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Volume 4

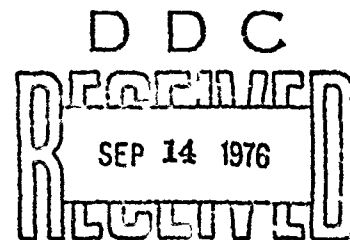


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**USAF BIOENVIRONMENTAL NOISE DATA
HANDBOOK
Volume 4
MA-1A Power Unit, Gas Turbine Engine
(AirResearch)**

JUNE 1975

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AEROSPACE MEDICAL RESEARCH LABORATORY
AEROSPACE MEDICAL DIVISION
Air Force Systems Command
Wright-Patterson Air Force Base, Ohio 45433

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FOR THE COMMANDER



HENNING L. VON GIERKE
Director
Biodynamics and Bionics Division
Aerospace Medical Research Laboratory

AIR FORCE - 20 MARCH 1970

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The MA-1A Power Unit is a turbine engine driven source of pneumatic power for starting aircraft jet engines and furnishing heated pneumatic power to other types of pneumatically operated equipment. This report provides measured and extrapolated data defining the bioacoustic environments produced by this unit operating outdoors on a concrete apron at normal rated/loaded conditions. Near-field data are reported for 37 locations in a wide variety of		

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physical and psychoacoustic measures: overall and band sound pressure levels, C-weighted and A-weighted sound levels, preferred speech interference level, perceived noise level, and limiting times for total daily exposure of personnel with and without standard Air Force ear protectors. Far-field data measured at 36 locations are normalized to standard meteorological conditions and extrapolated from 5-800 meters to derive sets of equal-value contours for these same seven acoustic measures as functions of angle and distance from the source. Refer to Volume 1 of this handbook, "USAF Bioenvironmental Noise Data Handbook, Vol 1: Organization, Content and Application," AMRL-TR-75-50(1) 1975, for discussion of the objective and design of the handbook, the types of data presented, measurement procedures, instrumentation, data processing, definitions of quantities, symbols, equations, applications, limitations, etc.

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PREFACE

This report was prepared by the Biodynamic Environment Branch Aerospace Medical Research Laboratory, under Project/Task 723104, Measurement of Noise and Vibration Environments of Air Force Operations.

The author acknowledges the efforts of Mr. Robert T. England and Mr. Robert G. Powell who conducted the field measurements, and Mr. John N. Cole who established the data analysis requirements and assisted in the preparation of this report. Mr. Henry Mohlman and Mr. David Eilerman of the University of Dayton assisted in the mechanics of data processing; and Mrs. Norma Peachy and Mr. Mike Patterson prepared the graphics.

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INTRODUCTION

The MA-1A Power Unit is a turbine engine-driven source of pneumatic power for starting aircraft jet engines and furnishing heated pneumatic power to other types of pneumatically-operated equipment. This unit is manufactured by the AiResearch Manufacturing Company.

This volume provides measured and extrapolated data defining the bioacoustic environments produced by this unit. Such data are essential to evaluate ear protection requirements, limiting personnel exposure times, voice communication capabilities, and annoyance problems associated with operation of the MA-1A power unit.

This volume is one of a series published by the Aerospace Medical Research Laboratory (AMRL) under the same report number (AMRL-TR-75-50) as a multi-volume handbook that quantifies the noise environments produced at flight/ground crew locations and in surrounding communities by operations of Air Force aircraft and aerospace ground equipment. The far-field, community-type, noise data in the handbook describe the noise produced during *ground operations* of aircraft, aerospace ground equipment, and other ground-based equipment or facilities.

Volume 1 of this handbook discusses the objectives and design of the handbook, the types of data presented, measurement procedures, instrumentation, data processing, definitions of quantities, symbols, equations, applications, limitations, etc. Volume 2 provides a method and data for adjusting the handbook's far-field noise data, which are for standard meteorological conditions (15C temperature, 70% rel humidity, 0.760 meters Hg barometric pressure) to derive comparable data for other meteorological conditions. *Refer to Volumes 1 and 2* (references 1 and 2) for such information because it is not repeated in other handbook volumes.

A cumulative index lists those aerospace systems contained in the handbook, and identifies the specific volumes containing each type of environmental noise data available (i.e., inflight/flight crew and passenger noise, near-field/ground crew noise, far-field/community noise). Volume numbers are assigned sequentially as individual volumes are published. This index is periodically updated as individual volumes are published, and is available upon request from AMRL/BBE, Wright-Patterson AFB, OH 45433. Organizations on the distribution list for the handbook will automatically receive a copy of the updated index as it is generated.

Direct any questions concerning the technical data in this report and other handbook volumes to: AMRL/BBE, Wright-Patterson AFB, OH 45433; Autovon 78-53675 or 78-53664; Commercial (513) 255-3675 or (513) 255-3664.

NEAR-FIELD NOISE

MEASUREMENTS

A standard MA-1A power unit was operated outdoors on a concrete apron at normal rated conditions of 42,500 RPM with no significant sound-reflective surfaces present except the ground plane. Table 1 notes the surface meteorological conditions at the time of measurement.

Figure 1 identifies 72 noise measurement locations at a height of 1.5 meters above the concrete apron (nominal ear level of ground crew). The 0 degree reference direction passes through the tow bar. The 36 locations on the two inner circles are in the acoustic near-field of the source where the sound wave fronts generally do not spherically diverge and the source appears to be spatially distributed (i.e., not a point source). Consequently, these near-field data cannot be extrapolated to longer distances but do properly define the levels at locations close to the unit.

Near-field measurements were also made at ear level at the operator control panel. Table 1 lists the numeric/alphabetic designator used on the data pages in this report to identify the operator measurement location and test condition. The designator 1/A means operator location 1 and test condition A. Such a descriptor is essential in many handbook volumes that involve multiple combinations of locations/conditions. It is used in this report to maintain format consistency.

RESULTS

The measured data presented in Table 2 define the sound pressure levels (SPL) produced by the MA-1A unit at the 37 specified, near-field locations. This table includes the overall, 1/3 octave band, and octave band levels. From these data one can calculate the variety of measures in Table 3 which are widely used to assess the effects of noise on personnel and their performance.

For data at other intermediate near-field locations (i.e., for radial distances less than 5 meters) you can interpolate between the 72 measured data points. All near-field data are for the meteorological conditions at the time of test but are valid for all typical airbase meteorology because of the short distances over which the sound is propagated.

TABLE 1
MEASUREMENT LOCATION AND TEST CONDITION
FOR OPERATOR NOISE MEASUREMENTS

MA-1A Power Unit, Gas Turbine Engine (AIResearch)
Eglin AFB, 26 Jul 1971
Serial # 283550DEF0509

Measurement Location

1 Operator Control Panel

AGE Operation

A 42,500 RPM

Meteorology

Temperature 29 C
Bar Pressure .760 M Hg
Rel Humidity 80%

FAR-FIELD NOISE

MEASUREMENTS

Noise measurements were also made on the same MA-1A unit under the same test conditions at the outer circle locations on Figure 1. These 36 locations are in the acoustic far-field of the source where the sound wave fronts spherically diverge and the unit may be regarded as a point noise source. Under these far-field conditions, the measured data can be extrapolated to longer distances.

RESULTS

Table 4 lists the overall and 1/3 octave band SPL measured at the 36 far-field locations under the meteorological conditions at the time of test. These data were normalized to 10 meters distance and standard meteorological conditions (15C temperature, 70% rel humidity, 0.760 meter Hg barometric pressure) and used to derive the graphic data in Figure 2 which provides a compact summary of the far-field noise characteristics of the MA-1A power unit in a standard format.

These measured data were also used to derive sets of equal noise contours (Figures 3 through 9) describing seven different measures of noise as functions of angle and distance from the source for standard day meteorology. Note that Figure 8 contours identify limiting exposure times for personnel. Missing data points on any of the contours are the result of eliminating measured data which contained excessive influence of spurious background noise present at the time of measurement. In some cases, contour levels at these missing data points were estimated and indicated with dashed lines.

Volume 2 of the handbook defines the influence of meteorology on far field noise environments and provides, if required, the factors necessary to adjust the handbook standard meteorological day data.

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)																IDENTIFICATION:			
1/3 OCTAVE BAND																			
2																OMEGA 3.2			
NOISE SOURCE/SUBJECT: (OPERATION:)																TEST 71-020-270			
HA-1A POWER UNIT, GAS ()																RUN 01			
TURBINE ENGINE (42,500 RPM)																19 AUG 74			
(AIRESEARCH) ()																			
NEAR FIELD NOISE LEVELS ()																PAGE F1			

LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)														IDENTIFICATION:	
2 1/3 OCTAVE BAND															
NOISE SOURCE/SUBJECT: (OPERATION:)															
HA-1A POWER UNIT, GAS ()															
TURBINE ENGINE (42,300 RPM)															
(LAISEARCH) ()															
NEAR FIELD NOISE LEVELS ()														PAGE F2	
FREQ (HZ)	DISTANCE (M)-->	2	280	300	320	2	1	20	40	60	80	100	120	140	
25	84	84	84	84	87	86	88	90	88	90	90	90	91	94	
31.5	85	84	84	84	85	86	88	89	92	91	89	91	91	93	
40	87	87	87	87	87	87	90	91	90	90	89	90	93	94	
50	85	85	85	86	87	86	88	89	89	89	89	89	90	92	
63	88	87	87	86	87	87	90	89	90	90	90	91	92	94	
80	86	86	86	86	84	84	88	89	90	90	90	92	94	95	
100	88	87	87	87	87	86	92	92	92	94	95	96	98	99	
125	96	97	97	97	97	96	99	99	99	100	101	102	104	106	
160	100	100	99	99	100	100	99	99	101	103	105	107	108	110	
200	97	94	93	93	91	92	93	96	99	100	100	100	103	105	
250	95	94	92	91	91	90	96	96	96	97	97	99	101	103	
315	97	96	97	97	97	97	99	99	99	100	99	100	102	104	
400	101	100	102	100	100	99	100	101	100	100	98	99	102	104	
500	88	86	89	90	90	89	93	93	94	93	94	96	98	99	
630	88	90	90	93	92	92	89	98	97	95	94	94	97	102	
800	89	89	90	92	90	90	91	97	97	94	92	94	97	100	
1000	87	87	87	88	86	86	90	91	92	91	92	94	97	96	
1250	84	87	86	87	87	85	90	93	94	95	91	91	91	90	
1600	87	87	86	87	87	85	92	94	94	94	92	92	91	95	
2000	88	89	90	90	90	88	94	95	96	94	92	92	93	100	
2500	90	89	91	93	91	91	96	99	98	96	93	93	97	106	
3150	92	94	94	96	94	94	97	101	103	98	96	97	100	106	
4000	93	95	97	98	96	96	99	102	104	102	98	99	101	109	
5000	94	96	99	100	97	97	100	104	105	104	100	99	101	109	
6300	95	97	100	105	100	99	102	106	108	106	102	102	102	110	
8000	110	115	116	115	113	113	116	119	124	119	117	115	112	113	
10000	114	119	120	119	116	116	120	123	128	121	121	120	116	112	
OVERALL	116	120	121	121	121	118	122	124	129	123	123	121	119	120	
LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.															

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)																					IDENTIFICATION:	
2 1/3 OCTAVE BAND																						
NOISE SOURCE/SUBJECT:																						
(OPERATION:																						
(MA-1A POWER UNIT, GAS																					OMEGA 3.2	
(TURBINE ENGINE																						
(42,500 RPM																					TEST 71-020-270	
((AIRESEARCH)																					RUN 03	
(NEAR FIELD NOISE LEVELS																					19 AUG 74	
(																					PAGE F3	
DISTANCE (M)-->																					1 OPERATOR LOCATION	
FREQ	ANGLE (DEG)-->	1	160	1	200	1	220	1	240	1	260	1	280	1	300	1	320	1	340	TEST CONDITION		
(HZ)																				1/A		
25		90	94	93	93	91	90	88	88	89	88	89	88	88	88	88	89	88	88	88		
31.5		94	93	96	92	92	94	90	92	90	92	92	90	90	90	90	90	90	90	88		
40		94	94	95	93	93	94	91	93	91	93	90	90	90	90	90	90	90	90	88		
50		93	92	94	93	93	92	90	93	89	91	91	89	91	90	90	91	87	88	88		
63		94	94	95	94	94	94	92	94	92	94	91	92	92	91	90	91	90	90	88		
80		96	96	96	95	95	94	91	94	91	94	89	91	90	89	89	89	88	88	88		
100		98	101	100	99	99	97	95	97	95	97	94	95	94	92	92	94	92	92	88		
125		106	107	107	104	104	104	102	104	102	103	102	100	100	100	99	100	99	99	88		
160		110	111	111	108	108	106	102	106	102	104	102	102	102	102	101	102	101	100	100		
200		105	107	107	104	104	103	101	103	97	99	94	96	93	92	92	93	92	93	93		
250		104	107	106	104	104	103	99	99	97	99	95	96	95	94	94	95	94	96	96		
315		105	108	106	102	102	101	100	100	99	100	99	100	99	99	99	99	99	99	99		
400		105	110	108	103	103	101	100	100	97	100	99	99	99	99	99	100	99	100	100		
500		100	105	103	101	101	99	93	96	93	96	91	92	91	92	92	91	92	93	93		
630		104	102	104	105	105	102	95	102	95	99	100	95	100	93	93	100	93	89	89		
800		102	101	104	101	101	99	97	99	93	97	97	93	94	94	97	97	94	91	91		
1000		93	101	98	93	93	94	91	90	90	93	91	90	90	90	89	90	90	90	90		
1250		92	100	93	93	93	90	92	90	92	92	90	92	92	92	94	90	90	90	90		
1600		105	104	107	102	102	93	93	93	92	93	94	92	94	94	90	94	90	92	92		
2000		107	108	108	106	106	97	93	93	94	93	97	93	94	94	97	97	94	94	94		
2500		109	111	112	107	107	102	99	95	93	95	99	96	99	96	99	97	96	96	96		
3150		109	111	113	110	110	103	99	99	97	99	102	99	102	101	102	101	101	97	97		
4000		113	115	113	113	110	103	98	98	99	98	102	99	102	104	100	104	100	99	99		
5000		113	115	113	109	109	100	99	99	100	99	106	100	106	106	102	106	100	100	100		
6300		112	114	113	111	111	102	101	101	103	101	109	104	109	103	102	109	103	102	102		
8000		114	116	116	114	114	113	114	113	114	114	119	119	119	115	116	123	115	116	116		
10000		113	114	114	114	114	110	124	118	124	118	126	124	126	118	120	126	118	120	120		
OVERALL		122	123	123	121	121	120	125	120	125	120	128	125	128	120	122	128	120	122	122		
LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.																						

[illegible]

MEASURED SOUND PRESSURE LEVEL (DB)										IDENTIFICATION:					
OCTAVE BAND															
2															
NOISE SOURCE/SUBJECT:															
HA-1A POWER UNIT, GAS															
TURBINE ENGINE															
(AIRESEARCH)															
NEAR FIELD NOISE LEVELS															
FREQ (HZ)	DISTANCE (M)-->	ANGLE (DEG)-->	OPERATION:												
			(42,500 RPM												
31.5	90	91	102	101	99	103	94	102	121	115					
63	91	102	101	99	103	94	102	121	115	116					
125	90	91	102	101	99	103	94	102	121	115					
250	90	91	102	101	99	103	94	102	121	115					
500	90	91	102	101	99	103	94	102	121	115					
1000	90	91	102	101	99	103	94	102	121	115					
2000	90	91	102	101	99	103	94	102	121	115					
4000	90	91	102	101	99	103	94	102	121	115					
8000	90	91	102	101	99	103	94	102	121	115					
OVERALL															

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)													IDENTIFICATION:	
OCTAVE BAND														
2													OMEGA 3.2	
													TEST 71-020-270	
NOISE SOURCE/SUBJECT: (OPERATION:													RUN 03	
(HA-1A POWER UNIT, GAS (														
(TURBINE ENGINE (42,500 RPM													19 AUG 74	
((AIRESEARCH) (														
(NEAR FIELD NOISE LEVELS (													PAGE J3	
DISTANCE (M)--> 1													1 OPERATOR LOCATION	
ANGLE (DEG)--> 160													TEST CONDITION	
FREQ (HZ)													1/A	

TABLE: MEASURES OF HUMAN NOISE EXPOSURE																IDENTIFICATION:	
3																	
NOISE SOURCE/SUBJECT: (OPERATION:)																OMEGA 3.2	
HA-1A POWER UNIT, GAS ()																TEST 71-020-270	
TURBINE ENGINE (42,500 RPM)																RUN 02	
(AIRESEARCH) ()																19 AUG 74	
NEAR FIELD NOISE LEVELS ()																PAGE H2	

DISTANCE (M)--> 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2																	
ANGLE (DEG)--> 260 260 260 260 260 260 260 260 260 260 260 260 260 260 260 260																	
HAZARD/PROTECTION																	
C-WEIGHTED OVERALL SOUND LEVEL (OASLC IN DB) AT EAR																	
A-WEIGHTED OVERALL SOUND LEVEL (OASLA IN DB) AT EAR																	
MAXIMUM PERMISSIBLE TIME (T IN MINUTES) FOR ONE EXPOSURE PER DAY (AFR 161-35, JULY 73)																	
NO PROTECTION																	
OASLC																	
OASLA																	
T																	
MINIMUM QPL EAR MUFFS																	
OASLA*																	
T																	
AMERICAN OPTICAL 1700 EAR MUFFS																	
OASLA*																	
T																	
V-51R EAR PLUGS																	
OASLA*																	
T																	
AMERICAN OPTICAL 1700 EAR MUFFS PLUS V-51R EAR PLUGS																	
OASLA*																	
T																	
H-133 GROUND COMMUNICATION UNIT																	
OASLA*																	
T																	
COMMUNICATION																	
PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)																	
PSIL																	
ANNOUNCE																	
PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNDB)																	
TONE CORRECTION (C IN DB)																	
PNLT																	
C																	

* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.
P ADDITIONAL EAR PROTECTION REQUIRED.

