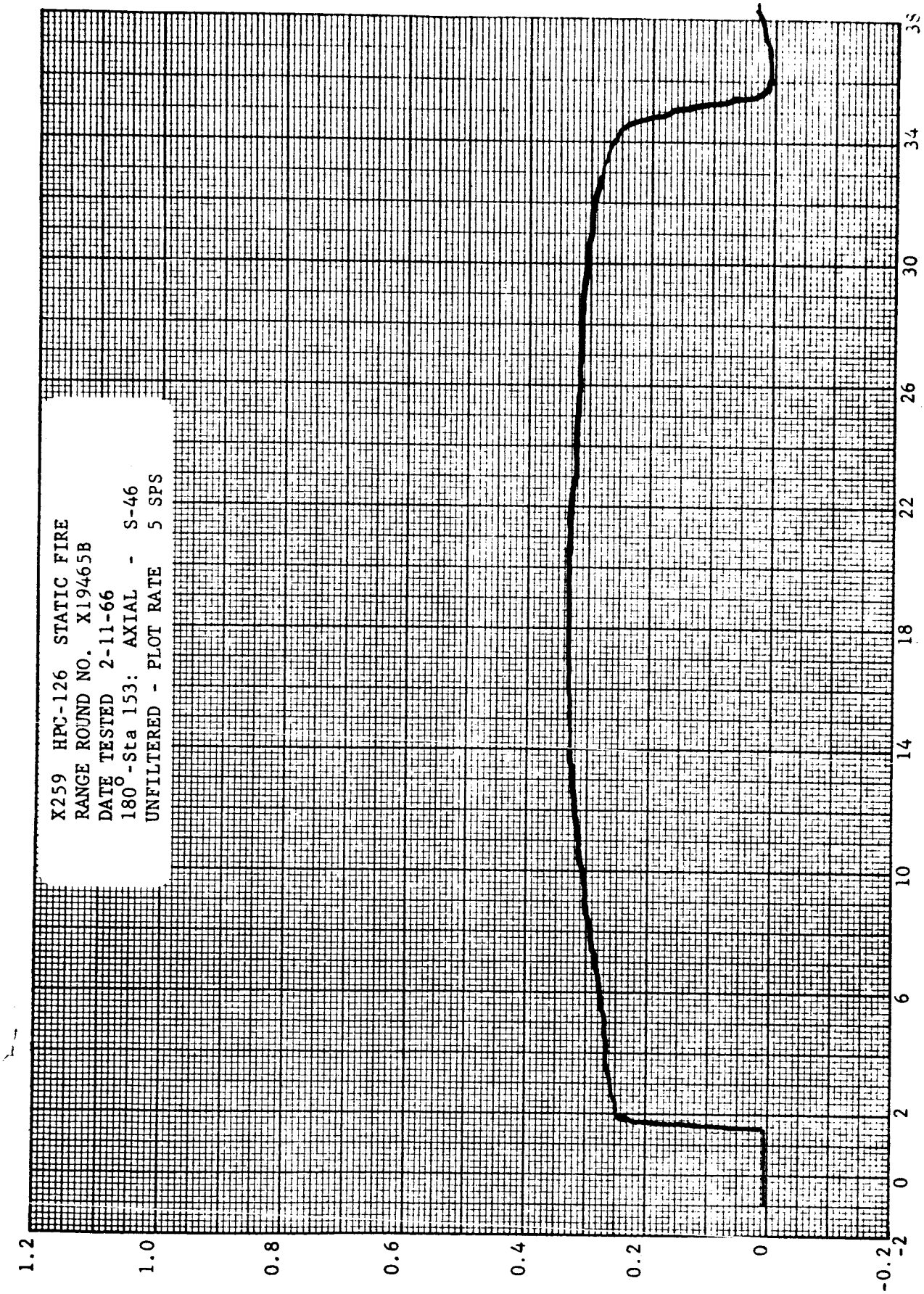

X259 HPC-126 STATIC FIRE
RANGE ROUND NO. X19465B
DATE TESTED 2-11-66 S-9
90° Sta. 137: (A) AX., (B) 45°, (C) HOOP
UNFILTERED - PLOT RATE 5 SPS
1.2
1.0
0.8
0.6
0.4
0.2
0
-0.2
C
B
A
-2
0
2
6
10
14
18
22
26
30
34
38
Strain - Percent
Time - Seconds

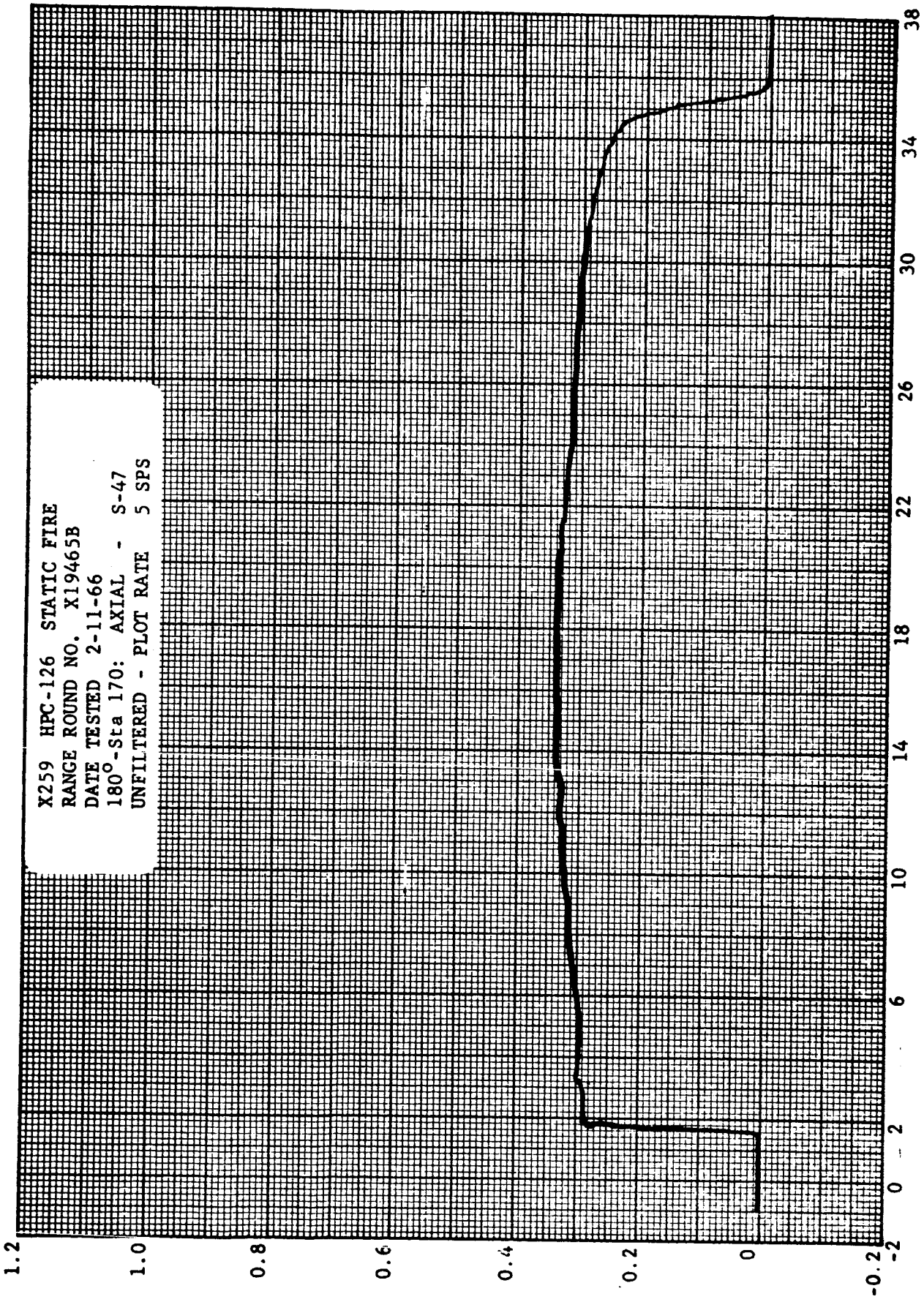

X259 HPC-126 STATIC FIRE
RANGE ROUND NO. X19465B
DATE TESTED 2-11-66
S-10
90°-Sta. 153: (A) AX., (B) 45°, (C) HOOP
UNFILTERED - PLOT RATE - 5 SPS
A
B
C
Strain - Per Cent
1.2
1.0
0.8
0.6
0.4
0.2
0
-.2
-2
0
2
6
10
14
18
22
26
30
34
38
Time - Seconds

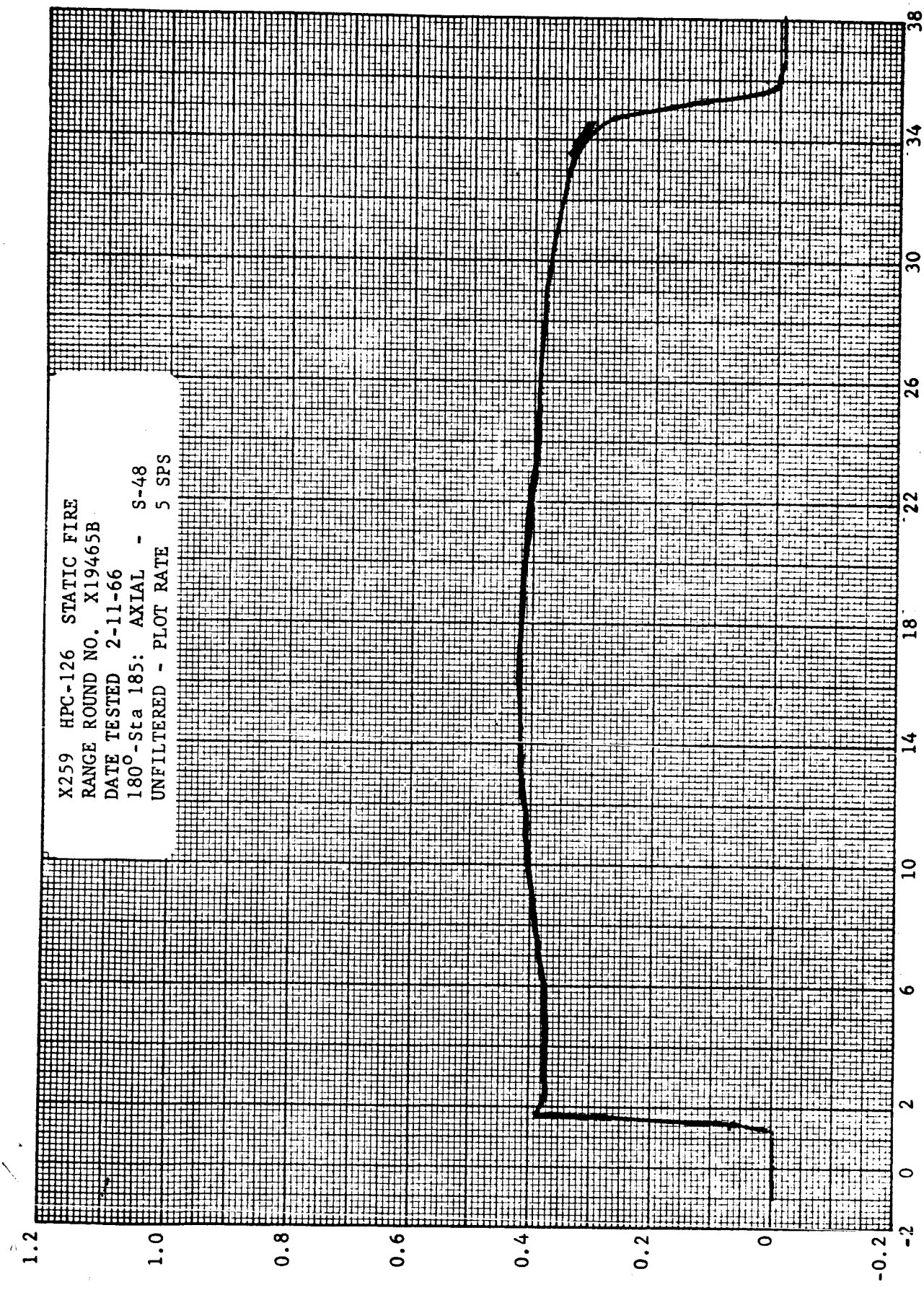

X259 HPC-126 STATIC FIRE
RANGE ROUND NO. X19465B
DATE TESTED 2-11-66 S-11
90°-Sta 170: (A) AX., (B) 45°, (C) HOOP
UNFILTERED - PLOT RATE 5 SPS
A
B
C
1.2
1.0
0.8
0.6
0.4
0.2
0
-0.2
-2
0
2
6
10
14
18
22
26
30
34
38
Strain - Percent
Time - Seconds

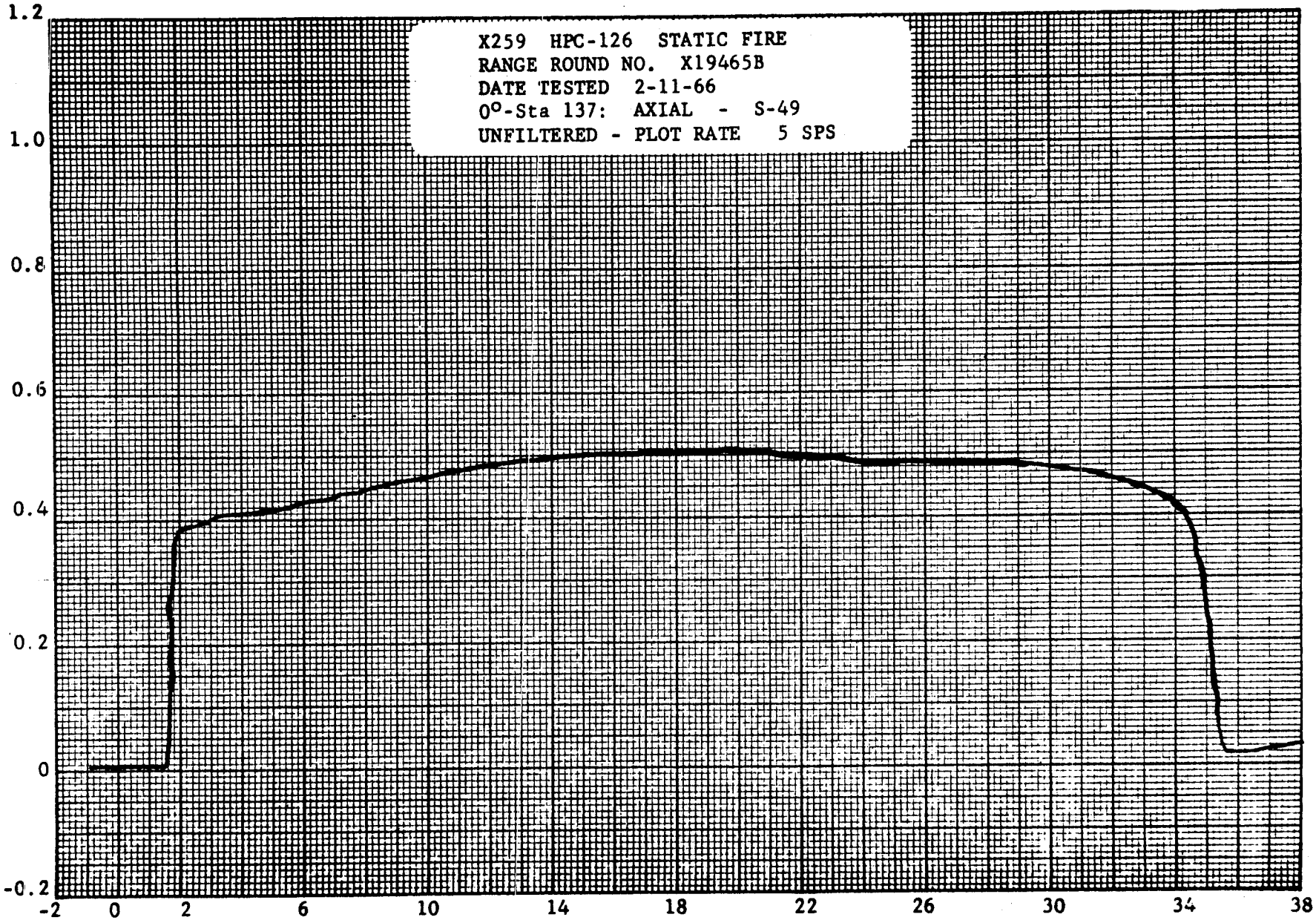

X259 HPC-126 STATIC FIRE
RANGE ROUND NO. X19465B
DATE TESTED 2-11-66 S-12
90° -Sta. 185: (A) AX., (B) 45°, (C) HOOP
UNFILTERED - PLOT RATE 5 SPS
A
B
C
1.2
1.0
0.8
0.6
0.4
0.2
0
-0.2
-2
0
2
6
10
14
18
22
26
30
34
38
Time - Seconds
Strain - Percent

