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*Technical Guidelines, Specifications and Standards referred to in these Guidelines may be obtained from the sources listed in Para. 9.1.*
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1. General conditions

The following Technical Guidelines are applicable to all programme items supplied to the ARD, the ZDF or the ORF for re-recording and/or broadcasting in their television services. For the production of these programme items, the arrangements set out in these guidelines are to be regarded as compulsory, whether for items undertaken internally or commissioned externally.

In principle, the values given for technical parameters in these guidelines conform to the recommendations of the European Broadcasting Union EBU and the specifications of the ARD/ZDF as well as the quoted standards.

The basis for the establishment of the technical parameters in these guidelines is a conventional 625/50 television system, i.e. with 625 lines per frame and a field frequency of 50 Hz (25 frames per second). Relevant specifications are laid down in ITU-R Recommendation BT.470 for the B/PAL and G/PAL systems.

The methods to be used for the recording, processing and finishing are to be decided in agreement with the individual customer.

1.1 Contrast, lighting

When shooting, it must be borne in mind that a picture with a contrast range of more than 40:1 can only be transmitted in our television system with a limited range of tonal values.

Moreover, in studio production, the lighting contrast ratio, i.e. the ratio of the key light plus the fill-in light to the fill-in light alone, may not exceed 2:1. The reflectance of black picture elements should not be less than 3 % and that of white elements not more than 60 % (up to 90% in exceptional cases). The relatively dark reference white (60 % reflectance) is necessary for a good gradation in the transmission of high-key pictures. Whenever possible each shot should include areas of reference white and reference black amounting to at least 1 % of the total picture area.

Too low a brightness difference between the foreground and the background (less than 1.5:1) spoils the impression of depth. In the studio, the colour temperature of all the lights used must lie between 3100 and 3200 K. For programmes shot out-of-doors in daylight, appropriate corrective measures should be taken to compensate for the predominant colour temperature, so that no visible colour errors appear.

1.2 Scenery, costumes

In order to avoid interference patterning in the television picture, there should be no fine patterns on the scenery or costumes. Fine patterns are, for example, regular stripes with a high degree of contrast, especially when the light-dark repetition rate of perpendicular or diagonal stripes is less than 2 % of the picture width. This also applies to captions and lettering.

Shiny objects occupying more than 0.2 % of the picture area should be rendered matt, in order to avoid over-modulation effects in electronic production and disturbing automatic gain-control effects in film-scanning. When self-illuminated objects appear in the scene, care must be taken to remain within the specified maximum contrast range.

1.3 Centre of interest

In order to ensure that the centre of interest is displayed on the screens of present-day domestic television receivers, the limits specified in Annex 8.1, for 4:3 and 16:9 picture formats, must be observed. This allows for safety margins of about 5% of the transmitted picture on all sides.

The special requirements for the centre of interest in programme production on film are given in Para. 5.5.
1.4 Captions, lettering and graphics

Captions and lettering for the 4:3 and 16:9 picture formats must lie within the limits of the caption area specified in Annex 8.1. This allows for safety margins of about 7.5% of the transmitted picture on all sides. Accordingly, the permissible vertical and horizontal extent of the caption area is within the range given below (a graphic presentation for 4:3 and 16:9 is given in Annex 8.1.

- In field 1: from line 66 to 267; and
- In field 2: from line 378 to 580.
- In analogue lines:
  - (length 64 µs, starting at middle of sync. pulse edge): from 14.5 µs to 58.5 µs; and
- In digital lines:
  - (length 864 pixels from start of active picture content): from pixel 53 to 666

In order to avoid sound interference in receivers with inter-carrier sound systems when inlaying or super-imposing captions, an overall level (chrominance plus luminance) of 100 % should not be exceeded. Also, the edges of the lettering signals must not be too sharp. In accordance with the ARD/ZDF "Handbook of Television System Engineering" [Handbuch der Fernsehsystemtechnik] Chapter 1.3, Para. 3.2, the rise-time of the edges of lettering may not be less than 174 ns for luminance signals and 364 ns for chrominance signals. This will ensure that, when lettering signals are inserted into the television signal, no interfering overshoots will occur.

1.5 Equipment and materials

The electronic, mechanical and optical characteristics of the vision and sound origination and recording equipment must comply with the ARD/ZDF specifications as well as the quoted standards and the VDE regulations. Moreover, the relevant standards in the EMC Directive and the EMV regulations must be observed. See also Technical Guidelines 3/1-8/2.

Vision and sound support materials must comply with the appropriate specifications and standards. In case of doubt, the client should be consulted. For complete productions, the vision and sound supports must be, as far as possible, from the same manufacturer and the same batch. This applies particularly to colour-film stock.

1.6 Pre-production planning

In order to obtain an optimum vision and sound quality, the video, audio and acoustic arrangements must be agreed between those responsible for the direction, production and technical sections before shooting is begun, for example in a technical production-planning meeting.

1.7 Information on the production chain

For the future exchange of programme material by means of file format, it is important to have additional information on the origination of the programme material. Consequently, for television production on video tape and on tape-less systems, this information is to be recorded both on the VTR record card that accompanies the production tape as well as in the corresponding Metadata (see Part 7). The extent of this information is to be agreed with the client, e.g.

- Acquisition format,
- Post-production processing systems involved,
- Data-reduction method (compression method) used,
- Reduction factors or data utilized,
- Interfaces used for the transfer.

1.8 Production and post-production processing standard

As it is still predominantly a PAL or a PALplus signal that is transmitted, it is necessary to make sure during the production process that it is possible to obtain a correctly coded PAL signal from the component signals that are produced. In particular, in the case of production in analogue and digital component format, as well as with computer-generated sequences, it is
necessary to make sure that each of the signals produced is also valid within the RGB colour space (see Annex 8.10) that forms the basis of the PAL coding. The compliance must be monitored with a suitable measuring instrument or a monitor that indicates any violation (overshoot) of the RGB colour space.

In accordance with the relevant EBU Recommendations and according to the decision of the FSBL-K, the only systems authorized for television production for the ARD, ZDF and ORF, apart from the video-recording formats set out in Part 3, will be the transparent DSK270 system complying with ITU-R Recommendation BT.601, as well as the two data-reduction formats (compression formats), DV-based and MPEG-2 4:2:2P@ML (see Part 4 of these Guidelines).

1.8.1 Digital Betacam

The Digital Betacam recording format (Para. 3.2) makes use of its own internal compression process. This is, however, not accessible outside the videotape recorder, as there is no interface available for the conversion of the compressed and packaged data level.

1.8.2 M-JPEG

EBU Technical Statement D82 "M-JPEG in Future Networked Television Production" specifically points out that the M-JPEG family of compression processes is not suitable for TV production to be networked in the future. It stipulates that either the DV-based compression (SMPTE 314M) or the MPEG-2 4:2:2P@ML based compression (EBU Technical Statement D94 and SMPTE 356M) should be used for future networked television production.

1.9 Programme material with change of 4:3 and 16:9 aspect-ratio picture format

An alternating succession of sequences in 4:3 and 16:9 picture formats within a programme item is not permitted, as domestic receivers do not generally ensure disturbance-free switching of the picture format. Therefore programmes must be made in the same picture format, either 4:3 or 16:9, throughout. Programme material that is available in other picture formats is to be adapted to the picture format laid down for the production.

1.10 Vision and sound monitoring

Vision and sound monitoring should be carried out in rooms complying with DIN 15 996 (Electronic vision and sound processing in film, video and broadcasting services - workplace requirements [Elektronische Laufbild- und Tonbearbeitung in Film-, Video- und Rundfunkbetrieben, Anforderungen an den Arbeitsplatz]). In addition, the ARD Technical Guidelines for a uniform television picture display (8 R 7) are to be respected. Relevant listening conditions for the assessment of sound programme material are described in EBU Tech. 3276 (Mono, Stereo) and in EBU Tech. 3276 Supplement 1 (Multi-channel).

The monitoring must be carried out in the standard of the production, when it must be ensured that the alignment of the colour-control picture monitors is identical for the PAL input as well as for the analogue and the digital component input. As it is still predominantly a PAL or a PALplus signal that is transmitted, it is important to make sure during the monitoring of productions in analogue or digital component format that it is possible to obtain a correct PAL/PALplus coding of the respective output signal (see also Para.2.1.9). The observance of the RGB colour space (see Annex 8.10) must be monitored with a suitable measuring instrument or monitor that indicates any violation of the colour space. Keeping within the RGB colour space ensures a correct signal reproduction via a MPEG distribution, e.g. DVB.

The reproduction formats for picture sources with aspect ratios of 4:3 and 16:9 are shown in Annex 8.2.

For the monitoring of productions in wide-screen format, a 16:9 colour-control monitor is to be used in addition. The picture height should be the same as for a 4:3 colour-control monitor. In this way, possible artefacts (such as picture unsteadiness and film scratches in Super 16 productions) can be seen and assessed more easily than on a 4:3 monitor. In each case for
the assessment of technical picture quality, the correct viewing distance of four times the picture height is to be maintained.

When monitoring productions that are available in digital VTR format, it is necessary to check the error rate (video and audio channels) as well as subjectively monitoring the picture and sound quality. Because of the "built-in" error concealment, the quality of digital recordings cannot be clearly established by subjective monitoring on a picture monitor. Additionally, a check, during replay, of the actual error rate on the tape, makes it possible to make an exact analysis of the recording in question.

If a vision or sound signal has undergone error-concealment, it is no longer possible to assess subsequent production or transmission tapes by means of an error-rate indicator. On the other hand, such impairments of the picture and sound quality are only to be assessed by subjective monitoring.

General explanations about error-rate indication are to be found in Para. 2.10.11 and specific limits in the corresponding sections relating to the individual recording formats.

1.11 Monitoring of teletext sub-titling [FT-UT]
Monitoring of teletext sub-titling is to be carried out by using a television receiver with teletext decoder corresponding to current television equipment technology.

1.12 Audio description [Hörfilm]
An audio description film [Hörfilm] is a film with additional acoustic picture description. Concise commentaries are added in pauses in the dialogue to give partially-sighted members of the audience clear visual elements of the scene. This technique of spoken picture description is called audio description.

The additional descriptions are recorded on Sound Track 2 (Audio 2) of the transmission tape and broadcast using the two-channel sound system.

*Note:* It should be noted that, for an existing stereophonic recording, a monophonic version must first be made and recorded on Sound Track 1, before the audio description can be recorded on Sound Track 2.

1.13 Metadata
For the exchange of Metadata, it is additionally necessary to have an agreement on the extent and content of the information. Appropriate structures and models for the exchange are currently being worked out, e.g. Regelwerk Fernsehproduktion, DMS-1, P/Meta.

The conditions for the exchange of Metadata are contained in "Part 7. Metadata" of these guidelines.
2. **Conditions common to television production on video tape (Part 3) and on tape-less systems (Part 4)**

   **Note for Part 2:**

   (*) The passages marked with one asterisk are only relevant to TV production on video tape.
   (**) The passages marked with two asterisks are only relevant to TV production on tape-less systems.
   Unmarked passages are valid in both cases.

2.1 **Vision signals**

   The timing reference for the input function of video recording machines and tape-less production equipment is, as a rule, derived from the selected video input signal. Therefore the recorded video signals must also display, in addition to correct amplitude values, a high degree of timing stability. The requirements for a timing reference for all equipment involved in a television production are given in EBU Technical Standard N14.

2.1.1 **Recording of composite colour (PAL) vision signals**

   The television signals must comply with the characteristics of Systems B/PAL and G/PAL in ITU-R Recommendation BT.470 (see Annexes 8.3 and 8.4).

   For electronic editing, the television signals must also comply with the specifications given in EBU Technical Statement D23 for the sub-carrier-to-line-sync (Sc-H) relationship.

2.1.2 **Recording of vision signals with an analogue-component input**

   The television signals must comply with the characteristics given in EBU Technical Standard N10 and with the sections of ITU-R Recommendation BT.470 quoted therein (see Annex 8.5).

   **Note:** The signals described in EBU Technical Standard N10 as \( E'_Y, E'_C_R \) and \( E'_C_B \) are, from practical considerations, subsequently called \( Y, R-Y \) and \( B-Y \).

2.1.3 **Recording of vision signals with a digital-component input SDI (Serial Digital Interface)**

   a) **4:3 picture format**

      The television signals must comply with the encoding parameters given in ITU-R Recommendation BT.601 for the 625-line system (to be noted are the two possible display methods for the amplitude range, as set out in Annex 8.6). The serial digital component signals must comply with the specifications given in ITU-R Recommendation BT.656.

      Further information about ITU and EBU specifications, measurement methods and background information is to be found in EBU Tech.3283 and in Chapter 1 of the ARD/ZDF "Handbook of Television System Engineering" [Handbuch der Fernsehystem-technik].

   b) **16:9 picture format**

      In general, the requirements quoted in Para. 2.1.3a) are applicable; i.e. the generation and processing of vision signals in the 16:9 format are effected with the 13.5-MHz sampling rate and 10-bit resolution specified in ITU-R BT.601.

      **(*) Note:** The digital recording format D-5 quoted in Para. 3.3 facilitates, apart from this recording, an optional recording mode with a sampling frequency of 18 MHz and 8-bit resolution. Whereas in the standard case with digital input and output, a data rate of 270 Mbit/s (10-bit resolution) matches each of them, they should work in an optional mode at 360 Mbit/s.
If the optional mode is used for a production in the 16:9 picture format, it must be ensured that all items of equipment subsequently used in this production will operate at this higher data rate. Rules for the application of the optional mode are given in Para. 3.3.5.

2.1.4 Recording of vision and sound signals via a Serial Data Transport Interface (SDTI)

SDTI is a specification for the "packeted transport" of data via the SDI interface. Also necessary are corresponding specifications that set out the packaging of data in the different video-compression formats, including audio data and Metadata (Mapping documents).

When programme material is recorded in the "compressed, packaged data domain" via the SDTI interface, the standard documents for SDI and SDTI are relevant as well as the corresponding Mapping Standards.

a) Interfaces
   - ITU-R Recommendation BT.656 for SDI,
   - SMPTE 305M for SDTI - Serial Data Transport Interface.

b) Packaged data signals
   The Mapping Standards for the relevant video-compression formats have been established by the SMPTE. The standard to be complied with for each of the recording formats is quoted in the corresponding paragraph.

Annex 8.8 shows the fundamental relationship between the SDI interface and the SDTI interface.
Annex 8.9 shows the detailed correlation of the relevant video-compression formats and the video-recording formats in television production with the corresponding Mapping Standards:
   - DV-based (DVCPRO, DVCPRO50, Dig. S) SMPTE 321M;
   - DV (DVCAM) SMPTE 322M;

2.1.5 Field sequence

For the production of programme material, the edit point for all VTR formats must be chosen that the added and inserted video sequences begin with the first field of a frame (as defined in ITU-R Recommendation BT.470 for PAL systems B/G). It follows that a shot-change in a vision signal to be recorded must begin with the first field of a frame (see also EBU Technical Recommendation R62).

When recording from a film scanner, the beginning of a new film frame must coincide with the beginning of Field 1 of the television signal (see also Para. 5.2 of these Guidelines). This is an absolute pre-requisite for trouble-free subsequent use of this video recording in conjunction with any sort of bit-rate reduction process or more developed television systems such as PALplus. Incorrectly related recordings can also be corrected with the aid of a frame-store in "freeze mode" locked to a moving picture and with an appropriate design of the equipment (switchable field-changing).

In general, it is essential to maintain the correct field sequence in all the equipment involved in a production (mixer, synchronizer, etc.).

2.1.6 Beginning of the field of the active picture signal

a) Analogue vision signals as in 2.1.1 and 2.1.2
   In the case of the more developed television systems (e.g. PAL plus) it must be ensured that, in the first field, the active picture information runs from the second half of Line 23 (up to and including Line 310) and, in the second field, from the second half of Line 336 (up to and including Line 623).
b) Digital vision signals as in 2.1.3

In the case of the more developed television systems (e.g. PALplus) it must be ensured that, in the first field, the active picture information runs from Line 23 (up to and including Line 310) and, in the second field, from Line 336 (up to and including Line 623).

2.1.7 Vision-signal horizontal blanking

With digital-component signals, the duration of horizontal-blanking is only 10.67 µs instead of 12 µs for analogue-component and PAL signals. Thus the active line period of a digital-component signal begins 0.71 µs earlier and ends 0.62 µs later than for an analogue line (see Annex 8.7). This is due to an attempt to achieve a standardization of digital 525/60 and 625/50 signals and to provide a necessary additional time period to facilitate an optimal filter design for the D/A conversion. This means that an analogue blanking after passage through the D/A conversion will possibly remove disturbances (caused by the rise and fall times of the filter) still existing at the beginning and end of the active line.

2.1.8 Horizontal blanking in digital production equipment

Digital-component production equipment has both analogue and digital inputs and outputs for the vision signal. Basically it should be possible that, when replay is from the analogue output, the correct analogue blanking is available and, when replay is from the digital output, the correct digital blanking is available. In a mixing operation, however, it must be ensured that the analogue blanking can be applied simultaneously for the analogue and digital outputs.

2.1.9 Permissible and valid signal level

It is still a standard compliant PAL or PALplus signal that is transmitted. Therefore it is necessary to make sure, in the production of television programmes in a mixed production situation with PAL signals (composite colour video signals) as well as analogue-component (Y, R-Y, B-Y) signals and digital (Y, CR, CB) component signals, that it is possible to obtain a correctly coded PAL signal when replaying the transmission tape.

In no circumstances may programme material, whether for programme exchange or for transmission, contain invalid signal levels.

Here, it should also be mentioned that, in the analogue- and digital-component domains, not all permissible signal-level combinations are necessarily valid signal levels.

Experience has shown that invalid signal levels can arise in production equipment, which carries out internal signal manipulation or generation in the Y/CR/CB domain (e.g. computers, paint systems, digital effects generators, component mixers, caption generators). Also, the setting of "super black level" for key signals in analogue technique is not possible in digital technique.

