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USAF BIOENVIRONMENTAL NOISE DATA HANDBOOK VOLUME 155

1/1

CH-3 IN-FLIGHT CREW NOISE(U) AIR FORCE AEROSPACE

MEDICAL RESEARCH LAB WRIGHT-PATTERSON AFB. H K HILLE

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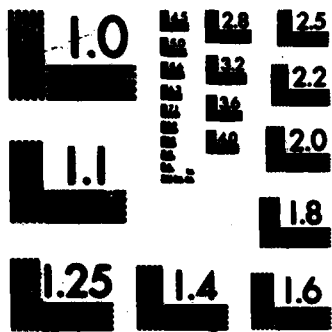
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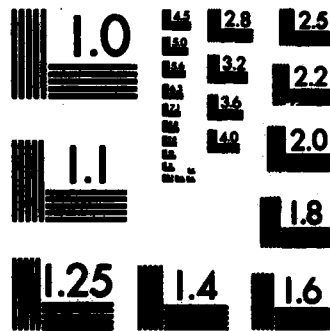
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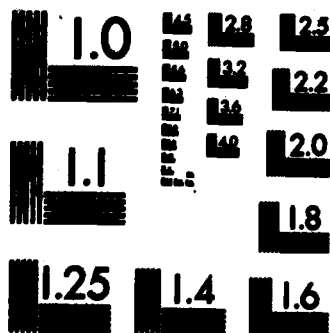
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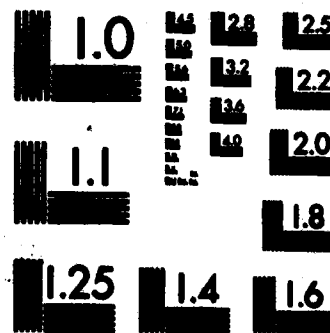
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MICROCOPY RESOLUTION TEST CHART
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Volume 155



USAF BIOENVIRONMENTAL NOISE DATA HANDBOOK

Volume 155

CH-3 IN-FLIGHT CREW NOISE

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AIR FORCE AEROSPACE MEDICAL RESEARCH LABORATORY
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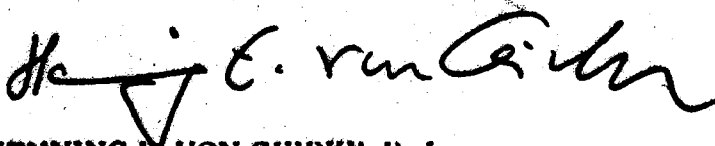
TECHNICAL REVIEW AND APPROVAL

ANRL-TR-75-50, Vol. 155

This report has been reviewed by the Office of Public Affairs (PA) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

FOR THE COMMANDER



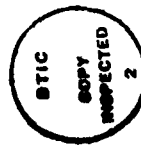
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Air Force Aerospace Medical Research Laboratory

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) → The CH-3 is a USAF tactical combat transport helicopter. This report provides measured data defining the bioacoustic environments at flight crew/passenger locations inside this helicopter during normal flight operations. Data are reported for nine locations in a wide variety of physical and psychoacoustic measures: overall and band sound pressure levels, C-weighted and A-weighted sound levels, preferred speech interference level, perceived noise →		

levels, and limiting times for total daily exposure of personnel with and without standard Air Force ear protectors. 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.

PREFACE

This report was prepared by the Biodynamic Environment Branch, Air Force Aerospace Medical Research Laboratory, under Project/Task 723109, Communication and Performance Capability and Operational Noises. The author acknowledges the efforts of Mr. John Cole who established the data analysis requirements, Mr. Henry Mohlman, and Mr. Fred Lampley of the University of Dayton who assisted in the mechanics of data processing and Mrs. Norma Peachey who typed this report and prepared it for publication.



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INTRODUCTION

The CH-3 is a USAF transport helicopter used to transport personnel or aerospace hardware. The helicopter, which is manufactured by the Sikorsky Aircraft Division of the United Technologies Corporation, is powered by two T58-GE-5 turboshaft engines each rated at 1500 shp. The engines drive both a four-blade fully-articulated 19m diameter main rotor and a conventional four-blade 4.2m diameter tail rotor. The engines are manufactured by the General Electric Company, Aircraft Engine Group, Military Engine Division.

This volume provides measured and extrapolated data defining bioacoustic environments produced inside this helicopter. Such data are essential to evaluate ear protection requirements, limiting personnel exposure times, voice communication capabilities, and annoyance problems associated with operations of the CH-3 helicopter.