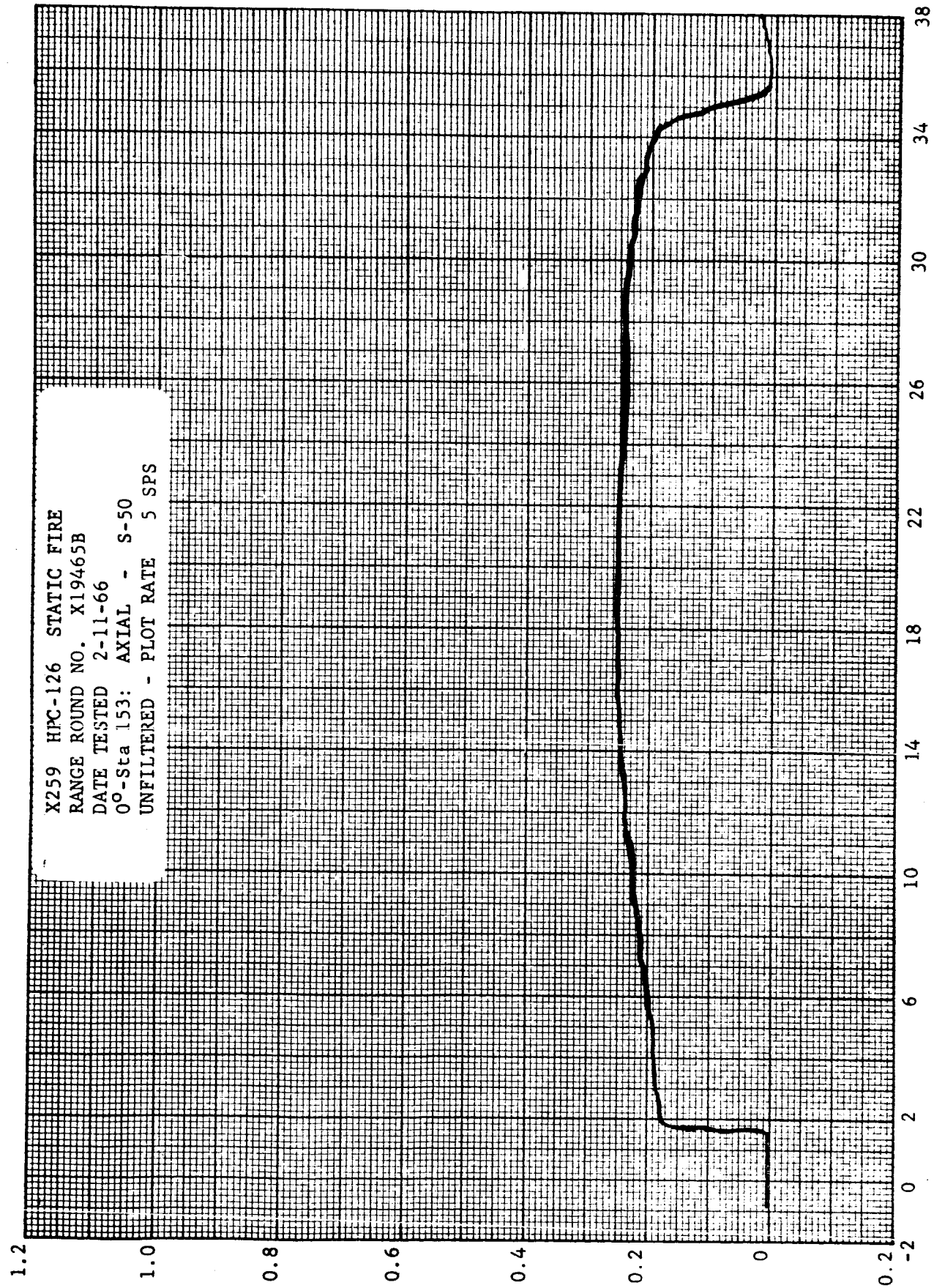

X259 HPC-126 STATIC FIRE
RANGE ROUND NO. X19465B
DATE TESTED 2-11-66
180°-Sta 137: AXIAL - S-45
UNFILTERED - PLOT RATE 5 SPS
1.2
1.0
0.8
0.6
0.4
0.2
0
-0.2
-2
0
2
6
10
14
18
22
26
30
34
38
Strain - Percent
Time - Seconds

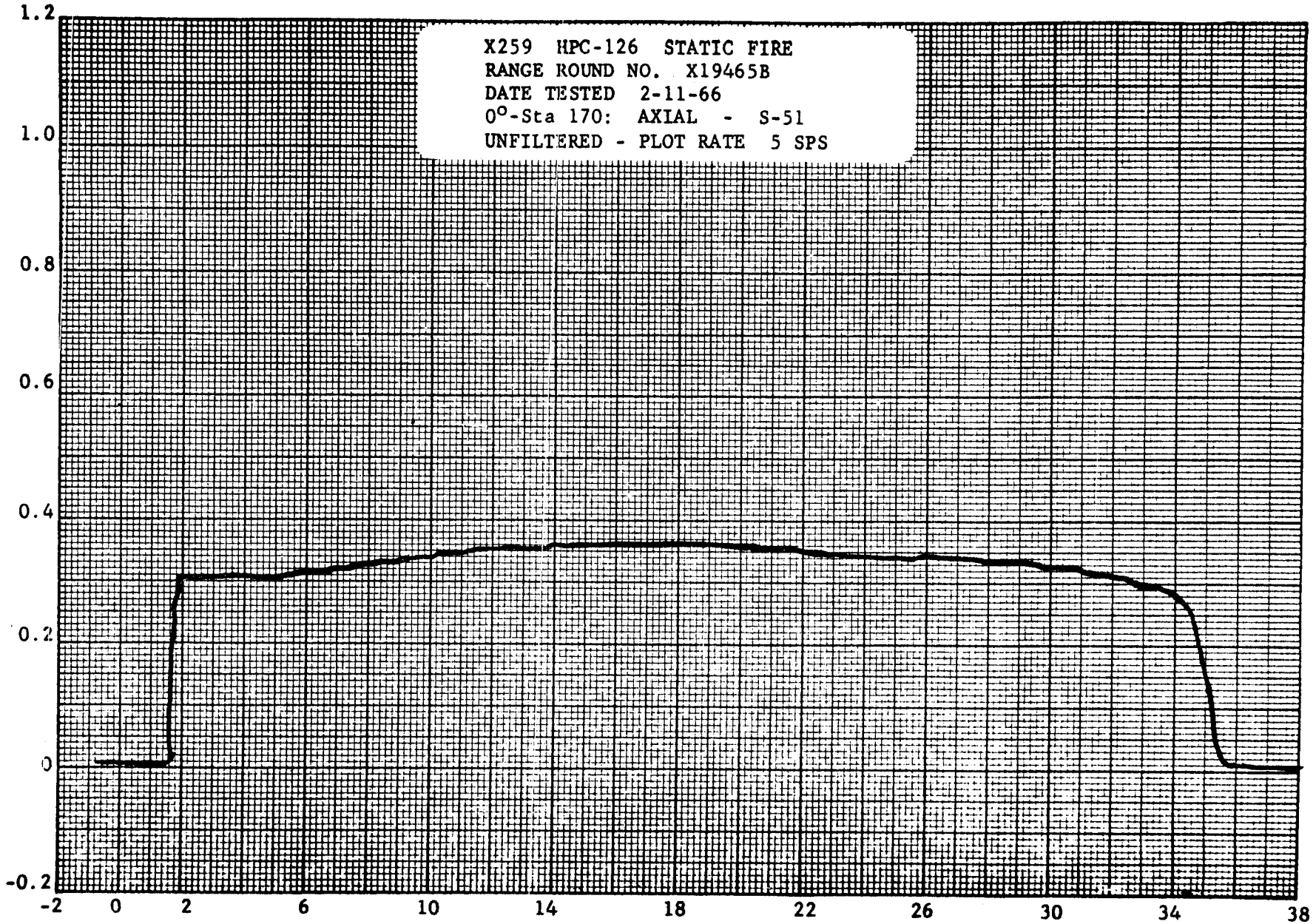

X259 HPC-126 STATIC FIRE
RANGE ROUND NO. X19465B
DATE TESTED 2-11-66
180°-Sta 153: AXIAL - S-46
UNFILTERED - PLOT RATE 5 SPS
1.2
1.0
0.8
0.6
0.4
0.2
0
-0.2
-2
0
2
6
10
14
18
22
26
30
34
Time - Seconds
Strain - Percent

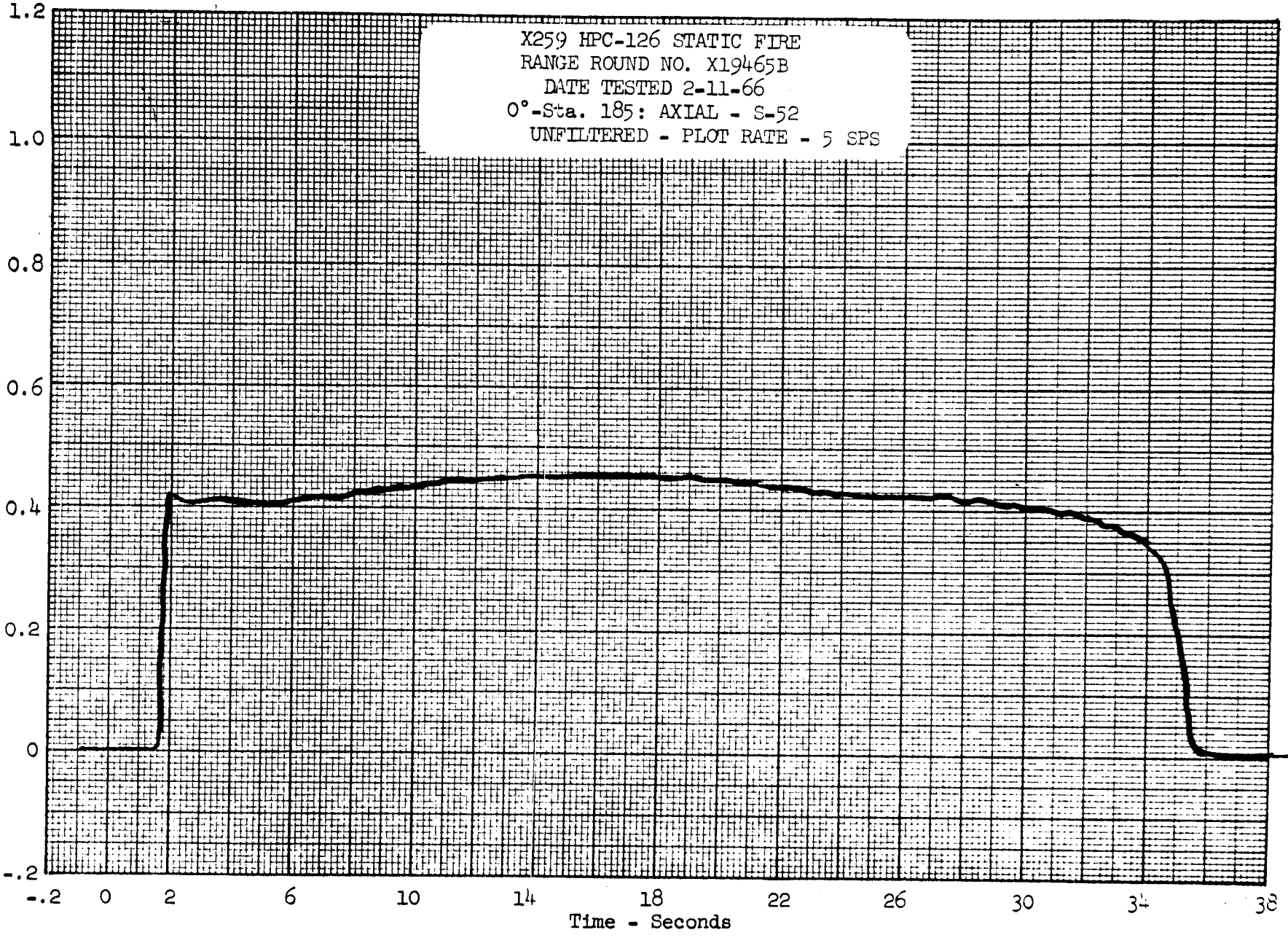

X259 HPC-126 STATIC FIRE
RANGE ROUND NO. X19465B
DATE TESTED 2-11-66
180°-Sta 170: AXIAL - S-47
UNFILTERED - PLOT RATE 5 SPS
1.2
1.0
0.8
0.6
0.4
0.2
0
-0.2
Strain - Percent
-2
0
2
6
10
14
18
22
26
30
34
38
Time - Seconds

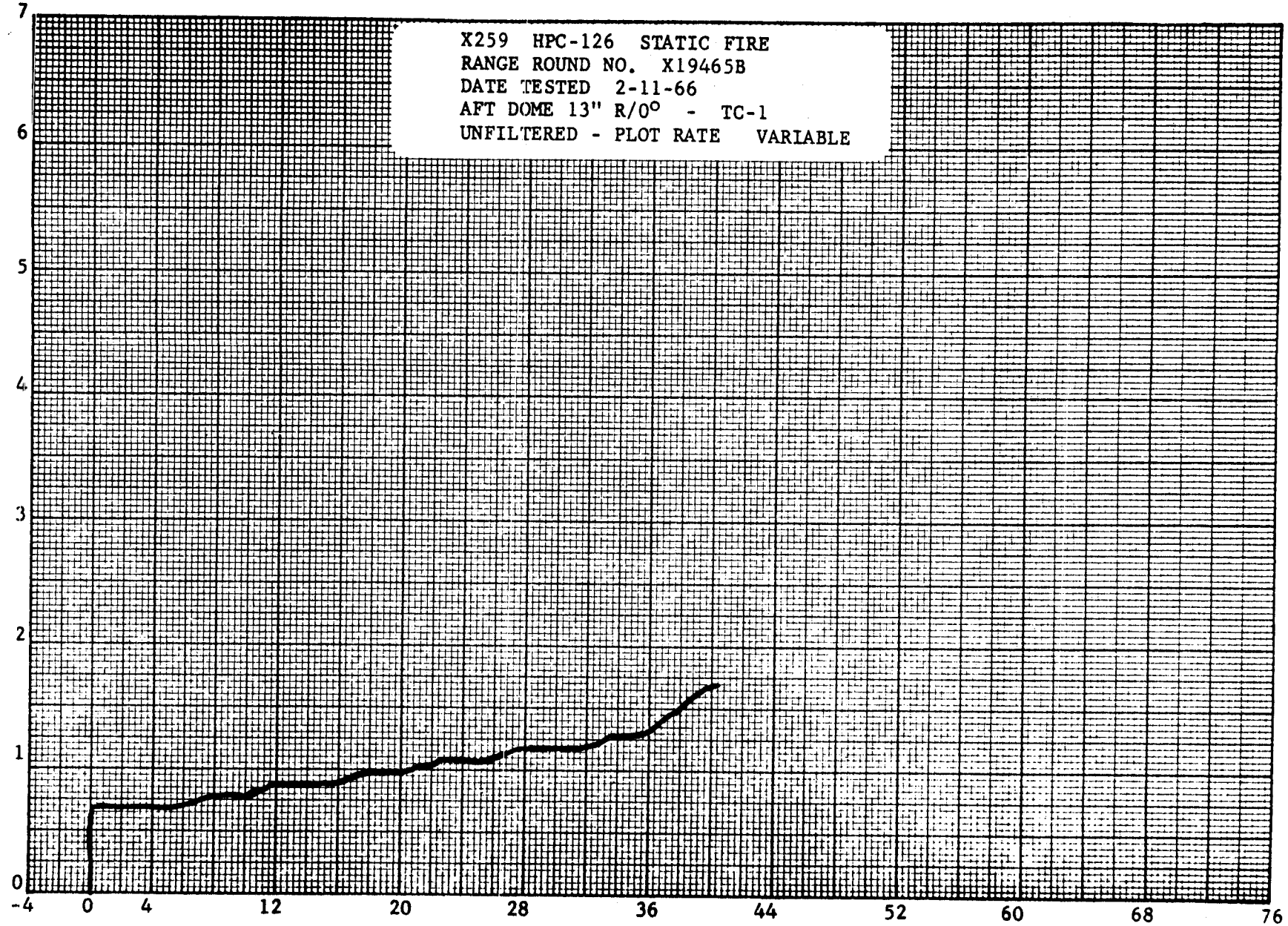

X259 HPC-126 STATIC FIRE
RANGE ROUND NO. X19465B
DATE TESTED 2-11-66
180°-Sta 185: AXIAL - S-48
UNFILTERED - PLOT RATE 5 SPS
1.2
1.0
0.8
0.6
0.4
0.2
0
-0.2
-2
0
2
6
10
14
18
22
26
30
34
38
Time = Seconds
Strain - Percent


X259 HPC-126 STATIC FIRE
RANGE ROUND NO. X19465B
DATE TESTED 2-11-66
0°-Sta 137: AXIAL - S-49
UNFILTERED - PLOT RATE 5 SPS
1.2
1.0
0.8
0.6
0.4
0.2
0
-0.2
-2
0
2
6
10
14
18
22
26
30
34
38
Strain - Percent
Time - Seconds