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)																	IDENTIFICATION:	
1/3 OCTAVE BAND																		
DISTANCE = 5 METERS																	OMEGA 1.3	
																	TEST 71-020-270	
NOISE SOURCE/SUBJECT:																	RUN 01	
(HA-1A POWER UNIT, GAS																		
(TURBINE ENGINE																	29 JAN 75	
((AIRESEARCH)																		
(FAR FIELD NOISE LEVELS																	PAGE 2	
FREQ																		
((HZ)																		
ANGLE (DEGREES)																		

< LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

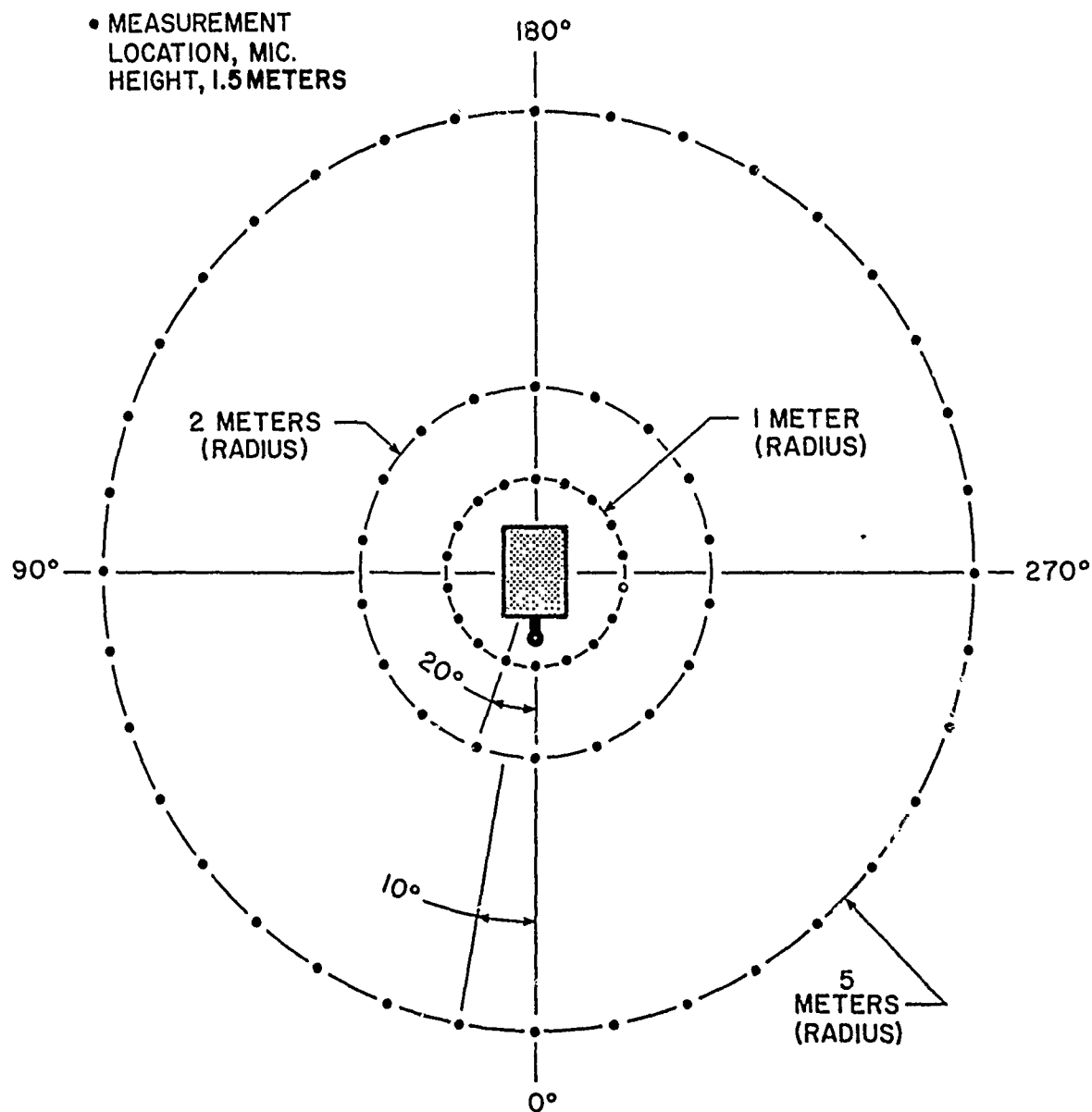
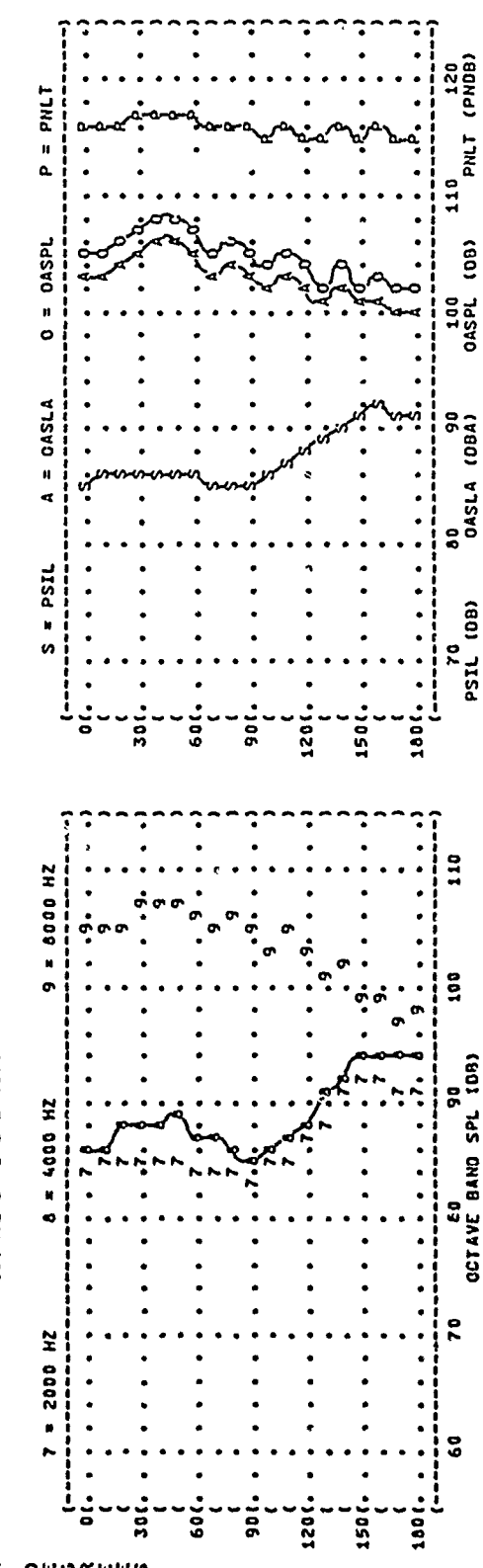
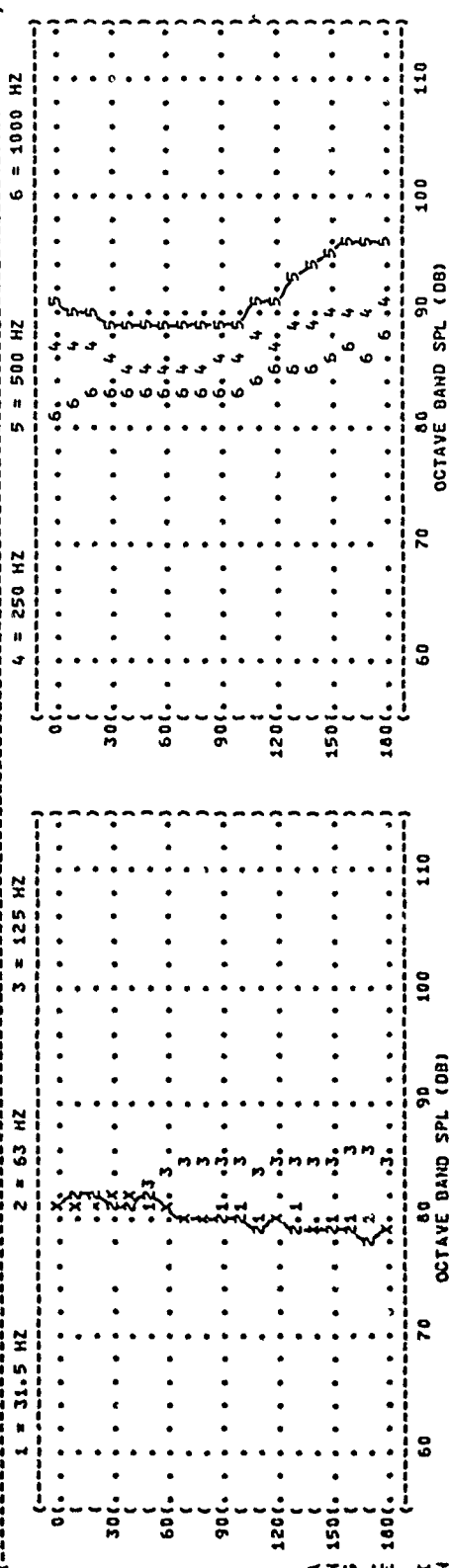
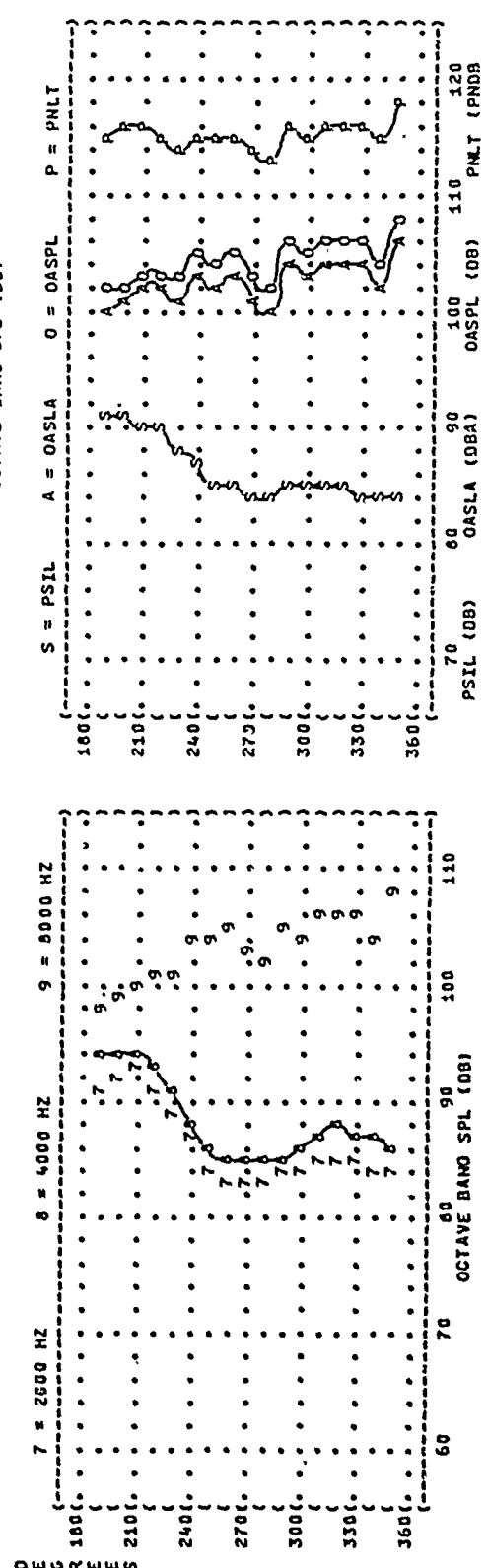
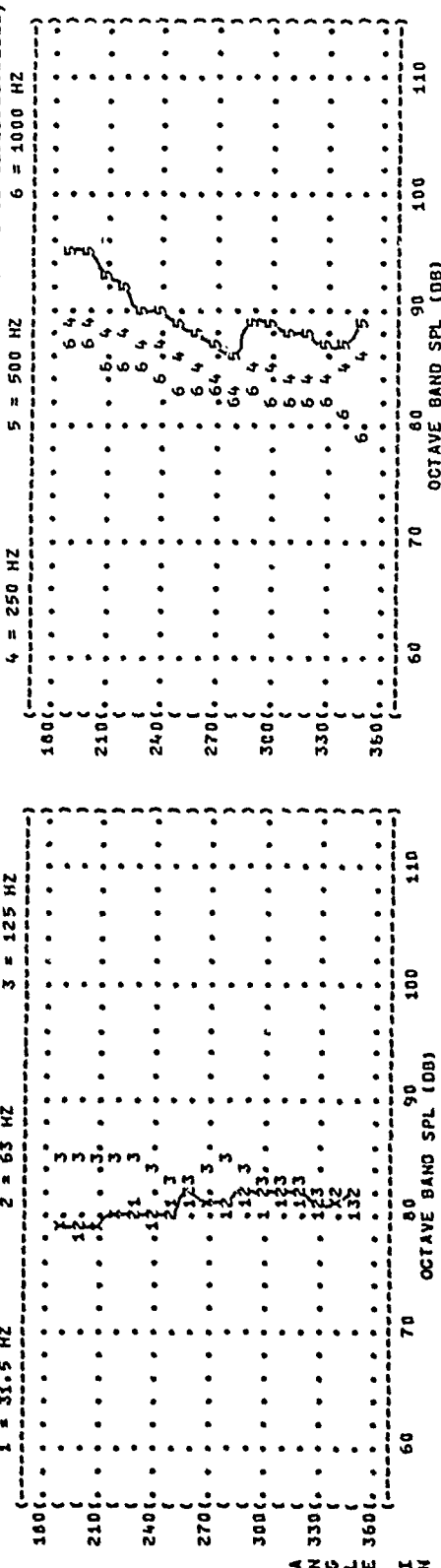


Figure 1. Measurement Locations

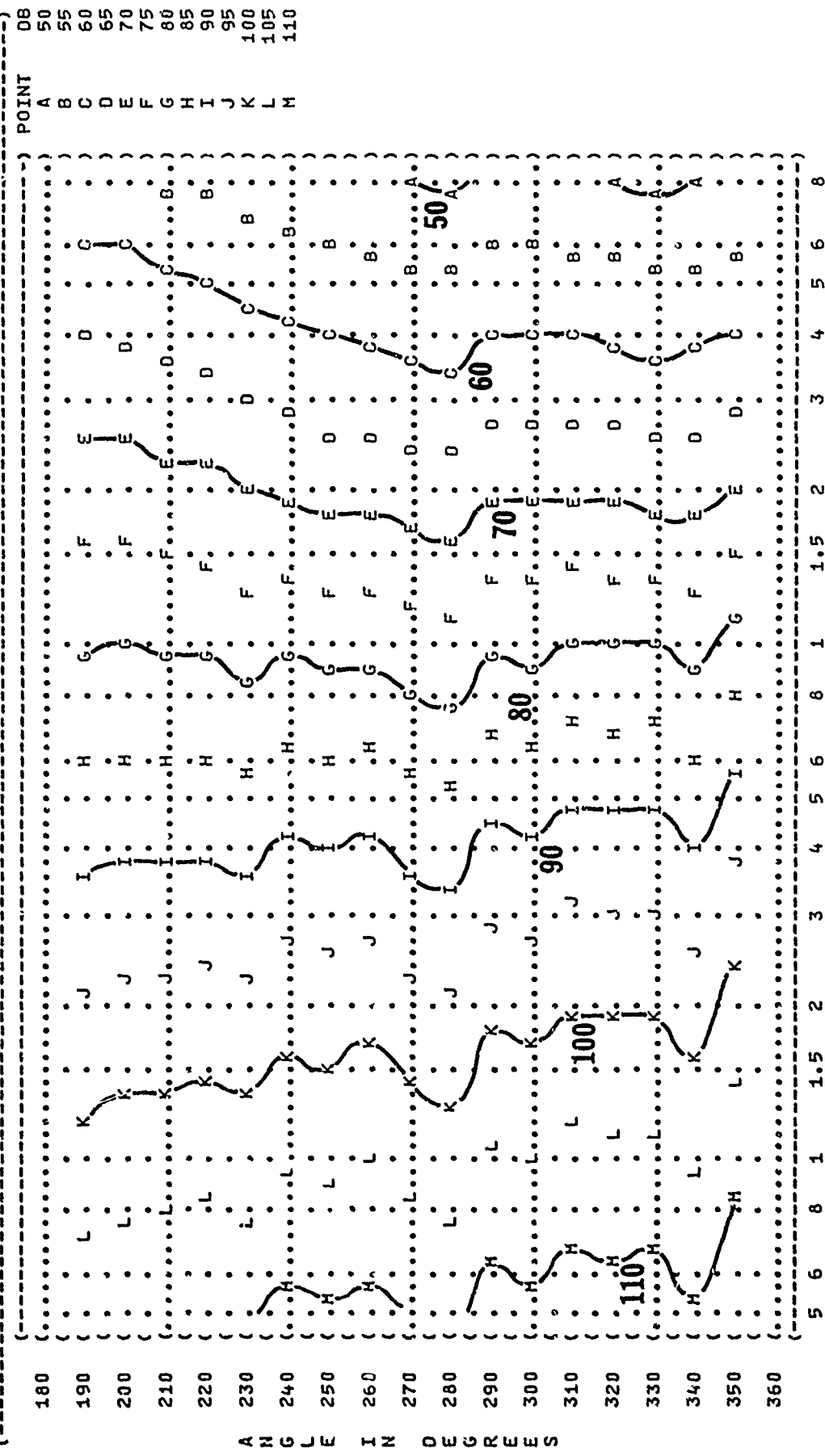
FIGURE: NORMALIZED FARFIELD NOISE LEVELS		IDENTIFICATION:	
2	DISTANCE = 10 METERS	OMEGA	1.3
		TEST	71-020-270
		RUN	01
NOISE SOURCE/SUBJECT:		METEOROLOGY:	
MA-1A POWER UNIT, GAS		TEMP = 15 C	
TURBINE ENGINE		BAR PRESS = .760 M HG	
(AIRESEARCH)		REL HUMID = 70 %	
FAR FIELD NOISE LEVELS		PAGE 4	