This volume is one of a series published by the Air Force Aerospace Medical Research Laboratory (AFAMRL) 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 ground support equipment. The far-field, community-type, noise data in the handbook describe the noise produced during ground operations of aircraft, ground support 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. Refer to Volume 1 (reference 1) 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.

-
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.

IN-FLIGHT NOISE

MEASUREMENTS

All noise measurements were made on-board a standard-configured CH-3 helicopter during typical speed, altitude, and flight maneuver conditions. These levels describe the standard CH-3 environments, but may not be representative of those levels encountered if the helicopter has been configured differently (e.g., major equipment or structural changes).

Acoustic measurements were made at various flight crew locations. Table 1 lists the measurement locations and test conditions as numeric/alphabetic designators which are used on the data pages. The designator 1/A means measurement location 1 and test condition A.

The microphone position was at ear level external to headgear in a region 0.2-0.3 meter from the head when an individual was present. At unoccupied locations, measurements were made at ear level throughout a volume where the head would normally be located. In both cases, the microphone was randomly moved throughout a spherical volume approximately 0.3 meter in diameter and the resultant samples analyzed using a 4- or 8- second integration time to obtain a power-averaged level, which effectively smooths out short-duration fluctuations and best describes the exposure.

Although the presence of a crew member at a measurement location affects the resultant sound field, the magnitude of such effects is generally small and not significant in determining exposure limits or voice communication capabilities. Consequently, no distinction is made in this report between occupied and unoccupied measurement locations.

RESULTS

The measured data presented in Table 2 define the sound pressure levels (SPL) produced inside the HH-43B helicopter at the 9 specified locations. This table includes the overall, 1/3 octave band, and octave band levels. From these data, C-weighted and A-weighted sound levels, maximum permissible time for one exposure per day (AFR 161-35) with and without standard Air Force ear protectors, preferred speech interference level, and perceived noise level are calculated and presented in Table 3. These measures are widely used to assess the effects of noise on personnel and their performance.

TABLE 1**MEASUREMENT LOCATIONS AND TEST CONDITIONS**

CH-3, Andrews AFB, 8 June 1982

LOCATION	POSITION	HEIGHT ABOVE DECK
1	Between Pilot and Copilot	Seated Head Level
2	Flight Engineer's Station	Seated Head Level
3	1st Row Seat Across From Entrance Door	1.5 Meters
4	2nd Row Seats, Centerline	1.5 Meters
5	3rd Row Seats, Centerline	1.5 Meters
6	4th Row Seats, Centerline	1.5 Meters
7	5th Row Seats, Centerline	1.5 Meters
8	Left Side Bunk, Aft of Aircraft	Head Level
9	Right Side Bunk, Aft of Aircraft	Head Level

CONDITION	DESCRIPTION
A	APU Running, Entrance Door Open
B	#1 Engine Start, APU Running, Entrance Door Open
C	#2 Engine Start, APU Running, Entrance Door Open
D	Ground Runup - Engine RPM 80%
E	Taxi - Engine RPM 90%, Entrance Door Open
F	Takeoff - Engine RPM 92%, Entrance Door Closed
G	Liftoff Climb to 500'
H	Level Cruise - 500' PA, 90 KIAS, Door Closed
I	Level Cruise - 500' PA - 70 KIAS, Door Closed
J	Level Cruise - 500' PA - 80 KIAS
K	Level Cruise - 1000' PA - 120 KIAS
L	Hover, 50' - Entrance Door Closed
M	Descent and Landing
O	Taxi - Entrance Door Closed

DATE: 10/15/70

PROJECT: [Illegible]

MEASUREMENT POINTS:
1. [Illegible]
2. [Illegible]
3. [Illegible]
4. [Illegible]
5. [Illegible]
6. [Illegible]
7. [Illegible]
8. [Illegible]
9. [Illegible]
10. [Illegible]

MEASUREMENT METHOD: [Illegible]

MEASUREMENT TIME: [Illegible]

MEASUREMENT DURATION: [Illegible]

MEASUREMENT FREQUENCY: [Illegible]

MEASUREMENT SENSITIVITY: [Illegible]

MEASUREMENT RESULTS:

MEASUREMENT POINT	MEASUREMENT VALUE (dB)
1	100
2	100
3	100
4	100
5	100
6	100
7	100
8	100
9	100
10	100
OVERALL	100

LEVEL CORRECTED TO AEROSOL BACKGROUND/ELECTRONIC NOISE.

