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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Helical-scan digital video cassette recording format using 12,65 mm magnetic tape and incorporating MPEG-4 compression – Type D-16 format

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Format d'enregistrement à balayage hélicoïdal pour cassette vidéo numérique utilisant une bande magnétique de 12,65 mm avec système de compression MPEG-4 – Format D-16

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HELICAL-SCAN DIGITAL VIDEO CASSETTE RECORDING FORMAT USING 12,65 mm MAGNETIC TAPE AND INCORPORATING MPEG-4 COMPRESSION – TYPE D-16 FORMAT

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International Standard IEC 62141 has been prepared by IEC technical committee 100: Audio, video and multimedia systems and equipment.

This bilingual version (2012-11) corresponds to the monolingual English version, published in 2005-10.

The text of this standard is based on the following documents:

CDV	Report on voting
100/925/CDV	100/1004/RVC

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

The French version of this standard has not been voted upon.

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HELICAL-SCAN DIGITAL VIDEO CASSETTE RECORDING FORMAT USING 12,65 mm MAGNETIC TAPE AND INCORPORATING MPEG-4 COMPRESSION – TYPE D-16 FORMAT

1 Scope

This International Standard specifies the track content, format, and recording method of the data blocks containing compressed video, AES3 audio data, and associated data which form the helical records on 12,65 mm tape in cassettes. This standard supports recording of source picture formats using 1920 × 1080 pixels with the 4:4:4 and 4:2:2 sampling structure specified in SMPTE 274M at the frame rate of 23,98 Hz, 24 Hz, 25 Hz and 29,97 Hz, and using 1280 × 720 pixels with the 4:2:2 sampling structure specified in SMPTE 296M at the frame rates of 50 Hz and 59,94 Hz (see note). This standard also supports recording of 12 channels of AES3 audio data and 3 lines of uncompressed blanking interval data. This standard includes packetizing and shuffling operations supporting picture compression using the DCT and DPCM encoding methods defined by ISO/IEC 14496-2 (MPEG-4 simple studio profile).

NOTE Early implementations of this standard might not comply to the frame rate of 50 Hz as specified in SMPTE 296M.

2 Normative references

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IEC 61213:1993, *Analogue audio recording on video tape – Polarity of magnetization*

IEC 61237-1:1994, *Broadcast video tape recorders – Methods of measurement – Part 1: Mechanical measurements*

ISO/IEC 14496-2:2004, *Information technology – Coding of audio-visual objects – Part 2:Visual*

ITU-R Recommendation BT.709:2002, *Parameter values for the HDTV standards for production and international programme exchange*

SMPTE 12M:1999, *Television – Audio and Film – Time and Control Code*

SMPTE 274M:2003, *Television – 1920 1080 Scanning and Analog and Parallel Digital Interfaces for Multiple Picture Rates*

SMPTE 276M:1995, *Transmission of AES-EBU Digital Audio Signals Over Coaxial Cable*

SMPTE 292M:1998, *Bit-Serial Digital Interface for High-Definition Television Systems*

SMPTE 296 M:2001, *Television – 1280 720 Progressive Image Sample Structure – Analog and Digital Representation and Analog Interface*

SMPTE 299M:1997, *Television – 24-Bit Digital Audio Format for HDTV Bit-Serial Interface*

SMPTE 372M:2002, *Television – Dual Link 292M Interface for 1920 x 1080 Picture Raster*

SMPTE RP 188:1999, *Transmission of Time Code and Control Code in the Ancillary Data Space of a Digital Television Data Stream*

AES3-1997, *Serial transmission format for two-channel linearly represented digital audio data*