(FIGURE: NORMALIZED FARFIELD NOISE LEVELS
 (2 DISTANCE = 10 METERS
 (NOISE SOURCE/SUBJECT: MA-1A POWER UNIT, GAS
 (TURBINE ENGINE
 ((AIRSEARCH)
 (FAR FIELD NOISE LEVELS
 (1 = 31.5 HZ 2 = 63 HZ 3 = 125 HZ
 (4 = 250 HZ 5 = 500 HZ 6 = 1000 HZ
 (METEOROLOGY: TEMPERATURE = 15 C
 (BAR PRESS = .760 M HG
 (REL HUMID = 70 %
 (29 JAN 75
 (PAGE 4
 (IDENTIFICATION: OMEGA 1.3
 (TEST 71-020-270
 (RUN 02

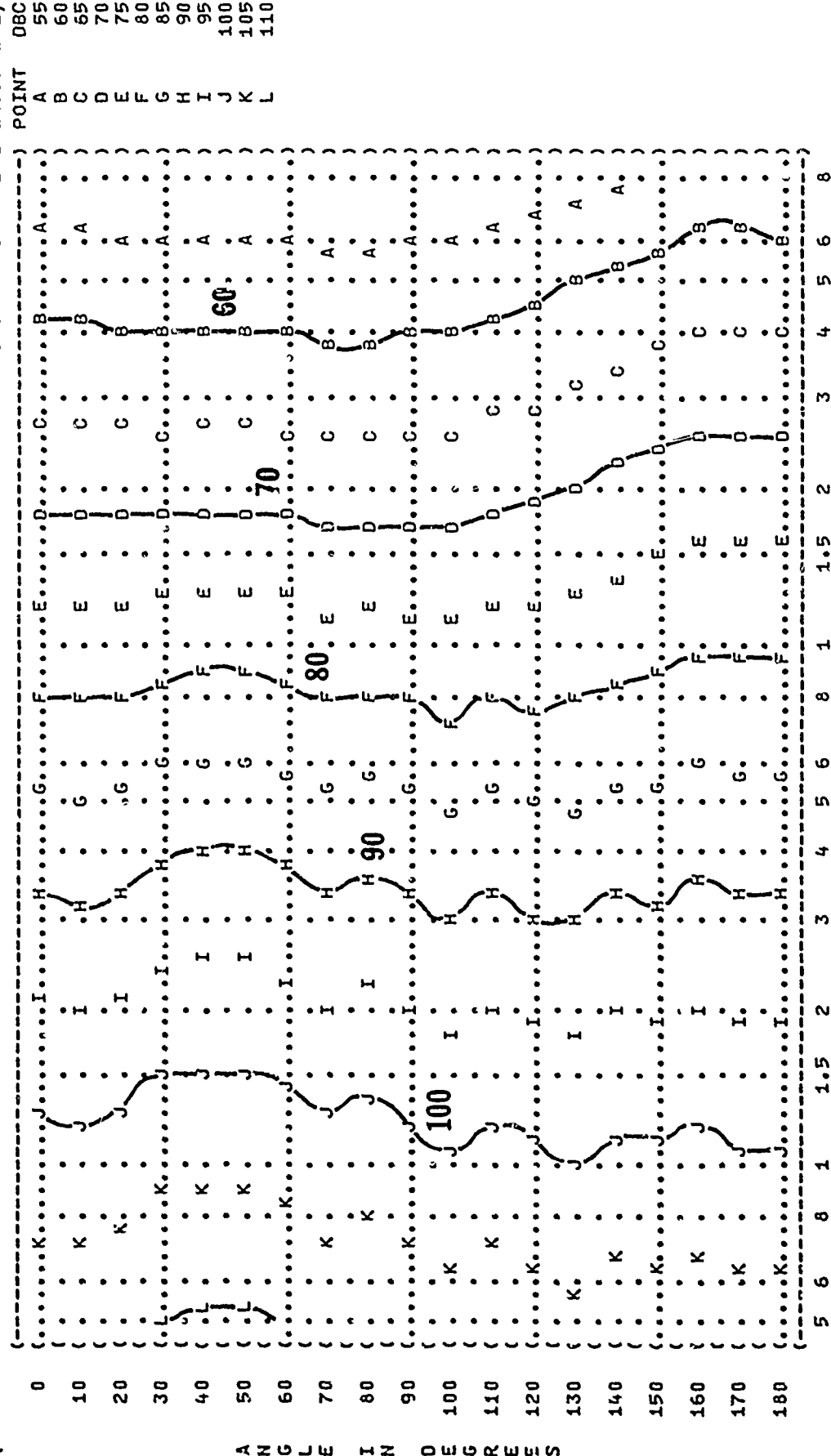


((FIGURE: OVERALL SOUND PRESSURE LEVEL (OASPL)
 ((3
 ((IDENTIFICATION:
 (() OMEGA 1.3
 (() TEST 71-020-270
 (() RUN 02
 (() METEOROLOGY:
 (() TEMP = 15 C
 (() BAR PRESS = .760 M HG
 (() REL HUMID = 70 %
 (() OPERATION:
 (() HA-1A POWER UNIT, GAS
 (() TURBINE ENGINE
 (() (AIRESEARCH)
 (() 42,500 RPM
 (() FAR FIELD NOISE LEVELS
 (() PAGE 11



A N G L E I N D E G R E E S

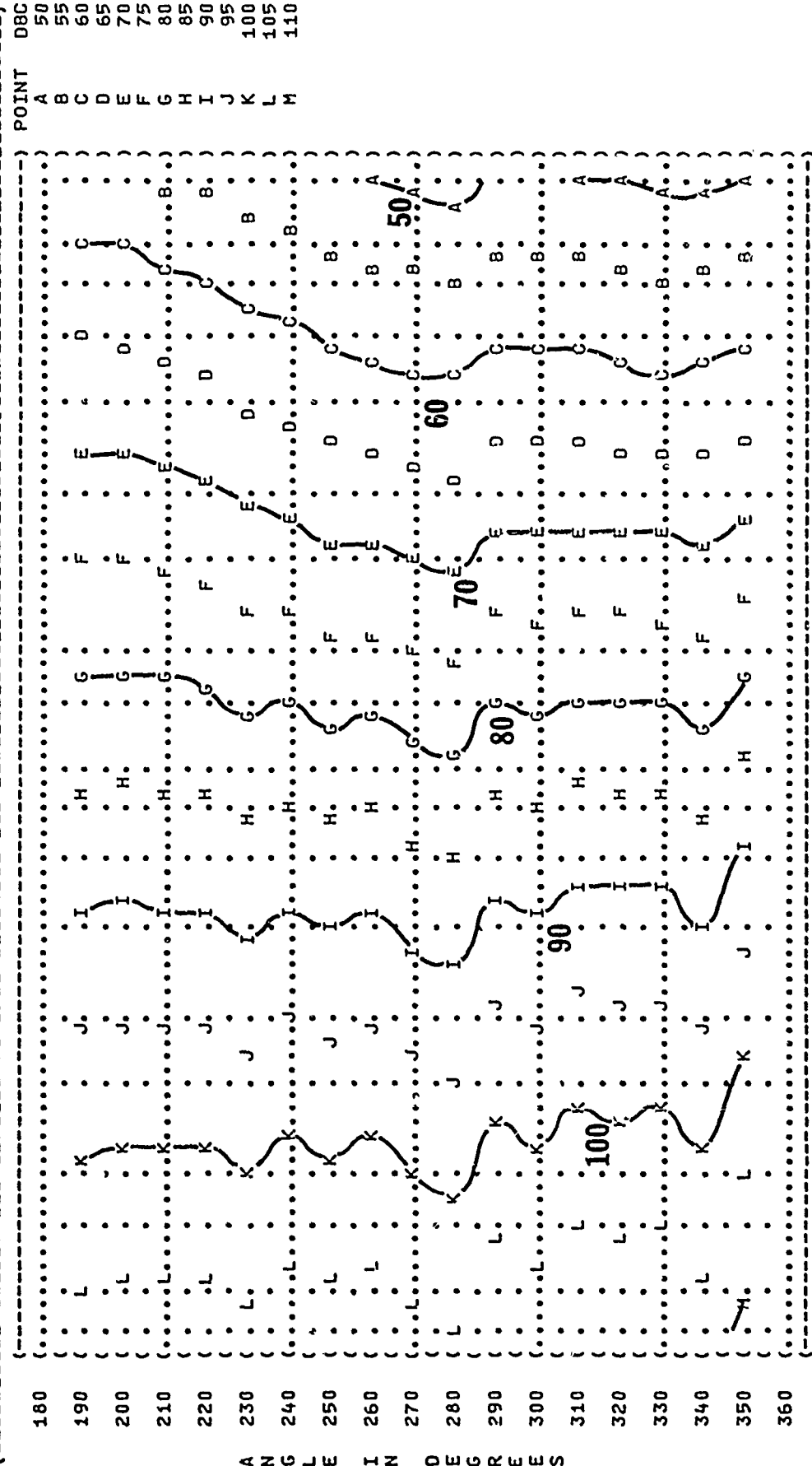
(FIGURE: C-WEIGHTED OVERALL SOUND LEVEL (OASLC))
 (4 EQUAL LEVEL CONTOURS (DBC))
 (IDENTIFICATION:)
 () OMEGA 1.3)
 () TEST 71-020-270)
 () RUN 01)
 () METEOROLOGY:)
 () TEMP = 15 C)
 () BAR PRESS = .760 M HG)
 () REL HUMID = 70 %)
 () 29 JAN 75)
 () PAGE 12)



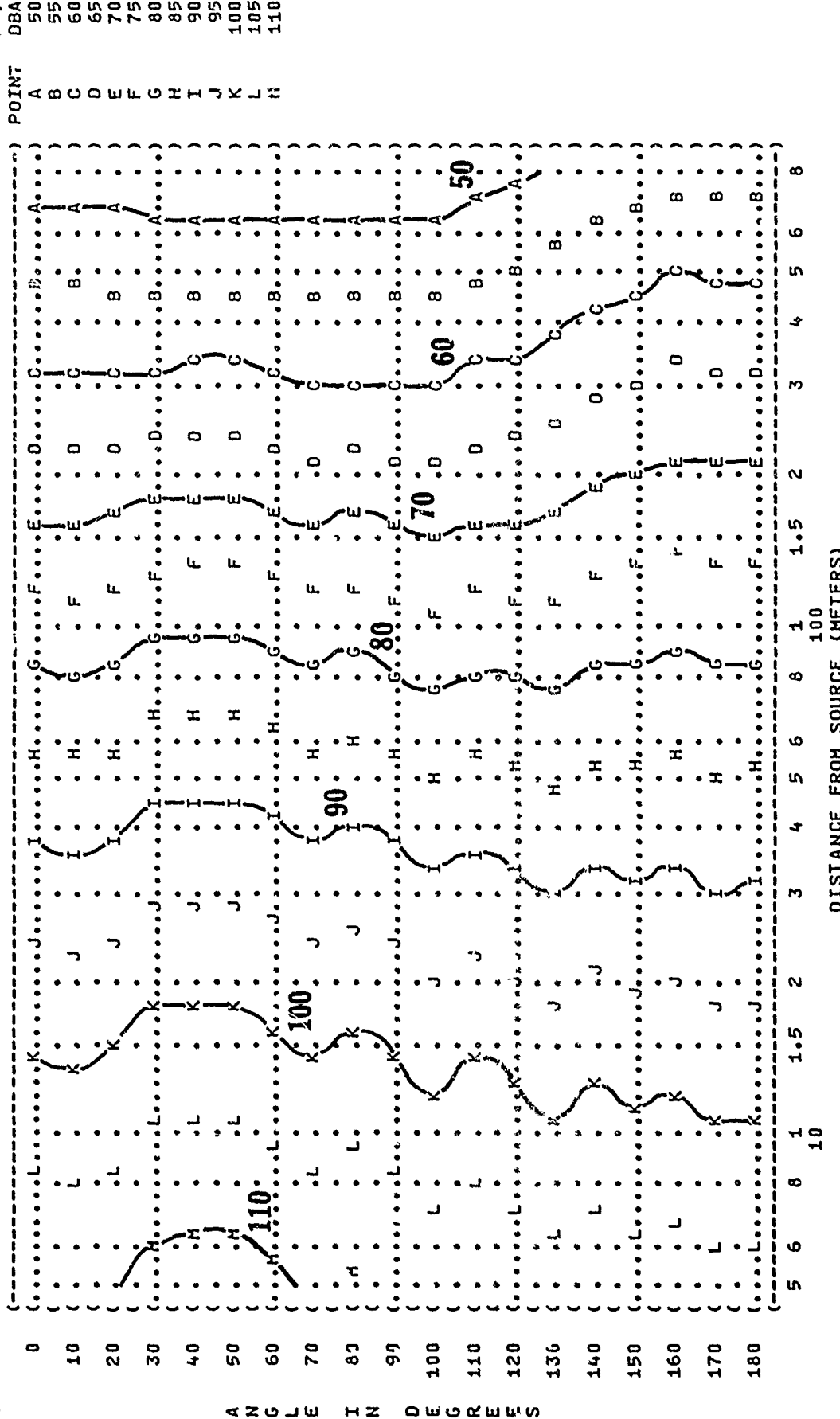
DISTANCE FROM SOURCE (METERS)

A N G L E I N D E G R E E S

(FIGURE: C-WEIGHTED OVERALL SOUND LEVEL (OASLC))
 (4 EQUAL LEVEL CONTOURS (OBC))
 () IDENTIFICATION:)
 () OMEGA 1.3)
 (TEST 71-020-270)
 () RUN 02)
 () METEOROLOGY:)
 () TEMP = 15 C)
 () BAR PRESS = .760 M HG)
 () REL HUMID = 70 %)
 () 29 JAN 75)
 () PAGE 12)



(FIGURE: A-WEIGHTED OVERALL SOUND LEVEL (OASLA)
 (5
 (EQUAL LEVEL CONTOURS (DBA)
 () IDENTIFICATION:
 () OMEGA 1.3
 () TEST 71-020-270
 () RUN 01
 () METEOROLOGY:
 () TEMP = 15 C
 () BAR PRESS = .760 M HG
 () REL HUMID = 70 %
 () 29 JAN 75
 () PAGE 13
 () NOISE SOURCE/SUBJECT:
 () OPERATION:
 () MA-1A POWER UNIT, GAS
 () TURBINE ENGINE
 () (AIRESEARCH)
 () FAR FIELD NOISE LEVELS



A N G L E I N D E G R E E S

(FIGURE: PERCEIVED NOISE LEVEL, TONE CORRECTED {PNLT}
 (6
 (EQUAL LEVEL CONTOURS (PNDB)
 () IDENTIFICATION:
 ()
 () OMEGA 1.3
 (TEST 71-020-270)
 (RUN 01)
 ()
 (NOISE SOURCE/SUBJECT:) METEOROLOGY:
 (HA-1A POWER UNIT, GAS) TEMP = 15 C
 (TURBINE ENGINE) BAR PRESS = .760 M HG
 ((AIRESEARCH)) REL HUMID = 70 %
 (FAR FIELD NOISE LEVELS)
 ()
 () PAGE 14
 ()