FREQ (HZ)	MEASURED SOUND PRESSURE LEVEL (DB)										LOCATION/CONDITION			
	1/N	2/N	3/N	4/N	5/N	6/N	7/N	8/N	9/N	5/I		2/J	3/J	4/J
25	95	91	89	96	99	100	93	93	93	90	92	91	93	94
31.5	96	89	97	95	92	90	84	87	87	90	96	96	94	94
40	89	86	92	93	89	95	86	87	87	87	93	93	90	90
50	89	94	96	95	97	94	89	89	89	93	95	95	93	98
63	85	89	87	92	92	90	82	85	85	81	87	87	85	86
80	89	90	86	95	90	89	83	84	84	84	90	89	88	88
100	91	90	89	93	93	91	91	90	90	86	92	92	90	93
125	88	90	90	94	95	92	91	91	88	88	96	96	91	93
160	86	94	91	94	96	94	90	91	89	89	96	96	92	93
200	88	100	92	96	92	91	89	87	87	90	92	91	92	94
250	87	91	90	90	89	87	87	88	84	87	90	90	89	91
315	85	90	88	89	88	88	87	83	86	84	91	91	94	92
400	84	87	88	87	86	85	83	84	83	82	87	85	87	88
500	87	93	86	86	85	86	82	83	84	81	85	85	86	86
630	90	96	94	92	89	89	89	90	88	95	94	94	98	98
800	80	84	85	87	90	89	87	86	86	88	87	87	89	90
1000	78	83	83	85	85	85	81	80	81	79	82	82	83	85
1250	81	85	88	87	84	84	79	79	83	84	84	84	88	90
1600	75	80	80	84	85	85	78	78	78	78	79	79	82	85
2000	71	75	75	75	78	73	71	70	71	73	74	74	76	77
2500	71	74	72	76	76	73	67	66	67	71	73	73	75	76
3150	69	74	73	79	85	75	66	65	65	76	75	75	78	81
4000	68	75	69	71	75	68	62	63	64	67	69	69	70	72
5000	69	75	69	68	68	65	61	62	63	64	68	68	68	70
6300	68	72	67	65	65	63	60	61	62	62	66	66	66	67
8000	69	74	68	65	64	61	60	61	63	61	67	67	66	66
10000	80	86	78	74	73	70	61	62	62	67	78	78	73	71
OVERALL	102	105	104	105	105	105	100	100	100	101	105	104	104	105

LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

IDENTIFICATION:
)
)
) OMEGA 3.2
) TEST CA-082-001
) RUN 02
)
) 27 JUL 82
) PAGE F2

NOISE SOURCE/SUBJECT:
 CH-3 IN-FLIGHT
 CREW NOISE

OPERATION:
)
)
)
)

LOCATION/CONDITION

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)		IDENTIFICATION:												
OCTAVE BAND														
2		OMEGA 3.2												
NOISE SOURCE/SUBJECT:		TEST CA-082-001												
CH-3 IN-FLIGHT		RUN 02												
CREW NOISE		27 JUL 82												
		PAGE J2												
		LOCATION/CONDITION												
FREQ (HZ)	1/H	2/H	3/H	4/H	5/H	6/H	7/H	8/H	9/H	5/I	2/J	3/J	4/J	5/J
31.5	99	94	99	99	100	102	94	94	95	93	99	99	97	98
63	99	96	97	99	99	96	91	90	91	94	96	96	94	99
125	93	97	95	98	99	97	95	96	95	93	100	100	95	98
250	91	101	95	97	95	94	92	92	91	92	96	95	97	97
500	92	98	95	94	92	92	91	91	90	96	95	95	98	99
1000	84	89	91	91	92	91	89	88	87	89	89	89	92	94
2000	77	82	82	85	86	85	79	79	79	80	81	81	83	86
4000	73	79	76	80	85	76	68	68	69	76	76	77	79	82
8000	80	86	79	75	74	71	65	65	67	69	79	79	74	73
OVERALL	102	105	104	105	105	105	100	100	100	101	105	104	104	105

TABLE: MEASURED SOUND PRESSURE LEVEL (dB)
OCTAVE BAND

2

IDENTIFICATION:

OMEGA 3.2
TEST CA-082-001
RUN 03
27 JUL 82
PAGE J3

NOISE SOURCE/SUBJECT:

CH-3 IN-FLIGHT
CREW NOISE

LOCATION/CONDITION

FREQ (HZ)	6/J	7/J	8/J	9/J	1/K	2/K	3/K	5/K	1/L	2/L	3/L	1/M	1/O
31.5	101	101	97	97	104	99	102	103	102	99	98	99	93
63	97	96	98	100	98	100	99	100	97	100	97	100	96
125	96	97	101	100	97	101	100	101	97	100	99	99	100
250	95	93	94	95	98	103	98	99	95	101	99	100	99
500	96	95	92	91	95	98	98	99	99	99	98	98	95
1000	93	91	89	90	88	92	93	93	86	93	93	91	88
2000	83	81	80	82	83	86	84	83	80	86	85	83	81
4000	75	72	71	72	79	84	78	77	77	82	80	79	77
8000	71	68	70	71	82	87	79	77	81	87	74	84	89
OVERALL	105	105	105	105	107	108	107	108	105	107	105	106	105

MEASURES OF HUMAN NOISE EXPOSURE										IDENTIFICATION:				
1/A	2/A	1/B	2/B	1/C	2/C	1/D	2/D	1/E	2/E	1/F	2/F	1/G	2/G	
HAZARD/PROTECTION														
C-HEIGHTED OVERALL SOUND LEVEL (OASLC IN DBC) AT EAR														
A-HEIGHTED OVERALL SOUND LEVEL (OASLA IN DBA) AT EAR														
MAXIMUM PERMISSIBLE TIME (T IN MINUTES) FOR ONE EXPOSURE PER DAY (AFR 161-35, JULY 73)														
NO PROTECTION														
OASLC	88	99	92	99	91	100	96	101	102	102	101	105	103	108
OASLA	84	88	88	93	85	95	89	94	96	96	94	100	95	104
T	480	85	240	101	404	71	202	85	60	60	85	90	71	15
HGU-2A/P HELMET WITH H-154														
OASLA*	73	83	78	84	77	86	82	88	86	86	86	92	87	94
T	960	571	960	480	960	339	679	240	339	339	339	120	285	85
HGU-2A/P HELMET WITH H-154(A)														
OASLA*	68	78	73	80	72	81	78	83	82	82	82	88	82	89
T	960	960	960	960	960	807	960	571	679	679	679	240	679	202
HGU-2A/P HELMET WITH CUSTOM LINER														
OASLA*	81	91	85	90	81	91	86	91	93	93	91	97	92	101
T	807	143	404	170	807	143	339	143	101	101	143	50	120	25
U-SIR EAR PLUGS														
OASLA*	62	71	65	71	61	71	66	71	73	73	71	77	72	81
T	960	960	960	960	960	960	960	960	960	960	960	960	960	807
H-157 IN-FLIGHT COMMUNICATION UNIT														
OASLA*	65	76	69	77	69	78	74	80	78	78	78	84	78	85
T	960	960	960	960	960	960	960	960	960	960	960	480	960	404
COMMUNICATION														
PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)														
PSIL	74	79	80	85	79	87	81	84	86	86	86	90	87	92
ANNOYANCE														
PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNDB)														
TONE CORRECTION (C IN DB)														
PNLT	98	107	103	109	100	110	104	110	112	112	110	116	111	120
C	4	5	4	4	2	3	2	3	5	5	3	4	3	5

* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.