A reliable control of the validity of signals is effected with an oscilloscope RGB display. The validity of the signals can be monitored with a suitable measuring instrument or a monitor that indicates any violation (overshoot) of the RGB colour space (Annex 8.10). A detailed explanation of this problem is given in Technical Guidelines 8/1.1, Para.1.13.2 [Technische Richtlinien 8/1.1, Punkt 1.13.2].

2.1.10 Permissible signal spectrum of digital signals

In general, all digital vision signals must comply with the encoding parameters given in ITU-R Recommendation BT.601 (see Para. 2.1.3). The pre-filtering of the video signal laid down therein must be carried before each digitization, in order to avoid the appearance of sub-sampling artefacts ("aliasing") in the picture.

This means, however, that vision signals generated directly in the digital domain must be subject to the same limitations (pre-filtering) of the spectral signal characteristics that are laid down in ITU-R Recommendation BT.601 for the digitization of analogue-component signals. This ensures that no excessively steep rising or falling edges occur in a subsequent D/A conversion.
Experience has shown that inadmissible signal spectra can occur in production equipment (e.g. computers, caption generators, etc.) due to excessive level changes generated between two successive picture elements (pixels).

*Note:* Care must also be taken that, in the generation or digitization of signals, "invalid signal levels" (excessively high levels) never arise in the luminance signal or the chrominance signal.

### 2.1.11 Pixel basis

In accordance with ITU-R Recommendation BT.601 the pixel basis of a digital vision signal corresponds to 720 picture elements per active line and 576 active lines per frame (giving 720 x 576 rectangular pixels). When vision signals are generated on another pixel basis, e.g. from computers with 640 x 480 square pixels, they must, in each case, already be converted into the correct television pixel format at the point of production (by the supplier). Care must be taken that this conversion into the correct television pixel basis of 720 x 576 picture elements does not give rise to any disturbance to the pictures.

### 2.2 Additional signals accompanying the programme

When accompanying additional signals, e.g. Teletext, VPS data, WSS data and Metadata, are handled in the digital domain; it must be ensured that when they are replayed via the digital interface, the correct horizontal blanking must be available within the vertical blanking interval. If this condition is not observed, the total loss of the additional data is to be expected.

### 2.2.1 (*) Teletext sub-titles [FT-UT]

The specifications laid down in the document "Guidelines for the standardized origination and transmission of Teletext sub-titles" [Richtlinien zur einheitlichen Herstellung und Ausstrahlung von Fernsehtext-Untertitel-Beiträgen] must be adhered to.

It is of prime importance that the sub-title data must be recorded on the same tape.

For programme exchanges on tapes, the sub-title data must be recorded on the same tape.

#### a) Recording of tenement sub-titles via analogue interfaces

For simultaneous recording of teletext sub-titles with the television signal on video tape, the specifications for coding, signal-waveform and timing are to be in accordance with the "the Technical Guidelines 8 R 4: Teletext Specification" [Technische Richtlinie 8 R 4: Fernsehtext-Spezifikation].

The complete teletext sub-title must be carried on at least lines 20/21 as well as 333/334. In addition to this, the teletext sub-titles can also be carried on those lines that should be used for the transmission of the normal teletext sequence.

#### b) Recording of teletext sub-titles via digital interfaces

The instructions set out in a) above are applicable. This means that digitally generated sub-titles, as well as analogue generated and subsequently digitized sub-titles, must, when played back and transmitted in an analogue area, be as carefully controlled as analogue recorded sub-titles.

*Note:* If the original VTR material is available as an analogue-component signal or as a digital-component signal, it is absolutely imperative that the video tape is prepared with the sub-titling in the same signal domain as the original.

### 2.3 Sound signals

In principle, there should be no time difference between the vision and sound signals. Nevertheless, unavoidable errors have to be accepted, e.g. in a live programme with digital effects and in these cases the tolerances that may not be exceeded are those laid down in
EBU Recommendation R37 for the end of a complete production chain (at the transmitter input):
- The sound may not be more than 40 ms in advance of the picture,
- The sound may not be more than 60 ms behind the picture.

EBU Technical Recommendation R83 contains the rules for the synchronization of digital audio signals in a television production area.

Special guidelines for the adjustment of the sound channels of the video-tape recording formats are given in the "Sound signals" section of the respective formats.

Analogue audio signal sources use a frequency \( f = 1000 \text{ Hz} \) for the alignment level. In order to avoid sub-harmonic of the audio sampling frequency (48 kHz), a frequency \( f = 997 \text{ Hz} \) for the alignment level of digital signals sources is used.

2.3.1 Analogue sound signals

a) Permitted maximum level

The permitted maximum level corresponds to the studio level.

Permitted maximum level = +6 dBu = 1.55 V\(_{\text{rms}}\)

b) Alignment level

The alignment level (level for international programme exchange) is 9 dB below the permitted maximum level, and corresponds to the reading of -9 dB on a peak programme meter.

Alignment level = -3 dBu = 0.55 V\(_{\text{rms}}\)

2.3.2 Digital sound signals

<table>
<thead>
<tr>
<th></th>
<th>Digital</th>
<th>Analogue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clipping Level</td>
<td>+9 dB</td>
<td>+15 dBu*</td>
</tr>
<tr>
<td>Maximum Programme Level</td>
<td>0 dB</td>
<td>+6 dBu*</td>
</tr>
<tr>
<td>Reference Level</td>
<td>-9 dB</td>
<td>-3 dBu*</td>
</tr>
<tr>
<td>Headroom</td>
<td>-18 dBFS**</td>
<td>0 dBu = 0.775 V(_{\text{rms}})</td>
</tr>
</tbody>
</table>

*) 0 dBu = 0.775 V\(_{\text{rms}}\)
**) FS = Full Scale

Relationship between analogue and digital reference levels according to Rec. ITU-R BS.646

a) Headroom and permitted maximum level

Coding levels as well as an uniform coding level for digital sound systems are laid down in EBU Technical Recommendation R68. Accordingly and irrespective of the total number of bits available (16, 18, 20, ...), the digital code for the alignment level must lie 18 dB below the maximum possible digital code (clipping level). This results in a headroom of 9 dB.
Measurements in a system with a permitted maximum level of +6 dBu result in the relationship between digital and analogue sound signals shown above (see also HFBL-K Recommendation 15IRT [HFBL-K Empfehlung 15IRT]).

b) Sampling rate
Only sound signals with a sampling rate of 48 kHz shall be utilized.

c) Pre-emphasis
In principle, pre-emphasis shall not be utilized.

d) Digital additional data
Only the D-5 recording format facilitates the unrestricted recording of all the additional data specified in the AES/EBU format (Channel-status-, User-, Validity- and Parity-bits). The recording of each of these bits used reduces the maximum possible resolution in steps from 20 bits to 16 bits when all four additional data bits are used. Any variation from the 20-bit resolution must therefore be agreed.

2.3.3 Separate sound format
The method to be used for the sound synchronization and dubbing of productions is to be agreed in each case with the customer. This also applies to the production of a separate synchronous sound track (e.g. multi-channel sound).

For transmission, the complete programme sound (transmission sound) must be recorded on the transmission tape or the tape-less system.

2.4 Time-code

2.4.1 Linear time-code (LTC)
The 80-bit time-code must comply with the specifications given in DIN EN 60461 (see Annex 8.11 for code-word structure).

(*) On video tape the LTC must be recorded on the track specified for that purpose in the format used.

2.4.2 Time-code in the vertical blanking (VITC)
The 90-bit time-code must comply with the specifications given in DIN EN 60461 (for relationship between VITC and LTC: see Annex 8.12).

(*) With recording formats the VITC makes it possible to read the time-code with a frozen picture or slow motion. It should only be utilized in conjunction with the LTC and must indicate the identical time-code figures for a recorded television-signal frame.

(*) The lines in the vertical blanking, in which the VITC must be recorded, are specified in the "Time-code" section of the appropriate recording format.

2.4.3 User-bits
At present there is no standardized utilization of the user-bits for programme exchange. If no agreement has been made on the utilization of user-bits for a production, the corresponding positions in the time code are to be set at "zero".

2.4.4 Copying of time-code signals
In principle, when time-code signals are copied - just as in the case of long-distance transmission - the time code should be regenerated in such a way that the relationship of the original time-code address to the vision signal must be maintained.
2.5 Technical leader, programme and trailer

EBU Technical Recommendation R49 sets out in diagrammatic form the sequence for the technical leader, the programme recording and the trailer for international programme exchange. This diagram also describes in particular the details of the technical leader. The relevant specifications based on EBU Recommendation R49 are summarized below as well as in Paras. 2.6, Table 2.7 and Paras. 2.8, 2.9 and 2.10.

For a trouble-free operation, e.g. in order to guarantee an optimum adjustment of the replay machine for the tape to be played, a technical leader must be recorded at the beginning of each programme. The recording of the technical leader has to be done with the machine lined-up for the programme and via the vision and sound inputs used for the programme.

Note: If programme material from a file-based production unit, e.g. a server or an NLE system, is to be recorded on a magnetic tape, the technical leader must, likewise, be recorded from this production unit.

The duration and type of the signals on the technical leader when recording stereophonic sound signals are specified in EBU Technical Recommendation R49 (see Table 2.7).

With equipment that has more than two sound channels (e.g. digital formats with 4 or 8 equal sound channels) the time sequence given in the Table must be maintained in the technical leader for each sound channel that may be used.

(*) The assignment of the sound tracks of video-tape recording machines is given in Part 3 for the respective recording formats.
2.6 Sequence and details for leader, programme and trailer

2.6.1 Before the start of the programme, a continuous black-level signal without any edit is to be recorded for at least 10s, in accordance with Para. 2.7.

2.6.2 The start of the programme is usually at time code 10:00:00:00, continually increasing.

2.6.3 Each recording ends with at least 30 s of black level without sound.

2.6.4 The synchronizing signals, the control track and the time code must be recorded continuously from at least 30 s before the start of the programme until the end of the trailer. No interruption is permitted.

2.6.5 (*) In the editing of a programme, the time-code may be interrupted within a reel, but it must be recorded with continually increasing values. If there is an interruption, a run-in of at least 10 s before a picture-cut is essential.

2.6.6 (*) The first sound should begin 6 frames after the first picture of a programme item. With zero offset, the run-up time of the VTR machine will cause wow or the sound will be inaudible.

2.6.7 Electronic editing must be carried out in such a way that no disturbance is caused to the vision, sound and synchronization. In addition, the field sequence specified in Para. 2.1.5 must be maintained.

2.6.8 In order that the transmission material should be of immaculate quality, the number of copying operations required is to be kept to a minimum.

2.6.9 (*) A transmission tape must not contain more than one completed programme or transmission. In this respect, each episode of a series also counts as a complete programme. Compilation tapes with programme trailers are an exception.

2.6.10 (*) If a programme is divided into more than one tape, each tape must have a technical leader in accordance with Para. 2.5.
   The beginning and end of Tape 1 must be in accordance with Paras. 2.6.1, 2.6.2 and 2.6.3.
   In addition, for all subsequent tapes the time-code transition from the end of programme on one tape to the beginning of programme on the following tape must be ascending.
   Variations from this must be separately agreed in advance.

2.6.11 (*) In the case of a programme that is recorded in several takes on several tapes and delivered without any editing, each tape must have a technical leader.
   The beginning and end of each take must be in accordance with Paras. 2.6.1, 2.6.2 and 2.6.3.

2.6.12 (*) If a programme consists of more than one tape, the same type of tape should be used.

*Note: See the Table from EBU Technical Recommendation R49 on the next page.*
## 2.7 Table from EBU Technical Recommendation R49

<table>
<thead>
<tr>
<th>Tape selection</th>
<th>Duration</th>
<th>Picture</th>
<th>Sound track 1</th>
<th>Sound track 2</th>
<th>Control-track signal</th>
<th>Time-code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protection-leader</td>
<td>At least 10 s</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Blank tape</td>
</tr>
<tr>
<td>Alignment leader</td>
<td>At least 60 s</td>
<td></td>
<td></td>
<td></td>
<td>1000 Hz (6) ref. level (3)</td>
<td>Interruption or</td>
</tr>
<tr>
<td>Identificaton leader</td>
<td>At least 15 s</td>
<td></td>
<td>Picture-format identification 4:3/16:9 (2)</td>
<td></td>
<td>1000 Hz (6) ref. level (3)</td>
<td>Discontinuity in time-code possible</td>
</tr>
<tr>
<td>Cue-up leader</td>
<td>8 s</td>
<td></td>
<td>Black (5) or Identification</td>
<td>Silence or Identification</td>
<td>Silence or Identification</td>
<td>Continuous</td>
</tr>
<tr>
<td></td>
<td>2 s</td>
<td></td>
<td>Black (5)</td>
<td>Silence</td>
<td>Silence</td>
<td>Continuous</td>
</tr>
<tr>
<td>Programme</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10:00:00:00 (see 2.6.2)</td>
</tr>
<tr>
<td>Run-out trailer</td>
<td>At least 30 s</td>
<td></td>
<td>Black (5)</td>
<td>Silence</td>
<td>Silence</td>
<td></td>
</tr>
</tbody>
</table>

(1) Suitable alignment signals are described in Para. 2.8.

(2) A signal for picture-format identification is described in Para. 2.9.

(3) (*) Reference level: see under "Sound signals" of the appropriate recording format. In general, for reference level signals for a stereo signal, the sound signals on both tracks must be coherent, i.e. from the same source and in phase. See also EBU Technical Recommendation R49, Table 2, Note 3.

(4) (*) When time-code is recorded, the time-code data for the beginning and end of the programme must be marked on the VTR record card.

(5) When a PAL-coded signal is recorded, the black signal must always contain colour-synchronizing signals, in order to ensure an undisturbed PAL sequence from the beginning to the end of the programme recording.

(6) With digital sound-signal sources, a frequency f = 997 Hz is used instead of f = 1000Hz.
2.8 Alignment signals for the technical leader

2.8.1 PAL-coded signals
A suitable alignment signal for the recording of a PAL-coded signal is given in ITU-R Recommendation BT.471.
The alignment signal consists of a sequence of colour bars in descending order of their luminance values (white, yellow, cyan, green, magenta, red, blue, black), corresponding to a colour-bar signal of the type 100/0/75/0. It is advantageous if the lower third of the frame consists of a uniform red area with a red-signal level of 75%.

Description in ITU-R BT. 471

<table>
<thead>
<tr>
<th>100</th>
<th>0</th>
<th>75</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
</tr>
</tbody>
</table>

A: The primary colour signal level during the transmission of the "white" colour bar
B: The primary colour signal level during the transmission of the "black" colour bar
C: The maximum level of the primary colour signal during transmission of "coloured" colour bars
D: The minimum level of the primary colour signal during transmission of "coloured" colour bars

2.8.2 Analogue-component signals
A suitable alignment signal for the recording of an analogue-component input signal is a colour-bar signal in component form of the type 100/0/75/0 (described in ITU-R BT.471). It is advantageous if the lower third of the frame consists of a uniform red area with a red-signal level of 75%.

2.8.3 Serial digital-component signals – SDI
A suitable alignment signal for the recording of a digital-component input signal is as described in Para. 2.8.2 but in digital form.

2.8.4 Serial digital data signals – SDTI
A suitable alignment signal is as described in Para. 2.8.2. However, for the recording of a digital data signal, a signal in the compressed, packaged data domain is required.

2.9 Identification of the 4:3 and 16:9 picture formats in the technical leader
In order to ensure a clear identification of the picture format on replay, the characters 16:9 must be super-imposed in the middle of the 75% red area in the lower third of the frame of the alignment signal for productions in the 16:9 format. Optionally, for productions in the 4:3 format, the characters 4:3 may be super-imposed in the same position of the alignment signal.
The characters must be of sufficient size that a clear identification can be made even with a relatively small picture monitor.

(*) For the international exchange of recordings in the 16:9 picture format, EBU Technical Recommendation R71 recommends the identification of cassettes and containers as well as on the VTR record card and within the technical leader.
2.10 Special technical requirements

2.10.1 (*) For the replay of PAL recordings, the time-stability of the signals from a genlocked VTR must comply with the following requirements at the PAL output:
   - 2.5 ns quasi peak-to-peak for random disturbances, and
   - 0.4 ns for periodic disturbances.

2.10.2 (*) For the replay of analogue-component recordings, the time-stability of the signals from a genlocked VTR must meet the following conditions:
   - Component output: line-frequency jitter < ±5 ns,
   - PAL output: see Para. 2.10.1.

2.10.3 (*) In the case of productions in the Betacam-SP format, the equipment must comply with the "Video and sound specifications for ARD/ZDF unified acceptance tolerances for Betacam-SP studio installations" [Video- und Ton-Spezifikationen für ARD/ZDF einheitliche Abnahme-toleranzen von Betacam-SP-Studioanlagen].

2.10.4 (*) With analogue recording formats, care is to be taken that none of the equipment or video tapes used in a production gives rise to excessively high drop-out rates. The causes of faults (head-clogging, tape) are to be remedied and the corresponding section re-recorded. Permissible drop-out rates are given in Technical Guideline 8/6.4 [Technische Richtlinie 8/6.4].

2.10.5 (*) In the case of productions in the digital Betacam format, the equipment must comply with the "ARD-ZDF acceptance guidelines for digital VTR machines in the digital Betacam format" [ARD-ZDF-Abnahme-Richtlinien für digitale MAZ-Maschinen des Formats Digital-Betacam].

2.10.6 (*) In the case of productions in the D-5 format, the equipment must comply with the "ARD-ZDF acceptance guidelines for digital VTR machines in the D-5 format" [ARD-ZDF-Abnahme-Richtlinien für digitale MAZ-Maschinen des Formats D-5].

2.10.7 (*) In the case of productions in the DVCPRO format, the equipment must comply with the "ARD-ZDF-ORF acceptance guidelines for digital VTR machines in the DVCPRO format" [ARD-ZDF-ORF Abnahme-Richtlinien für digitale MAZ-Maschinen des Formats DVCPRO].