3 Terms, definitions and acronyms

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

23,98, 29,97, 59,94:	When used as values of field or frame rates, exact values are respectively: 24/1.001, 30/1.001, 60/1.001.
alternate_scan:	A 1-bit flag, fixed to ‘1’ in this format, defined in ISO/IEC 14496-2.
Basic block:	The basic packing unit, comprising 4 block identifier (BID) bytes and 226 payload bytes containing auxiliary or compressed picture data.
BID:	Block identifier bytes in each basic block, BID0 to BID3.
bits_per_pixel:	A 4-bit integer, fixed to ‘10’ in this format, defined in ISO/IEC 14496-2.
block_mean:	A 10-bit unsigned integer, defined for DPCM encoding in ISO/IEC 14496-2.
Chroma_format:	A 1-bit value indicating YC_BC_R or RGB mode, defined in ISO/IEC 14496-2.
Chroma_intra_quantiser_matrix:	A list of 64 8-bit unsigned integers, defined in ISO/IEC 14496-2.
Coded sequence:	A group of 24 auxiliary basic blocks followed by 4080 compressed data basic blocks.
Coding channel:	The MBU encoding process, producing coded sequences.
Compression_mode:	A 1-bit flag indicating DCT or DPCM coding, defined in ISO/IEC 14496-2.
dct_precision:	A 2-bit integer, defined in ISO/IEC 14496-2.
dct_type:	A 1-bit flag, fixed to ‘1’ in this format, defined in ISO/IEC 14496-2.
dpcm_scan_order:	A 1-bit flag used in the DPCM coding, defined in ISO/IEC 14496-2.
frame_rate_code:	A 4-bit integer indicating the frame rate, defined in ISO/IEC 14496-2.
intra_dc_precision:	A 2-bit integer, fixed to ‘0’ in this format, defined in ISO/IEC 14496-2.
intra_quantizer_matrix:	A list of 64 8-bit unsigned integers, defined in ISO/IEC 14496-2.
Macro block	A 16×16 area of picture data, rearranged shuffle block. Note that this block is not equivalent to the ‘macroblock’ defined for ISO/IEC14496-2.
MBU:	Macro block unit, A group of 204 or 180 macro blocks, used for rate control and packing.
q_scale_type:	A 1-bit flag used in the Quantiser, defined in ISO/IEC 14496-2.
quantizer_scale_code:	A 5-bit unsigned integer, defined in ISO/IEC 14496-2.
Record unit:	For picture formats with 23,98 Hz, 24 Hz, 25 Hz and 29,97 Hz frame rates, equivalent to a frame, For picture format with 50 Hz and 59,94 Hz frame rate format, equivalent to a successive frame pair.

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rgb_components:	A 1-bit flag indicating 4:2:2 or 4:4:4 data, defined in ISO/IEC 14496-2.
rice_parameter:	A 4-bit integer used in DPCM coding, defined in ISO/IEC 14496-2.
Sector:	A data unit that includes a preamble, sync blocks and a postamble, comprising the minimum record block in a helical track.
Segment:	A time interval that represents a field of video for I and PsF picture formats and a frame of video for P picture formats. A Segment has half the duration of a Record Unit.
Shuffle block	A 16 × 16 area of picture data from a field or frame.
VTR:	Video Tape Recorder. A Type D-16 tape recorder in this document.

3.2 Acronyms

For the purposes of this document, the following acronyms apply.

AUX:	Auxiliary
DCT:	Discrete cosine transform
DPCM:	Differential pulse code odulation
ECC:	Error correcting code
EOB:	End of block
I:	Interlace scan format
NRZ:	Non return to zero
MUX:	Multiplex
P:	Progressive scan format
PCM:	Pulse code modulation
PsF:	Progressive scan format with segmented frame structure.
RU:	Record unit
RS:	Reed-Solomon
TC:	Time code
VLC:	Variable length coding

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4 Environment and test conditions

Tests and measurements made on the system to check the tape track recorder requirements of this standard shall be carried out under the following conditions:

– temperature: 20 °C ± 1 °C
– relative humidity: 50 % ± 2 %
– barometric pressure: from 86 kPa to 106 kPa
– tape tension: 0,3 N ± 0,05 N
– tape conditioning: not less than 24 h

4.1 Calibration tape

Calibration tapes meeting the tolerances specified below should be made available by manufacturers of digital television tape recorders and players in accordance with this standard.

4.2 Record locations and dimensions

Geometrical location and dimensions of the recordings on the tape and their relative positions with regard to timing relations of the recorded signals shall be as specified in Figure 27 and Table 2. Tolerances shown in Table 2 should, however, be reduced by 50 % for calibration tapes.

5 Tape and cassette physical specifications

5.1 Magnetic tape specifications

5.1.1 Base

The base material shall be polyester or equivalent.

5.1.2 Tape width and width fluctuation

The tape width shall be 12,650 mm ± 0,005 mm. Tape width fluctuations shall not exceed 6 μm peak to peak. The value of tape width fluctuation shall be evaluated by measuring 10 points, each 20 mm apart, over a tape length of 200 mm.

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5.1.3 Tape thickness

The tape thickness shall have a minimum value of 10,1 μm and a maximum value of 11,3 μm.

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5.1.4 Offset yield strength

The offset yield strength shall be greater than 13 N.