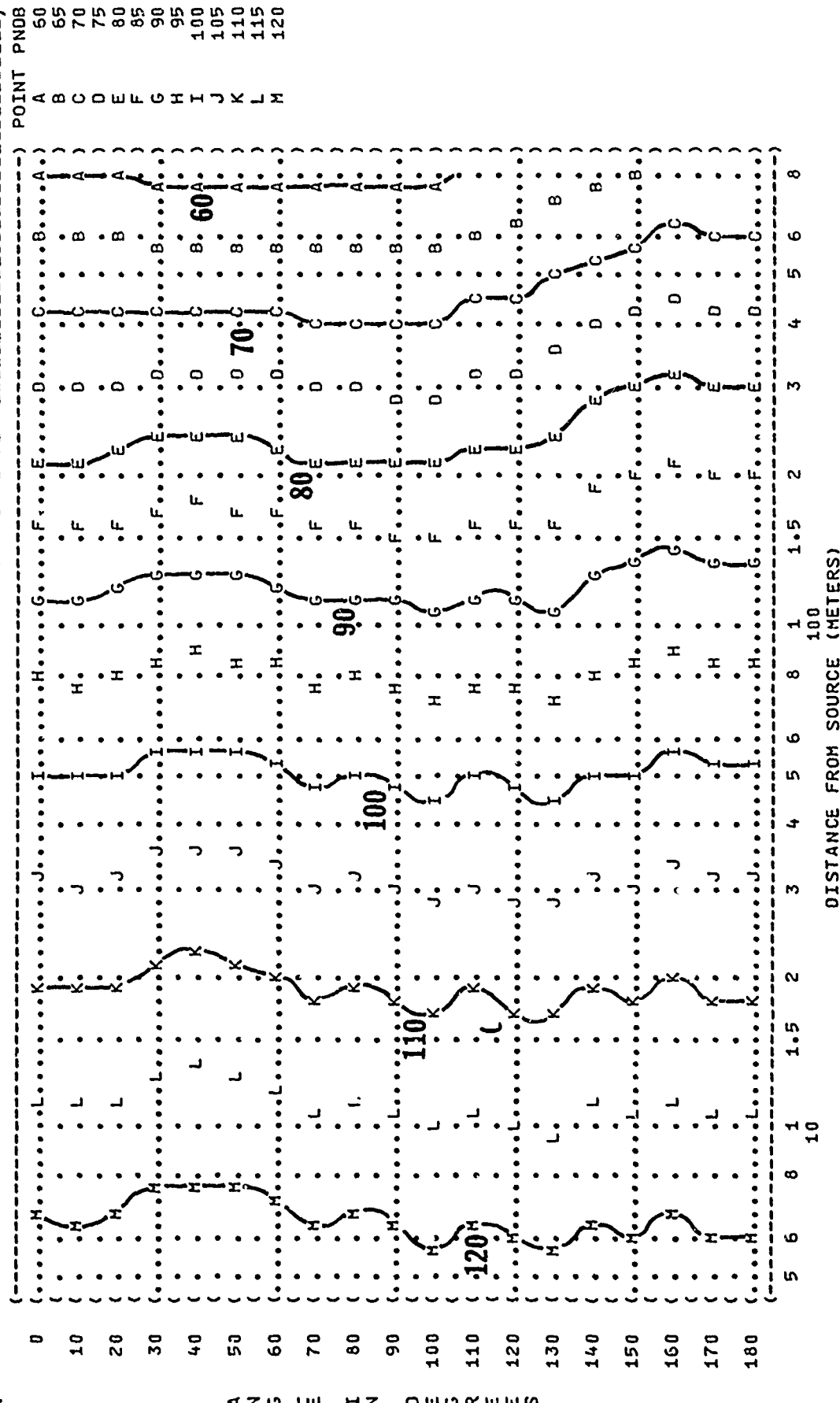
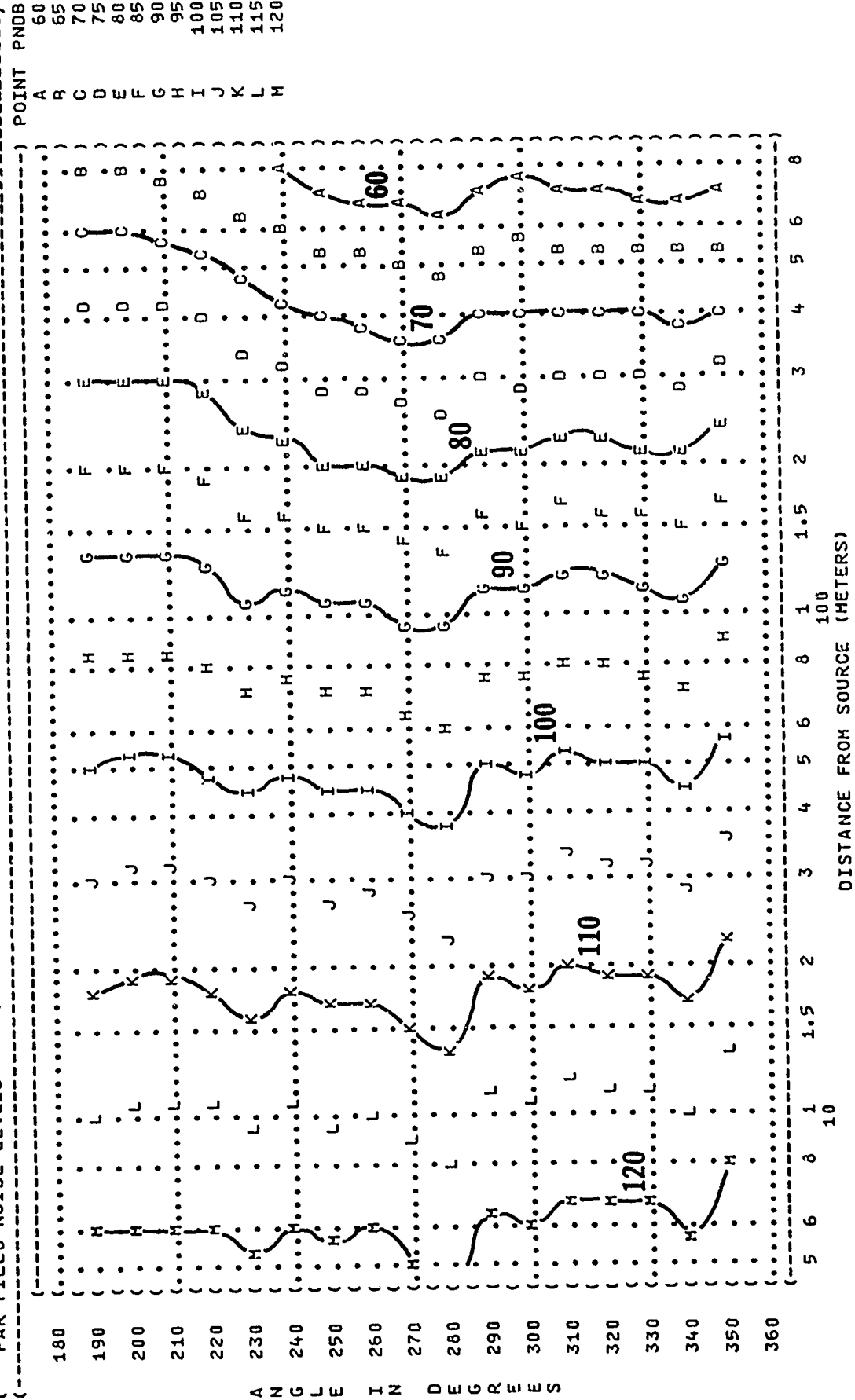
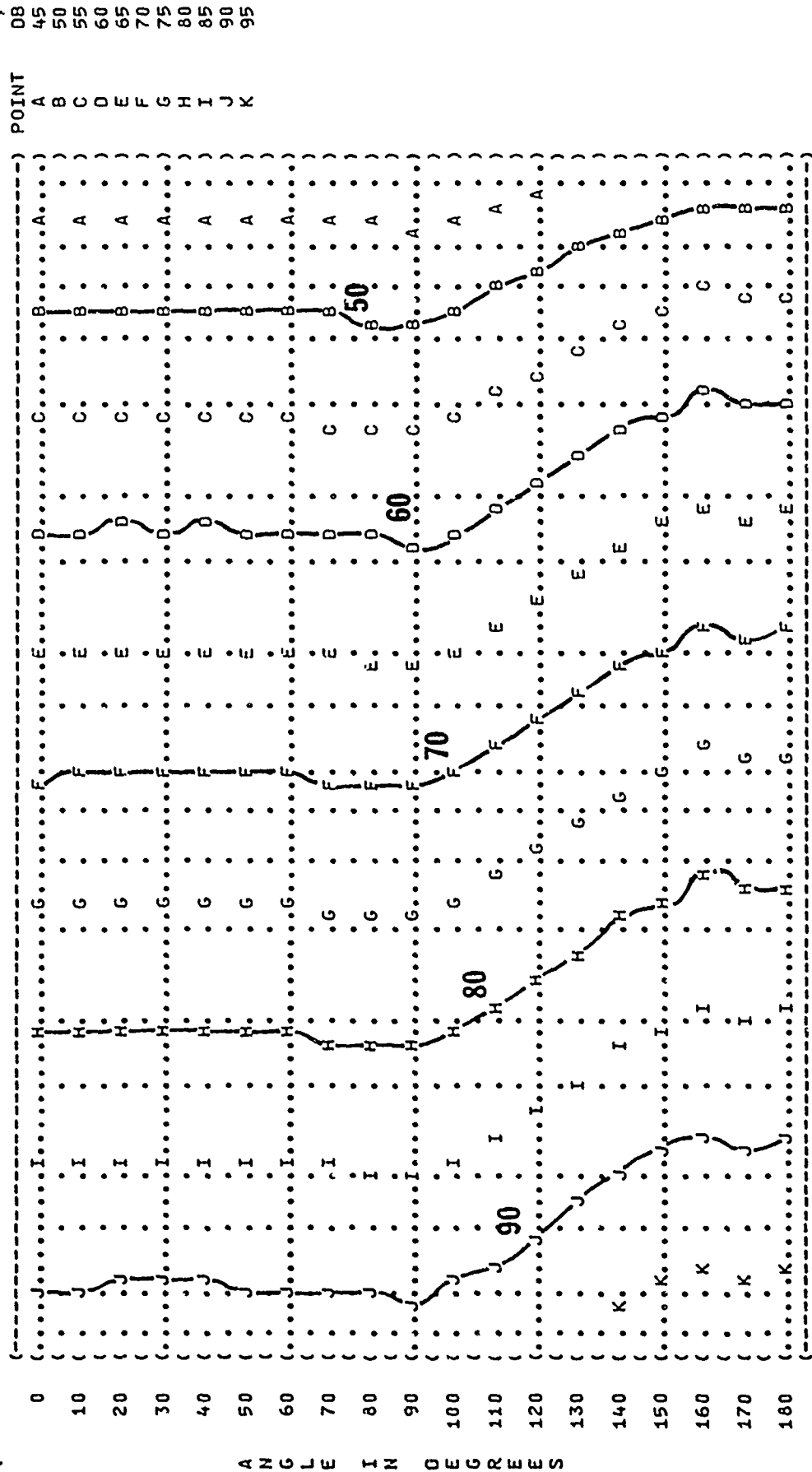


FIGURE: PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT)
 6
 EQUAL LEVEL CONTOURS (PNDB)

IDENTIFICATION:
 OMEGA 1.3
 TEST 71-020-270
 RUN 02
 METEOROLOGY:
 TEMP = 15 C
 BAR PRESS = .760 M HG
 REL HUMID = 70 %
 OPERATION:
 HA-1A POWER UNIT, GAS
 TURBINE ENGINE
 (AIRESEARCH)
 FAR FIELD NOISE LEVELS
 29 JAN 75
 PAGE 14



(FIGURE: PREFERRED SPEECH INTERFERENCE LEVEL (PSIL)
 (7 EQUAL LEVEL CONTOURS (DB)
 () IDENTIFICATION:
 () OMEGA 1.3
 () TEST 71-020-270
 () RUN 01
 () METEOROLOGY:
 () TEMP = 15 C
 () BAR PRESS = .760 M HG
 () REL HUMID = 70 %
 () PAGE 15
 ()

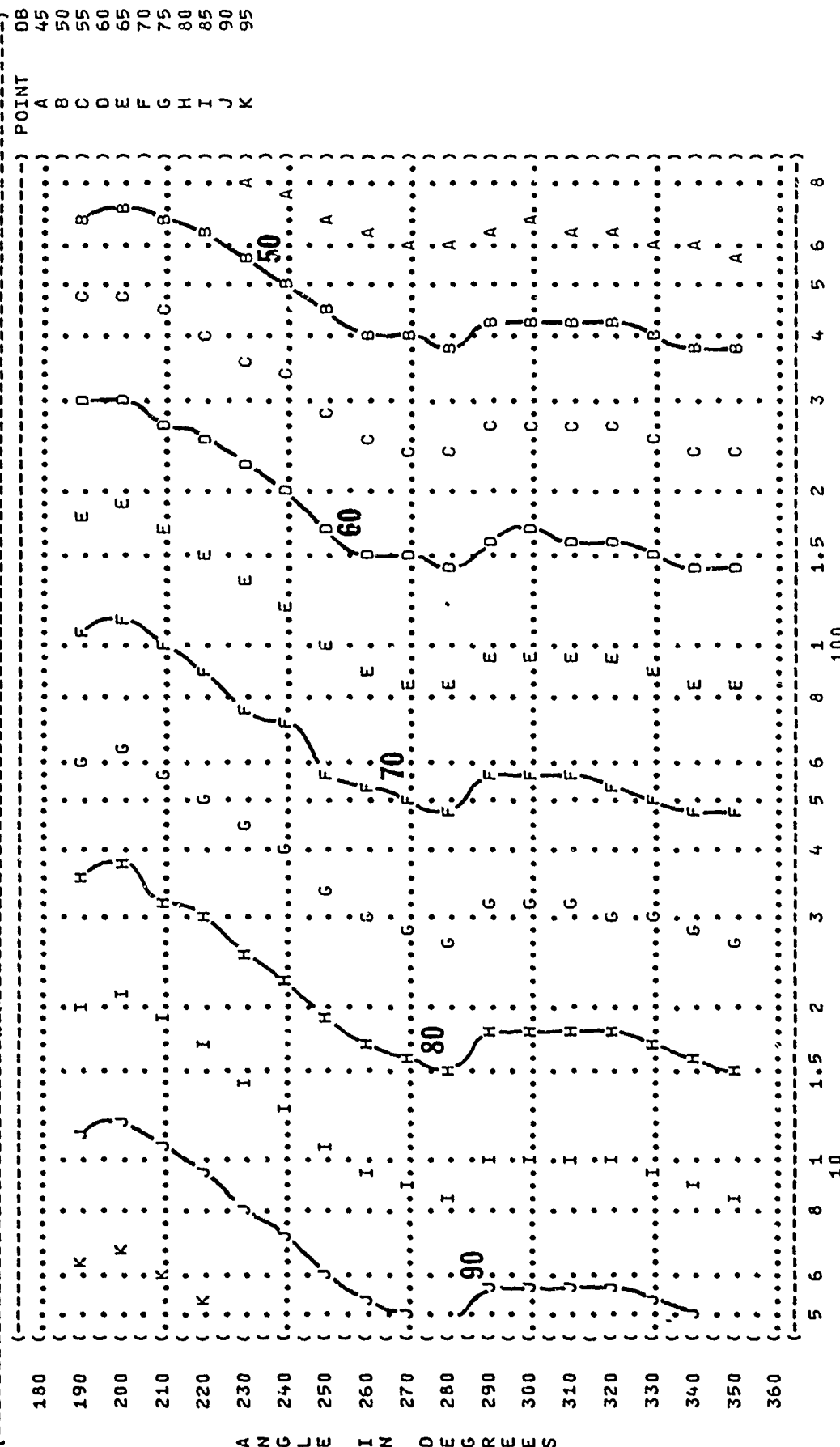


() NOISE SOURCE/SUBJECT:
 () OPERATION:
 () MA-1A POWER UNIT, GAS
 () TURBINE ENGINE
 () (AIRESEARCH)
 () FAR FIELD NOISE LEVELS
 ()

DISTANCE FROM SOURCE (METERS)
 100
 10

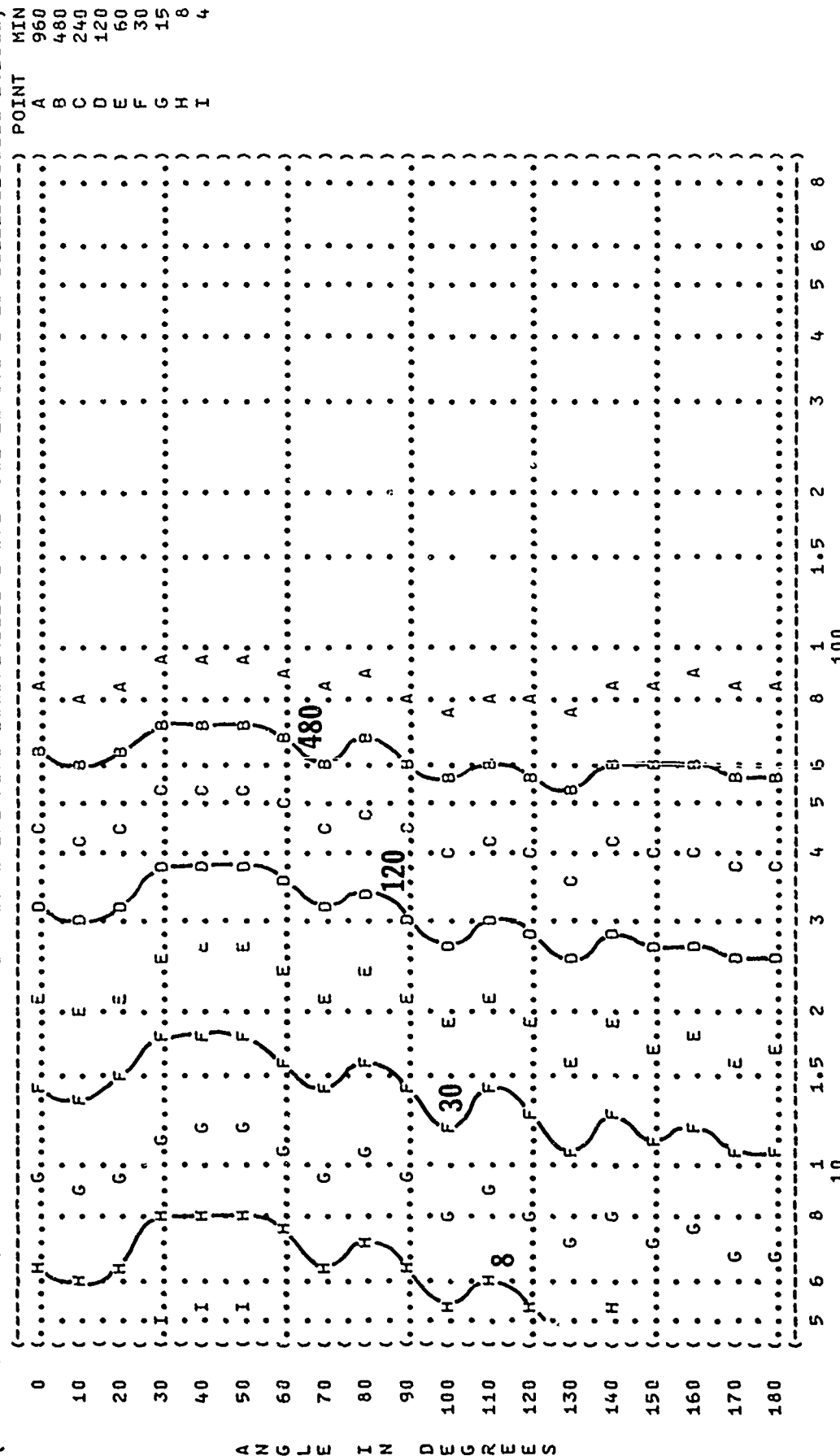
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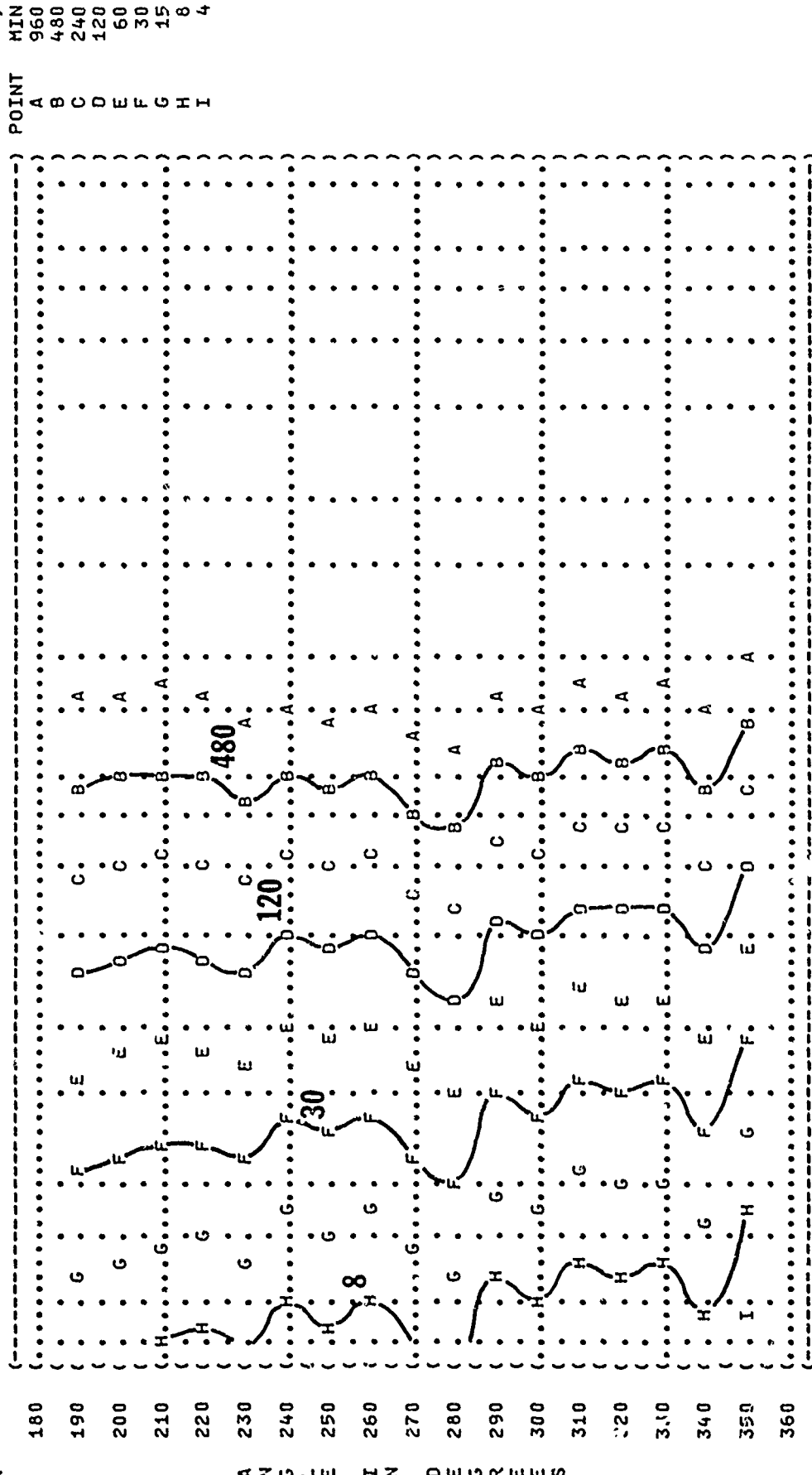
() FIGURE: PREFERRED SPEECH INTERFERENCE LEVEL (PSIL)
 () 7
 () IDENTIFICATION:
 () OMEGA 1.3
 () TEST 71-020-270
 () RUN 02
 () NOISE SOURCE/SUBJECT:
 () MA-1A POWER UNIT, GAS
 () TURBINE ENGINE
 () (AIRESEARCH)
 () FAR FIELD NOISE LEVELS
 () OPERATION:
 () 42,500 RPM
 () METEOROLOGY:
 () TEMP = 15 C
 () BAR PRESS = .760 M HG
 () REL HUMID = 70 %
 () PAGE 15