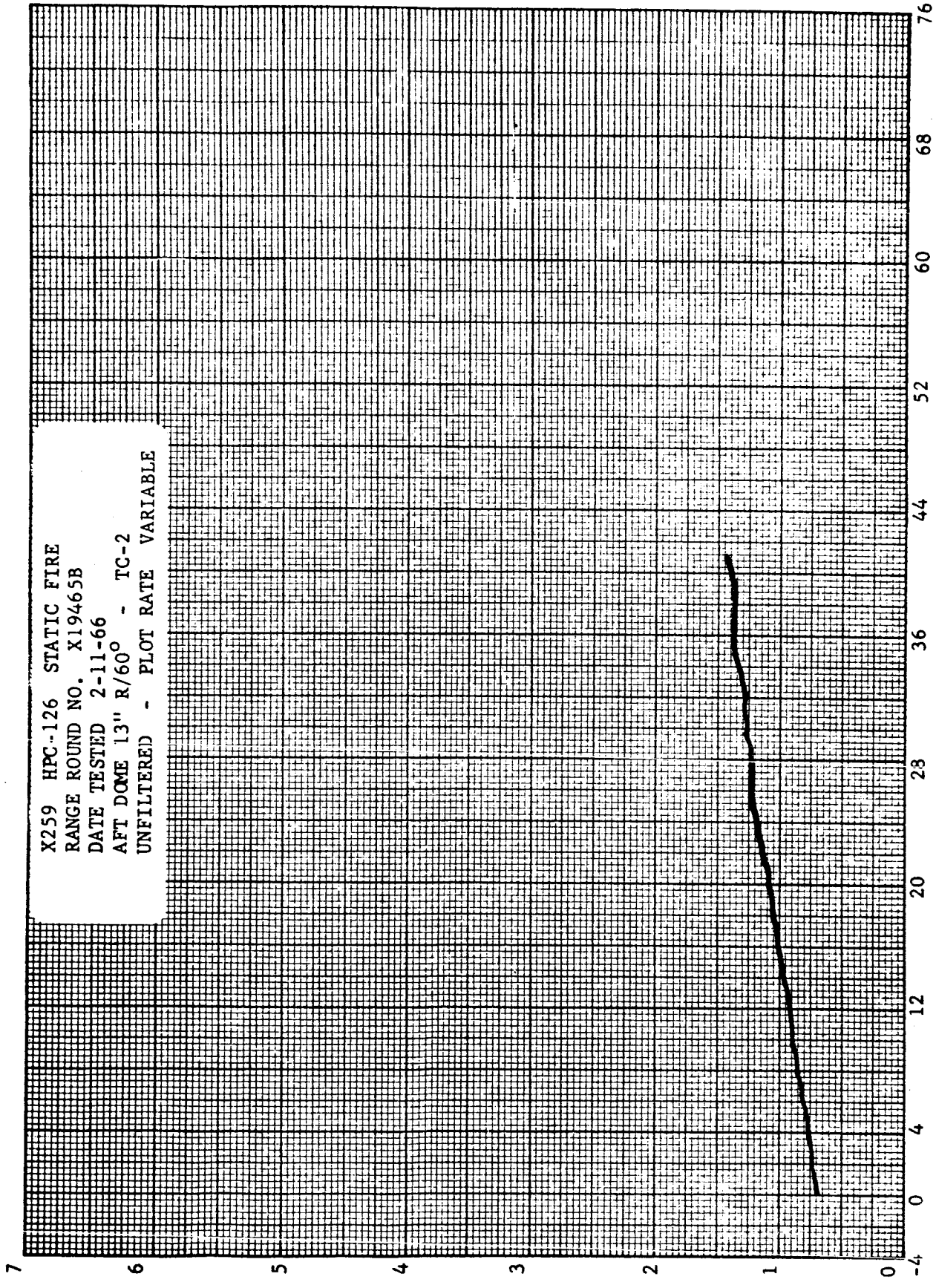

X259 HPC-126 STATIC FIRE
RANGE ROUND NO. X19465B
DATE TESTED 2-11-66
0°-Sta 153: AXIAL - S-50
UNFILTERED - PLOT RATE 5 SPS
1.2
1.0
0.8
0.6
0.4
0.2
0
-0.2
-2
0
2
6
10
14
18
22
26
30
34
38
Time - Seconds
Strain - Percent


X259 HPC-126 STATIC FIRE
RANGE ROUND NO. X19465B
DATE TESTED 2-11-66
0°-Sta 170: AXIAL - S-51
UNFILTERED - PLOT RATE 5 SPS
1.2
1.0
0.8
0.6
0.4
0.2
0
-0.2
-2
0
2
6
10
14
18
22
26
30
34
38
Strain - Percent
Time - Seconds

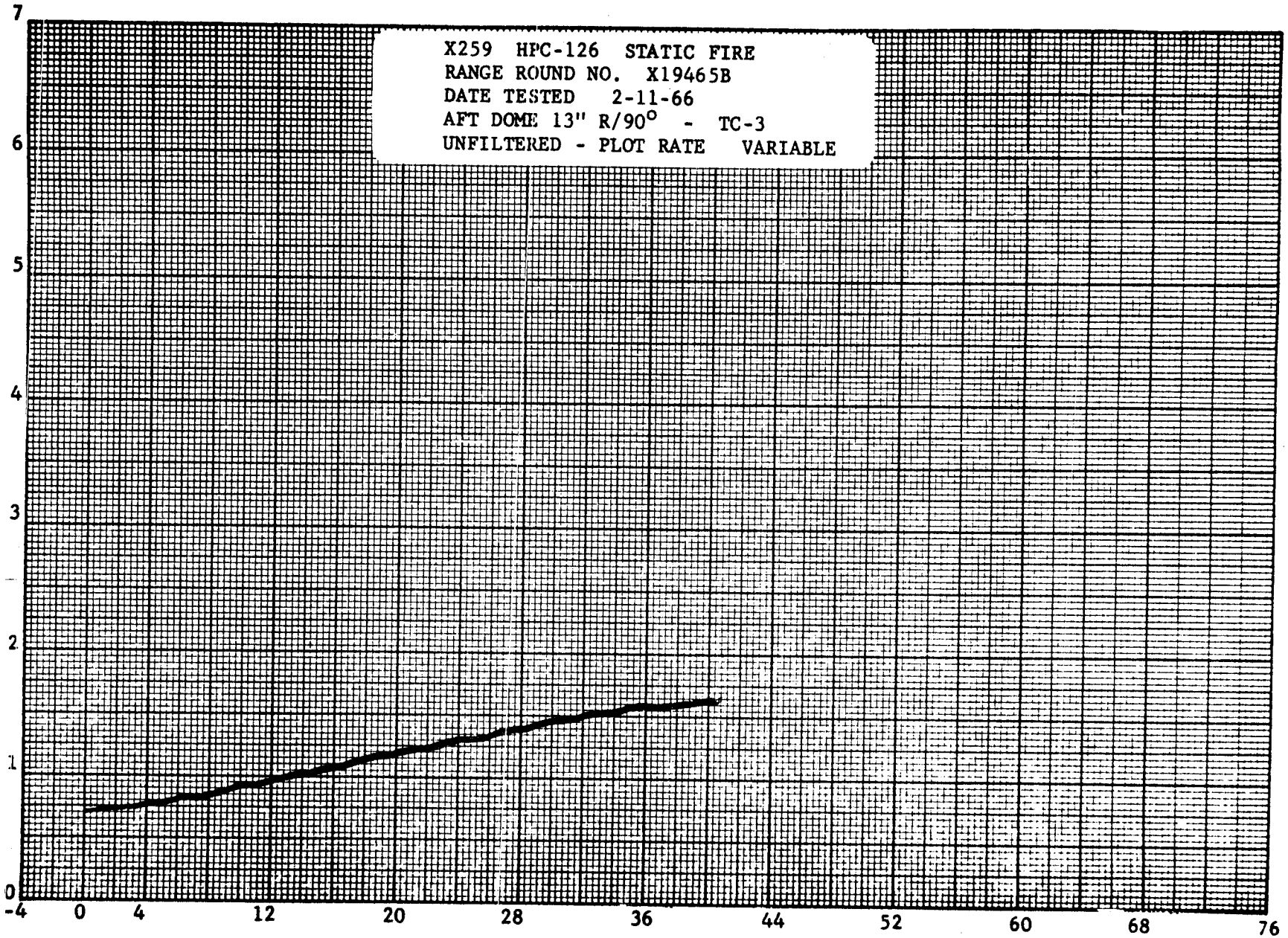

X259 HPC-126 STATIC FIRE
RANGE ROUND NO. X19465B
DATE TESTED 2-11-66
0°-Sta. 185: AXIAL - S-52
UNFILTERED - PLOT RATE - 5 SPS
Strain - Per Cent
1.2
1.0
0.8
0.6
0.4
0.2
0
-.2
-.2
0
2
6
10
14
18
22
26
30
34
38
Time - Seconds

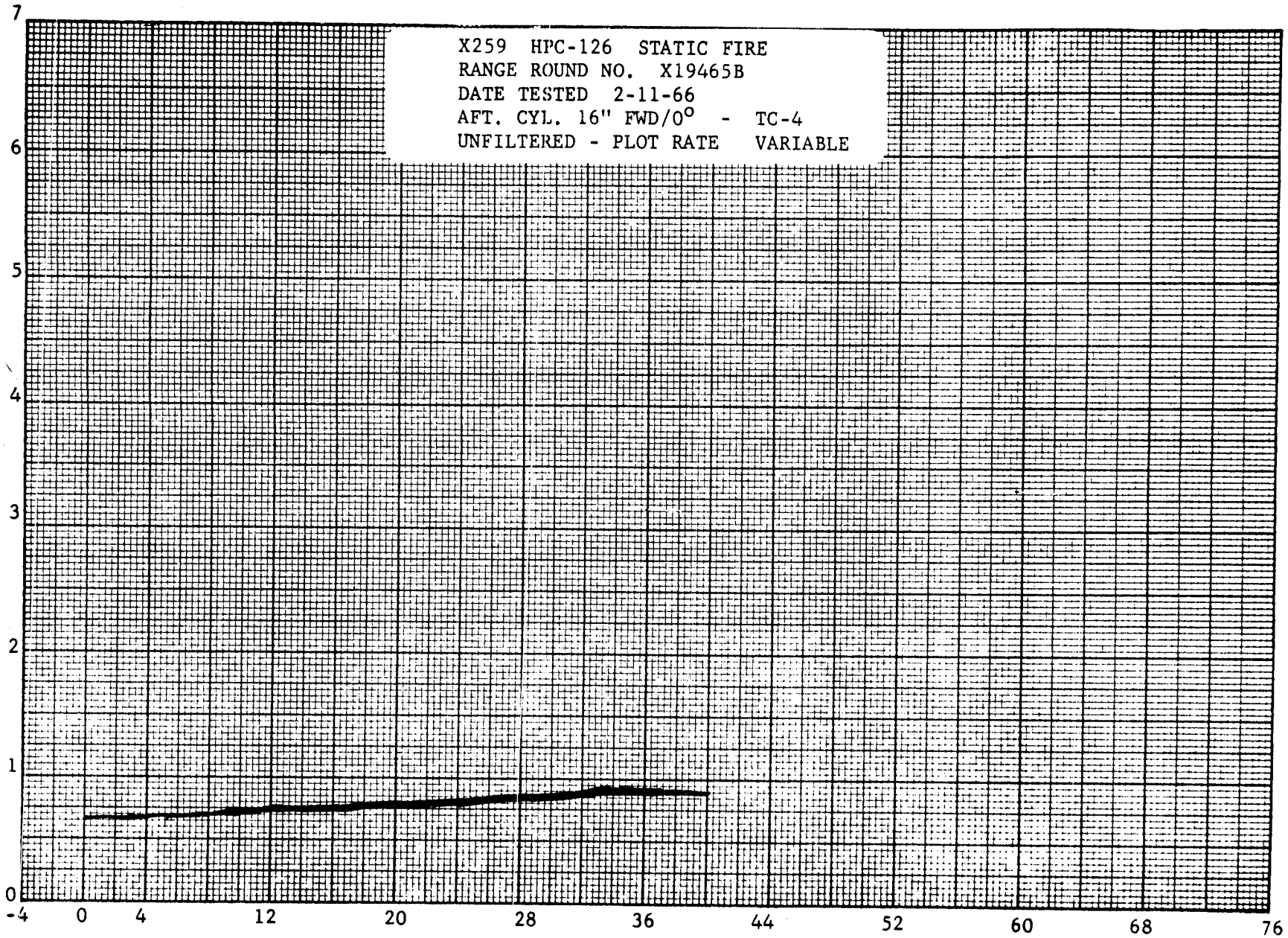

X259 HPC-126 STATIC FIRE
RANGE ROUND NO. X19465B
DATE TESTED 2-11-66
AFT DOME 13" R/0° - TC-1
UNFILTERED - PLOT RATE VARIABLE
7
6
5
4
3
2
1
0
-4
0
4
12
20
28
36
44
52
60
68
76
Thermocouple - Fahrenheit - Degree X10-2
Time - Seconds

