



WORLD AIRLINE ENTERTAINMENT ASSOCIATION TECHNOLOGY COMMITTEE

WAEA SPECIFICATION 1289-2

Specification for Mastertape Recording, Tape Duplication, Compact Disc Replication, and Digital Encoding for Airborne Audio Entertainment Systems

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1.0 This document establishes guidelines for the recording, duplication, replication, and digital encoding of program master tapes for airborne audio systems. Where applicable, specifications are with reference to the NAB Standard "Magnetic Tape Recording and Reproducing" (April 1965), issued by the Engineering Department of the National Association of Broadcasters, CD Avionics Specification: 1994, and ISO/IEC 11172-3, Coding of Moving Pictures and Associated Audio for Digital Storage Media.

2.0 PROGRAM MASTERTAPES, ANALOGUE

2.1 Audio recording tape used shall be mastering quality supplied to the duplicator on 10 1/2 inch diameter NAB reels, tails out, flat packed.

2.2 Tape width shall be 1/4 inch.

2.3 Mastertape speed shall be 7.5 ips (19cms) or 15 ips (38 cms).

2.4 Track format shall be 2, 1/2 tracks. For stereo recordings, left channel information shall be recorded on Track 1, right channel information on Track 2. Both tracks shall be recorded in phase. All monaural programs shall be recorded on Track 1.

2.5 The program material shall be preceded by 2 recorded reference tones.

2.5.1 A 700 Hz tone, 30 sec duration, at the reference flux level. A 10 kHz tone, 30 sec duration, recorded 10 db lower than the reference flux level.

2.5.2 Operationally, a standard reference level may be established as follows: Reference flux level is a 700 Hz sine wave recorded at a level 8 db below the level that will produce 3% third harmonic distortion.

3.0 PROGRAM MASTERTAPES, DIGITAL

3.1 Audio recording tape used shall be digital audio tape (R-DAT) cassette.

3.2 Mastertape speed shall be 8.150 mm/sec or 12.225 mm/sec (usually automatically selected).

3.3 Sample Frequency shall be 44.1 kHz.

3.4 Left channel information shall be recorded on CHANNEL 1; right channel information shall be recorded on CHANNEL 2.

3.5 The program material shall be preceded by a 1 kHz reference tone, 30 seconds in duration, recorded at a level of - 18 VU referenced to digital zero, with input from 0 VU at +4 dbm.

3.6 Peak recorded levels shall not exceed digital zero causing overload indicators to illuminate.

4.0 PRE-RECORDED ANNOUNCEMENT MASTERS

4.1 Compliance with all sections of 2.0 and 3.0 is required dependent upon whether the master is analogue or digital.

4.2 Acceptable master formats:

Digital Audio Tape (DAT)
Compact Disc (CDDA)
Analogue Reel to Reel

4.3 Masters shall be free from excessive "s", "sh", or "tsh" sounds that may cause sibilance in the target format from subsequent generation distortion.

4.4 Master dynamic range shall not exceed 40 db.

4.5 Preceding each announcement, a slate shall be recorded in a language appropriate for use by the post-production studio, stating the name of the announcement, the language in which it is recorded, and the duration (min, sec) of the announcement.

4.6 Accompanying each announcement mastertape shall be a printed table of contents, in a language appropriate for use by the post-production studio, specifying the name of the announcement, the language in which it is recorded, and the duration (min, sec) of the announcement.

5.0 TAPE DUPLICATIONS

5.1 These parameters describe the audio signal, measured at the output of the audio reproducer or the input to the main multiplex, which will offer optimum sound reproduction throughout the aircraft.

5.2 Audio Signal Reference Level: Reference flux levels are not compatible for all entertainment systems. Thus, the appropriate flux level must be referenced to produce a maximum signal level of '0' dbm at the ARU output, also defined as 1 milliwatt applied to a 600 ohm impedance.

5.3 The average signal level shall be 8 to 10 db below the maximum signal level.

5.4 The entire audio signal should "fit" within the envelope produced by the peak-to-peak value (0 dbm = 2.2 v pp) of the maximum signal level when viewed on an

oscilloscope screen. Music is a very complex waveform containing sharp transients of short duration. Occasional transient peaks to 3.5 v pp are acceptable provided their duration is less than 10 msec.