DISTANCE FROM SOURCE (METERS)

(FIGURE: MAXIMUM PERMISSIBLE TIME (T) FOR ONE EXPOSURE PER DAY (AFR 161-35, JULY 73)) IDENTIFICATION:)
 (8 EQUAL TIME CONTOURS (MINUTES)))
 (NO PROTECTION))
 (NOISE SOURCE/SUBJECT: (OPERATION:) METEOROLOG:)
 (HA-1A POWER UNIT, GAS (42,500 RPM)) TEMP = 15 C)
 (TURBINE ENGINE ()) BAR PRESS = .760 M HG)
 ((AIRESEARCH) ()) REL HUMID = 70 %)
 (FAR FIELD NOISE LEVELS ()) PAGE 5)



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DISTANCE FROM SOURCE (METERS)

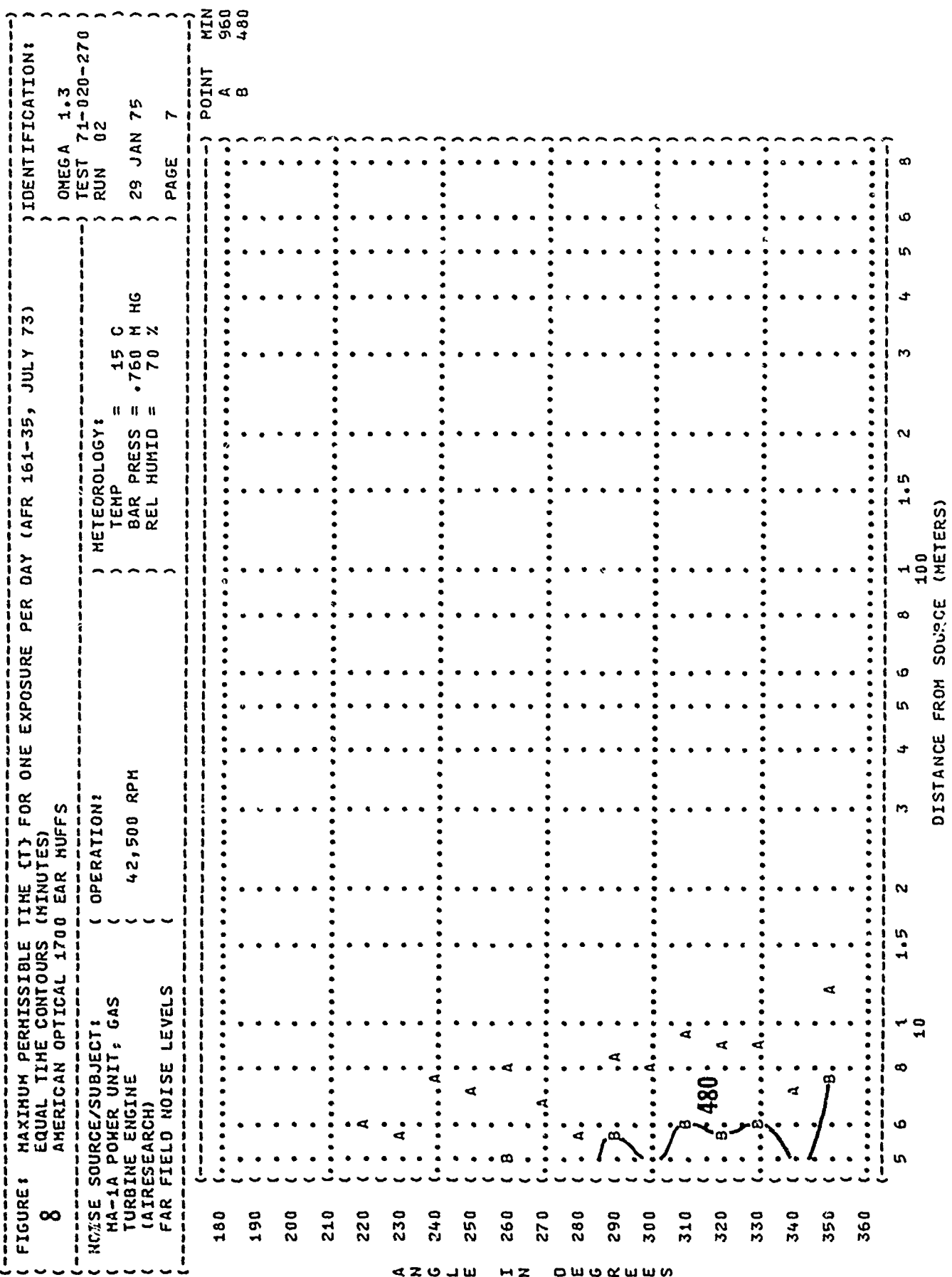

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(-----)
( ( FIGURE: MAXIMUM PERMISSIBLE TIME (T) FOR ONE EXPOSURE PER DAY (AFR 161-35, JULY 73) ) IDENTIFICATION: )
( ( EQUAL TIME CONTOURS (MINUTES) ) )
( ( 8 AMERICAN OPTICAL 1700 EAR MUFFS ) OMEGA 1.3 )
(-----)
( ( NOISE SOURCE/SUBJECT: ) METEOROLOGY: ) TEST 71-020-270 )
( ( HA-1A POWER UNIT, GAS ) TEMP = 15 C ) RUN 01 )
( ( TURBINE ENGINE ) BAR PRESS = .760 M HG ) 29 JAN 75 )
( ( (AIRESEARCH) ) REL HUMID = 70 % ) )
( ( FAR FIELD NOISE LEVELS ) ) PAGE 7 )
(-----)

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POINT	MIN									
	A					B				
0	B	A	A	A	A	B	A	A	A	A
10	B	A	A	A	A	B	A	A	A	A
20	B	A	A	A	A	B	A	A	A	A
30	B	A	A	A	A	B	A	A	A	A
40	B	A	A	A	A	B	A	A	A	A
50	B	A	A	A	A	B	A	A	A	A
60	B	A	A	A	A	B	A	A	A	A
70	B	A	A	A	A	B	A	A	A	A
80	B	A	A	A	A	B	A	A	A	A
90	B	A	A	A	A	B	A	A	A	A
100	B	A	A	A	A	B	A	A	A	A
110	B	A	A	A	A	B	A	A	A	A
120	B	A	A	A	A	B	A	A	A	A
130	B	A	A	A	A	B	A	A	A	A
140	B	A	A	A	A	B	A	A	A	A
150	B	A	A	A	A	B	A	A	A	A
160	B	A	A	A	A	B	A	A	A	A
170	B	A	A	A	A	B	A	A	A	A
180	B	A	A	A	A	B	A	A	A	A

DISTANCE FROM SOURCE (METERS)



[illegible]

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(-----)
( FIGURE: MAXIMUM PERMISSIBLE TIME {} FOR ONE EXPOSURE PER DAY (AFR 161-35, JULY 73) ) IDENTIFICATION: )
( ( EQUAL TIME CONTOURS (MINUTES) ) )
( 8 CONFIT TRIPLE FLANGE EAR PLUGS ) OMEGA 1.3
(-----)
( NOISE SOURCE/SUBJECT: ( OPERATION: ) METEOROLOGY: )
( ( HA-1A POWER UNIT, GAS ( ) TEMP = 15 C ) )
( ( TURBINE ENGINE ( 42,500 RPM ) ) BAR PRESS = .760 M HG ) 29 JAN 75
( ( (AIRESEARCH) ( ) REL HUMID = 70 % ) )
( ( FAR FIELD NOISE LEVELS ( ) ) ) PAGE 9
(-----)

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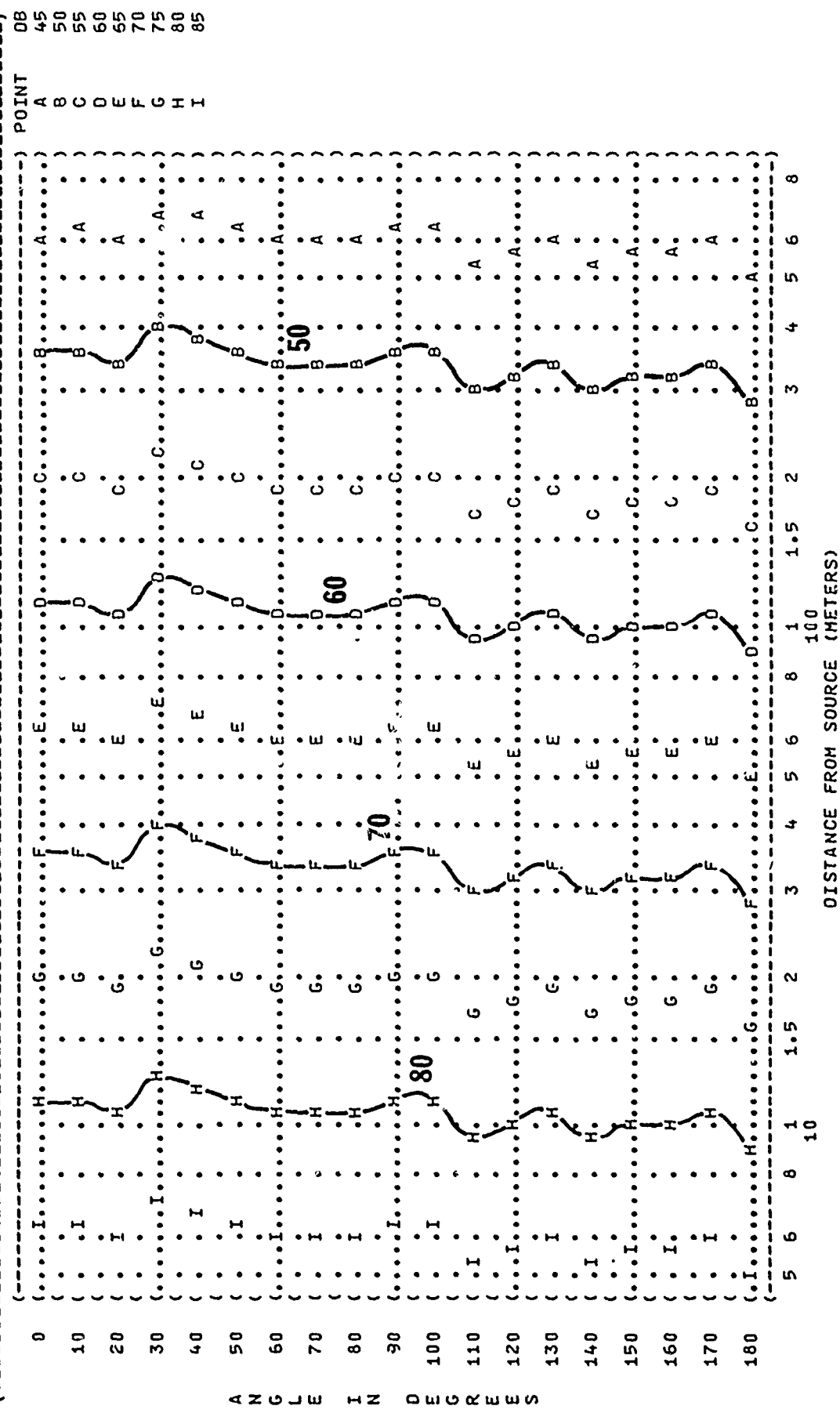
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DISTANCE FROM SOURCE (METERS)

180	(-----)	POINT	MIN
180	(.....)	A	960

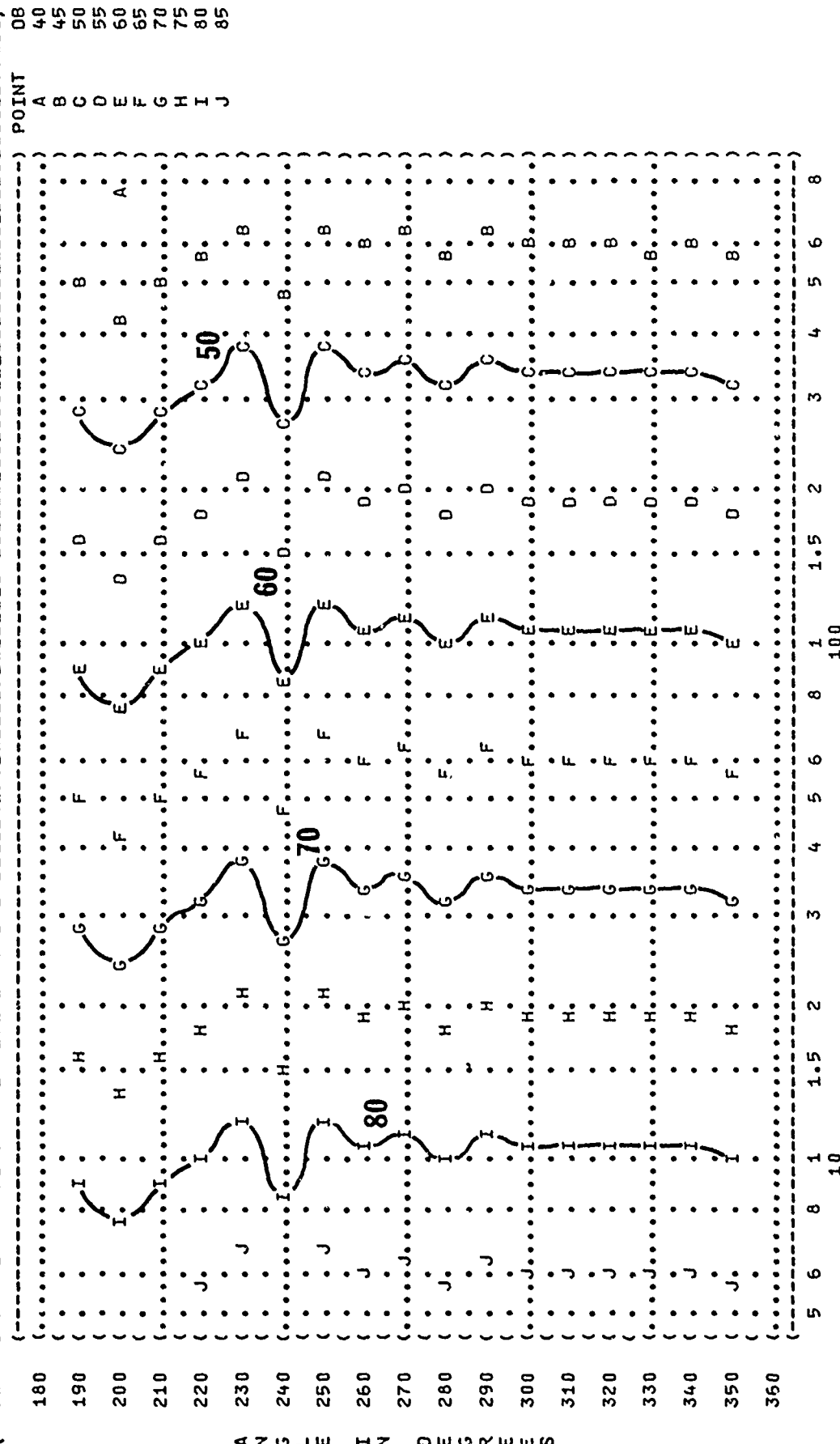
DISTANCE FROM SOURCE (METERS)