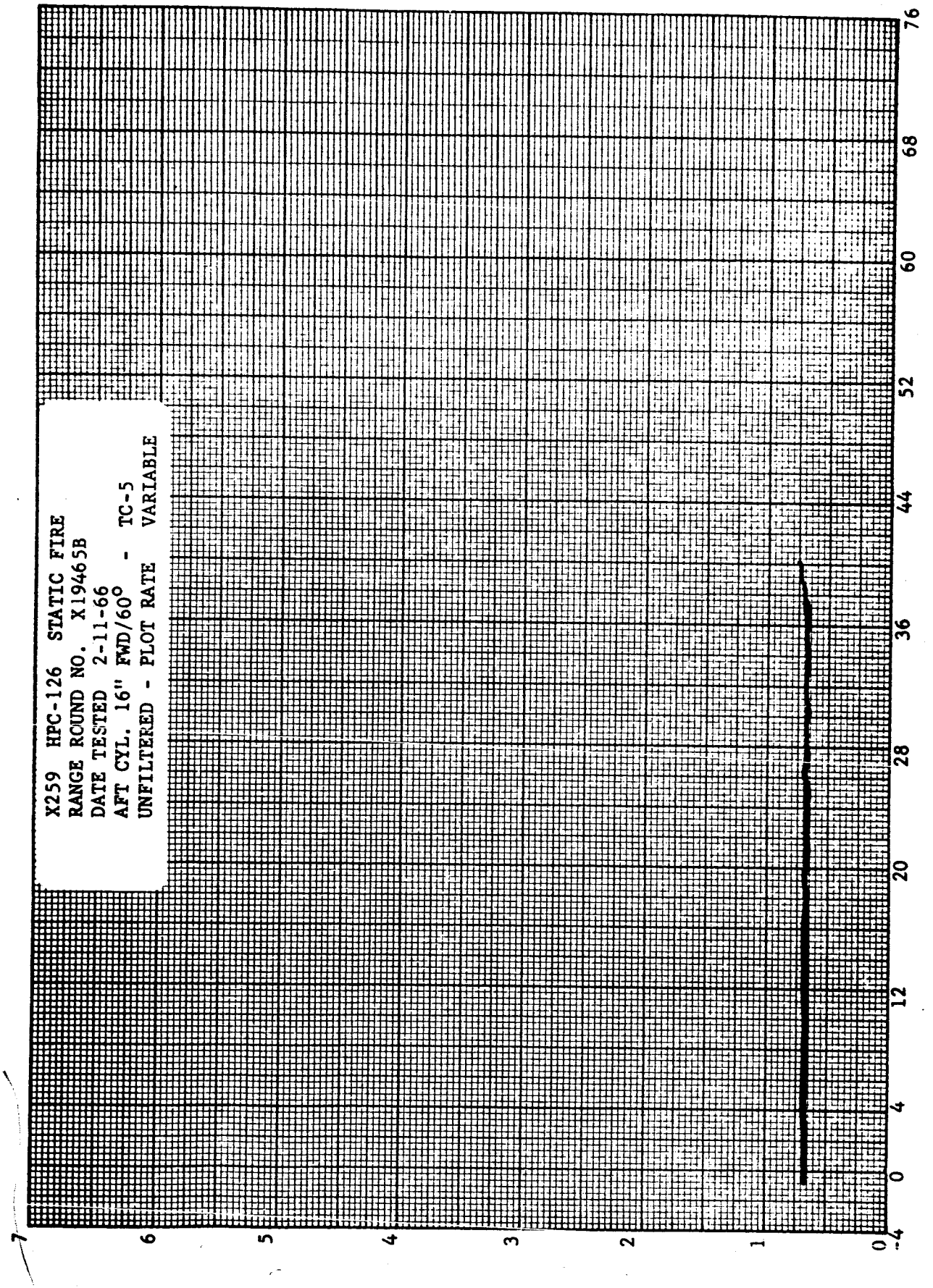
V-23

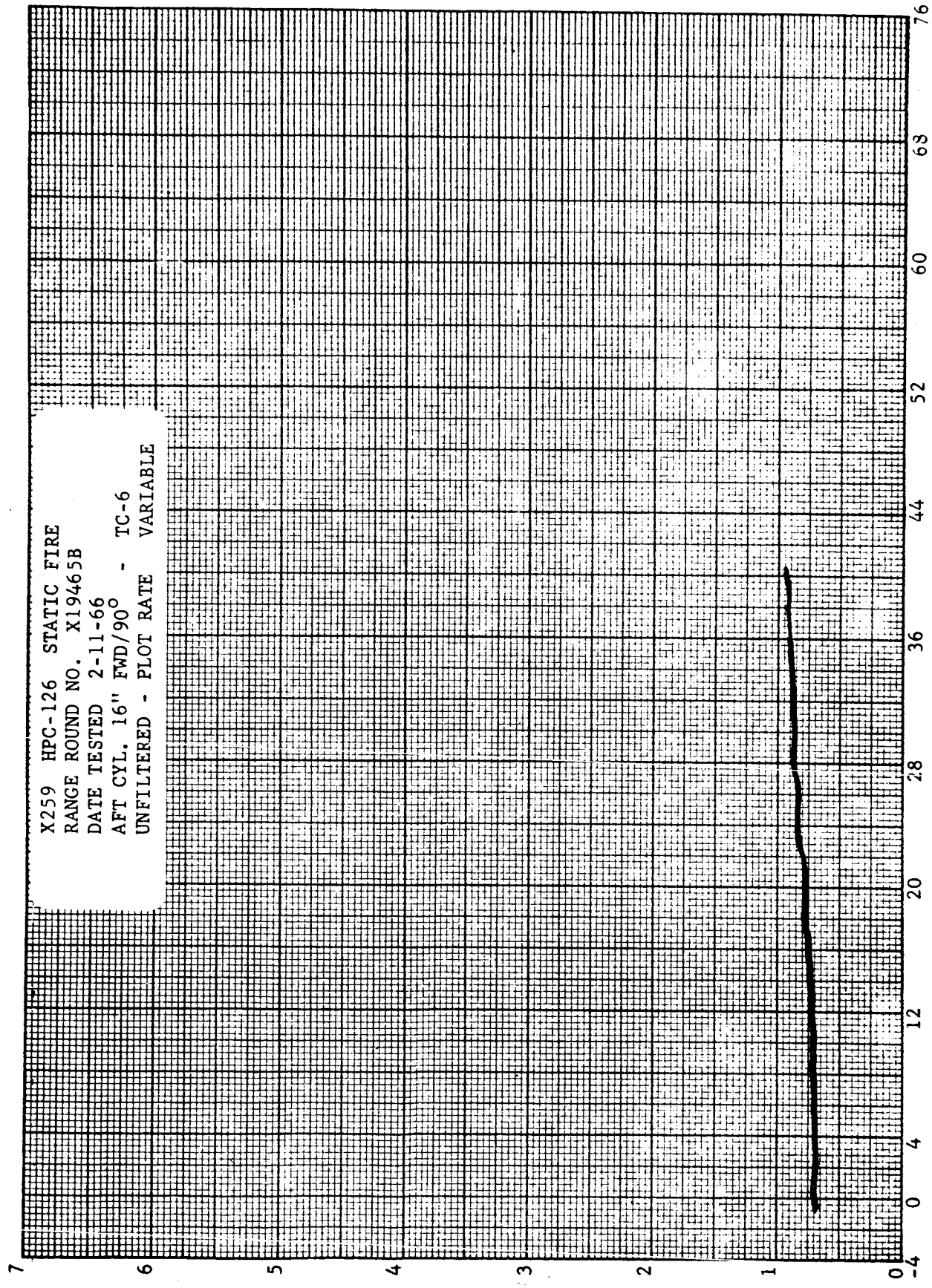


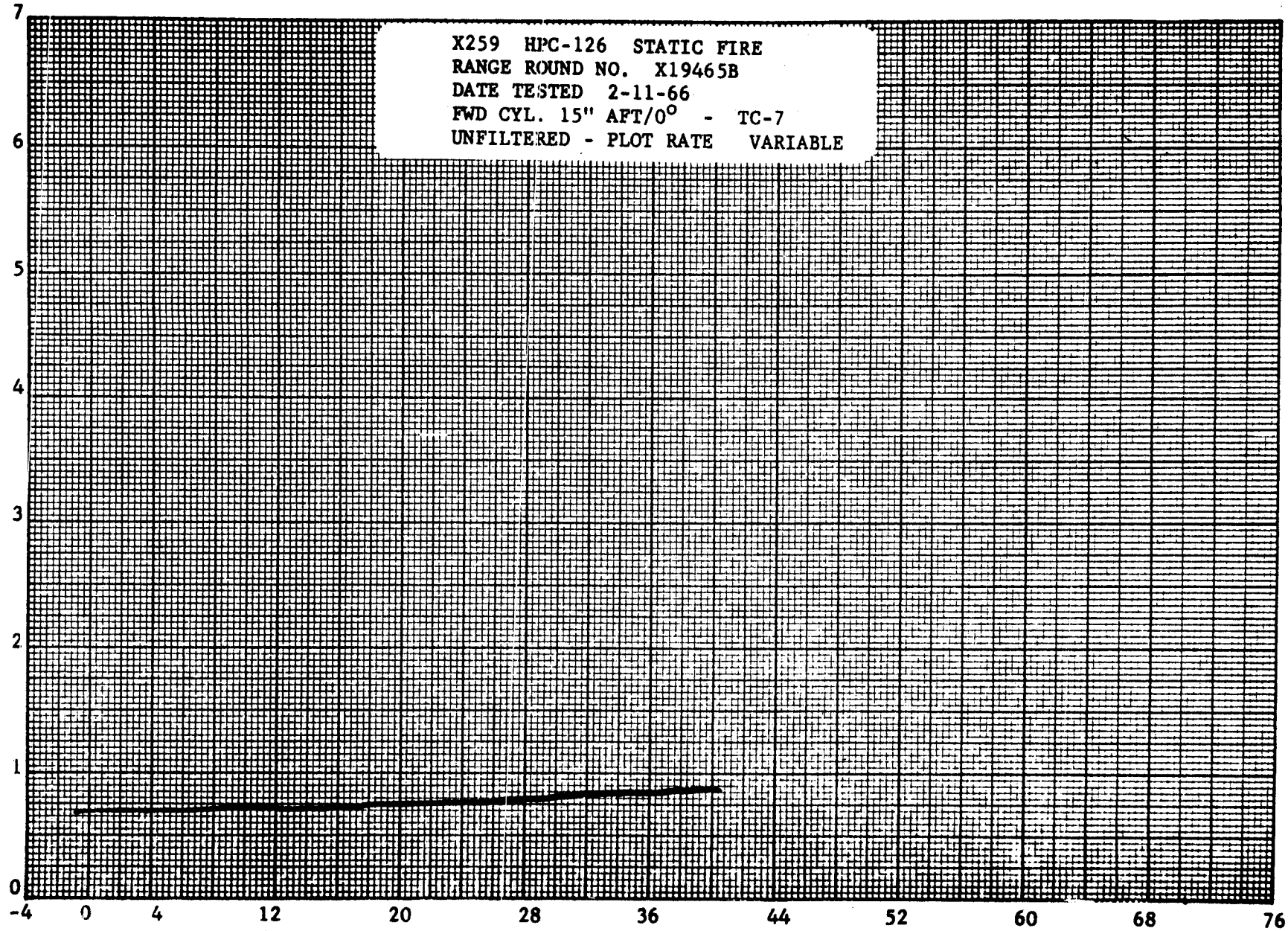
Thermocouple - Fahrenheit - Degree X10-2

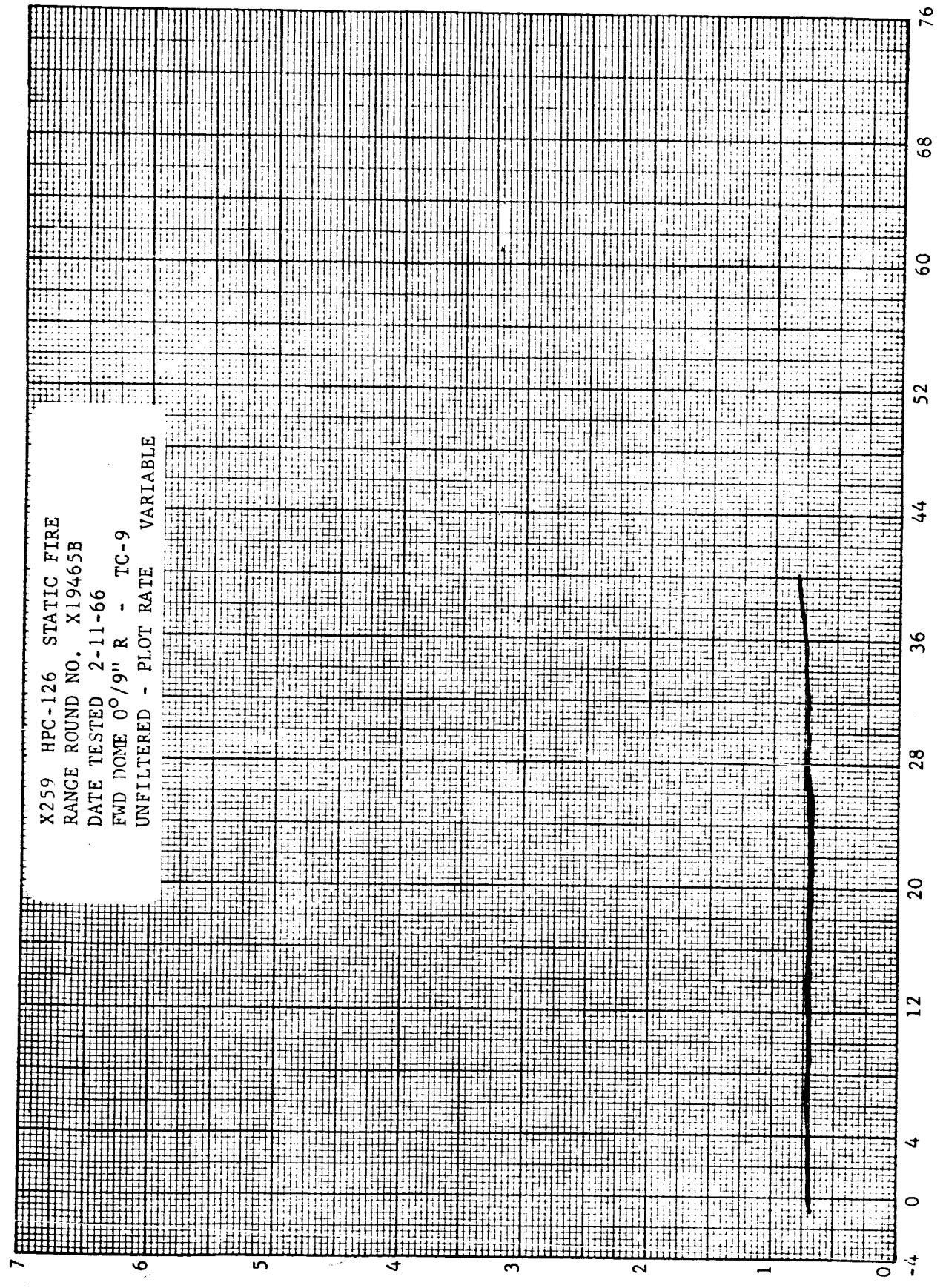

X259 HPC-126 STATIC FIRE
RANGE ROUND NO. X19465B
DATE TESTED 2-11-66
AFT DOME 13" R/90° - TC-3
UNFILTERED - PLOT RATE VARIABLE
7
6
5
4
3
2
1
0
-4
0
4
12
20
28
36
44
52
60
68
76
Thermocouple - Fahrenheit - Degree X10-2
Time - Seconds

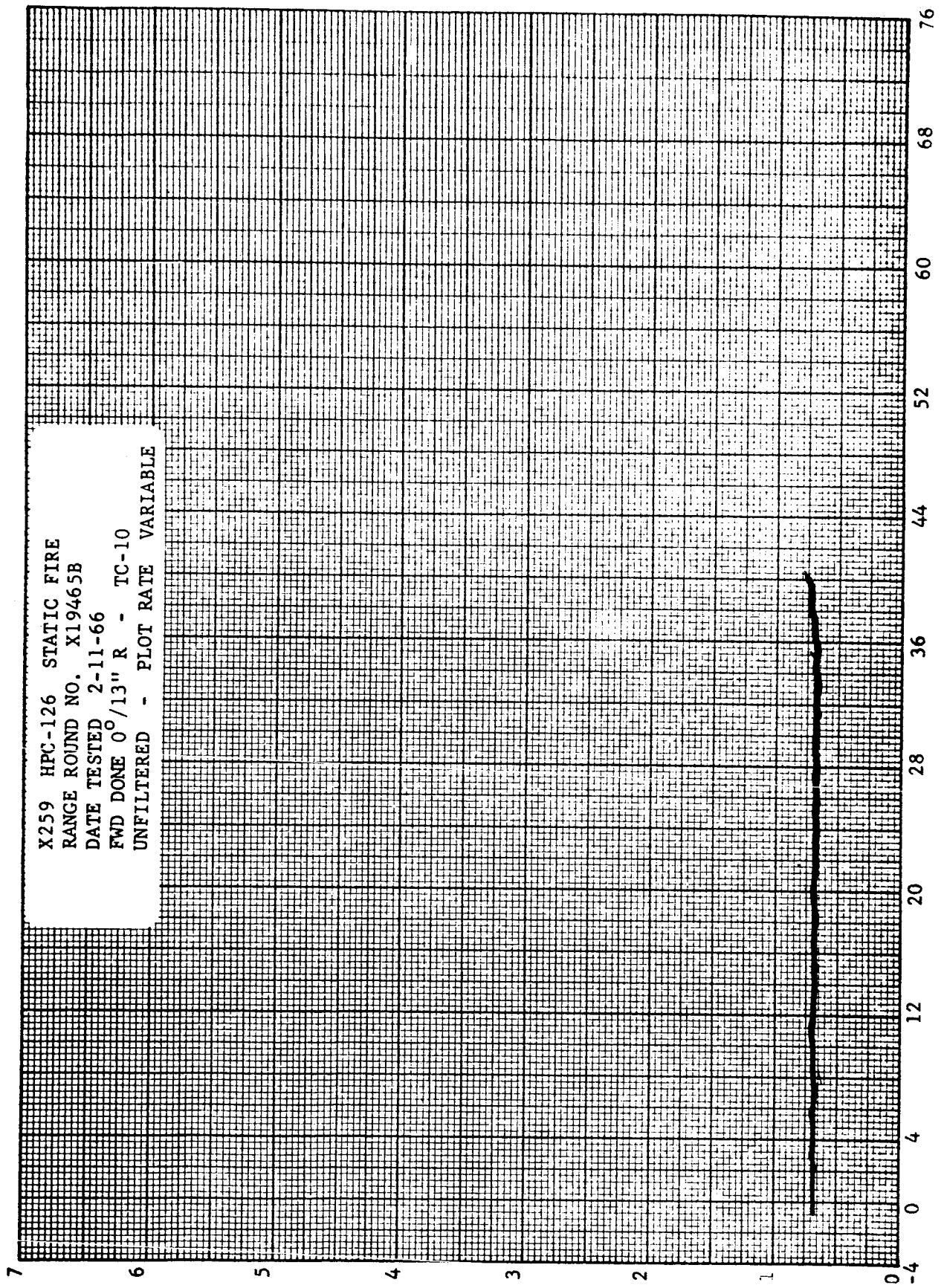

X259 HPC-126 STATIC FIRE
RANGE ROUND NO. X19465B
DATE TESTED 2-11-66
AFT. CYL. 16" FWD/0° - TC-4
UNFILTERED - PLOT RATE VARIABLE
Thermocouple - Fahrenheit - Degree X10-2
0
1
2
3
4
5
6
7
-4
0
4
12
20
28
36
44
52
60
68
76
Time - Seconds