2.10.8 (*) In the case of productions in the DVCPRO50 format, the equipment must comply with the "ARD-ZDF-ORF acceptance guidelines for digital VTR machines in the DVCPRO for 50 Mbit/s format" [ARD-ZDF-ORF Abnahme-Richtlinien für digitale MAZ-Maschinen des Formats DVCPRO für 50 Mbit/s].

2.10.9 (*) In the case of productions in the IMX format, the equipment must comply with the "ARD-ZDF-ORF-(TPC) acceptance guidelines for digital VTR machines in the IMX format" [ARD-ZDF-ORF-(TPC) Abnahme-Richtlinien für digitale MAZ-Maschinen des Formats IMX].

2.10.10 (*) In the case of digital-component recording, it must be ensured that no excessively high drop-out rate occurs during any recording or replay operation within a production. If this does happen, or there is "error-concealment", the cause of the fault is to be eliminated and the corresponding section re-recorded (see also Paras. 2.10.11 and 1.10 in these Guidelines).
2.10.11 (*) Permissible error-rates for digital recording formats

The state of the replay channel is generally indicated by means of a so-called "channel-condition indicator" on the control panel. The three-colour indicator lamps indicate the following operational conditions:

- **Green**: Good condition in replay channel. Very low error rate. All tape faults can be corrected.
- **Yellow**: An increased error rate in one or more replay channels. All tape faults can still be corrected, but there may already be a problem.
- **Red**: Too high an error rate in one or more replay channel. All faults can no longer be corrected. Concealment is being applied.

**Warning**: The change from **Yellow** to **Red** takes place with a small safety margin before the actual onset of concealment.

In normal circumstances, only the green indicator should be lit during the replay sequence. Brief illumination of the yellow lamp is not critical, as all errors will be corrected. Longer or continual illumination of the yellow lamp, or even the red lamp, should not occur. In these cases, the replay of the tape sections concerned should be repeated in order to ascertain whether it is a matter of a real recording fault or only short-duration head-clogging (loose dust particles).

In addition, it is to be noted that a vision or sound signal affected by concealment on subsequent production tapes can no longer be detected by means of the error-rate indicator. This is why it is necessary to monitor the error rate during each recording session of a production (by separate-head monitoring if necessary).

Specific limits for the permissible error rates are given in the corresponding chapters relating to the individual recording formats.

**Warning**: In digital sound recording systems, the **Yellow** lamp indicates a higher error rate and that concealment is already taking place.

In general: **no concealment at all should take place in sound recording** (cf. also Para. 6.9).

2.11 (*')VTR record-card and VTR-tape nomenclature

A VTR record card is to be prepared for each reel of a programme on video tape. The video tape and the VTR record card are always to be kept together. An example of a VTR record card is given in EBU Technical Recommendation R81.

In the case of electronically produced VTR records, care is to be taken that a change made in the data bank is enclosed with the relevant edition of the tape.

It is recommended that each tape should be identified using the appropriate VTR nomenclature set out in Annex 8.14 (on labels for the tape and tape box). This will ensure a precise identification of the tapes in relation to the work stage that has been reached.

2.12 Information on the production chain

For the future exchange of programme material by means of file format, it is important to have additional information on the origination of the programme material. Consequently, for television production on video tape and on tape-less systems, this information should be recorded both on the VTR record card that accompanies the production tape as well as in the corresponding Metadata (see Part 7), e.g.

- Acquisition format,
- Post-production processing systems involved,
- Data-reduction method (compression method) used,
- Reduction factors or data rates set,
- Interfaces used for the transfer.
2.13 (*) Handling and storage of video tapes

2.13.1 Methods of handling and storing video tapes should take into consideration ITU-R Recommendation BR.1215.

2.13.2 In principle, video tapes (reels or cassettes) are to be stored only in containers that are suitable for archive storage.

2.13.3 As there are not yet any special requirements for the handling and storage of magnetic data tapes, in principle, the same conditions as for video tapes should, initially, be applied.

2.14 Sound-synchronization of VTR productions

The methods to be used for the synchronization and dubbing of productions is to be agreed in each case with the customer. This also applies to the production of a separate synchronous sound track (e.g. multi-channel sound). See also Para. 2.3.3 in these Guidelines.
3. **Television production on video tape**

In general, the video tapes must meet the high quality requirements for professional use, e.g. very low drop-out rate. In particular, when using cleaned tapes that have already been used several times for the production of programme material, care must be taken to ensure that their technical and mechanical condition meets these high quality requirements.

3.1 **Betacam SP..............."12.65 mm (0.5 in.) Helical-scan format L"**

3.1.1 **Recording format**

International Standard IEC 60961 and DIN Standard EN 60961 set out the parameters for the "Video-tape-cassette system with helical-scan recording on 12.65 mm (0.5") L-format". Two recording possibilities are specified in it:

- **MODE I** Oxide-particle tape (Betacam), is not to be used for new productions
- **MODE II** Metal-particle tape (Betacam-SP) with the possibility of recording Audio-FM signals

Checking of the VTR machine's record and replay chains and of the tape guidance may only be carried out with the calibration cassettes recommended by the manufacturer.

3.1.2 **Unified acceptance tolerances for ARD, ZDF and ORF**

The video and sound specifications for acceptance and alignment procedures laid down in the "ARD/ZDF unified acceptance tolerances for Betacam-SP studio installations" [ARD/ZDF einheitliche Abnahmetoleranzen von Betacam-SP-Studioanlagen] must be respected. This will ensure optimal vision and sound quality even after multiple copying. The specifications apply to Betacam-SP studio equipment (Models 60 and 70) with metallic tape. In general, the machines should be optimized for metallic tape.

3.1.3 **Video-tape**

The mechanical parameters of the video-tape cassette and the characteristics of the magnetic tape for recording in MODE II must comply with the requirements given in the International Standard IEC 60961.

3.1.4 **Vision signals**

For preference, the recording should be carried out via the component-signal input. The component-signal domain is to be retained during subsequent processing in order to avoid loss of quality.

For MODE II, the frequencies of the recorded IF signals corresponding to the video levels in the luminance and chrominance channels are specified in the International Standard IEC 60961.

**Note on MODE II:**

In MODE II, when a composite colour-television signal is recorded, a reference signal and an identification signal are generated by the PAL decoder and are recorded in the respective field-blanking intervals of the Y and B-Y signals. They identify a decoded PAL signal and comprise the reference to the original colour sub-carrier relationship:

- **Vertical Interval Subcarrier Reference (VISC)** on Lines 8 and 321 of the Y signal,
- **Colour Field Identification** on Lines 12 and 325 of the B-Y signal.

These signals must remain combined with the video signals throughout the whole production process in component form in order to avoid an accumulation of errors when recoded into PAL (appropriate options for PAL coders and PAL decoders are set out in Technical Guideline 8/9.1 and 8/9.2).
3.1.5 Sound signals

MODE II - Metallic tape

a) Longitudinal recording

In principle, the recording is carried out with the Dolby C compander system switched into circuit.

The magnetic-flux level for the maximum modulation level (+6 dBu) is 254 nWb/m.

The alignment of the replay chain is carried out with the Sony company's metallic audio calibration tape CR 8 - 2 B PS, "1 kHz 0 VU". This recording corresponds to a magnetic-flux level of 127 nWb/m trackwidth; with this, the level at the Dolby module is -10 dBu (Sony standard!), to give an output level of 0 dBu.

For the record chain, the bias adjustment is made with a voltage 20 dB below maximum level at a frequency of 6.3 kHz; the bias current is increased until the maximum replay voltage is reduced by 2 dB. The LF gain is adjusted so that an input level of +6 dBu gives a level of -4 dBu at the Dolby module and a magnetic-flux level of 254 nWb/m trackwidth. Under these conditions, the replay of a recording of a single 1 kHz tone gives a replay level of +6 dBu at the output.

The peak meter is adjusted so that it gives an indication of "0 dBu" for a level of +6 dBu (permitted maximum level).

b) FM-recording

The replay chain is set to a level of 0 dBu for the 25-kHz-deviation of the Sony FM-calibration tape.

The record chain must be adjusted so that an output level of +6 dBu is obtained from a recording at maximum level (+6 dBu) and an output level of -3 dBu is obtained from a recording at reference level (9 dB below maximum modulation).

3.1.6 Assignment of tracks

MODE II – Metallic tape

Because of the large number of possible variants, it is not intended to give at present, as an aid to practical use, a list of the assignments of sound tracks for the various requirements of studio production.

For this reason, the track assignment to be used for studio productions is to be agreed with the each customer.

Note: See the next page for the track assignment for Betacam-SP transmission tapes.
The standardized track assignment for transmission tapes

<table>
<thead>
<tr>
<th></th>
<th>Longitudinal track</th>
<th>FM-track (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mono (1)</td>
<td>Track 1</td>
<td>Programme sound</td>
</tr>
<tr>
<td></td>
<td>Track 2</td>
<td>Programme sound or International sound</td>
</tr>
<tr>
<td>Stereo</td>
<td>Track 1</td>
<td>Left</td>
</tr>
<tr>
<td></td>
<td>Track 2</td>
<td>Right</td>
</tr>
<tr>
<td>Two-channel (2)</td>
<td>Track 1</td>
<td>German prog. sound</td>
</tr>
<tr>
<td></td>
<td>Track 2</td>
<td>Original programme sound or Audio description</td>
</tr>
</tbody>
</table>

(1) In accordance with EBU Technical Recommendation R38, an available international sound, e.g. an insert or replay in sport, is recorded on Audio Track 2.
(2) Audio description is a special case of a two-channel programme. The German programme sound with additional scenic description for partially-sighted viewers is broadcast instead of the usual other foreign-language original programme sound. See also Para. 1.12 Audio description [Hörfilm].
(3) Only for original recordings or copies.

3.1.7 Time-code
The time-code must be recorded on the longitudinal time-code track.
The record current is to be adjusted so that an increase of 1 dB in the input level raises the replay voltage by 0.5 dB (measured with an RMS voltmeter).
If an additional time-code recording is made in the vertical blanking interval (VITC), this must be recorded on lines 9, 10, 322 and 323 of the vertical blanking.

*Note: In the case of another use of these lines in the future, a new allocation will have to be made*

3.1.8 Adhesive labels for video-tape cassettes
Adhesive labels are used on video-tape cassettes and cassette boxes. An example is shown in EBU Technical Recommendation R 81.
The labels are to be stuck on the appropriate label area on the cassette (not on the edge). Additional identification in accordance with Paras. 2.9 (picture-format identification), 2.11 (VTR-tape nomenclature) and 2.12 (Information on the production chain) is strongly recommended.

3.2 Digital Betacam......."12.65 mm (0.5 in.) Helical-scan format Digital-L"

3.2.1 Recording format
International Standard IEC 61904 and DIN Standard EN 61904 set out the parameters for the digital-component video-tape cassette system with helical-scan recording on 12.65-mm magnetic tape with data compression (Digital-L format).
Verification of the VTR machine's record and replay chains and of the tape guidance may only be carried out with the calibration cassettes recommended by the manufacturer.

3.2.2 Unified acceptance specifications for ARD, ZDF and ORF
The video and sound specifications for acceptance and alignment procedures laid down in the "ARD/ZDF acceptance guidelines for digital VTR machines for the digital Betacam format" [ARD/ZDF Abnahme-Richtlinien für digitale MAZ-Maschinen des Formats Digital Betacam] must be respected.

3.2.3 Video-tape
The mechanical parameters of the video-tape cassette and the characteristics of the magnetic tape must comply with the requirements of International Standard IEC 61904.

In particular, care should be taken that only such tape material is used that will ensure the maintenance of an acceptable error rate.

3.2.4 Error rate
On Digital-Betacam equipment, the error rate is indicated by means of the "channel-condition indicator" on the front panel. Monitoring of the error rate is possible during replay, as well as when recording via the separate tape heads. Longer or continual illumination of the yellow lamp, or even the red lamp, indicates an excessively high error rate in the vision and/or sound channel. Illumination of the different lamps of the "channel-condition indicator" will indicate the following:

**Green** Error rate in permissible range, all in order.
**Yellow** An increased error rate in one or more replay channels. All faults can still be corrected, but there may already be a problem.
**Red** Equipment and/or tape must be checked. Inform maintenance service.

In addition, with Digital-Betacam equipment an error-rate indication can be obtained by selection on the preview monitor. Separate indications are given here for video and audio. Moreover, with the "ERROR LOGGER" function an error list can be displayed on the preview monitor. Here, at any one time, the last 99 events that have caused the illumination of the red lamp are registered with their respective time-code figures.
General comments on the error-rate indication are given in Para. 2.10.11.

3.2.5 Vision signals
All vision signals routed via the PAL, the analogue-component and the serial digital-component inputs must be recorded so that, when replayed on a machine complying with the specifications, the permissible error rate is not exceeded.
In general, recordings are made in the 10-bit mode. In exceptional cases, e.g. in a production environment with other compression processes, the use of the 8-Bit mode must be agreed separately.

**Note:** Whereas the use of the 10-bit mode is advantageous in a wholly Digital-Betacam production environment, in a mixed production environment with 8-bit compression systems, e.g. NLE-system with M-JPEG, the inbuilt rounding algorithms in the 10-bit mode leads to colour errors in programme material.

For preference, the recording should be carried out via the component-signal input (analogue or digital). The component-signal domain is to be retained during subsequent processing in order to avoid loss of quality.

3.2.6 Sound signals
The recording of the sound signals must be made in all four channels with linear quantization and, for an optimal signal-to-noise ratio, with the highest possible resolution (20-Bit).
The alignment level (997 Hz) on the Sony ZR5-1P calibration tape corresponds to:
• -11 dBr = -20 dBFS (-5 dBu),
• +9 dBr = 0 dBFS (+15 dBu).

3.2.7 Assignment of tracks
In accordance with EBU Technical Recommendation R48, the following track assignment is standardized:

<table>
<thead>
<tr>
<th></th>
<th>Mono (1)</th>
<th>Stereo</th>
<th>Two-channel (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Audio 1</td>
<td>Programme sound</td>
<td>Left</td>
<td>German programme sound</td>
</tr>
<tr>
<td>Audio 2</td>
<td>Programme sound or Int. sound</td>
<td>Right</td>
<td>Original programme sound or Audio description</td>
</tr>
<tr>
<td>Audio 3</td>
<td>International sound</td>
<td>Int. sound left or foreign language left</td>
<td>Other foreign language or Int. sound (left)</td>
</tr>
<tr>
<td>Audio 4</td>
<td>Free</td>
<td>Int. sound right or foreign language right</td>
<td>Other foreign language or Int. sound (right)</td>
</tr>
</tbody>
</table>

(1) If the same sound track assignment as for analogue Betacam (EBU R38) is preferred for Digital Betacam, then, in accordance with EBU R48, the international sound, e.g. an insert or replay in sport, may also be recorded on Track 2 at the same time (or instead of on Track 3). Should such a recording be used for international exchanges, the track assignment must be clearly marked on the label and the VTR record card.

(2) Audio description is a special case of a two-channel programme. The German programme sound with additional scenic description for partially-sighted viewers is broadcast instead of the usual other foreign-language original programme sound. Audio channels 3 and 4 can be assigned to the original programme (left/right) in German or in a foreign language. See also Para. 1.12 Audio description [Hörfilm].

3.2.8 Time-code
The time-code must be recorded on the longitudinal time-code track. The record current is to be adjusted so that an increase of 1 dB in the input level raises the replay voltage by 0.5 dB (measured with an RMS voltmeter). If an additional time-code recording is made in the vertical blanking interval (VITC), this must be recorded on lines 9, 10, 322 and 323 of the vertical blanking.

*Note: In the case of another use of these lines in the future, a new allocation will have to be made.*

3.2.9 Adhesive labels for video-tape cassettes
Adhesive labels are used on video-tape cassettes and cassette boxes. An example is shown in EBU Technical Recommendation R 81. Particular care is to be taken that there is clear identification of productions in the 16:9 format. The labels are to be stuck on the appropriate label area on the cassette (not on the edge). Additional identification in accordance with Paras. 2.9 (picture-format identification), 2.11 (VTR-tape nomenclature) and 2.12 (Information on the production chain) is strongly recommended.
3.3 D-5......................"12.65 mm (0.5 in.) Helical-scan format"

3.3.1 Recording format
International Standard IEC 61835 and DIN Standard EN 61835 set out the parameters for the "Digital-component video-tape cassette system with helical-scan recording on 12.65-mm (0.5 in) magnetic tape (D-5 format)."

Verification of the VTR machine’s record and replay chains and of the tape guidance may only be carried out with the calibration cassettes recommended by the manufacturer.

3.3.2 Unified acceptance specifications for ARD, ZDF and ORF
The video and sound specifications for acceptance and alignment procedures laid down in the "ARD/ZDF acceptance guidelines for digital VTR machines for the D-5 format" [ARD/ZDF Abnahme-Richtlinien für digitale MAZ-Maschinen des Formats D-5] must be respected.

3.3.3 Video tape
The mechanical parameters of the video-tape cassette and the characteristics of the magnetic tape must comply with the requirements of International Standard IEC 61835

In particular, care should be taken that only such tape material is used that will ensure the maintenance of an acceptable error rate.

3.3.4 Error rate
On D-5 equipment, the error rate is indicated by means of the "channel-condition indicator" on the control panel. Monitoring of the error rate is possible during replay, as well as when recording via the separate tape heads. Longer or continual illumination of the yellow lamp, or even the red lamp, indicates an excessively high error rate in the vision and/or sound channel. Illumination of the different lamps of the "channel-condition indicator" will indicate the following:

Green  Error rate in permissible range, all in order.
Yellow An increased error rate in one or more replay channels. All faults can still be corrected, but there may already be a problem.
Red    (For video and audio separately) Equipment and/or tape must be checked. Inform maintenance service

In addition, on the D-5 equipment, it is possible to call up separately, on the control panel, a bar display of the error rate in the vision and sound channels. With this it is possible to make an accurate analysis of the actual situation at any one time. Moreover, with an "ID card" and the "ERROR LOGGER" function an error list can be called up. Here, at any one time, the last (or first) 50 events that have caused the illumination of the red lamp are registered with their respective time-code figures.