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(-----)
( FIGURE: SOUND PRESSURE LEVEL {SPL} ) IDENTIFICATION: )
( EQUAL LEVEL CONTOURS (DB) ) )
( 9 ) OMEGA 1.3 )
( 31.5 HZ OCTAVE BAND ) TEST 71-020-270 )
(-----)
( NOISE SOURCE/SUBJECT: ) METEOROLOGY: )
( MA-1A POWER UNIT, GAS ) TEMP = 15 C )
( TURBINE ENGINE ) BAR PRESS = .760 M HG )
( (AIRESEARCH) ) REL HUMID = 70 % )
( FAR FIELD NOISE LEVELS ) ) PAGE 16 )
(-----)
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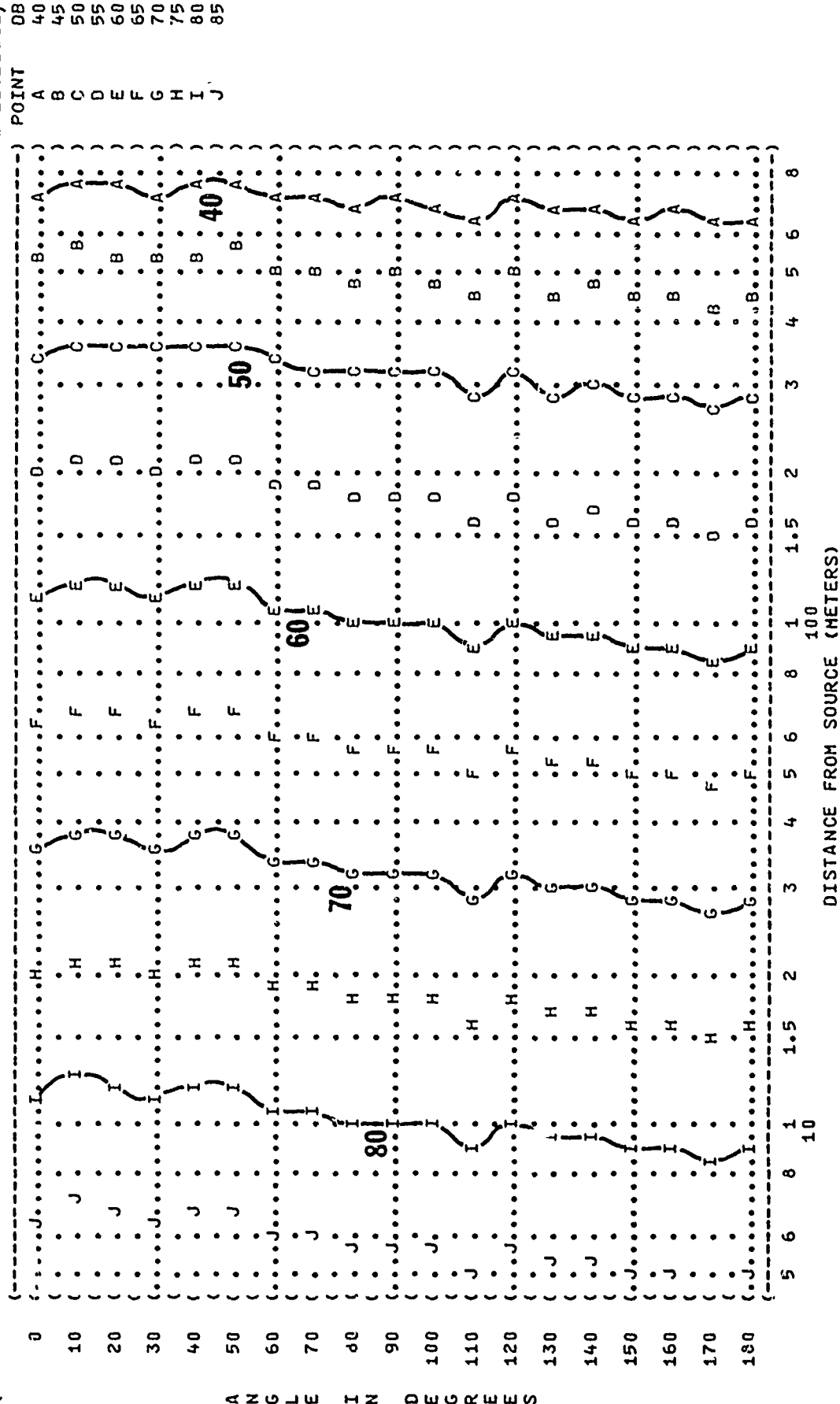
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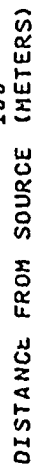
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(-----)
( FIGURE: SOUND PRESSURE LEVEL {SPL} ) IDENTIFICATION: )
( 9 EQUAL LEVEL CONTOURS (DB) ) )
( 31.5 HZ OCTAVE BAND ) OMEGA 1.3 )
(-----)
( NOISE SOURCE/SUBJECT' ) METEOROLOGY: )
( HA-1A POWER UNIT, GAS ) TEMP = 15 C )
( TURBINE ENGINE ) BAR PRESS = .760 M HG )
( (AIRESEARCH) ) REL HUMID = 70 % )
( FAR FIELD NOISE LEVELS ) PAGE 16 )
(-----)
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(FIGURE: SOUND PRESSURE LEVEL {SPL}
 (9 EQUAL LEVEL CONTOURS (DB)
 (63 HZ OCTAVE BAND
 (NOISE SOURCE/SUBJECT: (OPERATION:
 (HA-1A POWER UNIT, GAS (42,500 RPM
 (TURBINE ENGINE (BAR PRESS = .760 M HG
 ((AIRESEARCH) (REL HUMID = 70 %
 (FAR FIELD NOISE LEVELS ()
 () METEOROLOGY:
 () TEMP = 15 C
 () RUN 01
 () TEST 71-020-270
 () OMEGA 1.3
 () IDENTIFICATION:
 () PAGE 17



[illegible]

(FIGURE: SOUND PRESSURE LEVEL (SPL)
 (9 EQUAL LEVEL CONTOURS (DB)
 (125 HZ OCTAVE BAND
 (NOISE SOURCE/SUBJECT: (OPERATION:
 (HA-1A POWER UNIT, GAS (TEMP = 15 C
 (TURBINE ENGINE (BAR PRESS = .760 M HG
 ((AIRESEARCH) (REL HUMID = 70 %
 (FAR FIELD NOISE LEVELS () PAGE 18)

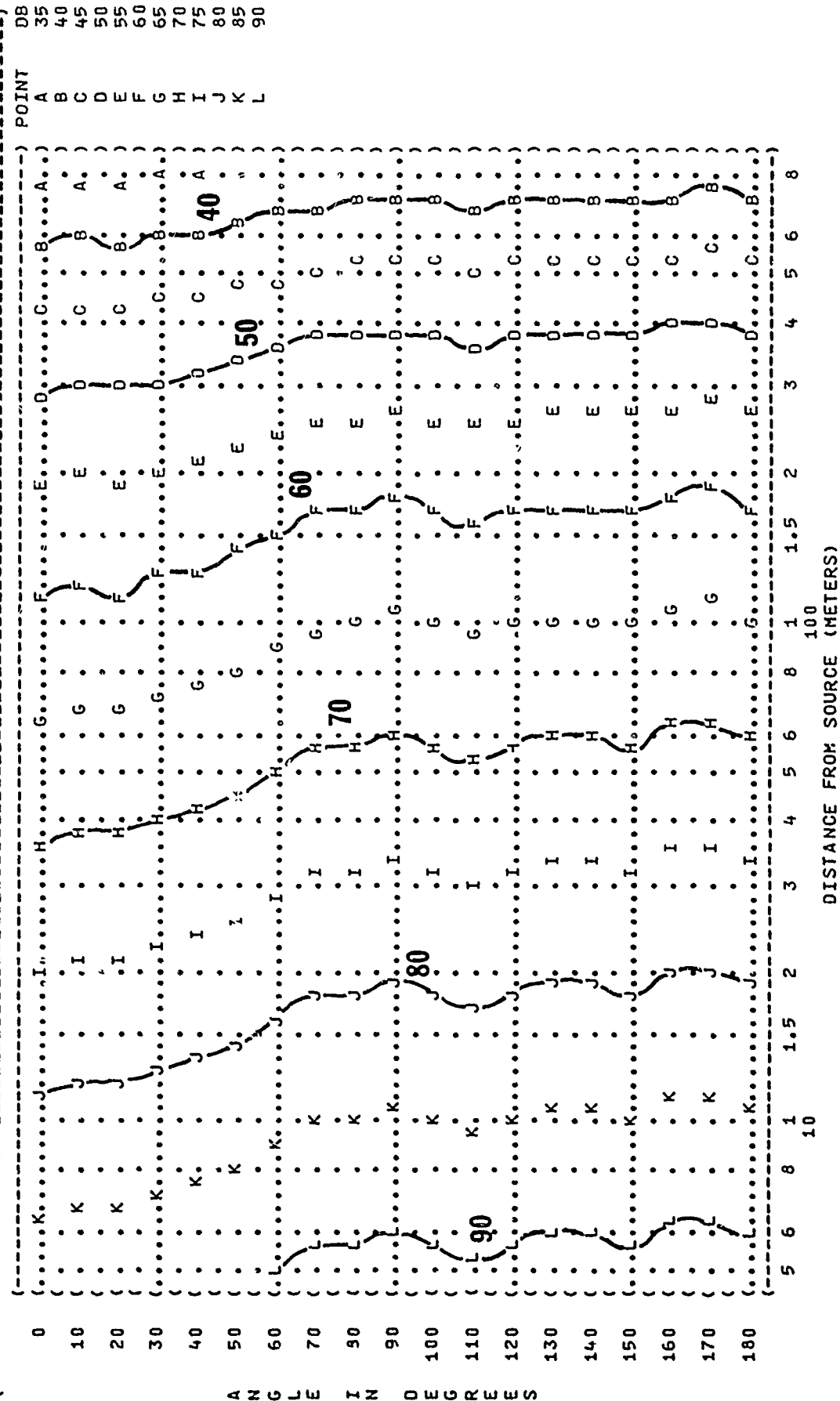
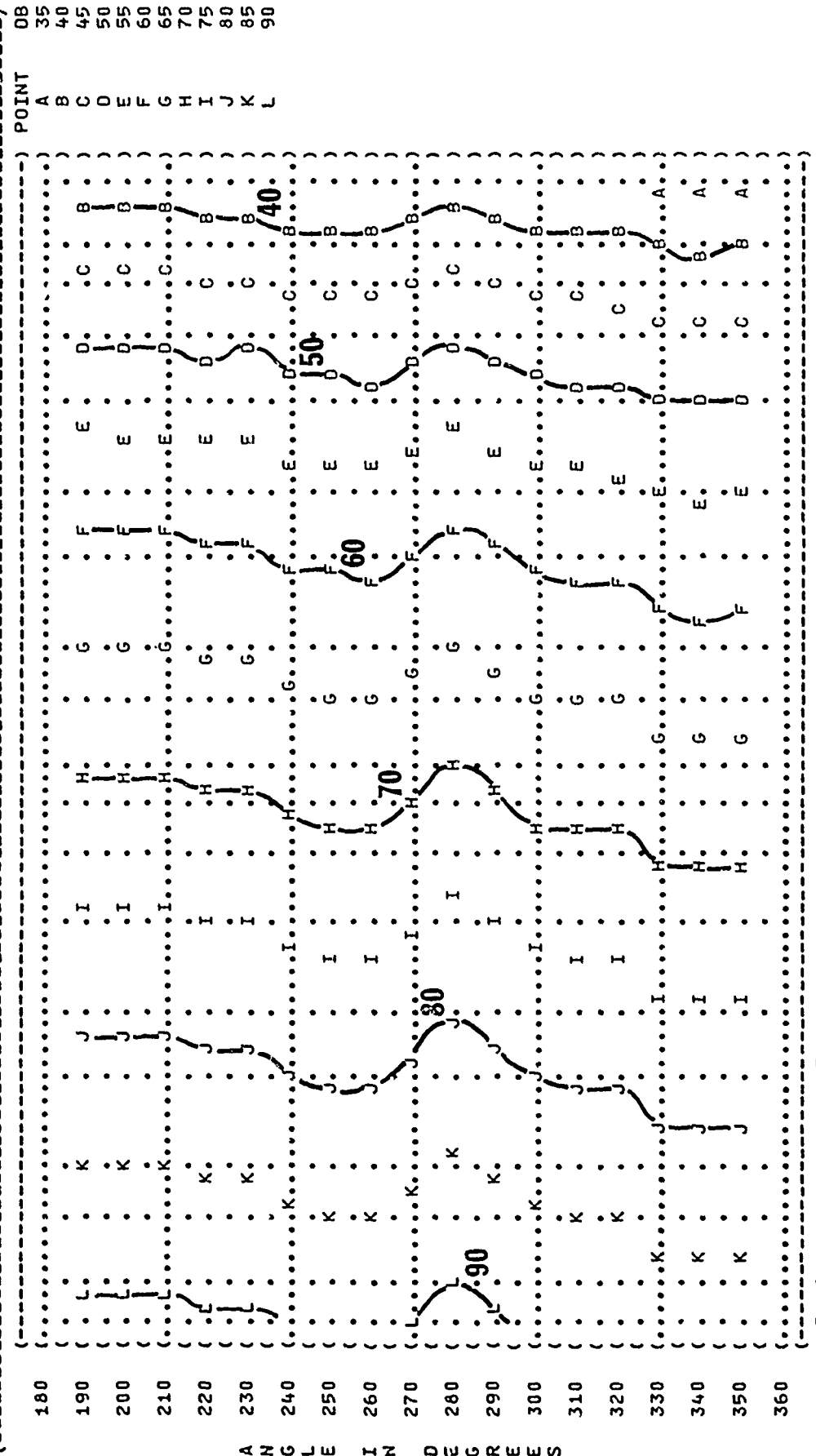


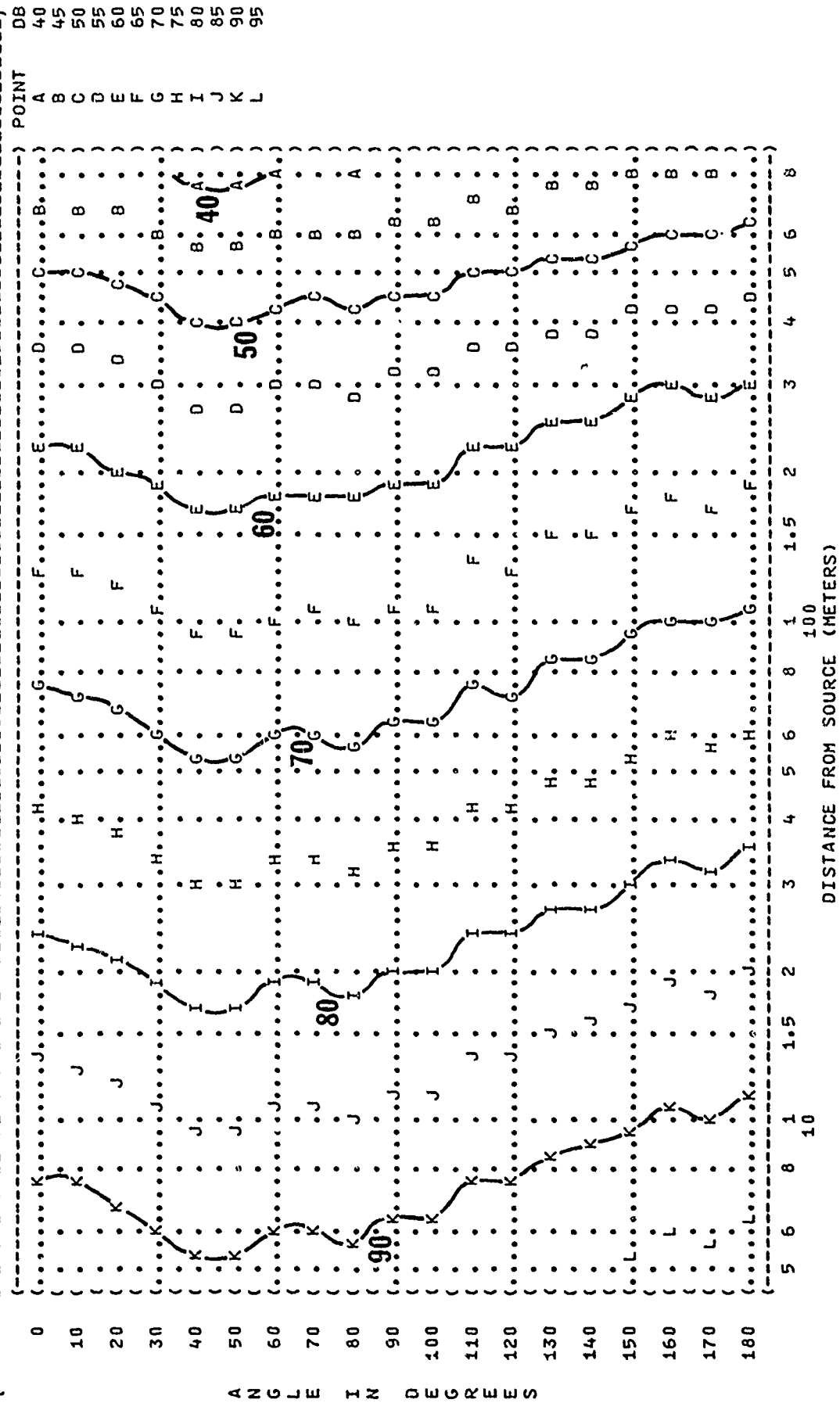
FIGURE: SOUND PRESSURE LEVEL (SPL)
 9 EQUAL LEVEL CONTOURS (DB)
 125 HZ OCTAVE BAND
 NOISE SOURCE/SUBJECT: (OPERATION:
 MA-1A POWER UNIT, GAS (TEMP = 15 C
 TURBINE ENGINE (42,500 RPM BAR PRESS = .760 M HG
 (AIRESEARCH) (REL HUMID = 70 %
 FAR FIELD NOISE LEVELS (PAGE 18



