

Helical-scan video-tape cassette system using 19 mm ($\frac{3}{4}$ in) magnetic tape, known as U-format

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Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee ELP/60, Recording, upon which the following bodies were represented:

- Association of Professional Recording Services Limited
- Audio Engineering Society
- British Broadcasting Corporation
- British Kinematograph, Sound and Television Society
- British Tape Industry Association
- Federation of the Electronics Industry
- ITV Association (ITVA)
- National Council for Educational Technology (NCET)
- Royal Photographic Society
- Royal Television Society

This British Standard, having been prepared under the direction of the Electrotechnical Sector Board, was published under the authority of the Standards Board and comes into effect on 15 April 1996

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The following BSI references relate to the work on this standard:
Committee reference ELP/60
Drafts for comment 86/31040 DC and 88/34416 DC

ISBN 0 580 24963 8

Amendments issued since publication

Amd. No.	Date	Comments

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National foreword

This British Standard has been prepared by Technical Committee EPL/60 and is the English language version of EN 60712:1994 *Helical-scan video-tape cassette system using 19 mm ($\frac{3}{4}$ in) magnetic tape, known as U-format*, plus amendment A1:1994, published by the European Committee for Electrotechnical Standardization (CENELEC). It is identical with IEC 712:1993, plus amendment 1:1993, published by the International Electrotechnical Commission (IEC). This British Standard supersedes BS 6370:1983 which is withdrawn.

Cross-references

Publication referred to	Corresponding British Standard
EN 60094 (IEC 94)	BS EN 60094 <i>Magnetic tape sound recording and reproducing systems</i>
HD 507 S1:1988 (IEC 461:1986)	BS 6865:1987 <i>Specification for time control codes for video tape recorders</i>

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 42, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Descriptors: Magnetic video recording, helical scanning, television recording and replay, cassettes, dimensions, requirements, properties

English version

Helical-scan video-tape cassette system using 19 mm ($\frac{3}{4}$ in) magnetic tape, known as U-format (includes amendment A1:1994)

(IEC 712:1993 plus amendment 1:1993)

Système à cassette à bande vidéo à balayage
hélicoidal utilisant la bande magnétique
de 19 mm ($\frac{3}{4}$ in), d'appellation format-U (inclut
l'amendement A1:1994)
(CEI 712:1993 et l'amendement 1:1993)

Video-Bandkassettensystem mit
Schrägschraufzeichnung auf
Magnetband 19 mm, bekannt als U-Format
(enthält Änderung A1:1994)
(IEC 712:1993 und Änderung 1:1993)

This European Standard and amendment A1 were approved by CENELEC on 1994-07-05. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B-1050 Brussels

Foreword

The CENELEC questionnaire procedure, performed for finding out whether or not the International Standard IEC 712:1993 could be accepted without textual changes, has shown that no common modifications were necessary for acceptance as a European Standard.

The reference document was submitted to the CENELEC members for formal vote and was approved by CENELEC as EN 60712 on 5 July 1994.

This European Standard replaces HD 447 S1:1984.

The following dates were fixed:

- latest date of publication of an identical national standard (dop) 1995-07-15
- latest date of withdrawal of conflicting national standards (dow) 1995-07-15

Annexes designated "normative" are part of the body of the standard. In this standard, Annex ZA is normative.

Foreword to amendment A1

The CENELEC questionnaire procedure, performed for finding out whether or not amendment 1:1993 to the International Standard IEC 712:1993 could be accepted without textual changes, has shown that no common modifications were necessary for acceptance as a European Standard.

The reference document was submitted to the CENELEC members for formal vote and was approved by CENELEC as amendment A1 to EN 60712 on 5 July 1994.

The following dates were fixed:

- latest date of publication of an identical national standard (dop) 1995-07-15
- latest date of withdrawal of conflicting national standards (dow) 1995-07-15

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Introduction

This International Standard provides specifications for a helical-scan video-tape cassette recording and reproducing system which makes use of tape 19 mm ($\frac{3}{4}$ in) wide. The system is widely used in educational and industrial television facilities and is suitable for both 625 line-50 field and 525 line-60 field television signals. The parameters for different systems are given in the specifications which follow. This cassette system is also used in some broadcasting facilities in conjunction with special equipment designed to stabilize the reproduced signals to meet broadcasting requirements.

The mechanical and electrical specifications for the U-matic H-format and SP-format are contained in this standard.

Chapter 1. Specifications for basic system

Section 1. General

1 Scope and object

This standard applies to magnetic video recording and/or playback with 19 mm ($\frac{3}{4}$ in) tape cassettes on two-head helical-scan videocassette recorders, suitable for recording and/or playback of monochrome as well as colour television programmes.