5.1.5 Magnetic coating

The magnetic tape used shall have a coating of metal particles or equivalent, longitudinally oriented. The coating coercivity shall be in the range of 190 000 A/m to 240 000 A/m, with an applied field of 800 000 A/m (10 000 oersted) as measured by a 50 Hz or 60 Hz BH meter or vibrating sample magnetometer (VSM).

5.2 Cassette specifications

5.2.1 Cassette dimensions

Two sizes of cassettes shall be identified as follows.

S cassette: 96 × 156 × 25 mm (as shown in Figures 1 to 13)

L cassette: 145 × 254 × 25 mm (as shown in Figures 14 to 26)

5.2.2 Tape length and recording time

Maximum tape length and recording time are recommended as follows.

S cassette:	293 m $^{+2}_{-0}$ m	40 min for 29,97 Hz RU rate	48 min for 25 Hz RU rate	50 min for 23,98 Hz and 24 Hz RU rates
L cassette:	893 m $^{+2}_{-0}$ m	124 min for 29,97 Hz RU rate	148 min for 25 Hz RU rate	155 min for 23,98 Hz and 24 Hz RU rates

5.2.3 Datum planes

Datum plane Z shall be determined by three datum areas A, B and C, as shown in Figures 3a and 16a. Datum plane X shall be orthogonal to datum plane Z and shall include the centres of datum holes (a) and (b). Datum plane Y shall be orthogonal to both datum plane X and datum plane Z and shall include the centre of the datum hole (a) as shown in Figures 2 and 15.

5.2.4 Tape winding

The magnetic coating side of the magnetic tape shall face outside on both the supply reel and the take-up reel as shown in Figures 4 and 17.

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5.2.5 Label area and window area

The hatched areas shown in Figures 1 and 14 are for the label and window. Labels attached to the cassette shall not protrude above the outside cassette surface plane.

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5.2.6 Guiding groove

For correct insertion into the VTR, four guiding grooves for S cassettes, as shown in Figures 1 and 2, and three guiding grooves for L cassettes, as shown in Figure 15, shall be provided.

5.2.7 Safety tab and safety plug for recording inhibition

For S cassettes, a safety plug at the supply reel side and a hole of a minimum depth of 10 mm from datum plane Z at the take-up reel side shall be provided as shown in Figure 2.

For L cassettes, a safety plug shall be provided at the take-up reel side as shown in Figure 15.

The safety plug shall not be deformed by 0,3 mm or more when a force of 2,0 N (204 gf) is applied to the centre of it, using a 2,5 mm diameter rod. See Figures 12 and 25.

5.2.8 Identification holes

Six identification holes (holes 1 to 6) shall be located as specified in Figures 2 and 15. For this format, holes 1, 3 and 6 shall be closed and holes 2, 4 and 5 shall be open.

5.2.9 Reels

The reels shall be automatically unlocked when the cassette is inserted into the video tape recorder and/or player unit and automatically locked when the cassette is ejected from it.

The locations of the reels, when in the unlocked position, are shown in Figures 4 and 17. The dimensions of the reels are shown in Figures 6 and 19 and the heights of the reels are shown in Figures 7 and 20.

The reel shall be completely released when the cassette lid is opened 23,5 mm min. from datum plane Z.

5.2.9.1 Reel spring force

The reels assembled in the cassette shall be pressed by the reel spring with a specified force under the conditions specified in Figures 11 and 24. The spring force shall be 1,5 N ± 0,5 N (153 gf ± 51 gf) for S cassettes and 3,5 N ± 0,5 N (357 gf ± 51 gf) for L cassettes when pressing on a reel 2,4 mm above datum plane Z, as shown in Figures 11 and 24.

5.2.9.2 Extraction force

The force (F1, F2) required to pull the tape out of the reel shall not exceed 0,17 N (17 gf), as specified in Figures 13a and 26a.

5.2.9.3 Friction torque

The torque required to wind the tape shall be less than 15 mN m (152 gf cm) for S cassettes and less than 30 mN m (305 gf cm) for L cassettes, as specified in Figures 13b and 26b.

5.2.10 Protecting lid

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The cassette lid shall be automatically unlocked when the cassette is inserted into the video tape recorder and/or player unit and automatically locked when the cassette is ejected from it.

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The unlocking lever insertion area is specified in Figures 8 and 21. The lid shall be unlocked when the lid-lock lever is shifted in either direction A or B, as illustrated in Figures 9 and 22. The force required to unlock the lid shall be less than 1 N (101 gf) in the A direction or less than 1,5 N (152 gf) in the B direction.

The lid shall open 29,0 mm with a force of 1,5 N (152 gf) or less as specified in Figures 10 and 23.