General comments on the error-rate indication are given in Para. 2.10.11.

3.3.5 Vision signals
All vision signals routed via the PAL, the analogue-component and the serial digital-component inputs must be recorded so that, when replayed on a machine complying with the specifications, the permissible error rate is not exceeded.

For preference, the recording should be carried out via the component-signal input (analogue or digital). The component-signal domain is to be retained during subsequent processing in order to avoid loss of quality.

In general, recordings are made in the 10-Bit mode. In exceptional cases the use of the 8-Bit mode must be agreed separately.
a) **Vision signals in the 4:3 picture format**

All vision signals in the 4:3 picture format must be recorded in the standard mode with a sampling rate of 13.5 MHz.

b) **Vision signals in the 16:9 picture format**

All vision signals in the 16:9 picture format must be recorded in the standard mode with a sampling rate of 13.5 MHz. For programme exchange, only recordings in this mode are permissible. Should the optional mode with a sampling rate of 18 MHz be used for particular productions in the 16:9 format, this should be specifically agreed with the customer. See also Para. 2.1.3 b) of these guidelines.

### 3.3.6 Sound signals

The recording of the sound signals must be made in all four channels with linear quantization and, for an optimal signal-to-noise ratio, with the highest possible resolution (20-bit). The alignment level (997 Hz) on the Panasonic VFM 5180 JR calibration tape corresponds to:

-9 dBr = -18 dBFS (-3 dBu).

### 3.3.7 Assignment of tracks

In accordance with EBU Technical Recommendation R48, the following track assignment is standardized:

<table>
<thead>
<tr>
<th>AudioClip</th>
<th>Mono (1)</th>
<th>Stereo</th>
<th>Two-channel (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Audio 1</td>
<td>Programme sound</td>
<td>Left</td>
<td>German programme sound</td>
</tr>
<tr>
<td>Audio 2</td>
<td>Programme sound or Int. sound</td>
<td>Right</td>
<td>Original programme sound or Audio description</td>
</tr>
<tr>
<td>Audio 3</td>
<td>International sound</td>
<td>Int. sound left or foreign language left</td>
<td>Other foreign language or Int. sound (left)</td>
</tr>
<tr>
<td>Audio 4</td>
<td>Free</td>
<td>Int. sound right or foreign language right</td>
<td>Other foreign language or Int. sound (right)</td>
</tr>
</tbody>
</table>

(1) In accordance with the possibility set out in EBU Recommendation R48 of a modified track assignment for international sound, the same track assignment is authorized for the D-5 format. Thus, the international sound, e.g. an insert or replay in sport, may also be recorded on Track 2 at the same time (or instead of on Track 3). Should such a recording be used for international exchanges, the track assignment must be clearly marked on the label and the VTR record card.

(2) Audio description is a special case of a two-channel programme. The German programme sound with additional scenic description for partially-sighted viewers is broadcast instead of the usual other foreign-language original programme sound. Audio channels 3 and 4 can be assigned to the original programme (left/right) in German or in a foreign language. See also Para. 1.12 Audio description [Hörfilm].

#### 3.3.8 Time-code

The time-code must be recorded on the longitudinal time-code track. The record current is to be adjusted so that an increase of 1 dB in the input level raises the replay voltage by 0.5 dB (measured with an RMS voltmeter).

If an additional time-code recording is made in the vertical blanking interval (VITC), this must be recorded on lines 9, 10, 322 and 323 of the vertical blanking.

*Note: In the case of another use of these lines in the future, a new allocation will have to be made*
3.3.9 Adhesive labels for video-tape cassettes

Adhesive labels are used on video-tape cassettes and cassette boxes. An example is shown in EBU Technical Recommendation R 81. Particular care is to be taken that there is clear identification of productions in the 16:9 format. Should a production in the 16:9 picture format be recorded in the new mode with a sampling rate of 18 MHz, this must be clearly indicated. The labels are to be stuck on the appropriate label area on the cassette (not on the edge). Additional identification in accordance with Paras. 2.9 (picture-format identification), 2.11 (VTR-tape nomenclature) and 2.12 (Information on the production chain) is strongly recommended.

3.4 DVCPro............."6.35 mm - Helical-scan format D-7"  

3.4.1 Recording format  
International Standard IEC 62071 and DIN Standard EN 62071 set out the parameters for the "Video-cassette system with compressed digital helical-scan recording on 6.35 mm magnetic tape (D-7 format)."

Verification of the VTR machine's record and replay chains and of the tape guidance may only be carried out with the calibration cassettes recommended by the manufacturer.

3.4.2 Unified acceptance specifications for ARD, ZDF and ORF  
The video and sound specifications for acceptance and alignment procedures laid down in the "ARD/ZDF acceptance guidelines for DVCPro" [ARD/ZDF DVCPro- Abnahme-Richtlinien] for 25 Mbit/s operation must be respected.

3.4.3 Video tape  
The mechanical parameters of the video-tape cassette and the characteristics of the magnetic tape must comply with the requirements of International Standard IEC 62071.

In particular, care should be taken that only such tape material is used that will ensure the maintenance of an acceptable error rate.

3.4.4 Error rate  
On DVCPro equipment, the error rate is indicated by means of the "channel-condition indicator" on the control panel. Longer or continual illumination of the yellow lamp, or even the red lamp, indicates an excessively high error rate in the vision and/or sound channel. Illumination of the different lamps of the "channel-condition indicator" will indicate the following:

Green Error rate in permissible range, all in order.

Yellow An increased error rate in one or more replay channels. It may no longer be possible to correct all faults and there is a problem.

Red Equipment and/or tape must be checked. Inform maintenance service.

In addition, on the DVCPro equipment, it is possible, on the control panel, to switch in the service mode of the audio display to a bar display of the actual error rate. With this it is possible to make an accurate analysis of the actual situation in the individual recording channels at any one time. The "ARD/ZDF acceptance guidelines for DVCPro" [ARD/ZDF DVCPro-Abnahme-Richtlinien] give a corresponding error-rate assignment for the audio display. General comments on the error-rate indication are given in Para. 2.10.11.
3.4.5 Recording of vision, sound and data via the SDTI interface
Programme material recorded in the compressed and packaged data domain via the SDTI interface must comply with the following specifications:

a) The picture material must be contained in the DV-based data structure in accordance with SMPTE 314M (for 625/50 systems with a 4:1:1 image-sampling structure and 25 Mbit/s data rate) as well as being coded with the compression algorithm specified in IEC 61834-1 and 61834-2.

b) The format of the DV-based data stream (compressed video, audio and data) must comply with the specifications in SMPTE 321M.

3.4.6 Vision signals
All vision signals routed via the PAL, the analogue-component, the serial digital-component input (SDI) and the serial data transport interface (SDTI) must be recorded so that, when replayed on a machine complying with the specifications, the permissible error rate is not exceeded.

For preference, the recording should be carried out via the digital interfaces. The digital-signal domain is to be retained during subsequent processing in order to avoid unnecessary loss of quality. The SDTI interface is to be used for preference for straightforward transfer operations.

3.4.7 Sound signals
The recording of the sound signals must be made in both channels with linear quantization and, for an optimal signal-to-noise ratio, with the highest possible resolution (16-bit). The alignment level (997 Hz) on the Panasonic VFM 3680KM calibration tape corresponds to: -18 dBFS (-3 dBu).

3.4.8 Assignment of tracks
In accordance with EBU Technical Recommendation R48, the following track assignment is standardized:

<table>
<thead>
<tr>
<th>Audio 1</th>
<th>Mono (1)</th>
<th>Stereo</th>
<th>Two channel (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programme sound</td>
<td>Left</td>
<td>German programme sound</td>
<td></td>
</tr>
<tr>
<td>Audio 2</td>
<td>Programme sound or Int. sound</td>
<td>Right</td>
<td>Original programme sound or Audio description</td>
</tr>
<tr>
<td>Cue</td>
<td>Free available</td>
<td>Free available</td>
<td>Free available</td>
</tr>
</tbody>
</table>

(1) In accordance with EBU R48 an available international sound, e.g. an insert or replay in sport, is recorded on Audio 2.
(2) Audio description is a special case of a two-channel programme. The German programme sound with additional scenic description for partially-sighted viewers is broadcast instead of the usual other foreign-language original programme sound.

See also Para. 1.12 Audio description [Hörfilm].

3.4.9 Time-code
In the D-7 format, there is no longitudinal recording track for the LTC (Linear Time Code). The LTC is recorded in the sub-code region of the digital data stream in which the sub-code data are combined with each frame. The VITC, however, is recorded in the VAUX region (auxiliary video data), which is included with the compressed video data.

If an additional time-code recording is made in the vertical blanking interval (VITC), this must be recorded on lines 9, 10, 322 and 323 of the vertical blanking.
Note: In the case of another use of these lines in the future, a new allocation will have to be made.

3.4.10 Adhesive labels for video-tape cassettes

Adhesive labels are used on video-tape cassettes and cassette boxes. An example is shown in EBU Technical Recommendation R 81. The small size of the DVCPRO video-tape cassettes and their containers call for special labels and storage containers (for archiving). The small versions of the labels are to be stuck on the label area on the cassette (not on the edge) and the larger versions on the storage containers. Particular care is to be taken that there is clear identification of productions in the 16:9 format. Additional identification in accordance with Paras. 2.9 (picture-format identification), 2.11 (VTR-tape nomenclature) and 2.12 (Information on the production chain) is strongly recommended.

Note: Multiple labelling, i.e. sticking new labels over old labels, is to be avoided.

3.5 Betacam SX............"12.65 mm (0.5 in.) Helical-scan format Betacam SX"

3.5.1 Recording format

An IEC Standard for this format is not yet available. Verification of the parameters for the "Digital-component video-tape cassette system with helical-scan recording of digital component on 12.65-mm magnetic tape with data compression (Betacam SX format)" can only be carried out in accordance with the system manufacturer's specifications.

Verification of the VTR machine's record and replay chains and of the tape guidance may only be carried out with the calibration cassettes recommended by the manufacturer.

3.5.2 Acceptance specifications

There are no unified ARD-ZDF-ORF acceptance guidelines for this recording format. Consequently, only compliance with the manufacturer's vision and sound specifications for acceptance and alignment procedures can be recommended.

3.5.3 Video tape

The mechanical parameters of the video-tape cassette and the characteristics of the magnetic tape for recording must comply with the requirements of the manufacturer's specifications.

In particular, care should be taken that only such tape material is used that will ensure the maintenance of an acceptable error rate.

3.5.4 Error rate

On Betacam SX equipment, the error rate is indicated by means of the "channel-condition indicator" on the front panel. Longer or continual illumination of the yellow lamp, or even the red lamp, indicates an excessively high error rate in the vision and/or sound channel. Illumination of the different lamps of the "channel-condition indicator" will indicate the following:

Green Error rate in permissible range, all in order.
Yellow An increased error rate in one or more replay channels. It may no longer be possible to correct all faults and there is a problem.
Red Equipment and/or tape must be checked. Inform maintenance service.

In addition, with Betacam SX equipment an error-rate indication can be obtained by selection on the preview monitor. Separate indications are given here for video and audio.

General comments on the error-rate indication are given in Para. 2.10.11.
3.5.5 Vision signals

All vision signals routed via the PAL, the analogue-component and the serial digital-component inputs must be recorded so that, when replayed on a machine complying with the specifications, the permissible error rate is not exceeded.

For preference, the recording should be carried out via the component-signal input (analogue or digital). The component-signal domain is to be retained during subsequent processing in order to avoid loss of quality.

3.5.6 Sound signals

The recording of the sound signals must be made in all four channels with linear quantization and, for an optimal signal-to-noise ratio, with the highest possible resolution (16-bit). The alignment level (997 Hz) on the Sony SRS-1P calibration tape corresponds to:

\[ +9 \text{ dB} = 0 \text{ dBFS} (+15 \text{ dBu}). \]

3.5.7 Assignment of tracks

In accordance with EBU Technical Recommendation R48, the following track assignment is standardized:

<table>
<thead>
<tr>
<th>Mono (1)</th>
<th>Stereo</th>
<th>Two-channel (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Audio 1: Programme sound</td>
<td>Left</td>
<td>German programme sound</td>
</tr>
<tr>
<td>Audio 2: Programme sound or Int. sound</td>
<td>Right</td>
<td>Original programme sound or Audio description</td>
</tr>
<tr>
<td>Audio 3: International sound</td>
<td>Int. sound left or foreign language left</td>
<td>Other foreign language or Int. sound (left)</td>
</tr>
<tr>
<td>Audio 4: Free</td>
<td>Int. sound right or foreign language right</td>
<td>Other foreign language or Int. sound (right)</td>
</tr>
</tbody>
</table>

(1) In accordance with the possibility set out in EBU Technical Recommendation R48 of a modified track assignment for international sound, the same track assignment is authorized for the Betacam SX format. Thus, the international sound, e.g. an insert or replay in sport, may also be recorded on Track 2 at the same time (or instead of on Track 3). Should such a recording be used for international exchanges, the track assignment must be clearly marked on the label and the VTR record card.

(2) Audio description is a special case of a two-channel programme. The German programme sound with additional scenic description for partially-sighted viewers is broadcast instead of the usual other foreign-language original programme sound. Audio channels 3 and 4 can be assigned to the original programme (left/right) in German or in a foreign language. See also Para. 1.12 Audio description [Hörfilm].

3.5.8 Time-code

The time-code must be recorded on the longitudinal time-code track. The record current is to be adjusted so that an increase of 1 dB in the input level raises the replay voltage by 0.5 dB (measured with an RMS voltmeter).

If an additional time-code recording is made in the vertical blanking interval (VITC), this must be recorded on lines 9, 10, 322 and 323 of the vertical blanking.

*Note: In the case of another use of these lines in the future, a new allocation will have to be made.*
3.5.9 Adhesive labels for video-tape cassettes

Adhesive labels are used on video-tape cassettes and cassette boxes. An example is shown in EBU Technical Recommendation R 81. Particular care is to be taken that there is clear identification of productions in the 16:9 format.

The labels are to be stuck on the appropriate label area on the cassette (not on the edge). Additional identification in accordance with Paras. 2.9 (picture-format identification), 2.11 (VTR-tape nomenclature) and 2.12 (Information on the production chain) is strongly recommended.

3.6 DVCPRO50.............."6.3 mm - Helical-scan format D-7"

3.6.1 Recording format

International Standard IEC 62071 sets out the parameters for the "Video-cassette system with compressed digital helical-scan recording on 6.35 mm magnetic tape - D-7 format".

Verification of the VTR machine's record and replay chains and of the tape guidance may only be carried out with the calibration cassettes recommended by the manufacturer.

3.6.2 Unified acceptance specifications for ARD, ZDF and ORF

The video and sound specifications for acceptance and alignment procedures laid down in the "ARD/ZDF acceptance guidelines for DVCPRO" [ARD/ZDF DVCPRO-Abnahme-Richtlinien] for 50 Mbit/s operation must be respected.

3.6.3 Video tape

The mechanical parameters of the video-tape cassette and the characteristics of the magnetic tape for recording must comply with the requirements of International Standard IEC 62071.

In particular, care should be taken that only such tape material is used that will ensure the maintenance of an acceptable error rate.

3.6.4 Error rate

On DVCPRO50 equipment, the error rate is indicated by means of the "channel-condition indicator" on the control panel. Longer or continual illumination of the yellow lamp, or even the red lamp, indicates an excessively high error rate in the vision and/or sound channel. Illumination of the different lamps of the "channel-condition indicator" will indicate the following:

Green Error rate in permissible range, all in order.

Yellow An increased error rate in one or more replay channels. It may no longer be possible to correct all faults and there is a problem.

Red Equipment and/or tape must be checked. Inform maintenance service.

In addition, on the DVCPRO equipment, it is possible, on the control panel, to switch in the service mode of the audio display to a bar display of the actual error rate. With this it is possible to make an accurate analysis of the actual situation in the individual recording channels at any one time. The "ARD/ZDF acceptance guidelines for DVCPRO" [ARD/ZDF DVCPRO-Abnahme-Richtlinien] give a corresponding error-rate assignment for the audio display. General comments on the error-rate indication are given in Para. 2.10.11.

3.6.5 Recording of vision, sound and data via the SDTI interface

Programme material recorded in the compressed and packaged data domain via the SDTI interface must comply with the following specifications:

a) The picture material must be contained in the DV-based data structure in accordance with SMPTE 314M (for 625/50 systems with a 4:2:2 image-sampling structure and 50 Mbit/s
data rate) as well as being coded with the compression algorithm specified in IEC 61834-1 and 61834-2.

b) The format of the DV-based data stream (compressed video, audio and data) must comply with the specifications in SMPTE 321M.

3.6.6 Vision signals
All vision signals routed via the PAL, the analogue-component, the serial digital-component input (SDI) and the serial data transport interface (SDTI) must be recorded so that, when replayed on a machine complying with the specifications, the permissible error rate is not exceeded.

For preference, the recording should be carried out via the digital interfaces. The digital-signal domain is to be retained during subsequent processing in order to avoid unnecessary loss of quality. The SDTI interface is to be used for preference for straightforward transfer operations.

3.6.7 Sound signals
The recording of the sound signals must be made in all four channels with linear quantization and, for an optimal signal-to-noise ratio, with the highest possible resolution (16-bit).

The alignment level (997 Hz) on the Panasonic VFM 3480KM calibration tape corresponds to:
-18 dBFS (-3 dBu).