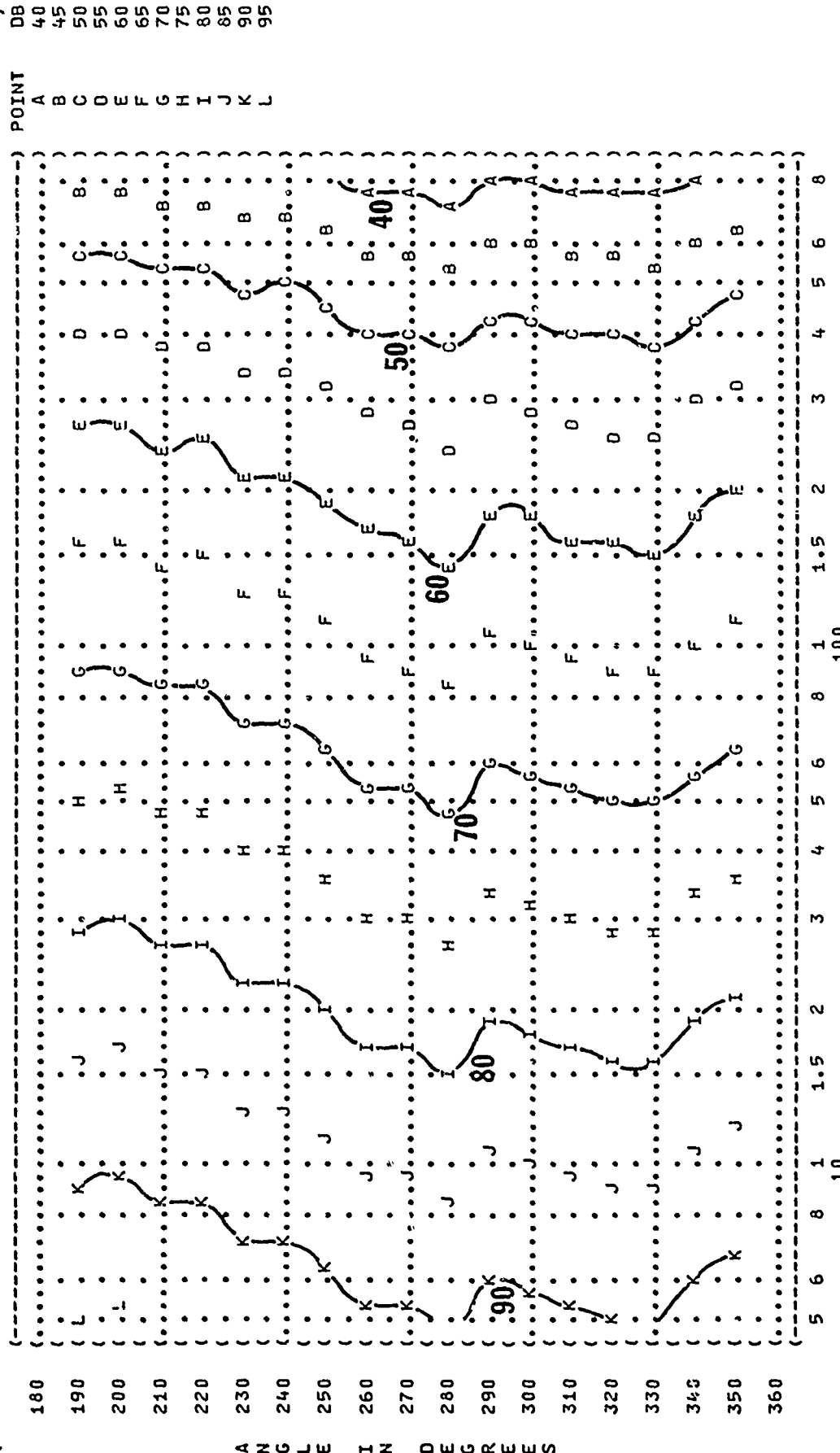
DISTANCE FROM SOURCE (METERS)

A N G L E I N D E G R E E S

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( FIGURE: SOUND PRESSURE LEVEL {SPL} ) IDENTIFICATION: )
( EQUAL LEVEL CONTOURS (DB) ) )
( 9 ) OMEGA 1.3 )
( 250 HZ OCTAVE BAND ) TEST 71-020-270 )
----- RUN 01 -----
( NOISE SOURCE/SUBJECT: ) METEOROLOGY: )
( MA-1A POWER UNIT, GAS ) TEMP = 15 C )
( TURBINE ENGINE ) BAR PRESS = .760 M HG )
( (AIRESEARCH) ) REL HUMID = 70 % )
( FAR FIELD NOISE LEVELS ) PAGE 19 )
```

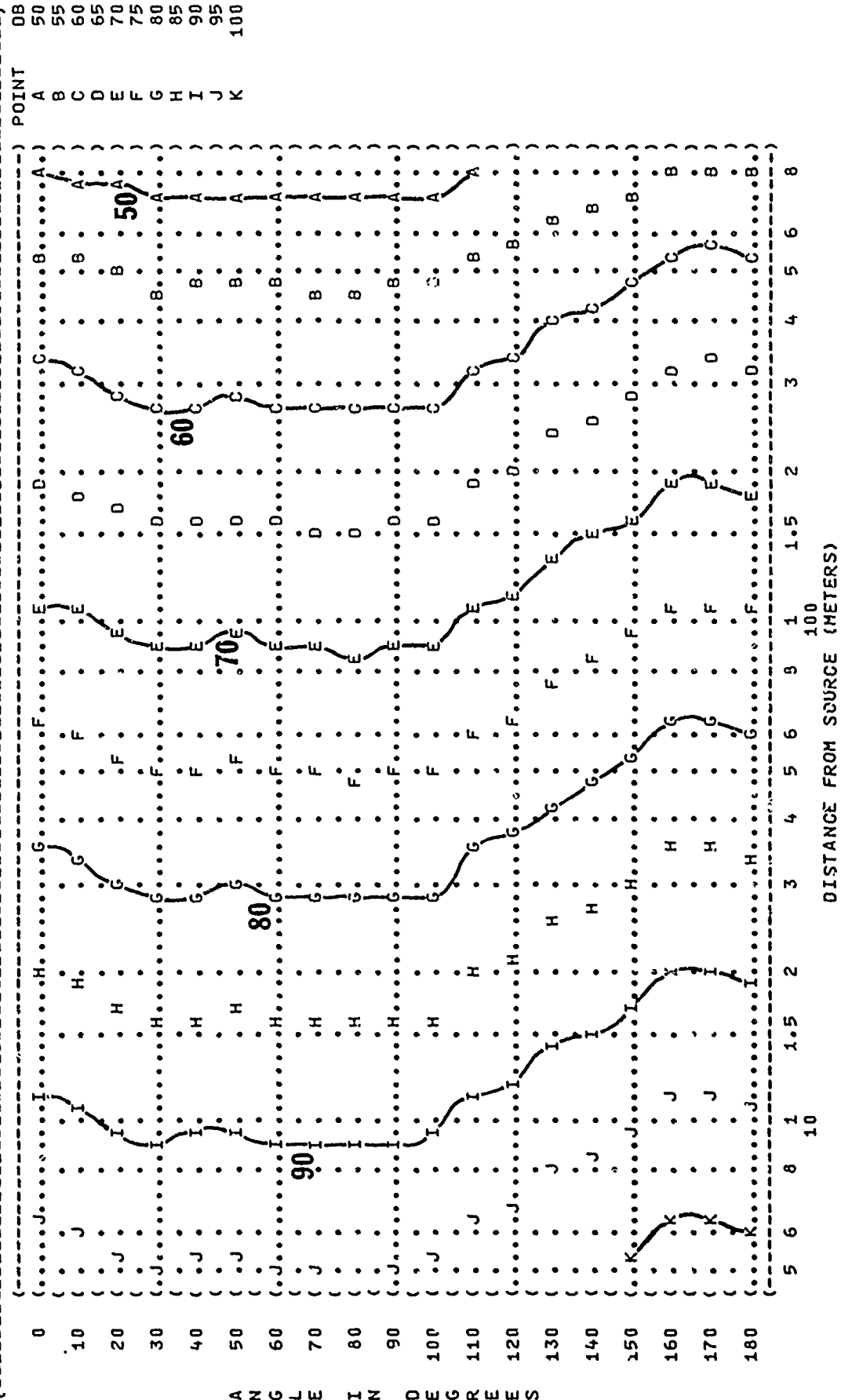


() FIGURE: SOUND PRESSURE LEVEL (SPL)
 () EQUAL LEVEL CONTOURS (DB)
 () 9 250 HZ OCTAVE BAND
 () NOISE SOURCE/SUBJECT:
 () HA-1A POWER UNIT, GAS
 () TURBINE ENGINE
 () (AIRESEARCH)
 () FAR FIELD NOISE LEVELS
 () OPERATION:
 () 42,500 RPM
 () METEOROLOGY:
 () TEMP = 15 C
 () BAR PRESS = .760 M HG
 () REL HUMID = 70 %
 () IDENTIFICATION:
 () OMEGA 1.3
 () TEST 71-020-270
 () RUN 02
 () 29 JAN 75
 () PAGE 19

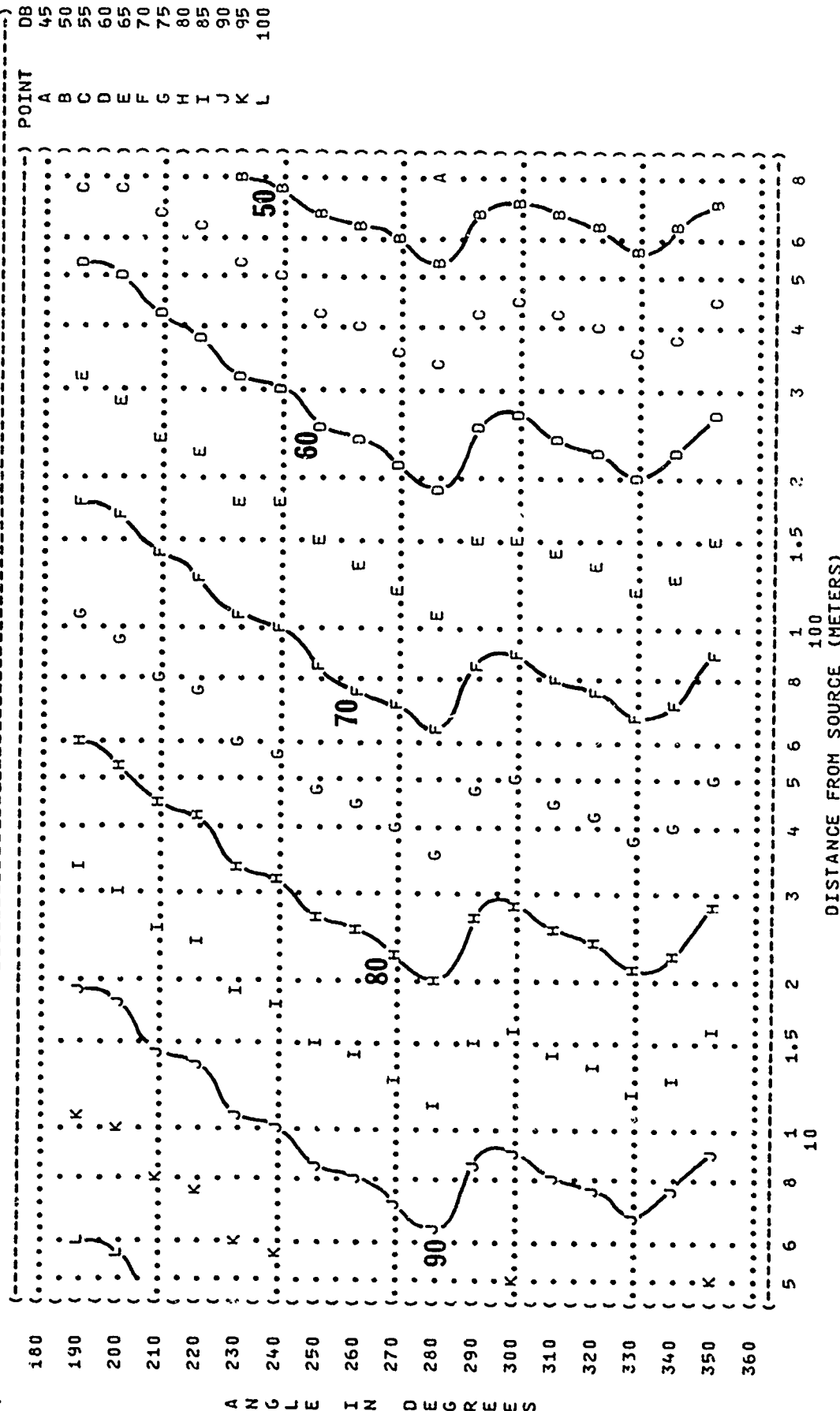


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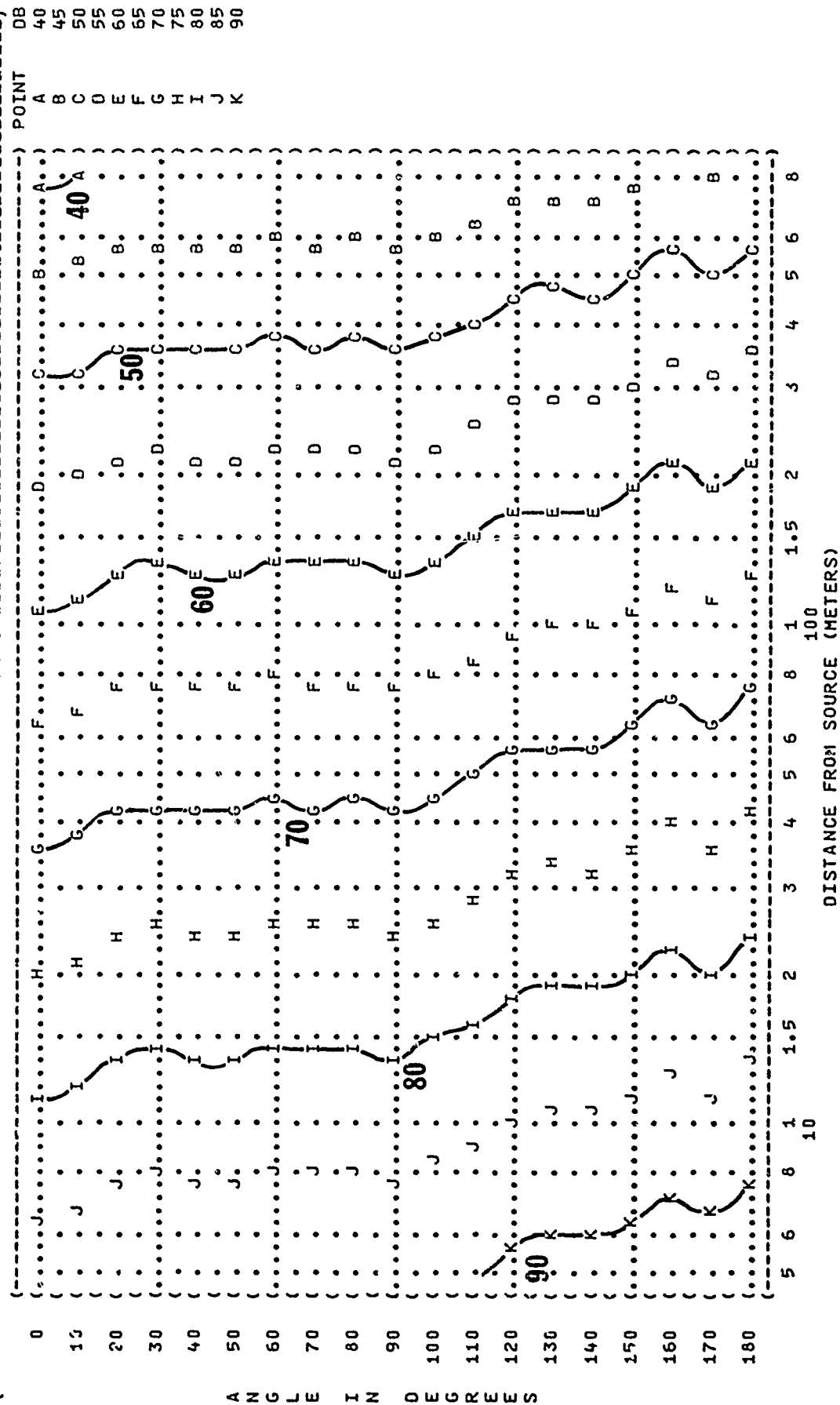
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( FIGURE: SOUND PRESSURE LEVEL {SPL} ) IDENTIFICATION: )
( EQUAL LEVEL CONTOURS (DB) ) )
( 9 ) OMEGA 1.3 )
( 500 HZ OCTAVE BAND ) TEST 71-020-270 )
(-----)
( NOISE SOURCE/SUBJECT: ) METEOROLOGY: )
( MA-1A POWER UNIT, GAS ) TEMP = 15 C )
( TURBINE ENGINE ) BAR PRESS = .760 M HG )
( (AIRESARCH) ) REL HUMID = 70 % )
( FAR FIELD NOISE LEVELS ) PAGE 20 )
(-----)
```



(FIGURE: SOUND PRESSURE LEVEL (SPL))
 (9 EQUAL LEVEL CONTOURS (DB))
 (500 HZ OCTAVE BAND)
 (NOISE SOURCE/SUBJECT:)
 (HA-1A POWER UNIT, GAS)
 (TURBINE ENGINE)
 ((AIRESEARCH))
 (FAR FIELD NOISE LEVELS)
 (OPERATION:)
 (42,500 RPM)
 (METEOROLOGY:)
 (TEMP = 15 C)
 (BAR PRESS = .760 M HG)
 (REL HUMID = 70 %)
 (IDENTIFICATION:)
 (OMEGA 1.3)
 (TEST 71-020-270)
 (RUN 02)
 (29 JAN 75)
 (PAGE 20)