It contains the definition of parameters for the two-head helical-scan video recording playback system, using 19 mm ($\frac{3}{4}$ in) tape cassettes, known as U-matic SP-format (Figure 2b and Figure 2c). The system is suitable for 625/50 PAL and 525/60 NTSC colour television systems.

It gives dimensional and other characteristics necessary to permit the interchangeability of cassettes. For some parameters, the specification is only possible through the description of recorded tapes which implies making reference to the television system or standard in use. In such cases, the reference made for instance to 525 line-60 field or 625 line-50 field systems shall be considered as an example.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 94, *Magnetic tape sound recording and reproducing systems*.

IEC 461:1986, *Time and control code for video-tape recorders*.

3 Environment

3.1 Testing environment

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

temperature:	20 ± 1 °C;
relative humidity:	48 % to 52 %;
air pressure:	86 kPa to 106 kPa;
conditioning before testing:	24 h.

3.2 Operation environment

The system shall operate under the following conditions:

temperature (in recorder):	15 °C to 50 °C;
relative humidity:	45 % to 75 %.

3.3 Reference tape (SP-format)

Blank tape to be used for reference recordings may be purchased from the manufacturers listed in Annex A. The electromagnetic compatibility parameters and their specifications should be specified by the manufacturers and controlled accordingly.

The *model name* is IEC U-matic SP-format reference tape.

Electromagnetic compatibility parameters and their specifications are indicated in Annex A.

3.4 Calibration tape

The calibration tapes which satisfy the following requirements will be available for purchase from the manufacturers producing video tape recorders and players in accordance with this format specification.

3.4.1 Record locations and dimensions

For the calibration tapes to be used for the purpose of calibrating the mechanical accuracy of recorder or player in accordance with this format specification, 50 % reduction in the tolerance shown in Table 2, page 63 of IEC 712, should be applied to them in principle. If necessary, the record locations and dimensions can be specially modified for some calibration tapes in order to avoid some calibration errors or to help some calibration work.

3.4.2 Calibration signals

Two classes of signals may be recorded on the calibration tapes:

a) A series of conventional test signals:

Video	Audio
— Colour bars (75 %)	— 1 kHz 0 VU
— Gated sweep	— 10 kHz -10 VU
— Pulse and bar	— 40 Hz -20 VU
	— 1 kHz -20 VU
	— 7 kHz -20 VU
	— 10 kHz -20 VU
	— 15 kHz -20 VU

b) Special test signals developed by each manufacturer for product alignment. These signals are not universally applicable too the products from all manufacturers and will not be specified.

Section 2. Video-tape cassette

4 Mechanical parameters

4.1 Dimensions of cassette

The dimensions necessary to permit interchangeability of cassettes shall be in accordance with Figure 1 to Figure 5 and Figure 1a to Figure 5a and Table 1.

4.2 Tape path and guidance

The tape path and guidance are given in Figure 6.

4.3 Tape winding

The magnetic coating on the tape shall face out of the cassette. The direction of tape travel is from left to right when the coated side is facing the observer, i.e., from supply reel and outside on the take-up reel (see Figure 6).

4.4 Label and window area

The level and window area shall be in accordance with the dimensions given in Figure 1 and Figure 1a. The label as well as the window shall not protrude beyond the surface of plane A in Figure 1 and Figure 1a.

4.5 Withdrawal force

The leader tape and trailer tape which are spliced to each end of the magnetic tape shall be so attached to the reels that they can withstand a withdrawal force of 20 N.

4.6 Guiding groove

The cassette shall be provided with a guiding groove for correct insertion into the record/playback equipment as shown in Figure 1 and Figure 1a.

4.7 Safety cap and safety hole

The safety hole to prevent accidental erasure is shown in Figure 2 and Figure 2a. Recording shall be possible only when the hole is covered by the safety cap as shown in the figures.

4.8 Automatic stop

The optical transmittance of the leader and the trailer tape shall be at least 30 % to ensure that the automatic stopping device of the machine functions properly at both ends of the magnetic tape.

4.9 Cassette support areas

The cassette shall be supported by the record/playback equipment only on the four datum points at the locations shown in Figure 5 and Figure 5a. (The supports are on the record/playback machine.)

4.10 Reels

4.10.1 Arrangement of reels

The supply reel shall be placed in the shell with its larger flange side down and the tape-up reel is laced with its larger flange side up.

4.10.2 Dimensions of reels

The dimensions of the reels shall be shown in Figure 3 and Figure 3a. Choice of hub diameter is as shown below.