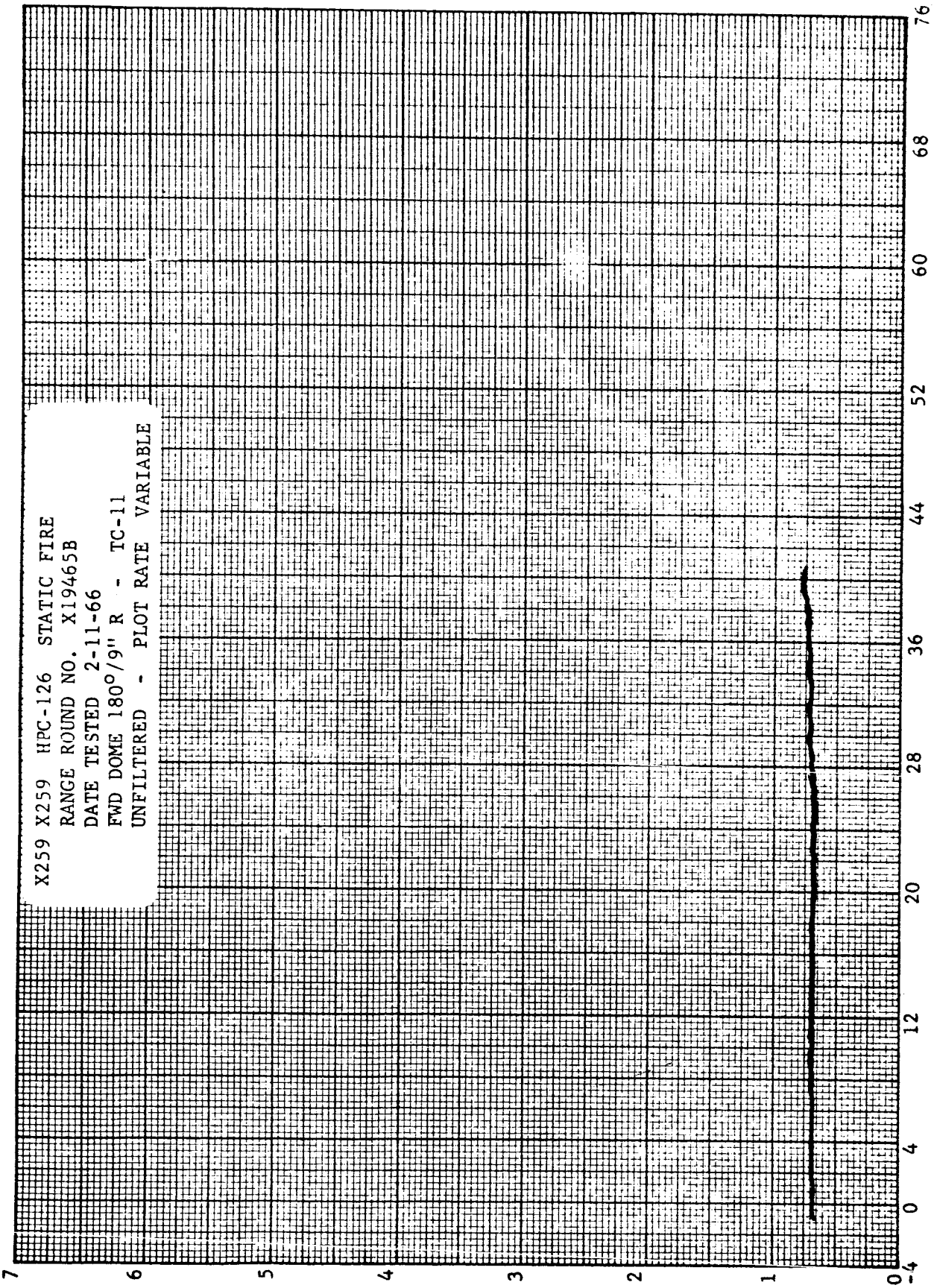

X259 HPC-126 STATIC FIRE
RANGE ROUND NO. X19465B
DATE TESTED 2-11-66
AFT CYL. 16" FWD/60° - TC-5
UNFILTERED - PLOT RATE VARIABLE
Thermocouple - Fahrenheit - Degree X10-2
Time - Seconds
0
1
2
3
4
5
6
7
-4
0
4
12
20
28
36
44
52
60
68
76


X259 HPC-126 STATIC FIRE
RANGE ROUND NO. X19465B
DATE TESTED 2-11-66
AFT CYL. 16" FWD/90° - TC-6
UNFILTERED - PLOT RATE VARIABLE
7
6
5
4
3
2
1
0
-4
0
4
12
20
28
36
44
52
60
68
76
Time - Seconds
Thermocouple - Fahrenheit - Degree X10-2


X259 HPC-126 STATIC FIRE
RANGE ROUND NO. X19465B
DATE TESTED 2-11-66
FWD CYL. 15" AFT/0° - TC-7
UNFILTERED - PLOT RATE VARIABLE
7
6
5
4
3
2
1
0
-4
0
4
12
20
28
36
44
52
60
68
76
Thermocouple - Fahrenheit - Degree X10-2
Time - Seconds


X259 HPC-126 STATIC FIRE
RANGE ROUND NO. X19465B
DATE TESTED 2-11-66
FWD DOME 0°/9" R - TC-9
UNFILTERED - PLOT RATE VARIABLE
Thermocouple - Fahrenheit - Degree X10-2
7
6
5
4
3
2
1
0
-4
0
4
12
20
28
36
44
52
60
68
76
Time - Seconds


X259 HPC-126 STATIC FIRE
RANGE ROUND NO. X19465B
DATE TESTED 2-11-66
FWD DONE 0°/13" R - TC-10
UNFILTERED - PLOT RATE VARIABLE
7
6
5
4
3
2
1
0
-4
0
4
12
20
28
36
44
52
60
68
76
Time - Seconds
Thermocouple - Fahrenheit - Degree X10-2


X259 X259 HPC-126 STATIC FIRE
RANGE ROUND NO. X19465B
DATE TESTED 2-11-66
FWD DOME 180°/9" R - TC-11
UNFILTERED - PLOT RATE VARIABLE
7
6
5
4
3
2
1
0
-4
0
4
12
20
28
36
44
52
60
68
76
Time - Seconds
Thermocouple - Fahrenheit - Degree
X10-2

APPENDIX

APPENDIX A

Structural Load Test
ABL X259 Motor
Loaded and Unloaded Case

Test Plan

HERCULES POWDER COMPANY
Allegany Ballistics Laboratory
Cumberland, Maryland

Test Plan
Structural Load Test
ABL X259 Motor
Loaded and Unloaded Case

Contract: NAS 1-3899

Prepared By: D. W. Fuller
DEVELOPMENT ENGINEERING TESTING

December 10, 1965

This test plan has been reviewed and is approved by the undersigned:

E. A. Stair

S. H. Harris

Reviewed By:

Testing Department for D. S. Wasness

DCASO/ABL

SECTION I

General

Introduction

This will be a structural load test program of an ABL X259 loaded motor case (Test A), an ABL X259 empty motor case (Test B), and the adjacent Scout "C" and "D" transition sections. The program will be conducted in accordance with LTV Report No. 23.220, Revision A, dated November 8, 1965. Following the structural load test of the loaded motor case, the motor will be radiographically inspected and static fired. A separate test plan will be issued for the static test.

Scope

This test plan provides the load test specifications, instrumentation requirements, and photographic coverage for the two (2) tests.

Test Control

Any change to this test plan must have prior approval of the Test Engineer. Changes to the test plan will be entered on both Range test plans and Data Acquisition Sheets with the dates and initials of the Test Engineer. If time permits, changes will be distributed, in writing, to all recipients of the test plan; otherwise, the changes will be documented on a deviation sheet in the data package.

Test Objectives

The purpose of this test plan is to establish the requirements for a structural load test of (1) an ABL X259 loaded motor, (2) an unloaded motor case and the adjacent Scout "C" and "D" transition sections. The results of these tests are anticipated to accomplish the following:

a. To evaluate the effect of internal strains (from externally applied structural loads) in a glass-filament wound solid propellant rocket motor case and propellant system on its subsequent performance during firing.

b. To establish the structural failing load capabilities of the ABL X259 unloaded motor case, the Scout lower "D" transition section, and the Scout upper and lower "C" transition sections.

Test Approval and Witness

All test plans and procedures established by ABL must be approved by LTV/Dallas prior to beginning of any test sequence. Approval by LTV/Dallas will be supplied on a timely basis upon receipt of a request for approval in order not to delay the test program.

All tests shall be witnessed by LTV/Dallas representatives. Sufficient notice of test operations shall be given LTV/Dallas so arrangements can be made to provide qualified witnesses.

Post-Test Inspection

a. Test A with the Loaded Motor Case

After completion of the tests as defined for Test A, all supporting structure shall be visually inspected for damage. (The loaded motor shall be processed per ABL special instructions upon completion of the test.)

b. Test B with the Unloaded Motor Case

After completion of the failing load tests as defined for Test B, the failures shall be sufficiently documented by sketches and photographs as required to define the failure.

Any failure of the GFE lower "D" transition or the upper and lower "C" transition section shall be documented and this hardware returned to LTV for additional inspection and investigation.

Any failure of the GFE unloaded motor case shall be documented. The motor case shall be sectioned as close as practical to the failure and the case wall thickness measured every 30° referenced about bolt hole No. 1.

Final Test Report

Upon completion of both Tests A and B, ABL shall prepare a formal test report to document the test results. This report shall be limited to the reporting of test results.

The formal test report shall contain a complete description of the test with drawings, sketches, and photographs to document the test program.

Data, consisting of deflections and strains, shall be reduced as required to be presented in tabular form for each increment of applied loads defined by load points presented in Tables 1 and 2. In addition, curves of deflection and strains vs. per cent of limit load shall be plotted for some typical gages. Specific data reduction requirements are presented in Section 4. All gages are to be located by Scout stations. Torsional and longitudinal displacement gages are also to be located radially.

One (1) reproducible copy and two (2) non-reproducible copies of the final test report shall be submitted to LTV/Dallas.

Upon receipt of the test report from the Test Facility, LTV/Dallas will analyze the test results and submit a final report to NASA which includes the test results and analysis of the test program.

Test Arrangement

During both phases of this test program, the ABL X259 unit will be mounted in the vertical position between a Scout production lower "D" transition section (structural shell only) and a production upper "C" transition section (structural shell only). The upper "C" section will be attached by use of a production diaphragm separation system to a production lower "C" section (structural shell only) which will be attached to the bay floor with ABL-supplied base hardware. Adapters, also ABL supplied, will be used and attached to the Scout lower "D" section for application of the shear, axial, bending and torsional loads to the ABL X259 unit.

A schematic of the test setup is presented in Figures 1 and 2.

The loaded motor, empty case, Scout lower "D" transition section, and Scout upper and lower "C" transition sections, including a separation diaphragm, will be supplied as Government-Furnished Equipment (GFE). It should be noted that only the structural shells, with all components removed, will be required for the Scout production transition sections.

ABL will supply the hydraulic loading cylinders and all associated equipment.

This test plan is divided into the following parts: Section I, Introduction; Section II, Test A for the loaded motor case; Section III, Test B for the unloaded motor case, and Section IV which establishes the instrumentation, test reports and general information which is common to both tests.

A 20% load (load point 2 for loaded motor, load point 9 for empty motor) will be manually applied to all load jacks immediately prior to conducting the test. The Visicorders will be run for a period of 5 seconds. All data channels not recorded on Visicorder will be manually recorded from the digital monitors on an appropriate data sheet. The Visicorder record and digital readings will be inspected for proper ranging and recording.

SECTION II

ABL X259 Loaded Motor Test

Test A

Purpose

The purpose of the loaded motor test program is to evaluate the effects of the application of Scout flight loads on an ABL X259 motor case prior to ignition and firing of the case. This condition is a design condition for both the Scout vehicle transition sections as well as the ABL X259 motor. This condition is considered very realistic, and it could be obtained during the flight regimes of the Scout Program.

ABL X259 motor S/N HPC-126 has been assigned to this test program. This motor has been in storage for a period of time in excess of the current motor storage period shelf life, and a successful operation would extend the current shelf life limitation. A separate test plan will be issued for firing the motor after application of the Scout design loads.

Test Arrangement

For this test program, an ABL X259 loaded motor, a Scout lower "D" transition section, and a Scout upper and lower "C" transition section including a separation diaphragm will be required. As noted in Section I, only the structural shells, with all components removed, will be required for the Scout production transition sections.

Instrumentation requirements are presented in Section IV.

The test arrangement will be in accordance with ABL drawing 60158S42001.

Motor Preparation

Prior to installation of the ABL X259 loaded motor case into the test fixture, it shall be inspected in accordance with ABL final inspection procedure to (1) determine the effects of the prior storage life test and (2) to establish the flight integrity of the motor. Upon completion of the structural load test, the motor case shall again be subjected to the same inspection criteria as before the test to determine any adverse effects on the motor case resulting from the structural loading test.

Test Loads

The loaded motor case will be subjected to the structural loading profile (loads and sequence) presented in Table 1. Simultaneous loads will be applied with hydraulic cylinders (jacks) at three (3) locations as shown in Figures 1 and 2. In Table 1, the three (3) loads are

described as Shear Load A, Shear Load B, and Axial Load. Note that Shear Load A subjects the structure to both torsional loads and bending moments.

TABLE 1

TEST SEQUENCE AND TEST LOADS
Loaded Motor - Test A

Load Point	% Axial	% Bending	Shear Load A (lbs)	Shear Load B (lbs)	Net Shear (lbs)	Axial Load (lbs)	Bending Moment (in-lbs)	Torsion (in-lbs)
1	0	0	0	0	0	0	0	0
2	20	20	1067	408	659	4,080	120,000	16,800
3	40	40	2133	817	1316	8,160	240,000	33,600
4	60	60	3200	1225	1975	12,240	360,000	50,400
5	67	67	3573	1368	2205	13,680	402,000	56,280
6	67	80	4266	1634	2632	13,680	480,000	67,200
7	67	100	5333	2042	3291	13,680	600,000	84,000
8	80	100	5333	2042	3291	16,320	600,000	84,000
9	100	100	5333	2042	3291	20,400	600,000	84,000
10	115	115	6133	2348	3785	23,460	690,000	96,600
11	20	20	1067	408	659	4,080	120,000	16,800
12	0	0	0	0	0	0	0	0

NOTES:

1. Per cent bending moment refers to per cent shear load, bending moments and torsional loads.

2. Load point 7 represents limit shear, bending moments and torsional loads combined with minimum axial load for this test condition.

3. Load point 9 represents limit shear, bending moments and torsional loads combined with maximum axial load for this test condition.

4. All loads are referenced to the ABL X259 aft thrust face, Scout Station 191.95.

SECTION III

ABL X259 Unloaded Motor Test

Test B

Purpose

The purpose of this unloaded motor test is to establish the structural failing load capabilities of the ABL X259 unloaded motor case, the Scout lower "D" transition section and the Scout upper and lower "C" transition sections.

Test Arrangement

For this test program, an ABL X259 unloaded motor case, a Scout lower "D" transition section, and a Scout upper and lower "C" transition section including a separation diaphragm will be required. These components will be supplied as Government-Furnished Equipment (GFE). As noted in Section I (and the loaded motor test), only the structural shells, with all components removed, will be required for the Scout production transition sections.

Instrumentation requirements are presented in Section IV.

The test arrangement will be in accordance with ABL Dwg. 601585420O1.

Test Loads

The unloaded motor case will be subjected to the structural loading profile (60 load points) presented in Table 2. As in the loaded motor test (Test A), simultaneous loads will be applied with hydraulic cylinders (jacks) at three (3) locations as shown in Figures 1 and 2. In Table 2, the three (3) loads are described as Shear Load A, Shear Load B, and Axial Load.

NOTE: For the test on the unloaded motor case, after application of 150% limit design loads (Load Point 27, Table 2), deflection measurement instruments that are subject to damage as a result of test failure may be removed. All remaining instrumentation must be recorded to the point of failure.

TABLE 2

TEST SEQUENCE AND TEST LOADS
Empty Chamber - Test B

Load Point	% Axial	% Shear	Shear Load A (lbs)	Shear Load B (lbs)	Net Shear (lbs)	Axial Load Sta. 253.06 (lbs)	Moment 131.1 (in-lbs)	Moment 191.95 (in-lbs)	Moment 238.18 (in-lbs)	Moment 253.06 (in-lbs)
1	0	0	0	0	0	0	0	0	0	0
2	0	20	927	358	569	0	69,400	104,000	130,350	138,950
3	0	40	1855	716	1139	0	138,800	208,000	260,700	277,900
4	0	60	2780	1075	1705	0	208,200	312,000	391,050	416,850
5	0	80	3710	1430	2280	0	277,600	416,000	521,400	555,800
6	0	100	4635	1790	2845	0	347,000	520,000	651,750	694,750
7	0	20	927	358	569	0	69,400	104,000	130,350	138,950
8	0	0	0	0	0	0	0	0	0	0
9	20	20	927	358	569	4,270	69,400	104,000	130,350	138,950
10	40	40	1855	716	1139	8,540	138,800	208,000	260,700	277,900
11	60	60	2780	1075	1705	12,810	208,200	312,000	391,050	416,850
12	80	80	3710	1430	2280	17,080	277,600	416,000	521,400	555,800
13	100	100	4635	1790	2845	21,350	347,000	520,000	651,750	694,750
14	100	115	5330	2060	3270	21,350	399,050	598,000	749,500	798,960
15	115	115	5330	2060	3270	24,553	399,050	598,000	749,500	798,960
16	100	100	4635	1790	2845	21,350	347,000	520,000	651,750	694,750
17	0	100	4635	1790	2845	0	347,000	520,000	651,750	694,750
18	0	115	5330	2060	3270	0	399,050	598,000	749,500	798,960
19	0	130	6030	2320	3710	0	451,100	676,000	847,275	903,175
20	0	115	5330	2060	3270	0	399,050	598,000	749,500	798,960
21	100	115	5330	2060	3270	21,350	399,050	598,000	749,500	798,960
22	100	130	6030	2320	3710	21,350	451,100	676,000	847,275	903,175
23	100	140	6490	2500	3990	21,350	485,800	728,000	912,450	972,650
24	100	150	6950	2680	4270	21,350	520,500	780,000	977,625	1,042,125
25	115	150	6950	2680	4270	24,553	520,500	780,000	977,625	1,042,125
26	130	150	6950	2680	4270	27,755	520,500	780,000	977,625	1,042,125
27	150	150	6950	2680	4270	32,000	520,500	780,000	977,625	1,042,125
28	130	130	6030	2320	3710	27,755	451,100	676,000	847,275	903,175
29	0	130	6030	2320	3710	0	451,100	676,000	847,275	903,175
30	0	140	6490	2500	3990	0	485,800	728,000	912,450	972,650