TABLE: MEASURES OF HUMAN NOISE EXPOSURE

NOISE SOURCE/SUBJECT:	LOCATION/CONDITION											IDENTIFICATION:			
	1/H	2/H	3/H	4/H	5/H	6/H	7/H	8/H	9/H	5/I	2/J		3/J	4/J	5/J
3															OMEGA 3.2
CH-3 IN-FLIGHT															TEST CA-082-001
CREW NOISE															RUN 02
															27 JUL 82
															PAGE 12
HAZARD/PROTECTION															
C-WEIGHTED OVERALL SOUND LEVEL (OASLC IN DBC) AT EAR															
A-WEIGHTED OVERALL SOUND LEVEL (OASLA IN DBA) AT EAR															
MAXIMUM PERMISSIBLE TIME (T IN MINUTES) FOR ONE EXPOSURE PER DAY (AFR 161-35, JULY 73)															
NO PROTECTION															
OASLC	100	105	103	104	104	103	99	99	99	99	100	104	104	103	105
OASLA	92	98	96	96	96	95	92	92	92	92	95	96	96	99	99
T	120	42	60	60	60	71	120	120	120	120	71	60	60	36	36
HGU-2A/P HELMET WITH H-154															
OASLC	84	92	88	89	88	87	85	85	84	85	85	89	89	89	90
T	480	120	240	202	240	285	404	404	400	404	404	202	202	202	170
HGU-2A/P HELMET WITH H-154(A)															
OASLC	80	88	84	85	84	83	81	81	80	82	85	85	85	86	86
T	960	240	480	404	480	571	807	807	960	679	404	404	404	359	359
HGU-2A/P HELMET WITH CUSTOM LINER															
OASLC	89	95	93	93	92	92	90	90	89	92	92	93	93	95	96
T	202	71	101	101	120	120	170	170	202	120	101	101	101	71	60
U-51R EAR PLUGS															
OASLC	70	75	73	73	73	72	70	70	69	72	73	73	73	76	76
T	960	960	960	960	960	960	960	960	960	960	960	960	960	960	960
H-157 IN-FLIGHT COMMUNICATION UNIT															
OASLC	77	84	79	82	81	80	77	77	77	77	77	81	81	81	82
T	960	480	960	679	807	960	960	960	960	960	960	807	807	807	679
COMMUNICATION															
PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)															
PSIL	85	90	89	90	90	89	86	86	85	88	88	88	88	91	93
ANNOYANCE															
PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PH08)															
TONE CORRECTION (C IN DB)															
PNLT	107	119	111	111	113	109	106	106	105	111	111	111	111	114	115
C	2	3	3	2	3	2	2	2	1	4	3	3	3	3	3

* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.

MEASURES OF HUMAN NOISE EXPOSURE													
IDENTIFICATION:													
3													
OMEGA 3.2													
TEST CA-082-001													
RUN 03													
27 JUL 62													
PAGE H3													
NOISE SOURCE/SUBJECT:													
(OPERATION)													
(CH-3 IN-FLIGHT)													
(CREW NOISE)													
()													
()													
()													
LOCATION/CONDITION													
6/J	7/J	8/J	9/J	1/K	2/K	3/K	5/K	1/L	2/L	3/L	1/M	1/O	
HAZARD/PROTECTION													
C-WEIGHTED OVERALL SOUND LEVEL (OASLC IN DBC) AT EAR													
A-WEIGHTED OVERALL SOUND LEVEL (OASLA IN DBA) AT EAR													
MAXIMUM PERMISSIBLE TIME (T IN MINUTES) FOR ONE EXPOSURE PER DAY (AFR 161-95, JULY 79)													
NO PROTECTION													
OASLC	104	103	104	104	105	107	106	107	104	107	105	106	104
OASLA	97	96	94	94	95	99	98	99	93	99	98	98	96
T	50	60	85	85	71	36	42	36	101	36	42	42	60
H8U-2A/P HELMET WITH H-154													
OASLC	88	87	88	89	90	94	91	92	88	93	91	92	91
OASLA	240	285	240	202	170	85	143	120	240	101	143	120	143
T	480	571	480	404	339	170	285	240	480	202	285	240	285
H8U-2A/P HELMET WITH H-154(A)													
OASLC	84	83	84	85	86	90	87	88	84	89	87	88	87
OASLA	480	571	480	404	339	170	285	240	480	202	285	240	285
T	480	571	480	404	339	170	285	240	480	202	285	240	285
H8U-2A/P HELMET WITH CUSTOM LINER													
OASLC	94	93	92	91	93	97	96	97	91	97	96	95	94
OASLA	94	93	92	91	93	97	96	97	91	97	96	95	94
T	85	101	120	143	101	50	60	50	143	50	60	71	85
U-SIR EAR PLUGS													
OASLC	74	73	72	72	73	77	76	77	71	77	76	76	74
OASLA	960	960	960	960	960	960	960	960	960	960	960	960	960
T	960	960	960	960	960	960	960	960	960	960	960	960	960
H-157 IN-FLIGHT COMMUNICATION UNIT													
OASLC	80	79	81	82	82	86	83	84	80	85	83	84	83
OASLA	80	79	81	82	82	86	83	84	80	85	83	84	83
T	960	960	807	679	679	339	571	480	960	404	571	480	571
COMMUNICATION													
PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)													
PSIL	91	89	87	88	88	92	92	92	86	93	92	90	88
ANNNOYANCE													
PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNDB)													
TONE CORRECTION (C IN DB)													
PNLT	112	111	109	108	110	115	113	115	108	114	113	113	112
C	3	3	2	1	1	1	2	3	1	1	2	2	3

* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.