	Type I (playing time 60 min)	Type II (playing time 30 min)	Type I (playing time 20 min)	Type II (playing time 10 min)
Flange diameter mm	121	121	87	87
Hub diameter (supply reel) mm	38	80	38	80

Section 3. Videocassette recorders

5 Mechanical parameters

5.1 Type of videocassette recorder

The videocassette recorder shall be of the helical-scan type with two video heads.

5.2 Reel spindle of videocassette recorder

Dimensions and other characteristics are given in Figure 4 and Figure 4a and Table 1.

5.3 Back tension

Back tension at the maximum amount of tape on the supply reel shall be between 0,60 N and 0,80 N at the entrance of the drum as indicated in Figure 6. The range of tension between the maximum and minimum amount of winding shall be set as follows:

$$\frac{\text{tension at minimum amount of winding (38 } \varnothing \text{)}}{\text{tension at maximum amount of winding (118 } \varnothing \text{)}} = 1,3$$

5.4 Audio and control head position

The distance on the tape pattern from the end of the 180° scan of video head (S_0) to the audio and control head position is $74,0 \pm 0,5$ mm, dimension (X) as shown in Figure 8.

5.5 Audio and control head dimensions

Audio and control head dimensions and tolerances shall be in accordance with Figure 7.

5.6 Audio and control-track head position

The distance (X) on the tape pattern between the end of the 180° scan of the video head (S_0) and the audio and control head position, is $74,0 \pm 0,2$ mm.

5.7 Time-code head position

For practical reasons, it was not possible in the past to specify a single figure for the distance (Y) on the tape from the beginning (S_1) of the 180° scan of video head to the address head position. The distance was:

for studio machines: $93,0 \pm 2,5$ mm

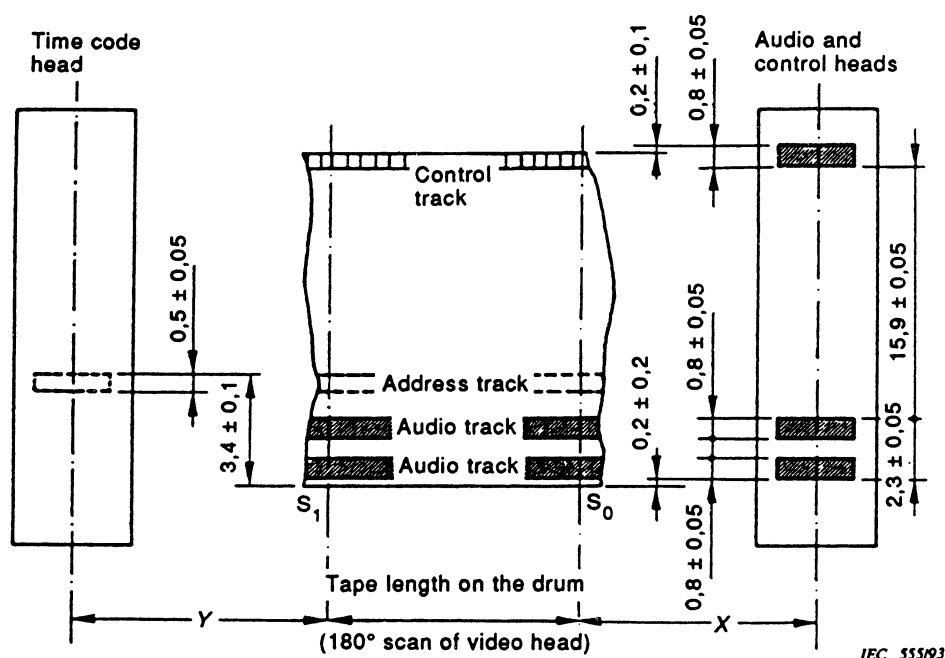
for portable machines: $45,5 \pm 2,0$ mm.

This difference in distance represents a time difference of 0,5 s which may have to be taken into account or corrected when tapes are interchanged between portable and studio-machines.

However, the figure of $45,5 \pm 2,0$ mm is now to be preferred.

5.8 Tolerances on audio and control heads and time-code head (U-matic H-format)

The audio, control and time-code head tolerances shall be in accordance with the following illustration:



NOTE Audio and control gaps shall be in line.

5.9 Gap azimuth

5.9.1 Recording of longitudinal tracks

The azimuth of all head gaps used for the recording of longitudinal tracks shall be perpendicular to the direction of tape motion.

5.9.2 Recording of video tracks

The azimuth of the video head gaps shall be perpendicular to the direction of head motion.