5.5 The dynamic range should be held to 40 db maximum. This is accomplished in the production mastering process through the use of compressors whose threshold and ratio controls are varied to achieve a maximum 40 db dynamic range without the "pumping" or "breathing" sound attributed to excessive compression.

5.6 The manufacturer of the entertainment system establishes the reproduction equalization curves. Thus, the appropriate NAB record equalization curve must be selected for the dubbing process to yield a frequency response of 50 Hz to 15 kHz +/-3 db.

5.7 To ensure the audibility of the entire audio signal, the signal-to-noise ratio must be held to 45 db minimum, referenced to the maximum signal level throughout the 50 Hz to 15 kHz bandwidth.

5.8 Crosstalk shall not exceed 45db between any two adjacent recorded tracks.

6.0 COMPACT DISC FORMATS

6.1 Compact Disc Digital Audio (CDDA)

6.1.1 CDDA audio discs are 16 bit resolution, 44.1 kHz sample rate. Reference: Sony-Phillips Redbook Standard.

6.2 Compact Disc Interactive

6.2.1 Audio content shall be encoded using Adaptive Delta Pulse Code Modulation (ADPCM).

6.2.2 CDI discs for aircraft players shall be recorded in one of three levels defined by the Sony-Phillips Green Book Standard.

6.2.2.1 Level A 8 bit resolution, 37.8 kHz sample rate

6.2.2.2 Level B 4 bit resolution, 37.8 kHz sample rate

6.2.2.3 Level C 4 bit resolution, 18.9 kHz sample rate

6.2.3 Level C is acceptable for spoken word content only.

6.2.4 Disc Capacity per level (maximum)

- 6.2.4.1 Level A 4 hours
- 6.2.4.2 Level B 8 hours
- 6.2.4.3 Level C 16 hours

6.2.5 Compact Discs shall be encoded to provide one of the following configurations:

2 stereo channels

4 mono channels

1 stereo channel, 2 mono channels

1 stereo channel, extended play

2 mono channels, extended play

6.2.6 It is acceptable for channels on a disc to remain blank if they are not electrically connected to a PCU channel or to the overhead speaker system.

6.3 During the encoding process, trigger bits shall be inserted for program turning point, and for end of program. The bits are coded as '1' at least ten sectors before the turning point and the end of program. Reference "CD Avionics Specification: 1994" for bit allocation.

6.4 The dynamic range for ADPCM encoded content should be held to 40 db maximum.

6.5 The standard record level is -14 dbfs to yield an ARINC standard ARU output level of '0' dbm defined as 1 milliwatt applied to a 600 ohm impedance.

7.0 ENCODED AUDIO FILES (Reference Document ISO/IEC 11172-3) First Edition 1993

7.1 For audio programs, compilation or compact disc format, that are encoded for aircraft file servers using the MPEG 1 algorithm in Layer 1, 2, or 3:

7.1.1 No signal emphasis shall be used prior to encoding.

7.1.2 Cyclical Redundancy Check (CRC) shall not be used.

7.1.3 Sample Rate of 44.1 kHz shall be used.

7.1.4 Dynamic range of encoded content shall not exceed 40 db.

7.1.5 Program reference level for source shall be -12 db below full scale (digital clip) with no transient peaks in excess of -4 dbfs.

7.2 Bitrates: MODE MINIMUM MAXIMUM

7.2.1 MPEG 1, Layer 1

Single Channel or Joint Stereo	128 kbps	448 kbps
Dual Channel or Independent Stereo	256 kbps	448 kbps

7.2.2 MPEG 1, Layer 2

Single Channel or Joint Stereo	128 kbps	384 kbps
Dual Channel or Independent Stereo	256 kbps	384 kbps

7.2.3 MPEG 1, Layer 3

Single Channel or Joint Stereo	128 kbps	320 kbps
Dual Channel or Independent Stereo	256 kbps	320 kbps

7.2.4 For Layer 1, 2, or 3, 56 kbps is acceptable for spoken word content only.

7.3 For hardware systems requiring transport streams, the audio file shall be multiplexed in accordance with ISO/IEC 13818-1: 1995.

7.4 File names and extensions are not standardized for all hardware systems. The manufacturer must specify their convention for character count, limitations, and file extension codes.