TABLE 2 CONTINUED

Load Point	% Axial	% Shear	Shear Load A (lbs)	Shear Load B (lbs)	Net Shear (lbs)	Axial Load Sta. 253.06 (lbs)	Moment 131.1 (in-lbs)	Moment 191.95 (in-lbs)	Moment 238.18 (in-lbs)	Moment 253.06 (in-lbs)
31	0	150	6950	2680	4270	0	520,500	780,000	977,625	1,042,125
32	100	150	6950	2680	4270	21,350	520,500	780,000	977,625	1,042,125
33	125	150	6950	2680	4270	26,688	520,500	780,000	977,625	1,042,125
34	150	150	6950	2680	4270	32,000	520,500	780,000	977,625	1,042,125
35	160	160	7410	2860	4550	34,160	555,200	832,000	1,042,800	1,111,600
36	170	170	7880	3040	4840	36,295	589,900	884,000	1,107,975	1,181,075
37	150	150	6950	2680	4270	32,000	520,500	780,000	977,625	1,042,125
38	125	150	6950	2680	4270	26,688	520,500	780,000	977,625	1,042,125
39	100	150	6950	2680	4270	21,350	520,500	780,000	977,625	1,042,125
40	0	150	6950	2680	4270	0	520,500	780,000	977,625	1,042,125
41	0	160	7410	2860	4550	0	555,200	832,000	1,042,800	1,111,600
42	0	170	7880	3040	4840	0	589,900	884,000	1,107,975	1,181,075
43	100	170	7880	3040	4840	21,350	589,900	884,000	1,107,975	1,181,075
44	150	170	7880	3040	4840	32,000	589,900	884,000	1,107,975	1,181,075
45	170	170	7880	3040	4840	36,295	589,900	884,000	1,107,975	1,181,075
46	180	180	8350	3220	5130	38,430	624,600	936,000	1,173,150	1,250,550
47	190	190	8800	3400	5400	40,565	659,300	988,000	1,238,325	1,320,025
48	170	170	7880	3040	4840	36,295	589,900	884,000	1,107,975	1,181,075
49	100	170	7880	3040	4840	21,350	589,900	884,000	1,107,975	1,181,075
50	0	170	7880	3040	4840	0	589,900	884,000	1,107,975	1,181,075
51	0	180	8350	3220	5130	0	624,600	936,000	1,173,150	1,250,550
52	0	190	8800	3400	5400	0	659,300	988,000	1,238,325	1,320,025
53	100	190	8800	3400	5400	21,350	659,300	988,000	1,238,325	1,320,025
54	150	190	8800	3400	5400	32,000	659,300	988,000	1,238,325	1,320,025
55	190	190	8800	3400	5400	40,565	659,300	988,000	1,238,325	1,320,025
56	200	200	9270	3580	5690	42,700	694,000	1,040,000	1,303,500	1,389,500
57	210	210	9720	3760	5960	44,835	728,700	1,092,000	1,368,675	1,458,975
58	230	230	10,653	4110	6543	49,000	798,500	1,167,000	1,500,000	1,600,000
59	250	250	11,587	4475	7112	53,375	868,000	1,297,000	1,630,000	1,732,000
60	0	0	0	0	0	0	0	0	0	0

Torsion at all load points and all stations is equal to shear load A times 15.75 inches.

See notes on the following page.

NOTES FOR TABLE 2

1. Load point 6 represents the yield tension load condition.
2. Load point 13 represents the limit compression load condition.
3. Load point 15 represents the yield compression load condition.
4. Load point 19 represents the ultimate tension load condition.
5. Load point 24 represents ultimate bending moment and minimum axial load on lower "C".
6. Load point 25 represents ultimate bending moment and axial load on the ABL X259 motor.
7. Load point 26 represents ultimate bending moment and axial load on upper "C".
8. Load point 27 represents ultimate bending moment and axial load on lower "C".
9. Load point 31 represents 173% of the limit tension load condition.
10. Load point 36 represents 170% of the limit compression load condition.
11. Load point 42 represents 196% of the limit tension load condition.
12. Load point 47 represents 190% of the limit compression load condition.
13. Load point 52 represents 219% of the limit tension load condition.
14. Load point 57 represents 210% of the limit compression load condition.
15. Load point 59 represents 250% of the limit compression load condition.

SECTION IV

Instrumentation, Data Reduction, and Photographic Requirements

Data Recording

Data for all instrumentation will be recorded per attached Instrumentation Requirements sheets.

All Visicorders will be operated at one (1) inch per second during calibration and testing. There will be a common time indication on all recording systems to facilitate hand data reduction work on oscillographic records.

Photographic Coverage

Motion picture coverage will be required as specified at the time of the test. It is anticipated that two (2) cameras (64 fps) will be employed and positioned per instructions from the test conductor.

Still black and white photographs will be required of the final test setup and following the test.

The test conductor will inform the Photographic Department regarding camera angles and areas of particular interest. Three (3) sets of 8 x 10 prints will be delivered to the test conductor for distribution.

Schedule for Data Processing, Delivery, and Distribution

X-Range

All processed Visicorder records and the original copy of the Test Data Acquisition Sheet(s) will be delivered to the test conductor after each test. The test conductor will be responsible for delivering to the Computing Department those Visicorder records requiring data reduction.

Computing

The digital data will be listed through a special program in which data will be printed out at particular load points (times). The specific times at which data will be listed will be indicated by the test conductor.

Reduction of Visicorder records will be handled in a similar manner. The test conductor will indicate on each record the times (locations) where data are to be reduced. All Visicorder channels will be tabulated for each load point and will be returned to the test conductor in standard engineering printout form.

After review of the digital data, the Computing Department will be instructed on data to be plotted and the format to be employed.

All linear potentiometers (LP's) should be considered as going plus (+) and minus (-), regardless of the Test Data Acquisition Sheet (DAS "road map").

SECTION IV

Instrumentation Requirements

Gage No.		Location	Max. Expected Value	Calibration	Recording
PG1		Shear Program		± 1	04 Vis.
PG2		Axial Program		± 1	04 Vis.
VC1		Valve Current for Shear Load A	± 15 MA	± 1	04 Vis.
VC2		Valve Current for Shear Load B	± 15 MA	± 1	04 Vis.
VC3		Valve Current for Axial Load	± 15 MA	± 1	04 Vis.
FB1		Feedback from F1	11.6 K	- 1	04 Vis.
FB2		Feedback from F2	4.5 K	+ 1	04 Vis.
FB3		Feedback from F3	54 K	+ 1	04 Vis.
P1		Hyd. Pressure (Shear Load A)	2810 psig	± 4	04 Vis.
P2		Hyd. Pressure (Shear Load B)	920 psig	± 4	04 Vis.
P3		Hyd. Pressure (Axial Load)	2310 psig	± 4	04 Vis.
F1		Force Gage A	11.6 K	± 4	04 Vis., D400
F2		Force Gage B	4.5 K	± 4	04 Vis., D400
F3		Force Gage - Axial	54 K	± 4	04 Vis., D400
	S1A	Upper C/Sta. 194/270° (Axial)	0.3%	± 1	Tunnel Vis.
R1	S1B	Upper C/Sta. 194/270° (45°)	0.3%	± 1	Tunnel Vis.
	S1C	Upper C/Sta. 194/270° (Hoop)	0.3%	± 1	Tunnel Vis.
	S2A	Upper C/Sta. 194/90° (Axial)	0.3%	± 1	D300, 06 Vis.
R2	S2B	Upper C/Sta. 194/90° (45°)	0.3%	± 1	D300, 06 Vis.
	S2C	Upper C/Sta. 194/90° (Hoop)	0.3%	± 1	D300, 06 Vis.
	S3A	Upper C/Sta. 235/270° (Axial)	0.3%	± 1	Tunnel Vis.
R3	S3B	Upper C/Sta. 235/270° (45°)	0.3%	± 1	Tunnel Vis.
	S3C	Upper C/Sta. 235/270° (Hoop)	0.3%	± 1	Tunnel Vis.
	S4A	Upper C/Sta. 235/90° (Axial)	0.3%	± 1	D300, 06 Vis.
R4	S4B	Upper C/Sta. 235/90° (45°)	0.3%	± 1	D300, 06 Vis.
	S4C	Upper C/Sta. 235/90° (Hoop)	0.3%	± 1	D300, 06 Vis.
	S5A	X259/Sta. 137/270° (Axial)	1%	± 1	Tunnel Vis.
R5	S5B	X259/Sta. 137/270° (45°)	1%	± 1	Tunnel Vis.
	S5C	X259/Sta. 137/270° (Hoop)	1%	± 1	Tunnel Vis.

Instrumentation Requirements Continued

Gage No.		Location	Max. Expected Value	Calibration	Recording
	S6A	X259/Sta. 153/270° (Axial)	1%	± 1	Tunnel Vis.
R6	S6B	X259/Sta. 153/270° (45°)	1%	± 1	Tunnel Vis.
	S6C	X259/Sta. 153/270° (Hoop)	1%	± 1	Tunnel Vis.
	S7A	X259/Sta. 170/270° (Axial)	1%	± 1	Tunnel Vis.
R7	S7B	X259/Sta. 170/270° (45°)	1%	± 1	Tunnel Vis.
	S7C	X259/Sta. 170/270° (Hoop)	1%	± 1	Tunnel Vis.
	S8A	X259/Sta. 185/270° (Axial)	1%	± 1	Tunnel Vis.
R8	S8B	X259/Sta. 185/270° (45°)	1%	± 1	Tunnel Vis.
	S8C	X259/Sta. 185/270° (Hoop)	1%	± 1	Tunnel Vis.
	S9A	X259/Sta. 137/90° (Axial)	1%	± 1	D300, 06 Vis.
R9	S9B	X259/Sta. 137/90° (45°)	1%	± 1	D300, 06 Vis.
	S9C	X259/Sta. 137/90° (Hoop)	1%	± 1	D300, 06 Vis.
	S10A	X259/Sta. 153/90° (Axial)	1%	± 1	D300
R10	S10B	X259/Sta. 153/90° (45°)	1%	± 1	D300
	S10C	X259/Sta. 153/90° (Hoop)	1%	± 1	D300
	S11A	X259/Sta. 170/90° (Axial)	1%	± 1	D300
R11	S11B	X259/Sta. 170/90° (45°)	1%	± 1	D300
	S11C	X259/Sta. 170/90° (Hoop)	1%	± 1	D300
	S12A	X259/Sta. 185/90° (Axial)	1%	± 1	D300, 06 Vis.
R12	S12B	X259/Sta. 185/90° (45°)	1%	± 1	D300, 06 Vis.
	S12C	X259/Sta. 185/90° (Hoop)	1%	± 1	D300, 06 Vis.
	S13	Lower D/Sta. 129/180° (Axial)	0.3%	± 1	D400, 03 Vis.
	S14	Lower D/Sta. 129/90° (Axial)	0.3%	± 1	D300
	S15	Lower D/Sta. 129/60° (Axial)	0.3%	± 1	Tunnel Vis.
	S16	Lower D/Sta. 129/15° (Axial)	0.3%	± 1	Tunnel Vis.
	S17	Lower D/Sta. 129/300° (Axial)	0.3%	± 1	Tunnel Vis.
	S18	Lower D/Sta. 129/270° (Axial)	0.3%	± 1	Tunnel Vis.
	S19	Lower D/Sta. 129/180° (Axial)	0.3%	± 1	D400, 03 Vis.
	S20	Lower D/Sta. 106/90° (Axial)	0.3%	± 1	D300
	S21	Lower D/Sta. 106/60° (Axial)	0.3%	± 1	Tunnel Vis.

Instrumentation Requirements Continued

Gage No.	Location	Max. Expected Value	Calibration	Recording
S22	Lower D/Sta. 106/0° (Axial)	0.3%	± 1	D300
S23	Lower D/Sta. 106/300° (Axial)	0.3%	± 1	Tunnel Vis.
S24	Lower D/Sta. 106/270° (Axial)	0.3%	± 1	Tunnel Vis.
S25	Upper C/Sta. 194/180° (Axial)	0.3%	± 1	D400, 03 Vis.
S26	Upper C/Sta. 194/135° (Axial)	0.3%	± 1	Tunnel Vis.
S27	Upper C/Sta. 194/45° (Axial)	0.3%	± 1	Tunnel Vis.
S28	Upper C/Sta. 194/0° (Axial)	0.3%	± 1	D300
S29	Upper C/Sta. 194/315° (Axial)	0.3%	± 1	Tunnel Vis.
S30	Upper C/Sta. 194/225° (Axial)	0.3%	± 1	Tunnel Vis.
S31	Upper C/Sta. 225.5/135° (Axial)	0.3%	± 1	Tunnel Vis.
S32	Upper C/Sta. 225.5/315° (Axial)	0.3%	± 1	Tunnel Vis.
S33	Upper C/Sta. 235/180° (Axial)	0.3%	± 1	D400, 03 Vis.
S34	Upper C/Sta. 235/45° (Axial)	0.3%	± 1	Tunnel Vis.
S35	Upper C/Sta. 235/0° (Axial)	0.3%	± 1	Tunnel Vis.
S36	Upper C/Sta. 235/225° (Axial)	0.3%	± 1	Tunnel Vis.
S37	Lower C/Sta. 241/180° (Axial)	0.3%	± 1	D400, 03 Vis.
S38	Lower C/Sta. 241/90° (Axial)	0.3%	± 1	D300
S39	Lower C/Sta. 241/0° (Axial)	0.3%	± 1	Tunnel Vis.
S40	Lower C/Sta. 241/270° (Axial)	0.3%	± 1	Tunnel Vis.
S41	Lower C/Sta. 250.5/180° (Axial)	0.3%	± 1	D400, 03 Vis.
S42	Lower C/Sta. 250.5/90° (Axial)	0.3%	± 1	D300
S43	Lower C/Sta. 250.5/0° (Axial)	0.3%	± 1	Tunnel Vis.
S44	Lower C/Sta. 250.5/270° (Axial)	0.3%	± 1	Tunnel Vis.

Instrumentation Requirements Continued

Gage No.	Location	Max. Expected Value	Calibration	Recording
S45	X259/Sta. 137/180° (Axial)	1%	± 1	D400, 03 Vis.
S46	X259/Sta. 153/180° (Axial)	1%	± 1	D400, 03 Vis.
S47	X259/Sta. 170/180° (Axial)	1%	± 1	D400, 03 Vis.
S48	X259/Sta. 185/180° (Axial)	1%	± 1	D400, 03 Vis.
S49	X259/Sta. 137/0° (Axial)	1%	± 1	D400
S50	X259/Sta. 153/0° (Axial)	1%	± 1	D400
S51	X259/Sta. 170/0° (Axial)	1%	± 1	D400
S52	X259/Sta. 185/0° (Axial)	1%	± 1	D400
LP1	Lower D - 0° Sta. 103.69 (Radial)	2"	± 4	D400
LP2	Lower D - 90° Sta. 103.69 (Radial)	0.5"	± 4	D300
LP3	Lower D - 180° Sta. 103.69 (Radial)	2"	± 4	D400 (Phase I), 03 Vis.
LP4	Lower D - 270° Sta. 103.69 (Radial)	0.5"	± 4	Tunnel Vis.
LP5	X259 Case - 0° Sta. 131.1 (Radial)	1.5"	± 4	D400
LP6	X259 Case - 90° Sta. 131.1 (Radial)	0.5"	± 4	D300
LP7	X259 Case - 180° Sta. 131.1 (Radial)	1.5"	± 4	D400 (Phase I), 03 Vis.
LP8	X259 Case - 270° Sta. 131.1 (Radial)	0.5"	± 4	D400 (Phase I), 03 Vis.
LP9	X259 Case - 0° Sta. 161.35 (Radial)	1.0"	± 4	D400
LP10	X259 Case - 90° Sta. 161.35 (Radial)	0.25"	± 4	D300