5.10 Time-code head position for SP-format

The distance on the tape from the beginning of the 180° scan of video head to the address head position shall be $48 \text{ mm} \pm 0,1$ mm.

6 Tape speed

The tape speed shall be $95,3 \pm 0,2$ mm/s.

7 Track configuration and dimensions

The track configuration and dimensions shall be in accordance with Figure 8, and Table 2.

The switching position between the two video heads shall lie between five and eight horizontal scanning lines ahead of the front edge of the vertical synchronizing pulse.

The minimum overlap of the two video heads shall be three horizontal lines on either side of the nominal position, as shown in Figure 9.

This recording format permits an optional address track, intended for special uses such as editing and cueing. Track dimensions are identified as *N* and *T* in Table 2. Longitudinal dimensions and electrical recording characteristics under study. The recording head for this track will be located between the main erase head and the video scanner.

7.1 Video track width (U-matic H-format)

Video track width (*M*) shall be $0,125 \pm 0,007$ mm.

7.2 Video guard-band width (U-matic H-format)

Video guard-band width (*S*) shall be 0,040 mm.

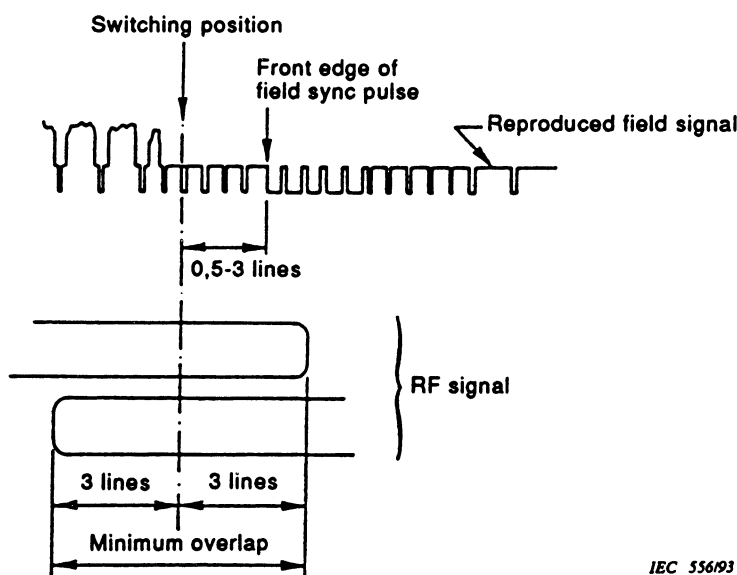
7.3 Location of address track (U-matic H-format)

Tape edge to upper limit address track (*N*) shall be $3,4 \pm 0,1$ mm.

7.4 Switching position between two video heads (U-matic H-format)

The switching position between the two video heads shall lie between 0,5 and 3 horizontal scanning lines ahead of the front edge of the field synchronizing pulse.

The minimum overlap of the two video heads shall be 3 horizontal lines on either side of centre, as shown below:



8 Recording characteristics

The recording characteristics of videocassette recorders shall be in accordance with the requirements specified in Section 5.

Section 4. Tape characteristics

9 Type of magnetic tape

A high-resolution magnetic tape (e.g. CrO_2) should be used. See 11.2.

10 Construction and dimensions of the tape

10.1 Magnetic tape thickness

The maximum allowable thickness of the magnetic tape, including the coating shall be $27,0\text{ }\mu\text{m}$.

NOTE Tape having total thickness between $27,0\text{ }\mu\text{m}$ to $28,5\text{ }\mu\text{m}$ may also be used for cassettes with a playing time substantially less than 60 min.

10.2 Magnetic tape width

The width of the magnetic tape shall be $19,00 \pm 0,03\text{ mm}$.