3.6.8 Assignment of tracks
In accordance with EBU Technical Recommendation R48, the following track assignment is standardized:

<table>
<thead>
<tr>
<th>Track</th>
<th>Mono (1)</th>
<th>Stereo</th>
<th>Two-channel (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Audio 1</td>
<td>Programme sound</td>
<td>Left</td>
<td>German programme sound</td>
</tr>
<tr>
<td>Audio 2</td>
<td>Programme sound or Int. sound</td>
<td>Right</td>
<td>Original programme sound or Audio description</td>
</tr>
<tr>
<td>Audio 3</td>
<td>International sound</td>
<td>Int. sound left or foreign language left</td>
<td>Other foreign language or Int. sound left</td>
</tr>
<tr>
<td>Audio 4</td>
<td>Free</td>
<td>Int. sound right or foreign language right</td>
<td>Other foreign language or Int. sound right</td>
</tr>
<tr>
<td>Cue</td>
<td>Free available</td>
<td>Free available</td>
<td>Free available</td>
</tr>
</tbody>
</table>

(1) In accordance with the possibility set out in EBU Technical Recommendation R48 of a modified track assignment for international sound, the same track assignment is authorized for the DVCPRO50 format. Thus, the international sound, e.g. an insert or replay in sport, may also be recorded on Track 2 at the same time (or instead of on Track 3). Should such a recording be used for international exchanges, the track assignment must be clearly marked on the label and the VTR record card.

(2) Audio description is a special case of a two-channel programme. The German programme sound with additional scenic description for partially-sighted viewers is broadcast instead of the usual other foreign-language original programme sound.

Audio channels 3 and 4 can be assigned to the original programme (left/right) in German or in a foreign language. See also Para. 1.12 Audio description [Hörfilm].

3.6.9 Time-code
In the D-7 format, there is no longitudinal recording track for the LTC (Linear Time Code). The LTC is recorded in the sub-code region of the digital data stream in which the sub-code data are combined with each frame. The VITC, however, is recorded in the VAUX region (auxiliary video data), which is included with the compressed video data.
If an additional time-code recording is made in the vertical blanking interval (VITC), this must be recorded on lines 9, 10, 322 and 323 of the vertical blanking.

*Note: In the case of another use of these lines in the future, a new allocation will have to be made.*

### 3.6.10 Adhesive labels for video-tape cassettes

Adhesive labels are used on video-tape cassettes and cassette boxes. An example is shown in EBU Technical Recommendation R 81. The small size of the DVCPRO video-tape cassettes and their containers call for special labels and storage containers (forarchiving). The small versions of the labels are to be stuck on the label area on the cassette (not on the edge) and the larger versions on the storage containers. Particular care is to be taken that there is clear identification of productions in the 16:9 format. Additional identification in accordance with Paras. 2.9 (picture-format identification), 2.11 (VTR-tape nomenclature) and 2.12 (Information on the production chain) is strongly recommended.

*Note: Multiple labelling, i.e. sticking new labels over old labels, is to be avoided.*

### 3.7 IMX "12.65 mm (0.5 in.) Helical-scan format D-10"

#### 3.7.1 Recording format

SMPTE Standard 365M and International Standard IEC 62289 (still in preparation) set out the parameters for the "Helical-scan digital video cassette recording format using 12.65 mm magnetic tape and incorporating MPEG-2 compression - Format D-10".

Verification of the VTR machine's record and replay chains and of the tape guidance may only be carried out with the calibration cassettes recommended by the manufacturer.

#### 3.7.2 Unified acceptance specifications for ARD, ZDF and ORF

The video and sound specifications for acceptance and alignment procedures laid down in the "ARD-ZDF-ORF-SRG (tpc) acceptance guidelines for IMX" [ARD-ZDF-ORF-SRG (tpc) IMX-Abnahme-Richtlinien] must be respected.

#### 3.7.3 Video tape

The mechanical parameters of the video-tape cassette and the characteristics of the magnetic tape for recording must comply with the requirements of the specifications in SMPTE Standard 365M and International Standard IEC 62289.

In particular, care should be taken that only such tape material is used that will ensure the maintenance of an acceptable error rate.

#### 3.7.4 Error rate

On IMX equipment, the error rate is indicated by means of the "channel-condition indicator" on the front panel. It is generally possible to monitor the error rate during recording and replay. Longer or continual illumination of the yellow lamp, or even the red lamp, indicates an excessively high error rate in the vision and/or sound channel. Illumination of the different lamps of the "channel-condition indicator" will indicate the following:

- **Green** Error rate in permissible range, all in order.
- **Yellow** An increased error rate in one or more replay channels. It may no longer be possible to correct all faults and there is a problem.
- **Red** Equipment and/or tape must be checked. Inform maintenance service.

In addition, with IMX equipment an error-rate indication can be obtained by selection on the preview monitor. Separate indications are given here for video and audio. Moreover, with the
"ERROR LOGGER" function an error list can be displayed on the preview monitor. Here, at any one time, the last 99 events that have caused the illumination of the red lamp are registered with their respective time-code figures and the relevant date and time.

General comments on the error-rate indication are given in Para. 2.10.11.

### 3.7.5 Recording of vision, sound and data via the SDTI interface

Programme material recorded in the compressed and packaged data domain via the SDTI interface must comply with the requirements of EBU Technical Statement D94. These include, amongst others, the following standards:

a) The MPEG-2 video elementary stream must comply with the compression limits and the bitstream characteristic in accordance with the specifications in SMPTE 356M, with a maximum data rate of 50 Mbit/s.

b) The format of this data stream (compressed video, audio and data) must comply with the specifications in SMPTE 326M.

### 3.7.6 Vision signals

All vision signals routed via the PAL, the analogue-component, the serial digital-component input (SDI) and the serial data transport interface (SDTI) must be recorded so that, when replayed on a machine complying with the specifications, the permissible error rate is not exceeded.

For preference, the recording should be carried out via the digital interfaces. The digital-signal domain is to be retained during subsequent processing in order to avoid unnecessary loss of quality. The SDTI interface is to be used for preference for straightforward transfer operations.

### 3.7.7 Sound signals

The recording of the sound signals must be made in all eight channels with linear quantization and, for an optimal signal-to-noise ratio, with the highest possible resolution (16-bit). The alignment level (997 Hz) on the Sony MR5-1P calibration tape corresponds to: -20 dBFS (-5 dBu).

### 3.7.8 Audio mode of operation

The "eight-channel" (8CH / 16bit) audio mode of operation is individually specified for transmission tapes.

Variations from the eight-channel audio mode of operation are only permitted for recordings that are not intended for transmission or for programme exchange. Therefore, the use of the four-channel audio mode of operation (4CH / 24 bit) for studio productions is to be agreed with each customer.

### 3.7.9 Assignment of tracks for the "eight-channel audio mode of operation (8CH / 16bit)

Because of the multiplicity of possible variants, it is not proposed at present to provide, as an aid to the practical utilisation, a compilation of the assignment of tracks for the different requirements of studio production. Consequently, the track assignment to be used for studio production is to be agreed with each customer.

*Note:* See next page for table of track assignment.
The track assignment for transmission tapes is standardized as follows:

<table>
<thead>
<tr>
<th>Audio</th>
<th>Mono (1)</th>
<th>Stereo</th>
<th>Two-channel (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Audio 1</td>
<td>Programme sound</td>
<td>Left</td>
<td>German programme sound</td>
</tr>
<tr>
<td>Audio 2</td>
<td>Programme sound or Int. sound</td>
<td>Right</td>
<td>Original programme sound or Audio description</td>
</tr>
<tr>
<td>Audio 3</td>
<td>International sound</td>
<td>Int. sound left or foreign language left</td>
<td>Other foreign language or Int. sound (left)</td>
</tr>
<tr>
<td>Audio 4</td>
<td>Free</td>
<td>Int. sound right or foreign language right</td>
<td>Other foreign language or Int. sound (right)</td>
</tr>
<tr>
<td>Audio 5</td>
<td>Free available, e.g. Cue (3)</td>
<td>Free available, e.g. Cue (3)</td>
<td>Free available, e.g. Cue (3)</td>
</tr>
<tr>
<td>Audio 6</td>
<td>Free available, e.g. Cue (3)</td>
<td>Free available, e.g. Cue (3)</td>
<td>Free available, e.g. Cue (3)</td>
</tr>
<tr>
<td>Audio 7</td>
<td>Free available now, eventually Metadata (4)</td>
<td>Free available now, eventually Metadata (4)</td>
<td>Free available now, eventually Metadata (4)</td>
</tr>
<tr>
<td>Audio 8</td>
<td>Free available now, eventually Metadata (4)</td>
<td>Free available now, eventually Metadata (4)</td>
<td>Free available now, eventually Metadata (4)</td>
</tr>
</tbody>
</table>

(1) In accordance with the possibility set out in EBU Technical Recommendation R48 of a modified track assignment for international sound, the same track assignment is authorized for the D-10 (MPEG IMX) format. Thus, the international sound, e.g. an insert or replay in sport, may also be recorded on Track 2 at the same time (or instead of on Track 3). Should such a recording be used for international exchanges, the track assignment must be clearly marked on the label and the VTR record card.

(2) Audio description is a special case of a two-channel programme. The German programme sound with additional scenic description for partially-sighted viewers is broadcast instead of the usual other foreign-language original programme sound. Audio channels 3 and 4 can be assigned to the original programme (left/right) in German or in a foreign language. See also Para.1.12 Audio description [Hörfilm].

(3) Because of (4) a planned in-house specification of Cue should be made on Audio 5 and Audio 6 (for which an AES/EBU pairing must be sacrificed!), e.g. for a guide or end cue.

(4) Audio tracks 7 and 8 should be used for the recording of Metadata in the future. It is therefore recommended that Audio 7 and Audio 8 be kept free for this purpose.

3.7.10 Time-code
The time-code must be recorded on the longitudinal time-code track. The record current is to be adjusted so that an increase of 1 dB in the input level raises the replay voltage by 0.5 dB (measured with an RMS voltmeter).
If an additional time-code recording is made in the vertical blanking interval (VITC), this must be recorded on lines 9, 10, 322 and 323 of the vertical blanking.

Note: In the case of another use of these lines in the future, a new allocation will have to be made.
3.7.11 Adhesive labels for video-tape cassettes

Adhesive labels are used on video-tape cassettes and cassette boxes. An example is shown in EBU Technical Recommendation R 81. Particular care is to be taken that there is clear identification of productions in the 16:9 format. The labels are to be stuck on the appropriate label area on the cassette (not on the edge). Additional identification in accordance with Paras. 2.9 (picture-format identification), 2.11 (VTR-tape nomenclature) and 2.12 (information on the production chain) is strongly recommended.
4. **Television production on tape-less systems**

Systems for the production of television programmes with transparent processing throughout offer the best possible picture quality and facilitate the greatest degree of freedom in the post-production operations in television production. Transparent systems lead to processing exclusively in the digital studio format DSK270 in accordance with ITU-R Recommendation BT.601, therefore without data reduction.

In practice, however, most tape-less systems for the production of television programmes operate with data reduction, that is to say that the source material is recorded on disk after going through a bit-rate reduction process (compression).

In each case of on-line working with tape-less systems, consideration should be given to the following points:

- Transparent systems can be used in an SDI infrastructure for all television productions.
- Transparent systems are recommended for the production of synthetically generated pictures in a graphics area.
- Systems with data reduction should be used only in a native area, i.e. where all production equipment in this environment works with the same compression family. It is only in this way that it can be guaranteed that copying and transfer processes in the compressed and packaged data domain take place without re-coding and thus without loss of picture quality, as well as without additional loss of time.
- In general, re-codings are to be avoided as far as possible, in preference, only in post-production processing, e.g. for super-impositions, insertion of captions, etc., should the programme items be subjected to re-coding. It is advantageous to make hard cuts in the compressed and packaged data domain.

4.1 **EBU Recommendation for internal signal processing**

EBU Technical Statement D80 "Compression in Television Programme Production" contains definitive statements concerning suitable signal processing systems for television production.

a) **High-end - Programme production**

- Systems without video compression which operate with uncompressed DSK270 signals complying with ITU-R Recommendation BT.601;
- Systems that work with lossless compression; or
- Systems which use a lossy DCT-based compression with a compression factor of two or less.

b) **Mainstream - Programme production and programme acquisition**

- It is possible to employ compression formats with low bit-rates, which bring operational advantages in this area.
- Only a single standardized compression algorithm may be used for storage or file transfer applications.
- The system used should work with a data rate of 50 Mbit/s and an I-frame only format.

4.1.1 **EBU Recommendation for video-compression system (data-reduction method)**

EBU Technical Statement D80 identifies the need for an uniform, open video-compression algorithm throughout for storage and data transfer in television programme production. The EBU is of the opinion that a compression algorithm, which works with an I-frame only format and 50 Mbit/s, ensures both a satisfactory picture quality as well as an appropriately large "headroom" for post-production activities in the mainstream area.

On the basis of the conclusions of the EBU/SMPTE Task Force the EBU accepts that two compression families, DV-based (in accordance with SMPTE 314M) and MPEG-2 4:2:2P@ML
(in accordance with EBU Technical statement D94 and SMPTE 356M) are suitable for this purpose. Both make use of intra-frame coding with a bit-rate of 50 Mbit/s.

**Note:** EBU Technical Statement D82 "M-JPEG in Future Networked Television Production" stresses particularly that the M-JPEG compression family is not suitable for future networked television production. It specifies that either DV-based compression or MPEG-2 4:2:2P@ML should be used for future networked television production.

### 4.2 Authorized signal-processing formats for ARD, ZDF and ORF

In agreement with the recommendations of the EBU and by the decision of the Chief Engineers of the Television Services, only the following signal-processing formats are authorized:

- The transparent format DSK270 in accordance with ITU-R Recommendation BT.601,
- The DV-based compression format in accordance with SMPTE 314M, and
- The MPEG-2 4:2:2P@ML compression format in accordance with EBU Technical Statement D94 and SMPTE 356M.

**Note:** EBU D94 specifies the compression format MPEG-2 4:2:2P@ML, 50 Mbit/s, I-frame, with a coding range of 608 lines (according to the IMX implementation).

On the basis of EBU Technical Statement D80 (see Para. 4.1.1), the following systems are recommended for the different areas of tape-less television production:

#### a) High-end production

The transparent system DSK270 should be employed in this area.

#### b) Mainstream

Both the DV-based and the MPEG-2 4:2:2P@ML (EBU D94) compression formats, each with a data rate of 50Mbit/s, can be employed additionally in this area.

#### c) News/Current Affairs

In this area, the DV-based compression format with a data-rate of 25Mbit/s can also be used.

The use of other (lower quality) compression formats is to be avoided as far as possible and must be agreed with the customer in each case.

**Note:** In order to facilitate an economic migration towards the new uniform compression systems, programme material may still, after agreement with the customer, also be produced during a transitional period using tape-less systems that work with the M-JPEG compression. If productions are made using tape-less on-line systems with the M-JPEG compression, the processing system to be used is to be agreed with the customer in each case. In particular, the definition and utilization of variable reduction factors or picture-quality grades calls for detailed consultation.

### 4.2.1 Special case of off-line working

If tape-less off-line systems are used for the production of television programmes, the format of the EDL (edit decision list) is to be agreed between the customer and the contractor. Care must be taken that the appropriate version used each time is compatible with the subsequent on-line processing system.

The exchange of programme material, including the necessary editing and animation data for a composition, by means of the file formats MXF or AAF (OMF during a transitional period), must be agreed between the customer and the contractor.

**Note:** The MXF file format is currently standardized by the SMPTE (SMPTE 377M). The AAF file format is at present being developed through the "Advanced Authoring Association".
4.3 Vision signal processing

In principle, for the production of television programmes using tape-less systems, the common conditions relating to vision signal processing (Part 1 and Part 2 of these Guidelines) must be respected. In particular, the following points are to be taken into account:

- Operation at 25 frames per second,
- Scanning raster and internal processing raster for the vision signal (see Annex 8.1, transmitted picture area) of 576 lines by 720 picture elements (pixels), see Para. 2.1.11,
- Support of the 4:3 picture format and the 16:9 picture format for viewing and processing,
- Possibility of a correct PAL encoding, see Paras. 2.1.9 and 2.1.10.

4.4 Sound signal processing

In principle, for the production of television programmes using tape-less systems, the common conditions relating to sound signal processing (Part 1 and Para. 2.3 of these Guidelines) must be respected. In particular, the following points are to be taken into account:

- The on-line processing of audio signals using tape-less processing systems must be carried out with linear resolution (bit-transparency) dependent on a working range of 16 to 24 Bits and a sampling rate of 48 kHz.
- Source material with another sampling rate, e.g. 44.1 kHz, must be converted to the 48 kHz sampling rate.

4.5 Transfer of programme material from tape-less systems

4.5.1 Transfer on to video tape

When working with transparent systems, the finished programme must be transferred on to the production tape in the DSK270 domain via an SDI.

When working with systems with data reduction, the finished programme should preferably be transferred on to the production tape in native form (compressed data, without additional recoding) via a data-transparent interface, e.g. SDTI.

In the transitional period mentioned in Para. 4.2, the finished programme from a 50 Mbit/s processing system can be transferred via SDI on to a production tape, e.g. Digital Betacam.

In the transitional period mentioned in Para. 4.2, when working with M-JPEG systems, the finished programme must be transferred on the production tape via an SDI.

For the transfer of sound signals on to the production tape, use is preferably to be made of AES/EBU digital sound connections, SDI with embedded audio or SDTI.

As explained in Para.1.7, it is necessary to have, on the VTR record card accompanying the production tape, additional information about the production chain of the programme material produced as well as the equipment involved, e.g.:

- Acquisition format,
- Post-production processing systems involved,
- Data-reduction method (compression method) used,
- Reduction factors or data rates utilized,
- Interfaces used for the transfer.

The production tape must also have a technical leader in accordance with Para. 2.5.