Instrumentation Requirements Continued

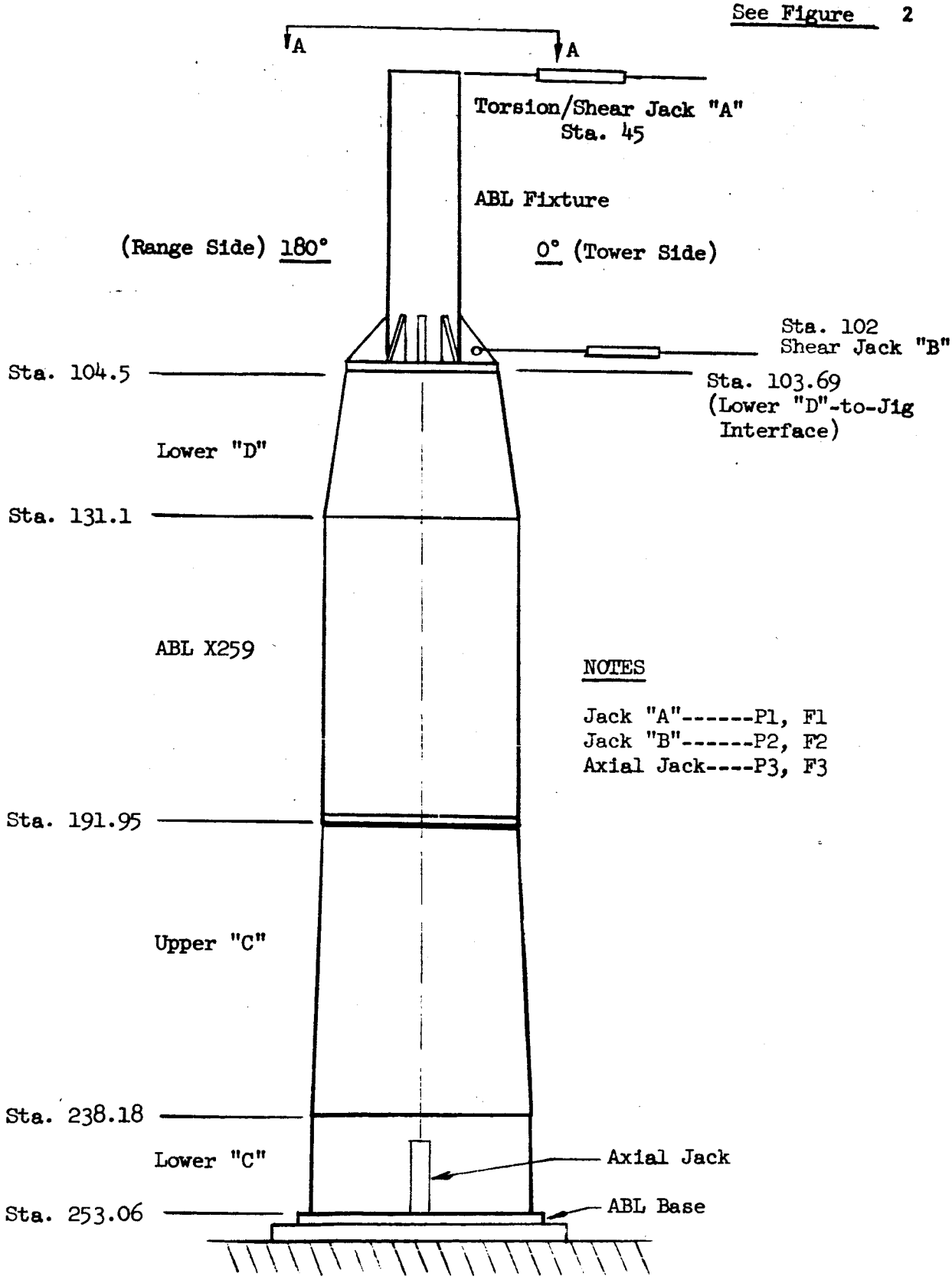
Gage No.	Location	Max. Expected Value	Calibration	Recording
LP11	X259 Case - 180° Sta. 161.35 (Radial)	1.0"	± 4	D400 (Phase I), 03 Vis.
LP12	X259 Case - 270° Sta. 161.35 (Radial)	0.25"	± 4	Tunnel Vis.
LP13	X259 Case - 0° Sta. 191.95 (Radial)	0.6"	± 4	D400
LP14	X259 Case - 90° Sta. 191.95 (Radial)	0.25"	± 4	D300
LP15	X259 Case - 180° Sta. 191.95 (Radial)	0.6"	± 4	D400 (Phase I), 03 Vis.
LP16	X259 Case - 270° Sta. 191.95 (Radial)	0.25"	± 4	Tunnel Vis.
LP17	Upper C - 0° Sta. 234.5 (Radial)	0.05"	± 4	D400
LP18	Upper C - 90° Sta. 234.5 (Radial)	0.02"	± 4	D300
LP19	Upper C - 180° Sta. 234.5 (Radial)	0.05"	± 4	D400 (Phase I), 03 Vis.
LP20	Upper C - 270° Sta. 234.5 (Radial)	0.02"	± 4	Tunnel Vis.
LP21	Lower C - 0° Sta. 241.5 (Radial)	0.02"	± 4	D400
LP22	Lower C - 90° Sta. 241.5 (Radial)	0.02"	± 4	D300
LP23	Lower C - 180° Sta. 241.5 (Radial)	0.02"	± 4	D400 (Phase I), 03 Vis.
LP24	Lower C - 270° Sta. 241.5 (Radial)	0.02"	± 4	D400
LP25	X259 Case - 90° Sta. 131.1 (Torsional)	0.8"	± 4	D400, 08 Vis.
LP26	X259 Case - 270° Sta. 131.1 (Torsional)	0.8"	± 4	D400, 08 Vis.

Instrumentation Requirements Continued

Gage No.	Location	Max. Expected Value	Calibration	Recording
LP27	X259 Case - 90° Sta. 191.95 (Torsional)	0.5"	± 4	D400, 08 Vis.
LP28	X259 Case - 270° Sta. 191.95 (Torsional)	0.5"	± 4	D400, 08 Vis.
LP29	Upper C - 90° Sta. 234.5 (Torsional)	0.5"	± 4	D400, 08 Vis.
LP30	Upper C - 270° Sta. 234.5 (Torsional)	0.5"	± 4	D400, 08 Vis.
LP31	Lower C - 90° Sta. 241.5 (Torsional)	0.2"	± 4	D400, 08 Vis.
LP32	Lower C - 270° Sta. 241.5 (Torsional)	0.2"	± 4	D400, 08 Vis.
LP33	Axial Growth - 0° Sta. 131.1	0.2"	± 4	D400
LP34	Axial Growth - 90° Sta. 131.1	0.2"	± 4	D400 (Phase I), 03 Vis.
LP35	Axial Growth - 180° Sta. 131.1	0.2"	± 4	D400 (Phase I), 03 Vis.
LP36	Axial Growth - 270° Sta. 131.1	0.2"	± 4	D400 (Phase I), 03 Vis.
LP37	Axial Growth - 0° Sta. 191.95	0.2"	± 4	D400
LP38	Axial Growth - 90° Sta. 191.95	0.2"	± 4	D400 (Phase I), 04 Vis.
LP39	Axial Growth - 180° Sta. 191.95	0.2"	± 4	D400 (Phase I), 04 Vis.
LP40	Axial Growth - 270° Sta. 191.95	0.2"	± 4	D400 (Phase I), 04 Vis.
LP41	Interface - 0° Sta. 238.18 (Axial)	0.02"	± 4	D400
LP42	Interface - 90° Sta. 238.18 (Axial)	0.02"	± 4	D400

Instrumentation Requirements Continued

Gage No.	Location	Max. Expected Value	Calib-ration	Recording
LP43	Interface - 180° Sta. 238.18 (Axial)	0.02"	± 4	D400 (Phase I), 04 Vis.
LP44	Interface - 270° Sta. 238.18 (Axial)	0.02"	± 4	D400 (Phase I), 04 Vis.

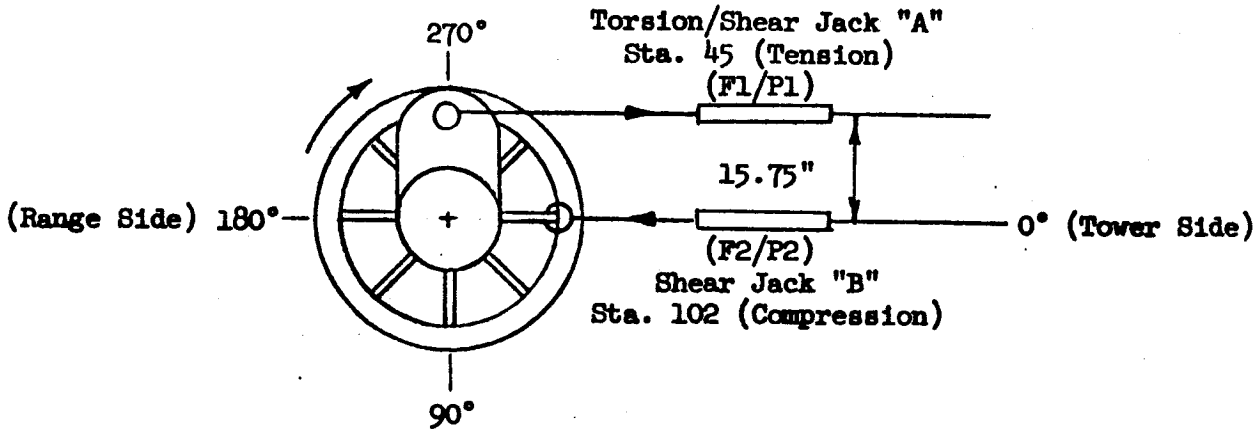


Test Arrangement

Figure 1

APPENDIX A

See Figure 1



View AA

Looking Aft

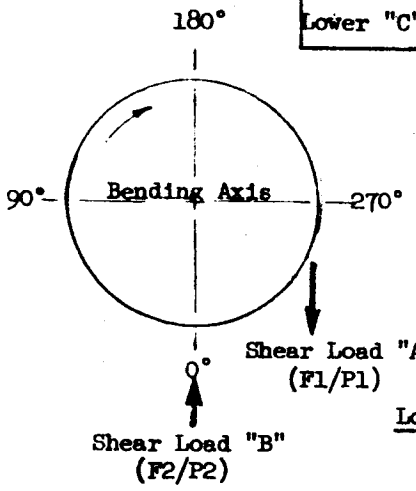
Test Arrangement

Figure 2

APPENDIX A

Station \ Degree		0°	15°	30°	45°	60°	90°	135°	180°	225°	270°	300°	315°
Lower "D"	106	S22	---	---	---	S21	S20	----	S19	----	S24	S23	----
	129	---	S16	---	---	S15	S14	----	S13	----	S18	S17	----
Upper "C"	194	S28	---	---	S27	---	R2	S26	S25	S30	R1	----	S29
	225	---	---	---	---	---	---	S31	----	----	----	----	S32
	235	S35	---	---	S34	---	R4	----	S33	S36	R3	----	----
Lower "C"	241	S39	---	---	---	---	S38	----	S37	----	S40	----	----
	250	S43	---	---	---	---	S42	----	S41	----	S44	----	----

Transition Sections "C" and "D"

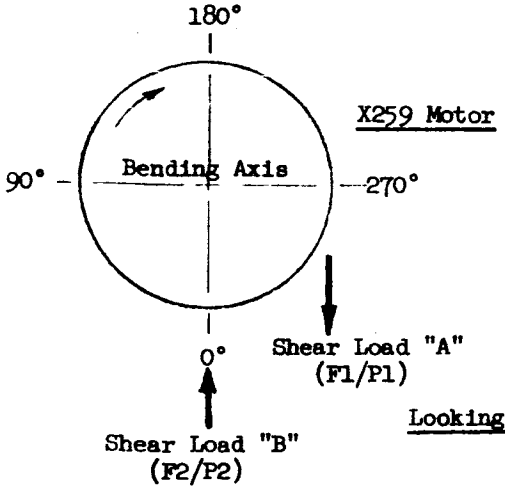


Looking Aft

NOTES:

All "S" gages are axial-oriented.
All "R" gages are 3-gage rosette type.
"C" and "D" section gages installed by LTV.

Gage locations are approximate. For exact locations, see LTV drawing AVDL-Scout-334.



Looking Aft

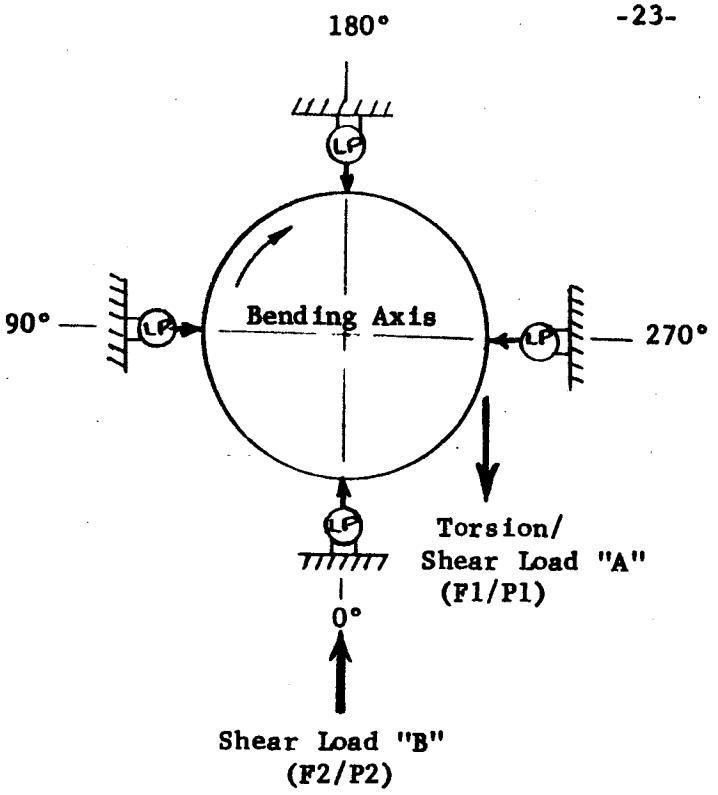
Station \ Degree	0°	90°	180°	270°
137	S49	R9	S45	R5
153	S50	R10	S46	R6
170	S51	R11	S47	R7
185	S52	R12	S48	R8

NOTES:

All "S" gages are axial-oriented.
All "R" gages are 3-gage rosette type.
Gages on motor case installed by ABL.

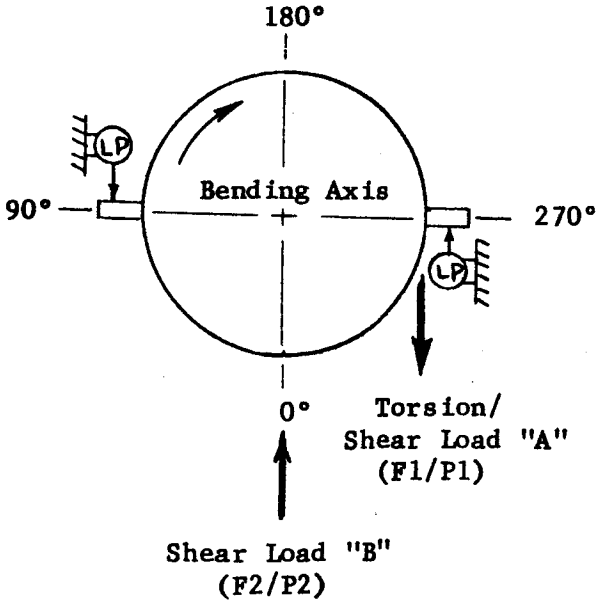
Strain Gage Locations

Figure 3



View Looking Aft (Down)

Radial LP Gage Locations				
Station \ Degree	0°	90°	180°	270°
103.69	LP1	LP2	LP3	LP4
131.1	LP5	LP6	LP7	LP8
161.35	LP9	LP10	LP11	LP12
191.95	LP13	LP14	LP15	LP16
234.5	LP17	LP18	LP19	LP20
241.5	LP21	LP22	LP23	LP24



View Looking Aft (Down)

Torsional LP Gage Locations

Station \ Degree	90°	270°
131.1	LP25	LP26
191.95	LP27	LP28
234.5	LP29	LP30
241.5	LP31	LP32

NOTE: Station locations are approximate. Exact locations to be established upon installation.

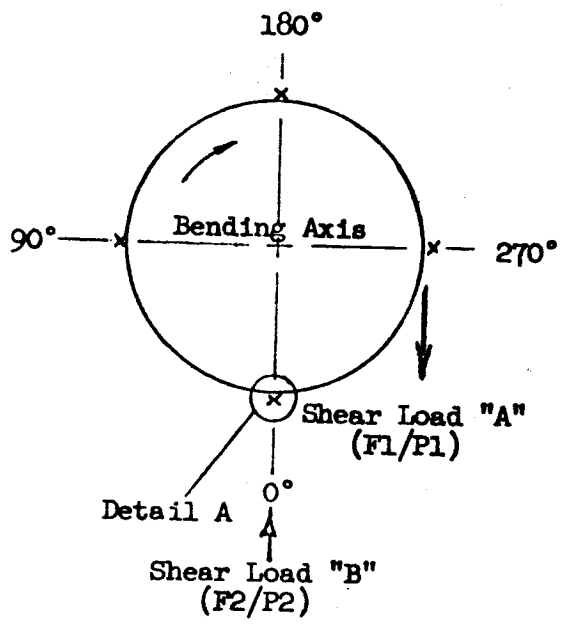
Radial and Torsional Displacement Gage Locations

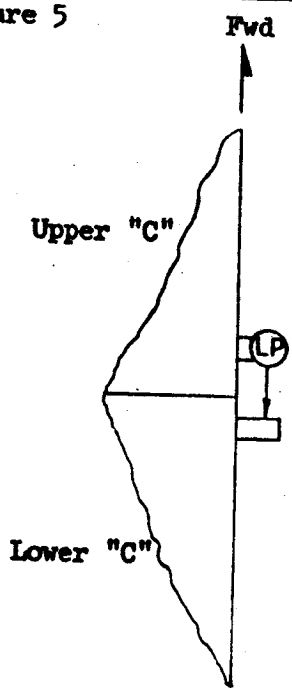
Figure 4

Longitudinal Displacement Gage Locations

Figure 5

All views looking aft (down).