10.3 Leader tape and trailer tape thickness

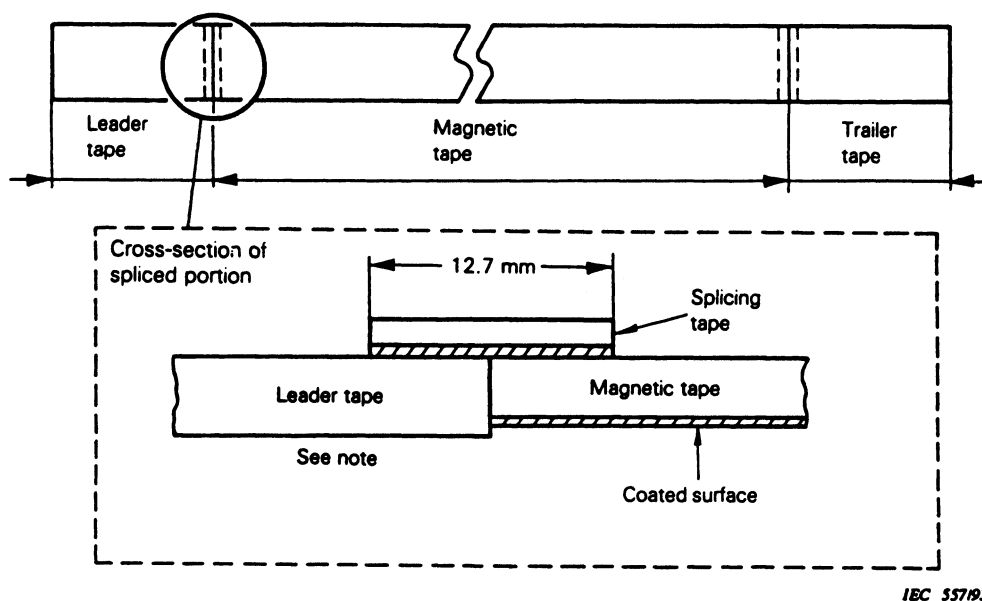
The maximum allowable thickness of the leader tape and trailer tape shall be $45\text{ }\mu\text{m}$.

10.4 Leader tape and trailer tape length

The length of the leader tape and trailer tape shall be $0,95 \pm 0,10\text{ m}$.

10.5 Splicing

The leader tape and trailer tape shall be spliced as illustrated below.



NOTE The leader tape must be free of electrostatic charge. If tape is treated for this purpose, then treated side should face same side as magnetically coated surface.

10.6 The splice gap between the leader tape and the magnetic tape shall be below $0,2\text{ mm}$.

11 Magnetic tape properties

11.1 Magnetic orientation

The magnetic coating shall be longitudinally oriented.

11.2 Coercivity

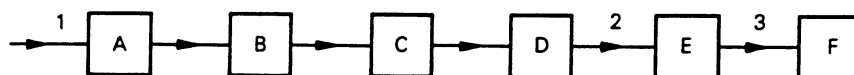
The coercivity shall be approximately $40 \times 10^3\text{ A/m}$ to $48 \times 10^3\text{ A/m}$ (approximately 500 Oe to 600 Oe).

11.3 Coercivity (SP tape)

The coercivity shall be approximately $56 \times 10^3\text{ A/m}$ ~ $64 \times 10^3\text{ A/m}$ (700 to 800 oersteds).

Section 5. Recording characteristics

12 Luminance channel



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A = low-pass filter

NOTE The characteristics of the low-pass filter are important in determining the performance of the luminance channel. At this time, specifications for this filter cannot be standardized since different designs are used by various manufacturers.

B = pre-emphasis (see 12.4)

C = FM modulator

D = FM high-pass filter (see 12.2.2)

E = recording amplifier

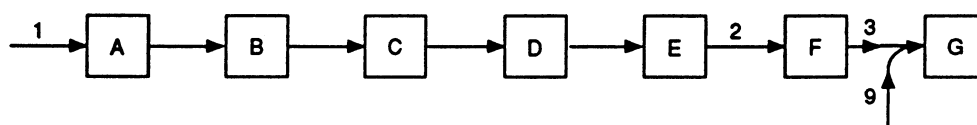
F = video head

1 = input signal: composite video signal (monochrome) or composite colour signal

2 = FM luminance signal

3 = recording current

Luminance channel (SP-format)



IEC 61693

A Low-pass filter

B Non-linear pre-emphasis

C Pre-emphasis

D FM modulator

E FM high-pass filter

F Recording amplifier

G Video head

1 Input signal: composite video signal or composite colour signal

2 Band-limited FM luminance signal

3 Luminance recording current

9 Chrominance recording current

12.1 Modulation system

The video information shall be recorded in the form of an RF signal frequency modulated by the video signal. The instantaneous frequencies of the RF signal shall vary linearly with respect to the amplitude of the modulating signal.

12.2 Recording current

12.2.1 The recording current shall have the optimum value over the entire FM carrier bandwidth.

For U-matic H-format the recording current shall be the optimum record current at 5,3 MHz over the entire FM carrier bandwidth.

For SP format the recording current shall be the optimum record current at frequencies shown in the table below over the entire FM carrier bandwidth.

625/50	525/60
6,1 MHz	5,5 MHz

NOTE "Optimum record current" is the recording current value which is necessary to obtain the maximum output signal level during playback.