4.5.2 Transfer by means of data file

For the exchange of programme material between items of equipment involved in a production, the MXF format (currently still being standardized, SMPTE 377M) is specified. In this connection, there are also corresponding requirements to be agreed, relating to:

- The signal processing format, see Para.4.2;
- The exchange of Metadata, see Paras. 1.7, 1.13 and Part 7.;
- The structure (operational pattern) of MXF.
In addition, the exchange of all the editing and animation data required for a production (composition) as well as relevant Metadata, must be supported with the AAF file format.

Note: In order to facilitate a corresponding migration towards the new uniform file formats MXF and AAF, it is still also possible, after agreement with the customer, to make use of the open file formats on a wider basis, like OMF, AVI, GXF (SMPTE 360M) or DIF.

4.6 File format for programme exchange over networks

For programme exchange over network connections, the MXF format (currently still being standardized, SMPTE 377M) is specified. In this connection, there are also corresponding requirements to be agreed, relating to:

- The signal processing format, see Para. 4.2;
- The exchange of Metadata, see Para. 1.13 and Part 7;
- The structure (operational pattern) of MXF.

In addition, the exchange of all the editing and animation data required for a production (composition) as well as relevant Metadata, must be supported with the AAF file format.

4.7 Exchange of graphics material

The format for the exchange of graphics material and graphics sequences, e.g. TIFF, BMP, JPEG, etc., is to be agreed between customer and contractor.

4.8 Exchange of Internet streaming formats

For the exchange of Internet streaming formats, e.g. Real-Video, Quicktime, etc., the respective format, including the compression parameters applied, is to be agreed between the customer and the contractor.

4.9 Exchange of LowRes (Browsing) material

For the exchange of LowRes material, e.g. MPEG-1, MPEG-2, etc., the respective format is to be agreed between the customer and the contractor.

4.10 Exchange of audio material

For the exchange of audio material, the format is to be agreed between the customer and the contractor, e.g. MXF (SMPTE 377M), AAF, BWF (EBU N22), OMF, etc.

4.11 Exchange of Metadata

Appropriate specifications for ARD, ZDF and ORF are currently being prepared. The bases for the exchange are given in Part 7 "Metadata" of these Guidelines.

Until a definitive specification is available for the exchange of Metadata relevant to a production, the content and the format is to be agreed between the customer and the contractor.
5. Television production on Film

5.1 Technical requirements for the transfer from film to the video domain

In television production on film, particular care is to be taken that, after a transfer of programme material from film to video, a suitable version for television is available.

For further on-line processing in the video domain, all important vision quality parameters must be maintained by pre-correction in the scanning and carried through in the video domain. The range of the film characteristics should be scanned in such a way that the optimal parameters are maintained for the video modulation in making the video master. In principle, it must also still be possible to correct the transferred content in the video domain. Therefore, particular care is to be taken that no white-level clipping or any black-level crushing occurs.

A comparative assessment of the video master is only guaranteed when the alignment of the picture monitor complies with Technical Guideline No.8 R 7 "Guideline for an uniform television picture display" [Richtlinie für eine einheitliche Fernsehbildwiedergabe]. Then, only with a monitor aligned in accordance with this Guideline and the viewing conditions specified therein can the correct alignment of the film scanner be checked in accordance with the recommendation in EBU Tech. 3218 (Colour Telecines - Methods of measurement and Specifications).

5.2 General

Television films are shot and replayed at 25 frames/s. Feature films from cinema production, which have been shot at 24 frames/s, are also scanned at 25 frames/s (4 % faster). The possibility of replaying a production on film that deviates from this standard must be verified in each individual case with the appropriate authority.

The film scanning must be carried out with a fixed relationship between the film frame and Field 1 of the television signal, in such a way that the beginning of a new film frame coincides with the beginning of Field 1 of the television signal (see also Para. 2.1.5 of these Guidelines).

Care must be taken with 16-mm films that, with different copying processes (optical or contact copies), no variation in the emulsion layer arises throughout the production; unavoidable deviations are to be indicated. In general, film with running scratches is to be avoided. If, nevertheless, they are present, the resulting blemishes should preferably be avoided by "wet" scanning. If copies are made on to video tape, the transfer should be made in digital-component form DSK270 in accordance with ITU-R Recommendation BT.601.

For precise vision/sound synchronization and for the whole post-production process, it is recommended that care should be taken that there is, on the edge-strip of the film, an optical time-code (either a barcode complying with ISO 8758 or a matrix-code) with exposure-control information, in order to obtain the correct exposure (corresponding to the film sensitivity). During replay on a film scanner, it must be ensured that the time-code/picture relationship (replay-head/picture-gate off-set) is correctly compensated. Similarly, whenever copies are made, attention should be paid to a precise exposure of the existing negative edge-numbers, the key-code as well as, if applicable, the recorded ARRI time-code (see Annex 8.13).

All film positives supplied for scanning must not contain light frame-bars. Care must also be taken that in editing colour-negative films, only masked film-stock is used (including leaders in accordance with Annexes 8.20 and 8.21).

Note: In order to be able to recognize any technical fault in the production in good time before the post-synchronization and before it is purchased, the basic stock intended for picture and sound must be tested by the responsible technical authority before it is processed.
5.3 Film and picture formats

For raw stock, the applicable DIN standard is:

16-mm film DIN ISO 69

For the picture size in shooting (and in part for replay in the 4:3 picture aspect-ratio), the applicable DIN standards are:

<table>
<thead>
<tr>
<th>Format</th>
<th>Standard</th>
<th>Aspect Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>35-mm film</td>
<td>DIN 15 502, Part 2</td>
<td>1.33:1</td>
</tr>
<tr>
<td>35-mm film</td>
<td>DIN 15 545</td>
<td>1.66:1</td>
</tr>
<tr>
<td>16-mm film</td>
<td>DIN 15 602, Part 2</td>
<td>1.33:1</td>
</tr>
<tr>
<td>16-mm film</td>
<td>DIN 15 602, Part 7</td>
<td>1.66:1, Super 16</td>
</tr>
</tbody>
</table>

5.4 Minimum requirements for technical characteristics of films

In order to obtain immaculate results when transmitting films in television, minimum values must be required for all film characteristics that affect the technical picture quality. Besides the mechanical characteristics (such as dimensions, nature of the surface, etc.), this particularly concerns the photographic parameters of the film materials used for shooting and for scanning, which are listed below:

- Film characteristic curve,
- Transmittable density range,
- Definition (modulation depth, modulation transfer),
- Signal-to-noise ratio (film-grain noise),
- Colour balance,
- Picture steadiness.

Some technical characteristics, such as definition and granularity are dependent on the film format and the film sensitivity and therefore are complex to consider.

The minimum values required for these technical film characteristics are given in the Technical Specification 12/10 (Television colour film) [Technisches Pflichtenheft 12/10 (Fernseh-Farbfilm)]. These are to be absolutely respected. All measurements of the technical film parameters should be carried out in accordance with the requirements of this Specification.

5.5 Picture-area size in shooting and in television transmission

In television, all films should be scanned so that the picture available at any time on the film is reproduced on the television receiver with the least possible loss with regard to picture content and filling the picture format. In order to establish the optimal transmitted picture area for the different picture formats occurring in production practice, it is appropriate to find a reasonable compromise for the scanning on each occasion between the content of the original picture and that of the television reproduction.

Up to now, the determination of the transmitted picture area of television films in the 4:3 aspect-ratio has been based on the reduced, projectable picture area (according to ISO 1223) or, with 16:9 scanning, on the maximum projectable picture area (according to ISO 2907). For safety reasons, the pictures on which the scanning is based are, when copied or re-recorded, by some 4 to 8% smaller in dimensions than the shooting picture area. Because the picture on a domestic receiver is over-scanned, about a further 5% is lost on all sides. As there is an increasing tendency to scan the negative directly, and in order to avoid excessive picture loss, international efforts are being made to scan the whole available picture area on the film.
5.5.1 Reproduction in the 4:3 aspect-ratio

See Annex 8.16 for the television-picture reproduction for different film-picture formats resulting from transmission in the 4:3 aspect-ratio.

Productions for television transmission in the 4:3 picture aspect-ratio are shot in the 1.33:1 (Academy or Normal format) and scanned in the 1.33:1 format with slightly greater cut-off at the sides (about 2.5% loss in comparison with the reduced projection picture size). The dimensions of the transmitted picture area, the centre of interest and the caption area for 16-mm and 35-mm films as well as slides are set out together in Annex 8.17.

Feature films with a picture aspect-ratio > 1.37:1 (1.66 to 1.85:1) that were originally produced for wide-screen showing in cinemas, as well as 16-mm productions in Super-16 format (1.66:1) should be scanned and reproduced with full picture width, i.e. in the so-called "letter-box" format. This results in black bands without picture information at the top and bottom of the picture, where the amount is about 8 to 9% for 1.66:1 or about 12% for 1.85:1.

Feature films in the Cinemascope format (2.35:1) can either be scanned and reproduced, in accordance with DIN 15 546, in the 1.85:1 compromise format (with loss of about 11% at the sides and black bands of about 14% at the top and bottom) or, if the scenic representation requires it, without significant cut-off at the sides in the "letter-box" format 2.21:1 (with black bands of about 20% at the top and bottom). The decision on the picture format for transmission is the responsibility of the editorial staff.

In order to avoid noise interference in the top and bottom bands (e.g. because of too wide splices with S16, dirty film-gate edges, etc.), the horizontal margins in "letter-box" reproduction should, if necessary, be electronically blanked out.

5.5.2 Reproduction in the 4:3 and 16:9 picture aspect-ratios

5.5.2.1 Separate transmission

If, for separate television transmission of film programmes (e.g. PAL or PALplus), full-format picture reproduction is required both for 4:3 transmission and for 16:9 transmission, it is advisable when shooting on 35-mm film to frame the picture in accordance with the so-called "Shoot-and-Protect" method. In this way, the picture area that is important for the action in the 16:9 format is located within the inner "Shoot"-zone.

Note: For dramatic reasons it may be advantageous when shooting to move the "Shoot-zone" upwards out of the customary central position.

The "Protect"-zone above and below the "Shoot"-zone should not show any scenically important picture area, it serves merely to fill up the higher 4:3 picture. For the overall exposed picture size, this results in a picture aspect-ratio of 1.37:1 (for dimensions see Annex 8.18).

Note: See next page for the "Shoot-and-Protect" markings for the 35-mm camera picture gate.
"Shoot" (16:9) "Protect" (1,33:1) 

35-mm Camera picture gate ("Academy format 1.37:1) with "Shoot-and-Protect" markings (transmitted picture area) in 4:3 or 16:9 TV format.

In post-production, the 16:9 shoot version has to be panned dynamically up and down. If necessary, this can either be done already in the scanner or later by means of vertical panning in the letter-box converter.

The "Shoot-and-Protect" method is actually conceivable, in principle, even for shooting on 16-mm film, but, on account of the reduced picture area which then arises for the 16:9 format and the consequently poor picture quality for the programme production for future wide-screen television systems, it is at present out of the question. If, nevertheless, 16-mm film in normal format from the library must be utilized for 16:9 productions (e.g. for inserts), this requires, as a rule, expensive scene-by-scene processing with effects equipment (e.g. DVE, letter-box converter). As this constitutes an additional intervention in the artistic picture composition, the approval of those responsible (e.g. director, cameraman) should be obtained.

5.5.2.2 Parallel transmission

For transmission in the "letter-box" format (e.g. PALplus) or in wide-screen format (DVB), programmes are, preferably, to be produced in the 16:9 full-format. This will result in a full-format display on the 16:9 receiver and, on the 4:3 receiver, depending on the system, a "letter-box" display (with black bands of about 12.5% above and below). In this connection, it would be desirable that the wide-screen format be indicated by the "Wide-screen signalling" in accordance with the ETSI Standard ETS 300 294.

**Note:** As 16-mm films (in the Super-16 picture format) and 35-mm films (in the European cinema wide-screen format) are shot with a picture aspect ratio of 15:9 = 1.66:1, there is, with 16:9 scanning, a loss of about 3% - relative to the maximum projectable picture - at the upper and lower edges. This is to be taken into account during the shooting by means of the "Shoot-zone".
5.5.3 Reproduction in the 16:9 picture aspect-ratio

See Annex 8.16 for the television-picture reproduction for different film-picture formats resulting from transmission in the 16:9 aspect-ratio and Annex 8.19 for the display of the most common wide-screen film formats on 16:9 monitors.

*Note:* For programme production on film for future wide-screen television systems, the obvious thing to do would be to use the world-wide standardized 16:9 TV picture aspect-ratio (= 1.78:1) also for shooting films (for dimensions see Annex 8.18). This was recommended by the EBU for the reproduction of HDTV programmes on 35-mm film, but, up to now, has not been accepted either as a shooting format for television films or as a compromise format for the cinema.

At the present time, during the transition of the TV picture aspect-ratio from 4:3 to 16:9, apart from the 1.37:1 Academy format with "shoot and protect" (in accordance with 4.4.2), it is the 1.66:1 cinema wide-screen format that is most widespread in Europe for the broadcasting organizations’ own productions and for commissioned productions on 35-mm film. This picture aspect-ratio has the advantage that, apart from full-format reproduction on 16:9 receivers, possible co-productions can also be shown in European cinemas without additional format conversion. The 16:9 reproduction takes place, filling the format, with a minimal loss of picture area of about 3% (relative to the maximum projection picture) at the upper and lower edges. The actual transmittable picture area in the 16:9 aspect-ratio should be taken into account in the picture composition, with the centre of interest clearly defined by means of format marking(s) on the viewfinder screen (for dimensions see Annex 8.16).
35-mm Camera picture gate ("Cinema wide-screen format Europe 1.66:1"), transmitted picture area and centre of interest in 16:9 TV format

For international cinematic marketing, the 1.85:1 picture format (USA wide-screen cinema format) is also occasionally required in Europe on 35-mm film. The 16:9 television reproduction is then effected in a similar fashion, filling the format, although with a minimal loss of picture area of about 2% on the left- and right-hand sides. By means of appropriate format markings on the viewfinder screen (1.78:1 or 1.66:1), these cut-offs at the sides should be taken into account, as well as also making possible reproduction in the European wide-screen cinema format (for dimensions see Annex 8.16).

The super-wide-screen system "Cinemascope" is, because of its 2.35:1 aspect-ratio, unsuitable for straightforward television film production. For transmission, cinema feature films in this format can be scanned and reproduced either in the 2:1 compromise format (with about 6% picture loss at the sides and 6% "letter-box" bands above and below) or, if the scenic composition calls for it, in the 2.21:1 "letter-box" format (with negligible picture loss at the sides of about 2.5%, but somewhat broader black bands of about 10% at the top and bottom). The decision on the picture format for transmission is the responsibility of the editorial staff.

For programme production for wide-screen television on 16-mm film, only the Super-16 picture format is possible on quality grounds. Better use is made of the width of the 16-mm film, with about the same height as the normal format and thus with a shooting picture aspect-ratio of 1.66:1 it comes really close to the 16:9 television format. The 16:9 reproduction takes place, filling the format, with a minimal loss of picture area of about 3% at the upper and lower edges. The actual transmittable picture area in the 16:9 aspect-ratio should be taken into account in the picture composition (possibly with the centre of interest) by means of format marking(s) clearly marked on the viewfinder screen (for dimensions see Annex 8.16).
5.5.4 Super-16 test film for initial scanner alignment in the 16:9 wide-screen format

For the initial alignment and for checking the most important operating parameters of film scanners in the 16:9 aspect-ratio, the EBU recommends a test pattern printed on Super-16 mm film (see illustration). The main purpose of the test film* is to provide the operator with a simple aid for standardized alignment of the film scanner as well as checking the scanning size and position, so that a 16:9 television picture can be obtained from a 15:9 Super 16 picture format with the smallest possible picture loss. In addition, it can be used for investigating other parameters such as overall picture sharpness, resolution limits, characteristic curves, interlace and streaking as well as linearity errors.

* The S-16 test film can be obtained in 25-ft. loops from the BKSTS (M6-14 Victoria House, Vernon Place, London WC1B 4D).
5.6 Quality grading

Whereas the slope of the characteristic curve (gamma), density range and colour balance are independent of the individual picture size, the picture-structure characteristics like picture sharpness and granularity are parameters that depend on the format. Thus, the different film formats and shooting methods have a direct influence on the picture quality.

5.6.1 625-line/4:3 and 16:9 television systems

The best picture quality is obtained with a directly-scanned 35-mm negative. The highest picture-quality requirements are also fulfilled with the 35-mm negative/interpositive as well as with the 35-mm negative/positive process.

With the directly-scanned 16-mm original-negative, the 16-mm negative/interpositive as well as the 16-mm negative/positive - either in the normal picture format for 4:3 transmission or in the Super-16 picture format for 16:9 transmission - the requirements of all present-day and future 625-line television systems can be met with adequate quality. This is particularly valid for film stock of lower to medium sensitivity. On the other hand, when using higher sensitivity materials, losses due to the granularity of the film must be accepted, leading inevitably to a reduction of the signal-to-noise ratio and thus to more noisy television pictures. By making subsequent use of electronic noise-reduction processes the disturbing effect of severe film granularity can be reduced within certain limits. Because of possible side effects with excessive use (e.g. blurring of rapid movement, severe beat patterning in otherwise unstructured areas, elimination of picture information such as raindrops), it is advisable to carry out post-processing like this with great care.

Each copying and possibly each additional processing (production of duplicates and dissolves, special-effects processes) give rise to a loss of picture quality. In particular, in the 16-mm format this can lead to noticeable reduction in picture quality.

5.6.2 Suitable HDTV - 24P / 25P

In order to ensure the re-usability of so-called long-term programmes, i.e. programmes of a "repertory" character, in future television systems with greater numbers of lines, the very highest demands must be made on the technical picture quality in the shooting and the processing. Consequently, at present, only 35-mm film is absolutely suitable for HDTV programme production on film. Also, for an eventual presentation of such a television film production in the cinema, e.g. for a co-production, or for sale abroad, as a rule only the 35-mm format is possible.