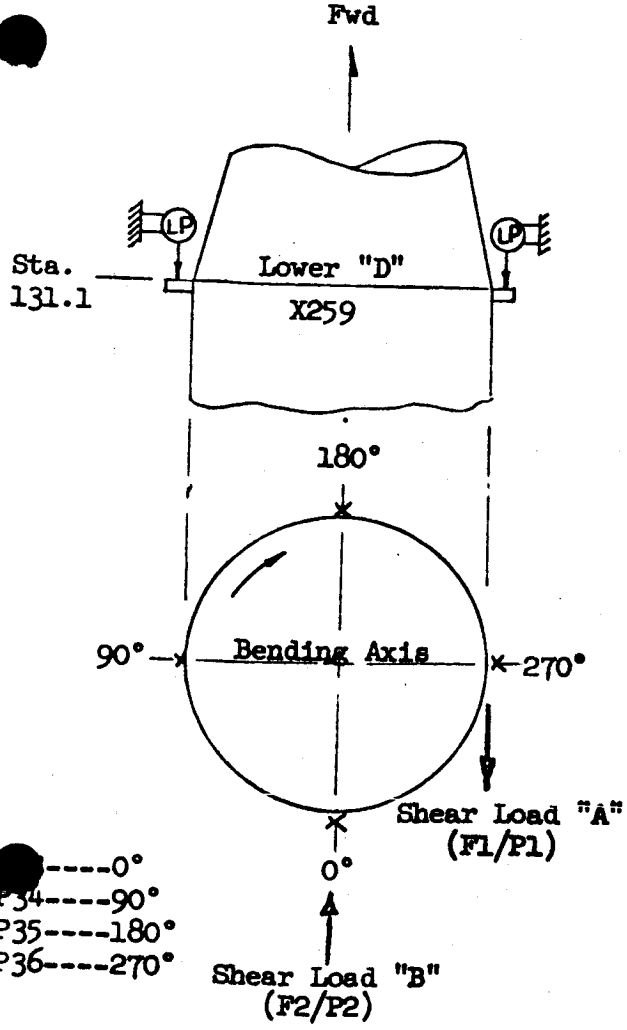


Detail A
Typical 4 Places

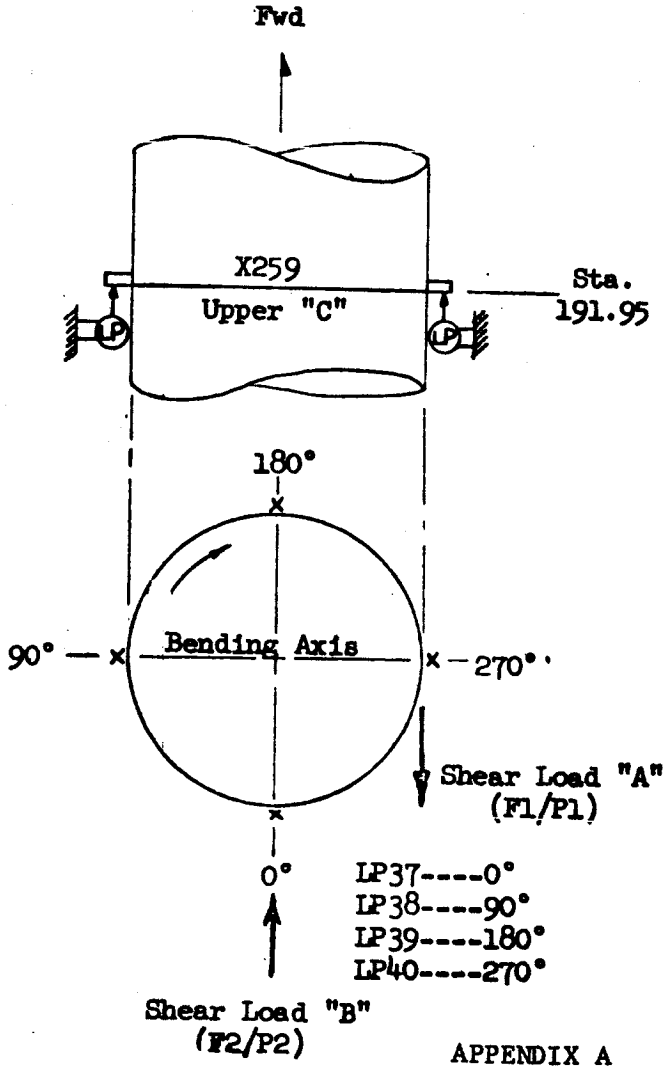
Sta. 238.18*

LP41----0°
LP42----90°
LP43----180°
LP44----270°

*These 4 LP's to measure gap at interface.



LP34----90°
LP35----180°
LP36----270°



LP37----0°
LP38----90°
LP39----180°
LP40----270°

APPENDIX B

Static Firing
ABL X259 Motor S/N HPC-126

Test Plan

HERCULES POWDER COMPANY
Allegany Ballistics Laboratory
Cumberland, Maryland

Test Plan

Static Firing
ABL X259 Motor S/N HPC-126

Contract: NAS 1-3899

Prepared By: D. W. Fuller
Development Engineering Testing
January 13, 1966

This test plan has been approved by the undersigned.

E. A. Stair

S. H. Harris

Reviewed By:

Testing Department

DCASO/ABL 2.1.66

Introduction

This will be a static firing at ABL of X259 motor S/N HPC-126. Prior to the static test, the motor will be subjected to a structural load test program in accordance with the requirements of LTV Report No. 23.220; a separate ABL test plan, dated December 10, 1965, has been written for the structural test.

Scope

This test plan provides the specifications, instrumentation requirements, data reduction requirements, and photographic coverage for the test.

Test Control

Any change to this test plan must have prior approval of the Test Engineer. Changes to the test plan will be entered on X-Range test plans and Data Acquisition Sheets with the dates and initials of the Test Engineer. All changes will be documented on a deviation sheet enclosed in the data package.

Test Objectives

(1) To evaluate the effects of Scout simulated flight loads on ballistic performance.

(2) To determine motor ballistic information.

(3) To determine the feasibility of extending the current shelf life limitation.

(4) To obtain strain gage and thermocouple data during static testing.

Test Description

The motor will be fired on V-blocks in accordance with drawing ABL 259-A3-1-04-0001. Prior to firing, it will be temperature conditioned at 75 $\pm$ 5°F. for five (5) days' minimum. The firing bay also will be maintained at 75 $\pm$ 5°F. while the motor is in the bay; the bay door is to remain closed until just prior to firing (within one (1) hour).

Also required are pre and post-fire weights of the motor, igniter, and nozzle. Motor must be completely dry before post-fire weighing.

Forty-six (46) channels of instrumentation will be recorded. They are four (4) pressures, two (2) thrusts, twelve (12) C.A. thermocouples, and thirty-two (32) strain gages; see Figures 1 and 2.

The unit is to be water quenched immediately after burnout.

Data Recording

Data from all instrumentation will be recorded in accordance with the attached Instrumentation Requirements Sheets.

All Visicorders will be operated at one (1) inch per second for calibration and ten (10) inches per second for the static firing. All Visicorders will show ten (10) millisecond timing marks.

All thermocouples (12) are chromel-alumel.

Schedule for Data Processing, Delivery, and Distribution

X-Range

All processed Visicorder records and the originator's copy of the Test Data Acquisition Sheet will be delivered to the Development Test Engineer.

The original copy of the Test Data Acquisition Sheet and the digital tape will be delivered to Data Processing as soon as possible after the firing.

Data Processing

The digital tape will be processed as soon as possible for data reduction.

In addition to the individual gage listings, an average of the two (2) igniter pressures, two (2) chamber pressures, and two (2) thrust channels are to be included. Pressure and thrust integrals will also be required along with the calculated I_{sp} and action time.

Photographic Coverage

Four (4) colored still photographs are to be taken of the unit immediately prior to and after the firing. Two (2) still photos are to be taken of the forward end looking aft (one on each side) and two (2) still photos are to be taken of the aft end looking forward (one on each side). In the event of a malfunction, additional photographs will be required.

Five (5) movie cameras are to be employed during the firing. They are to be positioned as follows:

1. One (1) colored 1,000 F/Sec at aft right rear to cover 0-13 seconds.

2. One (1) colored 1,000 F/Sec, same as 1 above, to cover 13 to 26 seconds.

3. One (1) colored 1,000 F/Sec, same as 1 and 2 above, to cover 26 to 39 seconds.

The above three cameras to be sequenced to cover entire motor with exhaust plume in the center of picture.

4. One (1) colored 250 F/Sec at right rear aft to cover entire motor.

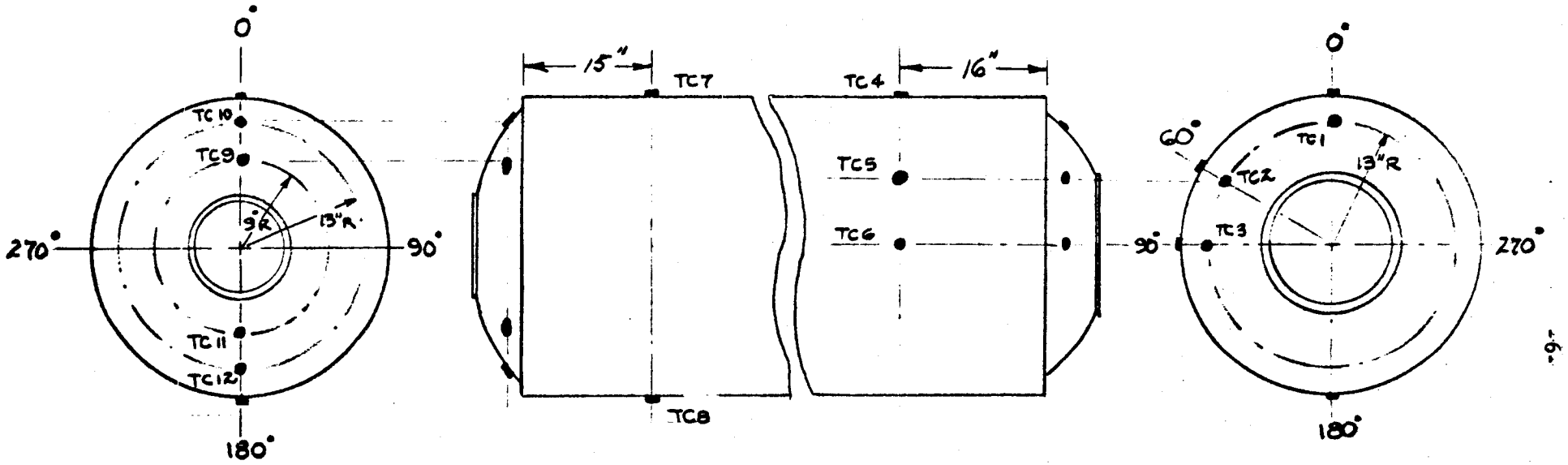
5. One (1) colored 250 F/Sec at left rear aft to cover entire motor.

Instrumentation Requirements

Gage No.	Location	Max. Expected Value	Calibration	Recording
P1	Igniter	800 psig	+ 4	03 Vis., FM, D400
P2	Igniter	800 psig	+ 4	03 Vis., FM, D400
P3	Chamber	400 psig	+ 4	03 Vis., FM, D400
P4	Chamber	400 psig	+ 4	03 Vis., FM, D400
F1	Fwd Thrust	17 K lbs	+ 4	03 Vis., FM, D400
F2	Fwd Thrust	17 K lbs	+ 4	03 Vis., FM, D400
S5A	X259/Sta. 137/270° (Axial)	2%	± 1	FM, D400
R5 S5B	X259/Sta. 137/270° (45°)	2%	± 1	FM, D400
S5C	X259/Sta. 137/270° (Hoop)	2%	± 1	FM, D400
S6A	X259/Sta. 153/270° (Axial)	2%	± 1	FM, D400
R6 S6B	X259/Sta. 153/270° (45°)	2%	± 1	FM, D400
S6C	X259/Sta. 153/270° (Hoop)	2%	± 1	FM, D400
S7A	X259/Sta. 170/270° (Axial)	2%	± 1	FM, D400
R7 S7B	X259/Sta. 170/270° (45°)	2%	± 1	FM, D400
S7C	X259/Sta. 170/270° (Hoop)	2%	± 1	FM, D400
S8A	X259/Sta. 185/270° (Axial)	2%	± 1	FM, D400
R8 S8B	X259/Sta. 185/270° (45°)	2%	± 1	FM, D400
S8C	X259/Sta. 185/270° (Hoop)	2%	± 1	FM, D400
S9A	X259/Sta. 137/90° (Axial)	2%	± 1	FM, D400
R9 S9B	X259/Sta. 137/90° (45°)	2%	± 1	FM, D400
S9C	X259/Sta. 137/90° (Hoop)	2%	± 1	FM, D400
S10A	X259/Sta. 153/90° (Axial)	2%	± 1	FM, D400
R10 S10B	X259/Sta. 153/90° (45°)	2%	± 1	FM, D400
S10C	X259/Sta. 153/90° (Hoop)	2%	± 1	FM, D400

Instrumentation Requirements Continued

	Gage No.	Location	Max. Expected Value	Calibration	Recording
R11	S11A	X259/Sta. 170/90° (Axial)	2%	± 1	FM, D400
	S11B	X259/Sta. 170/90° (45°)	2%	± 1	FM, D400
	S11C	X259/Sta. 170/90° (Hoop)	2%	± 1	FM, D400
R12	S12A	X259/Sta. 185/90° (Axial)	2%	± 1	FM, D400
	S12B	X259/Sta. 185/90° (45°)	2%	± 1	FM, D400
	S12C	X259/Sta. 185/90° (Hoop)	2%	± 1	FM, D400
	S45	X259/Sta. 137/180° (Axial)	2%	± 1	FM, D400
	S46	X259/Sta. 153/180° (Axial)	2%	± 1	FM, D400
	S47	X259/Sta. 170/180° (Axial)	2%	± 1	FM, D400
	S48	X259/Sta. 185/180° (Axial)	2%	± 1	FM, D400
	S49	X259/Sta. 137/0° (Axial)	2%	± 1	FM, D400
	S50	X259/Sta. 153/0° (Axial)	2%	± 1	FM, D400
	S51	X259/Sta. 170/0° (Axial)	2%	± 1	FM, D400
	S52	X259/Sta. 185/0° (Axial)	2%	± 1	FM, D400
	TC1	Aft Dome, 0°/13" R	200°F.	+ 1	Ol Vis.
	TC2	Aft Dome, 60°/13" R	200°F.	+ 1	Ol Vis.
	TC3	Aft Dome, 90°/13" R	200°F.	+ 1	Ol Vis.
	TC4	Aft Cyl., 0°/16" Fwd	200°F.	+ 1	Ol Vis.
	TC5	Aft Cyl., 60°/16" Fwd	200°F.	+ 1	Ol Vis.
	TC6	Aft Cyl., 90°/16" Fwd	200°F.	+ 1	Ol Vis.
	TC7	Fwd Cyl., 0°/15" Aft	200°F.	+ 1	Ol Vis.
	TC8	Fwd Cyl., 180°/15" Aft	200°F.	+ 1	Ol Vis.
	TC9	Fwd Dome, 0°/9" R	200°F.	+ 1	Ol Vis.
	TC10	Fwd Dome, 0°/13" R	200°F.	+ 1	Ol Vis.
	TC11	Fwd Dome, 180°/9" R	200°F.	+ 1	Ol Vis.
	TC12	Fwd Dome, 180°/13" R	200°F.	+ 1	Ol Vis.



FWD DOME

AFT DOME

NOTE

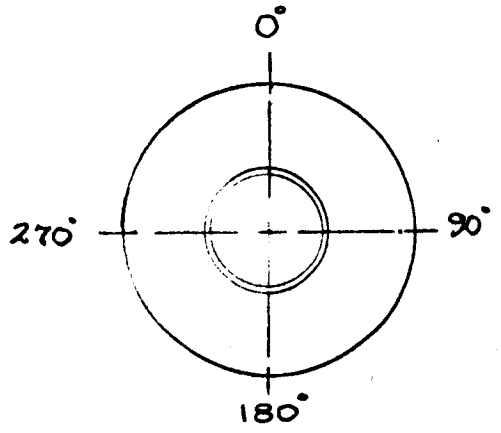
All thermocouples are chromel-alumel.

THERMOCOUPLE LOCATIONS

HPC-126 STATIC FIRING

FIGURE 1

APPENDIX B



X259 MOTOR
LOOKING AFT

SCOUT STATION	AZIMUTH			
	0°	90°	180°	270°
137	S49	R9	S45	R5
153	S50	R10	S46	R6
170	S51	R11	S47	R7
185	S52	R12	S48	R8

NOTES:
ALL "S" GAGES ARE AXIAL-ORIENTED.
ALL "R" GAGES ARE 3-GAGE ROSETTE TYPE.
ALL GAGES INSTALLED BY ABL FOR LTV STRUCTURAL LOAD TEST.
ALL GAGES TO BE INSTALLED ON GLASS CASE AFTER INSULATION REMOVAL.

STRAIN GAGE LOCATIONS

HPC-126 STATIC FIRING

FIGURE 2