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(-----)
( FIGURE: SOUND PRESSURE LEVEL (SPL) ) IDENTIFICATION: )
(    9   EQUAL LEVEL CONTOURS (DB) ) )
(      1000 HZ OCTAVE BAND ) )
(-----)
( NOISE SOURCE/SUBJECT: ) METEOROLOGY: )
( HA-1A POWER UNIT, GAS ) TEMP = 15 C )
( TURBINE ENGINE ) BAR PRESS = .760 M HG )
( (AIRESEARCH) ) REL HUMID = 70 % )
( FAR FIELD NOISE LEVELS ) )
(-----)
```



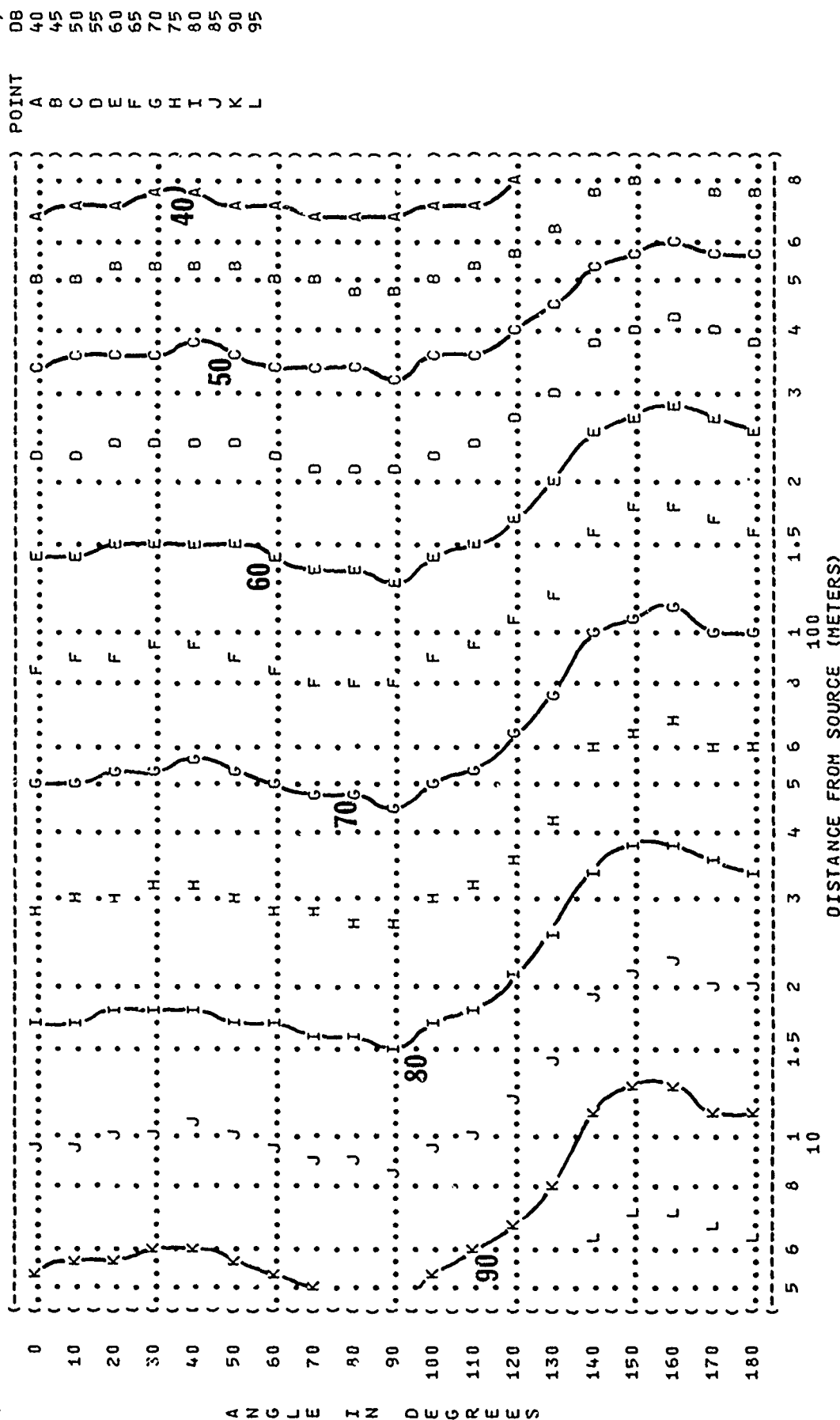
SOUND PRESSURE LEVEL {SPL}
EQUAL LEVEL CONTOURS (DB)
2000 HZ OCTAVE BAND

IDENTIFICATION:
OMEGA 1.3

ISE SOURCE/SUBJECT: (OPERATION:
MA-1A POWER UNIT, GAS ((
TURBINE ENGINE ((42,500 RPM
(AIRESEARCH) ((
FAR FIELD NOISE LEVELS ((

00 METEOROLOGY: :
00 TEMP :
00 BAR PRESS :
00 REL HUMID :
00

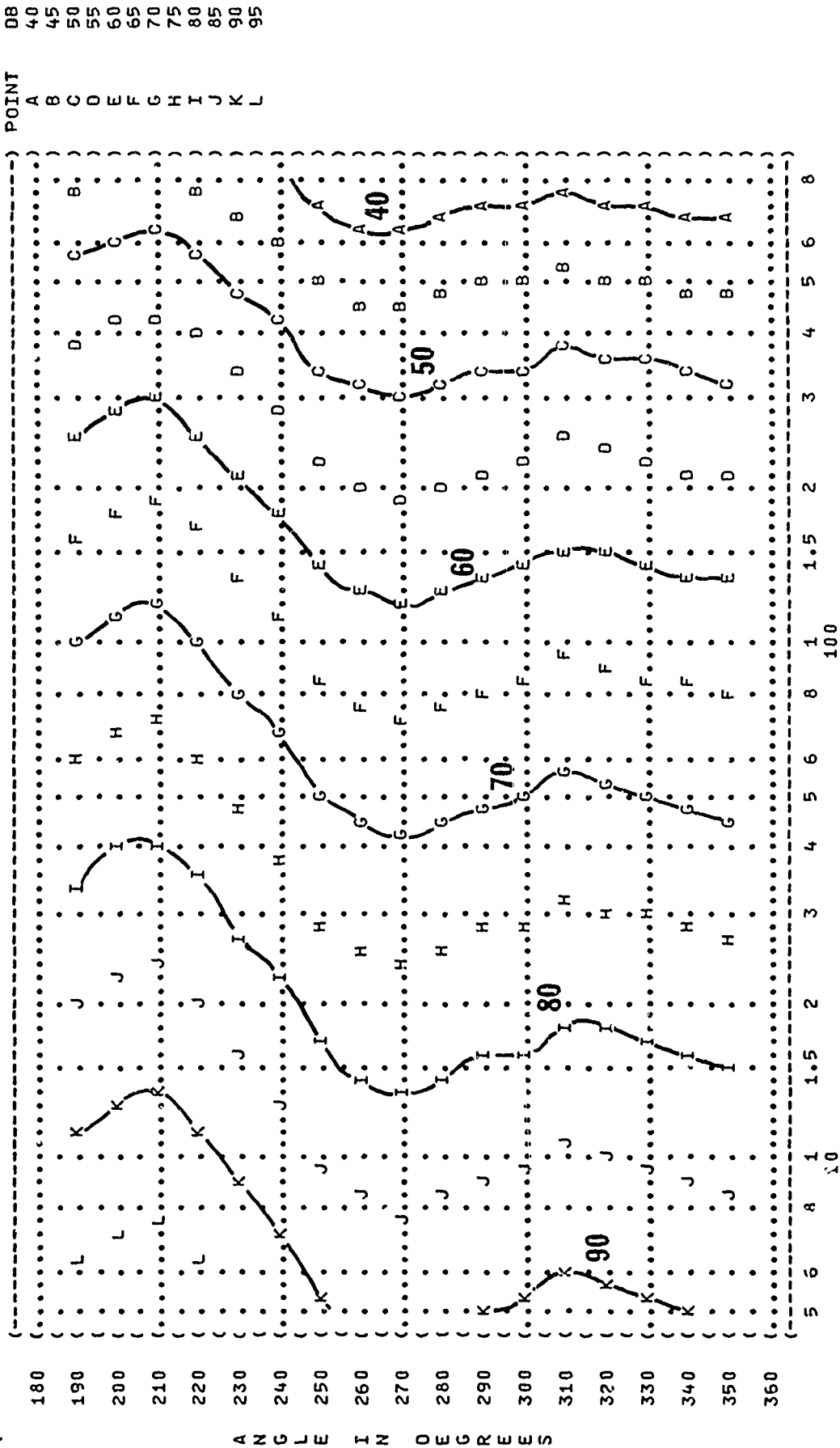
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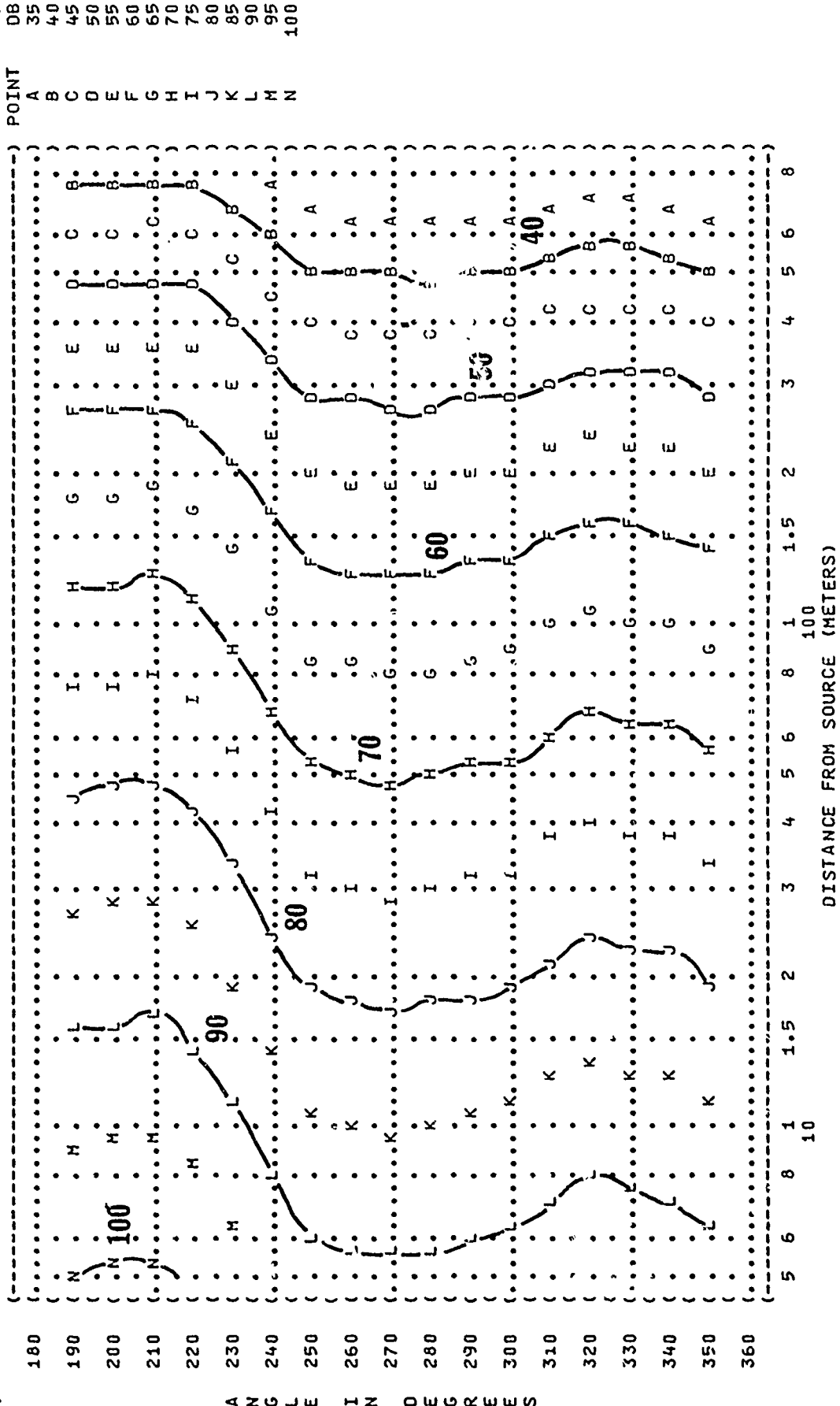
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(-----)
( FIGURE: SOUND PRESSURE LEVEL {SPL} ) IDENTIFICATION: )
( EQUAL LEVEL CONTOURS (DB) ) )
( 9 ) OMEGA 1.3 )
( 2000 HZ OCTAVE BAND ) TEST 71-020-270 )
( ) RUN 02 )
( NOISE SOURCE/SUBJECT: ) METEOROLOGY: )
( HA-1A POWER UNIT, GAS ) TEMP = 15 C )
( TURBINE ENGINE ) BAR PRESS = .760 M HG )
( (AIRESEARCH) ) REL HUMID = 70 % )
( FAR FIELD NOISE LEVELS ) )
(-----)

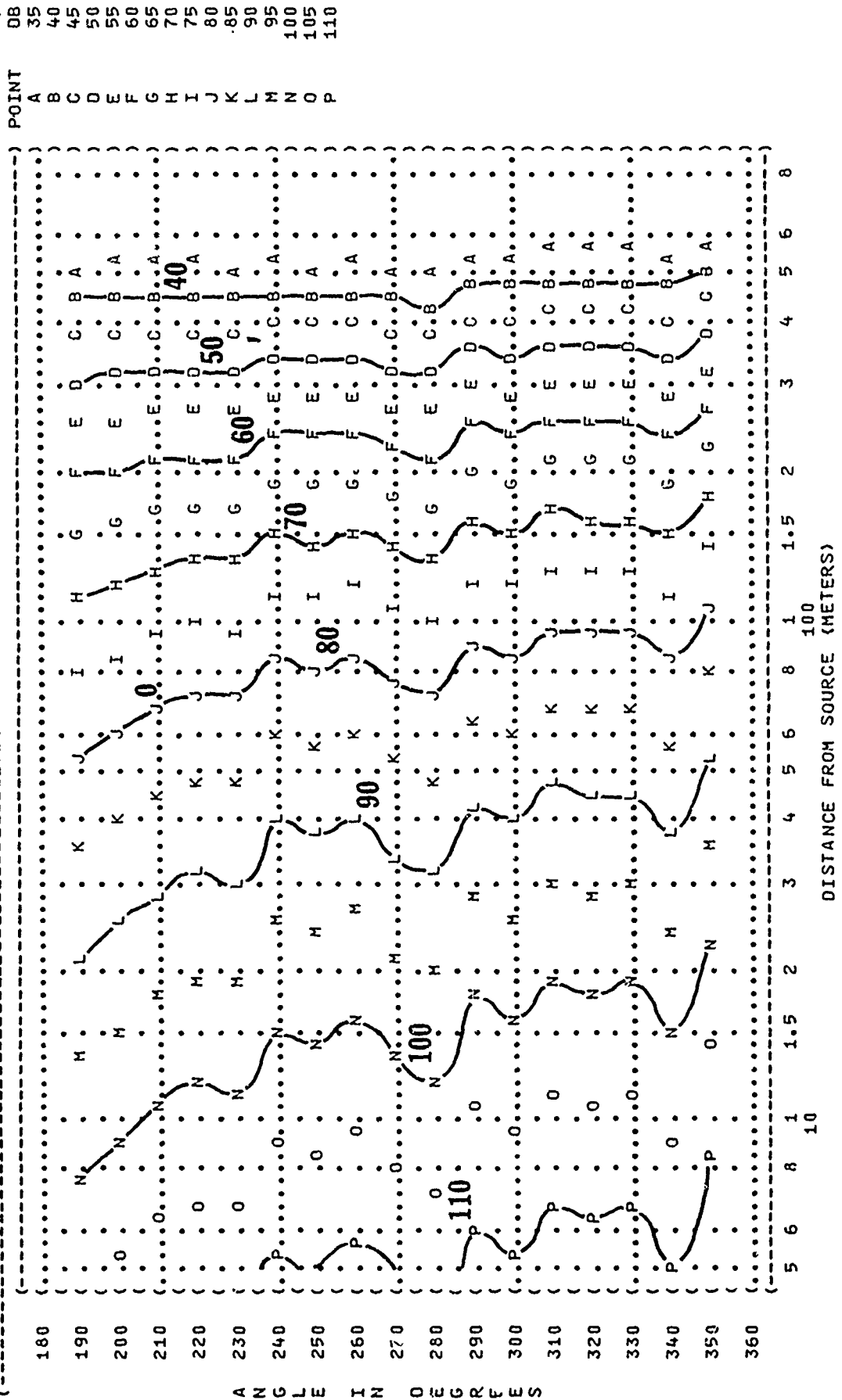
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(FIGURE: SOUND PRESSURE LEVEL (SPL))
 (9 EQUAL LEVEL CONTOURS (DB))
 (4000 HZ OCTAVE BAND)
 (NOISE SOURCE/SUBJECT:)
 (HA-1A POWER UNIT, GAS)
 (TURBINE ENGINE)
 ((AIRESEARCH))
 (FAR FIELD NOISE LEVELS)
 (OPERATION:)
 (42,500 RPM)
 (METEOROLOGY:)
 (TEMP = 15 C)
 (BAR PRESS = .760 M HG)
 (REL HUMID = 70 %)
 (IDENTIFICATION:)
 (OMEGA 1.3)
 (TEST 71-020-270)
 (RUN 02)
 (29 JAN 75)
 (PAGE 23)



(FIGURE: SOUND PRESSURE LEVEL (SPL))
 () EQUAL LEVEL CONTOURS (DB)
 () 8000 HZ OCTAVE BAND
 ()
 (NOISE SOURCE/SUBJECT:)
 () OPERATION:)
 () HA-1A POWER UNIT, GAS)
 () TURBINE ENGINE)
 () (AIRESEARCH))
 () FAR FIELD NOISE LEVELS)
 ()
 () METEOROLOGY:)
 () TEMP = 15 C)
 () BAR PRESS = .760 M HG)
 () REL HUMID = 70 %)
 ()
 () IDENTIFICATION:)
 () OMEGA 1.3)
 () TEST 71-020-270)
 () RUN 02)
 () 29 JAN 75)
 () PAGE 24)
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REFERENCES

1. Cole, John N., *USAF Bioenvironmental Noise Data Handbook, Volume 1: Organization, Content and Application*, AMRL-TR-75-50 (1), Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio, 1975.
2. Cole, John N., *USAF Bioenvironmental Noise Data Handbook, Volume 2: Procedure to Evaluate Effects of Non-standard Meteorological Conditions on Far-Field Noise*, AMRL-TR-75-50 (2), AMRL, WPAFB, OH, 1975.