The Super-16 picture format on 16-mm film stock does not meet the special requirements that are demanded of a high quality programme for high line-number television systems.

Note: In comparison with the 35-mm format, the HDTV-scanning of film shot in S-16 format gives rise to noticeably reduced picture quality (poor picture sharpness, greater film granularity, unsteadiness of pictures, etc.) as well as the limited technical capacity (e.g. transport problems because, due to the S-16 picture format, there are perforations on only one side of the film stock). These drawbacks can, however, be accepted, provided that the economies in production costs and/or in the use of in-house production facilities make the use of 16-mm film really necessary. In order to achieve the best possible picture quality for HDTV reproduction with the Super-16 format, the EBU recommends that the greatest care be taken in the shooting, processing and scanning, to use film stock only for shooting and, by direct scanning, to transfer the negative to another data support (tape, disk). From then on, further processing should be carried out in the video domain, if at all possible in digital component form DSK270 in accordance with ITU-R Recommendation BT.601

At present, only a few broadcasting organizations have carried out first experiments with the 24P/25P HDTV system. At the present time, however, it is not yet possible to settle upon a definitive format. Therefore, the use of the 24P/25P electronic formats is to be agreed separately between the customer and the contractor.
5.7 Splices

In order to ensure continuous running through the film-scanner and to avoid visible disturbances due to splices, all film prints, negatives, and negative-originals are to be delivered with "wet splices" in accordance with DIN 15653, Part 1 (16-mm film) and DIN 15540, Part 1 (35-mm film), in which preference is to be given to the asymmetric diagonal cut (Form A) for disturbance-free picture registration.

In addition to this, it is preferable, with 16-mm film and in agreement with the customer, to standardize the cut-width (overlapping) at 0.6 mm for single-striped negative (COMMAG) material and to make the splices with a slot-splicer.

5.8 Audio engineering techniques

5.8.1 The running speed for all magnetic-sound film supports for television purposes is 25 frames/s. The maximum recording level "maximum programme level" (+6 dBu) must

- for 16-mm audio equipment, correspond to a magnetic-flux level of 320 nWb/m. The alignment of the replay chains must be carried out with the alignment film BF 16-320 in accordance with DIN 15 638. The replay chains are to be lined up to +6 dBu with the 1-kHz level (297 nWb/m) on this alignment film.

Note: If, in order to obtain a better signal-to-noise ratio for "maximum modulation" (+6 dBu) a magnetic-flux level of 514 nWb/m is specially agreed, the replay channel must be lined up to +6 dBu with the 1-kHz level (477 nWb/m) on the BF 16-514 alignment film in accordance with DIN 15 638.

A 1-kHz line-up tone at maximum modulation level is to be recorded for at least 30 seconds at the beginning of every reel of magnetic-sound film.

5.8.2 For all 35-mm film prints, a separate sound recording on magnetic-sound film (17.5 mm SEPMAG) in accordance with DIN 15552, Part 3 is to be produced and used for the transmission version.

For all 16-mm film productions, a separate sound recording on magnetic-sound film (16 mm SEPMAG) in accordance with DIN 15655, Part 3, is to be produced and used for the transmission version.

5.8.3 For programme items in which the programme sound is to be transmitted as two channels, the following recommendations are to be observed:

For bilingual programme items, the programme-sound support should carry both languages as a two-track recording (SEPMAG) (DIN 15552, Part 3 for 17.5-mm magnetic-sound film, DIN 15655, Part 3 for 16-mm magnetic-sound film). In this case, the German-language version must be recorded on Track 1.

For stereophonic programmes, the left channel is to be recorded on Track 1 and the right channel on Track 2.

5.8.4 The programme-sound support should not contain any splices.

5.8.5 Subject to agreement, IS (international sound), pre-mixed speech, pre-mixed music and transmission versions may also be stored on time-coded digital sound supports. In the case of a multi-track recording, it must be clear from the labelling of the sound support and the accompanying documentation how the tracks are allocated.
5.9 Packing of picture and sound material

35-mm and 16-mm film prints are to be wound on to film centres complying with DIN 15531, having a diameter of **100 mm**. Centres with a smaller diameters are not permissible. The film must not be fixed to the centre with splicing tape.

The films are to be packed in transparent covers and in film boxes or film cans of the right size.

Similarly, 16-mm and 17.5-mm magnetic-sound films are to be wound on film centres of 100 mm diameter complying with DIN 15531 and packed in robust slide-in cartons of the right size.

Audio tapes are to be packed in slide-in tape cartons of the right size with centre bosses. For self-supporting reels of more than 250 m in length, an additional cardboard sheet with a boss for centring the reel in the carton should be used.

In accordance with EBU Technical Recommendation R74, magnetic film and tape is to be stored separately from film (not in the same cans with the film). This also applies to the accompanying documentation, e.g. technical assessment report or content information. Failure to observe this will enhance the chemical degradation process (vinegar syndrome), which leads to accelerated destruction of the film material. An explanation of the problem is to be found in EBU Technical Recommendation R74.

5.10 Labels for film cans and film cartons

5.10.1 Film cartons and cans are to carry adhesive labels in accordance with DIN 15575, Part 5, EBU Technical Document 3279 and EBU Technical Recommendations R81 and R82. The labelling and symbols shown therein are to be used.

5.10.2 For archive storage, the contents are to be shown by suitable labels stuck on the narrow side of the carton, giving the title, number of reels and production number.

5.11 Technical assessment report

A "technical assessment report" is to be completed for each film production; the film and the original of the technical assessment report are always to be kept together (not in the same can, see Para. 5.9).
6. **Sound**

6.1 **Production and reproduction engineering**

The sound pick-up and recording must be of a quality that corresponds to current professional studio technique. The sound pick-up must be structured to match the picture content in a meaningful manner. There should be no unintentional change in the acoustic atmosphere and the mixed sound must be properly balanced throughout. In order to obtain a suitable version for television, the sound-mixing must always be balanced to favour the audibility of speech.

The original dynamic range must take into account the technical limitations of the transmission system and must be restricted to the system's dynamic range of about 40 dB in a way that corresponds to the director's artistic intentions.

In order to avoid over- and under-modulation, a "headroom" (9 dB) and a "footroom" (about 20 dB above background-noise level) are to be maintained. Non-observance of this precaution can already result in irreparable faults or, in a subsequent stage of production, lead to costly audio post-production processing.

The audio engineering equipment must comply with the requirements of Technical Guideline 3/5 "Sound control room equipment" and 12/1 "Magnetic-sound film equipment for sound recording and reproduction" [Pflichtenheft 3/5 "Tonregieanlagen" und 12/1 "Magnetfilm-Anlagen für Tonaufnahme und -wiedergabe"] as well as the IRT's "Grundsätzliche Anforderungen an Magnettonanlagen und Richtlinien zu deren Einstellung". Corresponding Guidelines for the measurement of digital equipment and installations are given in the HFBL-K Recommendation 20RBT/AKAS.

A new sound mix suitable for television must be made for those programmes that originally have a severe lack of balance between the loudness of dialogue, accompanying music and noises (also effects) as well as severe variations in loudness with time. As already mentioned above, the sound-mixing balance must always favour the audibility of speech.

Should it be necessary, for good reasons (e.g. topical programmes), to deviate from the foregoing rules in a complete programme, this must be agreed with the customer in advance and clearly indicated on the documents accompanying the production with details of the occurrences and their timing. Notes on the accompanying documents are also necessary if the sound track of a production is deliberately under-modulated or has no sound for a long period.

6.2 **Principles of modulation control**

6.2.1 **Alignment signal**

The alignment level (analogue 1000Hz / digital 997Hz) is 9 dB below the permitted maximum level of +6 dBu that is at -3 dBu for an analogue signal or -18 dBFS for a digital signal. That means that the difference between full-scale and alignment level must amount to 18 dB (in accordance with EBU Technical Recommendation R68).

*Note:* See also Paras. 2.3.1 and 2.3.2 of these Guidelines for a detailed description of the relationship.

6.2.2 **Level control**

The control of the level of analogue and digital sound signals must be carried out with a programme meter in accordance with Specification 3/6 [Pflichtenheft 3/6], with an integration time \( t_i \) of 10 ms (Quasi Peak Programme Meter 'PPM').

*Note:* For control of peak levels, fast programme meters \( (t_i = 0 \text{ ms or } "exact \text{ sample}\)") are to be recommended. If necessary, a production may be checked with domestic content monitor complying with DIN IEC 60268.
6.2.3 Permitted maximum level and headroom

In accordance with HFBL-K Recommendation 15IRT [HFBL-K Empfehlung 15IRT], the permitted maximum level of a digital system is -9 dBFS. This recommendation complies with the requirements of EBU Technical Recommendation R68.

The range between the permitted maximum level -9 dBFS and full scale 0 dBFS is called headroom. This headroom avoids clipping of short-duration peak levels that are not indicated by the PPM.

Analogue signals are monitored before the A/D or after the D/A conversion, so that the maximum level of +15 dBu may not be reached, as otherwise there will be irreparable damage to the sound signal.

6.3 Control of modulation

The dynamic range of a programme may not exceed 40 dB. The maximum dynamic range results from a calculation of the limits of transmission technology, in which the appropriate headroom (9 dB measured with a PPM) and an adequate footroom of 20 dB (difference in level between system noise and minimum signal level) are maintained. The dynamic range of 40 dB in domestic reproduction situations is also taken into consideration. In this connection, experience shows that, on the basis of intelligibility, speech is not to be controlled for long periods at a level of more than 6 dB below the loudest parts of the programme.

In the production of television programmes, the loudness balance between individual programme elements (speech, music and noises, effects, etc.) merits special consideration. The loudness balance does not depend only on the modulation control or level ratio, but the technical processing of the sound signal, such as, for example, the use of compression, can also influence the loudness balance. The sound-mixing balance must always favour the audibility of speech.

Care is to be taken, by consistent use of the PPM (analogue and digital) and keeping to the 9 dB headroom recommendation, to avoid severe sudden changes in loudness between programme sequences, including the loudness changes between programme and commercial sequences.

For the optimization of the loudness balance, a suitable loudness meter is helpful.

For information: the modulation-control recommendations (maximum level, measured with a PPM) are given below as underlying target values for achieving a satisfactory loudness balance within a production:

- Spoken word programmes (not of an artistic nature): 0 dB
- Off-screen narrator: 0 dB
- Introductory music: -3 dB
- Introductory music (heavily compressed): -12 dB
- Commercials (heavily compressed): -12 dB
- Light music (compressed): -3 dB

In music productions, announcements or intervening dialogue are to be controlled with reduced level corresponding to the dynamic range of the orchestra:

- For chamber music: -4 dB
- For symphonic music: -8 dB

6.4 Sound systems

Monophonic sound systems with only one sound channel are increasingly being replaced in television studios with the currently used multi-channel systems, including the mainly used stereophonic systems with two channels. These multi-channel systems will be described with the generic multi-channel stereophonic systems.
6.5 Stereophonic productions

In the production of stereophonic programmes, it is very important to take care that it is possible to have a monophonic version. The control is effected at the mixing stage, not at the 90° filter.

For the maximum permissible phase-difference on replay, the following figures given in ITU-R Recommendation BR. 408-7 are applicable:

<table>
<thead>
<tr>
<th>Frequency Range</th>
<th>Phase Difference</th>
<th>Degree of Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>250 Hz to 4 kHz</td>
<td>15°</td>
<td>r = + 0.96</td>
</tr>
<tr>
<td>40 Hz</td>
<td>30°</td>
<td>r = + 0.86</td>
</tr>
<tr>
<td>10 kHz</td>
<td>30°</td>
<td>r = + 0.86</td>
</tr>
</tbody>
</table>

Consequently, on magnetic-sound films, the following test signals must be recorded on both channels between the film leader and the sound-start mark (level 9 dB below permissible maximum level):

- 1 kHz: 10 seconds duration
- 10 kHz: 30 seconds duration.

6.6 Dolby-surround productions

Dolby-Surround and Dolby-ProLogic systems are special cases of a multi-channel system, as the four channels are not transmitted separately, but are matrixed.

In principle, the Dolby-Surround system is a 3/1 system with three front channels and one (band-limited) surround channel which is reproduced over both surround loudspeakers LS and RS with reference to the reference-reproduction configuration (ITU-R Recommendation BS.775-1).

For storage and transmission the four channels utilized are matrixed into two stereo-compatible channels and de-matrixed on reproduction by means of Dolby-ProLogic decoders. This matrixing process must be included in the production of Dolby-Surround recordings. That means to say that the mixing down takes place, in principle, with the reference-reproduction configuration, but after the four-channel signal has first been coded and decoded by means of the Dolby-Surround processors.

Surround-sound signals are to be checked during the production for satisfactory monophonic and stereophonic compatibility.

For fundamental reasons, a reference tone that is closely coupled to the surround signal must be recorded at the beginning of the recording in all channels. This linkage may not be broken in the subsequent processing chain. As Dolby-Surround recordings with matrixed stereo signals are not recognizable, in the case of a surround recording, the production must be clearly identified as "surround" on the VTR record card and the box label.

Surround productions must be identified in the "opener" (see also the Handbook of Television Operating Procedure [Handbuch Fernseh-Betriebsabwicklung]). In addition, an announcement in the trailer, as well as a note for the viewer in teletext, is desirable.

6.7 Discrete multi-channel productions

A few years ago, an international agreement was reached on a configuration for systems with more than two channels, which described a compromise between the requirement for an optimal spatial enhancement and compatibility with conventional two-channel stereophony. This standard configuration (see Annex 8.15, in accordance with ITU-R Recommendation BS.775-1) is the five-channel stereophony which is described as a 3/2 system or a 5.1 system. It is therefore a question of a sound system with five discrete wide-band channels, of which three channels are used for the representation of the front and two channels for the surround.

Note: The suffix .1 in the expression 5.1 stands for an additional, optional, sixth channel (LFE-channel, Low Frequency Enhancement) with limited bandwidth, which can be used for the transmission of bass frequency effects.
The utilization of multi-channel systems, e.g. the 5.1 system in accordance with ITU-R Recommendation 775-1, must be agreed between the customer and the contractor. For transmission purposes, a stereophonic and a monophonic version is required in each case (see also EBU Technical Recommendation R96).

In order to ensure downwards compatibility within the hierarchy of multi-channel sound systems, simple matrixing requirements for the addition of the missing channels or contributing signals to the remaining channels are foreseen. The equations for the down-mix from 3/2 to the conventional stereo format (2/0) is according to ITU-R Recommendation BS.775-1 as follows:

<table>
<thead>
<tr>
<th>L</th>
<th>R</th>
<th>C</th>
<th>LS</th>
<th>RS</th>
</tr>
</thead>
<tbody>
<tr>
<td>L'</td>
<td>1.0L</td>
<td>0.0R</td>
<td>0.7C</td>
<td>0.7LS</td>
</tr>
<tr>
<td>R'</td>
<td>0.0L</td>
<td>1.0R</td>
<td>0.7C</td>
<td>0.0LS</td>
</tr>
</tbody>
</table>

For fundamental reasons, a reference tone that is closely coupled to the multi-channel signal must be recorded at the beginning of the recording in all channels. This linkage may not be broken in the subsequent processing chain.

As multi-channel signals are not recognizable as such, the programme must be clearly identified as multi-channel, e.g. "5.1 system" on the VTR record card and the tape box.

Multi-channel productions must be identified in the "opener". In addition, an announcement in the trailer, as well as a note for the viewer in teletext, is desirable.

### 6.8 Synchronization of foreign-language productions

The international-sound versions may be supplied only in time-coded analogue form or on a digital sound support. The time-code start-address of the start-cross must be indicated.

The digital international-sound tapes should be supplied as far as possible as DAT cassettes in accordance with EBU Technical Recommendation R64 (TC coupled).

The international-sound tapes should be supplied as far as possible as magnetic-sound films (matching the picture films) carrying recordings in accordance with the following DIN standards:

DIN 15552, Part 3 for 17.5-mm and 35-mm magnetic-sound film, DIN 15655, Part 3 for 16-mm magnetic-sound film (Track 1 and Track 2).

In the case of video productions, digital supports should be supplied for preference.

In order to avoid mistakes, the standard used is to be indicated on the accompanying documents and on the containers. The IS versions must carry at the start a clear and indelible marking giving the title and spool number. In the case of tapes recorded with multi-channel sound, the labelling must also specifically indicate the chosen allocation of the tracks.

### 6.9 Sound-recording, transmission engineering and sound supports

For sound-recording and processing apparatus equipped for time-code recording and control, the recommendations of DIN EN 60461 for 80-bit time-code are applicable (see Annex 8.11).

For two-channel recordings, particular care must be taken that the gap alignment in the direction of the film movement complies with DIN 15 910, Part 2.
The only magnetic audio tapes and sound films that may be used for recording and copying are those that comply with the Specification 3/4 "Studio magnetic audio tapes" [Pflichtenheft 3/4 “Studio-Magnettonbänder"] or DIN 15552, Part 1, DIN 15655, Part 4 and Specification 12/2 "16-mm, 17.5-mm and 35-mm magnetic sound film [Pflichtenheft 12/2 "Magnetfilm 16 mm, 17.5 mm und 35 mm"], respectively.

Digital sound recording must be carried out with linear quantization, a minimum resolution of 16 Bits and a sampling rate of 48 kHz (EBU Technical Recommendation R68 and ITU-R Recommendation BT.646).

During the recording, the error rate must be such that the green lamp of the error-rate indicator is illuminated, i.e. only a very low error rate may be permitted, which is compensated by error correction. With higher error rates with interpolation and muting of the sound signal (yellow and red lamps illuminated), the sound quality no longer matches the original. A new fault-free original-quality recording must therefore be made. Because of the reduction in sound quality due to cascading effects, no data reduction processes may be used throughout the whole sound production chain.

For the exchange of programmes as digital tape recordings, the professional version of the DAT format according to DIN EN 61119-5 is authorized. EBU Technical Recommendation R64 is also applicable (see also Para. 6.10). For recording and copying, only professional quality DAT cassettes complying with DIN EN 61119-3 may be used. Apart from the DAT format, other sound supports of equal quality that permit a professional sound quality can be agreed.

For the exchange of programmes on digital optical disk recordings, the MOD format according to DIN 15975, Part 1 is authorized. For recording and copying, only MOD optical disks complying with ISO/IEC 10089, Format A may be used.

Other digital formats for the exchange of programmes, such as, for example, the 8-channel format ADAT and DA88/98 (TASCAM) formats, must be agreed separately. In each case, the requirements in Para. 2.3.2 "Digital sound signals" of these Guidelines must be respected.

### 6.9.1 Track assignment for the supply and the exchange of multi-channel sound signals

For the exchange of programme material with multi-channel sound signals, in accordance with EBU Technical Recommendation R91, the 3/2 channel format or the 3/2+1 format if available (see Para. 6.7 and Annex 8.15) are specified with the following track assignment:

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Sound signal</th>
<th>3/2</th>
<th>3/2+1</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>Left</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>R</td>
<td>Right</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>C</td>
<td>Centre</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>LFE</td>
<td>Low frequency enhancement</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>LS</td>
<td>Left - surround</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>RS</td>
<td>Right - surround</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>MS</td>
<td>Mono – surround (*)</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>Left (two - channel stereo)</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Right (two - channel stereo)</td>
<td>x</td>
<td></td>
</tr>
</tbody>
</table>

(*) With a single-channel surround signal (in place of LS and RS signals).
6.10 Preparation of DAT cassettes

DAT cassettes are to be prepared in accordance with HFBL-K Recommendation 13IRT, with an extension for television production.

<table>
<thead>
<tr>
<th>ATIME (H:M:S)</th>
<th>Start –ID*</th>
<th>Modulation type</th>
<th>Programme</th>
<th>Channel assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>09:58:00:00</td>
<td>Silence</td>
<td>Leader</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10:00:00:00</td>
<td>-01-</td>
<td>Programme part 1</td>
<td>Mono</td>
<td>Channel 1 Programme sound</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Channel 2 Programme sound</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stereo</td>
<td>Channel 1</td>
<td>Left</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Channel 2</td>
<td>Right</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Two channel</td>
<td>Channel 1</td>
<td>German programme sound</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Channel 2</td>
<td>Original programme sound or Audio-description</td>
</tr>
<tr>
<td>xx:xx:xx:xx</td>
<td>-02-</td>
<td>Programme part 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>yy:yy:yy:yy</td>
<td>-nn-</td>
<td>Programme part n</td>
<td></td>
<td></td>
</tr>
<tr>
<td>zz:zz:zz:zz</td>
<td>End**</td>
<td>End of Programme part n</td>
<td></td>
<td></td>
</tr>
<tr>
<td>At least 10 s</td>
<td>Silence</td>
<td>Trailer</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* The details of a Start-ID for the supply for a television production are optional.

** If for equipment technical reasons, an End-ID cannot be inserted, a Start-ID must be used instead.
7. Metadata

The automated exchange of production-relevant information in an IT-based TV production environment requires the specification of the semantic significance and the structural modulation of the data, as well as its coding for transmission.

For the specification of the semantic significance of the data, a set of rules for the exchange of Metadata in television production (known as "Regelwerk Fernsehproduktion") has already been drawn up. It is currently in a first "test phase" in order to verify and optimize its applicability. The content is based on the conventional VTR record-card information (see Para.2.12), including the necessary extension for its use in an IT-based production environment. In principle, all involved must be prepared for the exchange of Metadata in television production.

Note: As the exchange of information from system to system should be carried out without human interaction, it must obviously be regulated. This applies not only to the interfaces, protocols and data formats utilized, but also to the significance of the contents and the modulation of these data. For this reason, there is an urgent need for a precise definition of the information exchanged, with which a clear mapping of the information to elements of the production- and archive-database will be possible. Only then is it possible to have an automated exchange without human interaction. For that, the resolution of the following points is required:

a) Definition of the information elements required as well as their semantic significance.

b) Definition of the hierarchical structure and the relationships of the information elements in view of the existing standards and exchange formats and those which are currently being developed.

c) Definition of the coding of the information elements and the protocols for exchanges.

Whereas Point a) must be settled exclusively by the user, Points b) and c) are increasingly orientated towards a technical implementation. The "Regelwerk Fernsehproduktion" deals only with the definition of the required information elements, the definition of their significance and their value range, as well as the drawing up of additional rules for the utilization.

The following explanations are a support for the preparation for the introduction of automated exchanges of programme-relevant information. After the completion of the operational specifications, they will be adopted here and are then to be respected.

7.1 "Regelwerk Fernsehproduktion"

The "Regelwerk Fernsehproduktion" has been developed in a joint study by the chief engineers of the ARD and ZDF broadcasting organizations as a basis for the exchange of Metadata. The present version is the "Version 1.10". Further work will be carried out by the ad-hoc "Regelwerk Fernsehproduktion" working group.

The "Regelwerk Fernsehproduktion" provides the pre-condition for the exchange of programme-relevant information. It defines the data elements required, organized into essential and optional and contains descriptive examples. Moreover, the "Regelwerk Fernsehproduktion" makes it possible to develop instructions from experience for the exchange. In order to ensure its integration in existing production and archive environments, verification will be made with the "Regelwerk Multimedia" (an available set of rules for the usage of Metadata in a multimedia environment). This also ensures compatibility with the still valid "Regelwerk Fernsehen" (an available set of rules for the usage of Metadata in a TV archive environment).

The "Regelwerk Fernsehproduktion" is a dynamic document and can be adapted to new requirements. Care is to be taken that every modification must be backwards compatible, i.e. existing elements may not be changed either slightly or in their definition or structure. Extensions must be matched with the existing elements in order to avoid overlapping and conflicts.
7.2 Structural elements of the "Regelwerk Fernsehproduktion"

The attributes contained in the "Regelwerk Fernsehproduktion" fall into two groups. The "essential" group includes those that must be given in every case. The "optional" group includes attributes that are not really necessary for the exchange, but, for certain applications can be of interest or even necessary.

Consequently and independently of the grouping into essential and optional, it is useful to implement production systems so that all data elements are supported. The division into "essential" and "optional" is particularly relevant in view of the exchange of information.

7.2.1 Overview of the attributes in the television production regulation

The data fields included in Version 1.10, structured in categories, are set out below. The detailed description and definition of these attributes, as well as the details on the value range are to be found in the "Regelwerk Fernsehproduktion".

<table>
<thead>
<tr>
<th>Category</th>
<th>Essential attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Origin-Identification</td>
<td>Country</td>
</tr>
<tr>
<td></td>
<td>Organisation</td>
</tr>
<tr>
<td></td>
<td>Typ</td>
</tr>
<tr>
<td></td>
<td>Number</td>
</tr>
<tr>
<td>Recipient</td>
<td>Organisation</td>
</tr>
<tr>
<td></td>
<td>Editorial office</td>
</tr>
<tr>
<td>Supplier</td>
<td>Organisation</td>
</tr>
<tr>
<td></td>
<td>Department</td>
</tr>
<tr>
<td>Transfer</td>
<td>Transfer date</td>
</tr>
<tr>
<td></td>
<td>Transfer time</td>
</tr>
<tr>
<td>Programme</td>
<td>Typ</td>
</tr>
<tr>
<td></td>
<td>Superordinate title</td>
</tr>
<tr>
<td></td>
<td>Main title</td>
</tr>
<tr>
<td></td>
<td>Sub title</td>
</tr>
<tr>
<td>Production</td>
<td>Organisation</td>
</tr>
<tr>
<td></td>
<td>Editorial office</td>
</tr>
<tr>
<td></td>
<td>Editorial notes</td>
</tr>
<tr>
<td>Material</td>
<td>Identification</td>
</tr>
<tr>
<td></td>
<td>Timecode-start</td>
</tr>
<tr>
<td></td>
<td>Timecode-end</td>
</tr>
<tr>
<td></td>
<td>Duration</td>
</tr>
<tr>
<td></td>
<td>Sound status</td>
</tr>
<tr>
<td></td>
<td>Sound track assignment_audio 1</td>
</tr>
<tr>
<td></td>
<td>Sound track assignment_audio 2</td>
</tr>
<tr>
<td></td>
<td>Sound track assignment_audio 3</td>
</tr>
<tr>
<td></td>
<td>Sound track assignment_audio 4</td>
</tr>
<tr>
<td></td>
<td>Sound track assignment_audio 5</td>
</tr>
<tr>
<td></td>
<td>Sound track assignment_audio 6</td>
</tr>
<tr>
<td></td>
<td>Sound track assignment_audio 7</td>
</tr>
<tr>
<td></td>
<td>Sound track assignment_audio 8</td>
</tr>
<tr>
<td></td>
<td>Picture aspect ratio</td>
</tr>
<tr>
<td></td>
<td>Teletext sub-title</td>
</tr>
<tr>
<td></td>
<td>Technical notes</td>
</tr>
<tr>
<td>Category</td>
<td>Optional-attributes</td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>----------------------------------------------------------</td>
</tr>
<tr>
<td>Production_Editor/Author’s Person</td>
<td>First name</td>
</tr>
<tr>
<td></td>
<td>Last name</td>
</tr>
<tr>
<td>Production_Editor/Author’s Contact</td>
<td>Street</td>
</tr>
<tr>
<td></td>
<td>Post code</td>
</tr>
<tr>
<td></td>
<td>Town</td>
</tr>
<tr>
<td></td>
<td>Country</td>
</tr>
<tr>
<td></td>
<td>Telephone</td>
</tr>
<tr>
<td></td>
<td>Fax</td>
</tr>
<tr>
<td></td>
<td>E-mail</td>
</tr>
<tr>
<td>Creation</td>
<td>Use_restriction</td>
</tr>
<tr>
<td></td>
<td>Content</td>
</tr>
<tr>
<td></td>
<td>Language</td>
</tr>
<tr>
<td>Material_picture_scanning_format</td>
<td>Total_lines_per_frame</td>
</tr>
<tr>
<td></td>
<td>Frame_rate</td>
</tr>
<tr>
<td></td>
<td>Field_rate</td>
</tr>
<tr>
<td></td>
<td>Interface_ratio</td>
</tr>
<tr>
<td>Material</td>
<td>Video_signal</td>
</tr>
<tr>
<td></td>
<td>Video_compression</td>
</tr>
<tr>
<td></td>
<td>Medium_typ</td>
</tr>
<tr>
<td></td>
<td>Black_white</td>
</tr>
<tr>
<td></td>
<td>Clean_feed</td>
</tr>
</tbody>
</table>
8. Annexes

8.1 Transmitted picture area, centre of interest and caption area (4:3 und 16:9)

8.1.1 Transmitted picture area, centre of interest and caption area in 4:3 picture format

8.1.2 Transmitted picture area, centre of interest and caption area in 16:9 picture format
8.2 Reproduction formats for picture sources of 4:3 and 16:9 picture aspect-ratios
8.3 Characteristics of the B and G PAL systems [1]

8.3.1 Composite colour video signal in the vicinity of field-blanking

8.3.2 Details of a composite colour video signal in the vicinity of horizontal blanking
8.4 Characteristics of the B and G PAL systems [2]

8.4.1 Details of a composite colour video signal at the beginning of the field-blanking

8.4.2 Details of the synchronizing signals at the beginning of the field-synchronizing pulse

8.4.3 Spectral range of the luminance and chrominance signals
8.5 Analogue component signals in accordance with EBU Technical Statement N10

The luminance signal $E'_Y$ includes the synchronizing signal. The two colour-difference signals $E'_{CR}$ and $E'_{CB}$ do not include synchronizing information.

The line- and field-blanking intervals of the signals are in accordance with ITU-R BT.470.

See also 8.3 and 8.4 of this Annex.

All three signals ($E'_Y$, $E'_{CR}$ and $E'_{CB}$) should be simultaneous in real time and carry time-coincident picture information.

Colour bars in component form

Amplitude range of the constituent primary colour signals R, G, B

700mV (100%) each

ITU-R description: 100/0/100/0 colour bars
8.6 Modulation range for luminance and chrominance in accordance with ITU-R Recommendation BT.601

Fig.1: 8-Bit luminance modulation range in accordance with Rec. ITU-R BT.601

Fig.3: 8-Bit chrominance modulation range in accordance with Rec. ITU-R BT.601

Fig.2: 10-Bit luminance modulation range in accordance with Rec. ITU-R BT.601

Fig.4: 10-Bit chrominance modulation range in accordance with Rec. ITU-R BT.601

<table>
<thead>
<tr>
<th>Voltage (mV)</th>
<th>Decimal</th>
<th>Hexadecimal</th>
<th>Binary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excluded</td>
<td>763.9</td>
<td>255</td>
<td>FF 1111 1111</td>
</tr>
<tr>
<td>Peak white</td>
<td>700.0</td>
<td>235</td>
<td>EB 1110 1011</td>
</tr>
</tbody>
</table>

3.196 mV / step

<table>
<thead>
<tr>
<th>Voltage (mV)</th>
<th>Decimal</th>
<th>Hexadecimal</th>
<th>Binary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excluded</td>
<td>350.0</td>
<td>240</td>
<td>F0 1111 0000</td>
</tr>
<tr>
<td>Max. positive</td>
<td>390.0</td>
<td>260</td>
<td>F9 1111 1111</td>
</tr>
</tbody>
</table>

3.125 mV / step

<table>
<thead>
<tr>
<th>Voltage (mV)</th>
<th>Decimal</th>
<th>Hexadecimal</th>
<th>Binary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excluded</td>
<td>-350.0</td>
<td>160</td>
<td>00 0000 0000</td>
</tr>
<tr>
<td>Max. negative</td>
<td>-390.0</td>
<td>130</td>
<td>00 0000 0000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Voltage (mV)</th>
<th>Decimal</th>
<th>Hexadecimal</th>
<th>Binary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black level</td>
<td>0.0</td>
<td>16</td>
<td>10 0001 0000</td>
</tr>
<tr>
<td>Excluded</td>
<td>-51.1</td>
<td>0</td>
<td>00 0000 0000</td>
</tr>
</tbody>
</table>

0.799 mV / step

<table>
<thead>
<tr>
<th>Voltage (mV)</th>
<th>Decimal</th>
<th>Hexadecimal</th>
<th>Binary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak white</td>
<td>755.0</td>
<td>255</td>
<td>FF 1111 1111</td>
</tr>
<tr>
<td>Excluded</td>
<td>763.9</td>
<td>255</td>
<td>FF 1111 1111</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Voltage (mV)</th>
<th>Decimal</th>
<th>Hexadecimal</th>
<th>Binary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excluded</td>
<td>-397.7</td>
<td>160</td>
<td>00 0000 0000</td>
</tr>
<tr>
<td>Max. negative</td>
<td>-400.0</td>
<td>150</td>
<td>00 0000 0000</td>
</tr>
</tbody>
</table>

0.781 mV / step

<table>
<thead>
<tr>
<th>Voltage (mV)</th>
<th>Decimal</th>
<th>Hexadecimal</th>
<th>Binary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excluded</td>
<td>0.0</td>
<td>16</td>
<td>10 0001 0000</td>
</tr>
<tr>
<td>Excluded</td>
<td>-51.1</td>
<td>0</td>
<td>00 0000 0000</td>
</tr>
</tbody>
</table>

0.799 mV / step

<table>
<thead>
<tr>
<th>Voltage (mV)</th>
<th>Decimal</th>
<th>Hexadecimal</th>
<th>Binary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excluded</td>
<td>-48.7</td>
<td>3</td>
<td>0.C 0000 0000</td>
</tr>
<tr>
<td>Excluded</td>
<td>-51.1</td>
<td>0</td>
<td>00 0000 0000</td>
</tr>
</tbody>
</table>

0.799 mV / step

Representation form "A" referring to 8 Bit, and "B" referring to 10 Bit
8.7 Digital and analogue horizontal blanking

Digital and analogue horizontal blanking for 625-line systems
(Recommendation ITU-R BT.601)
8.8 Relationship between SDI und SDTI

8.8.1 Embedding of the SDTI header in the SDI frames

8.8.2 Embedding of the SDTI data in the SDI frames
8.9 Relationship between relevant video-compression formats and digital video recording formats
8.10 RGB colour-space

The E'R E'G E'B colour-space (cube) shown in the left-hand half of the illustration is transformed, by matrixing in accordance with the formula given above, into a parallelepiped (a body that is contained by three pairs of mutually parallel surfaces) and is positioned in the E'Y E'CR E'CB colour-space as displayed in the right-hand half of the illustration.

\[
E'_{CR} = 0.71(E'_R - E'_Y) \\
E'_{CB} = 0.56(E'_B - E'_Y)
\]
## 8.11 Code-Format of the 80-bit Time-code according to DIN EN 60461

<table>
<thead>
<tr>
<th>Time address</th>
<th>Value (weight)</th>
<th>LTC bit number.</th>
<th>Start of the code word</th>
</tr>
</thead>
<tbody>
<tr>
<td>Units of frames</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSB</td>
<td>1 0</td>
<td>First binary group</td>
<td></td>
</tr>
<tr>
<td>MSB</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSB</td>
<td>1 5</td>
<td>Second binary group</td>
<td></td>
</tr>
<tr>
<td>MSB</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSB</td>
<td>1 8</td>
<td>Third binary group</td>
<td></td>
</tr>
<tr>
<td>MSB</td>
<td>22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSB</td>
<td>1 12</td>
<td>Fourth binary group</td>
<td></td>
</tr>
<tr>
<td>MSB</td>
<td>31</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSB</td>
<td>1 16</td>
<td>Fifth binary group</td>
<td></td>
</tr>
<tr>
<td>MSB</td>
<td>40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSB</td>
<td>1 20</td>
<td>Sixth binary group</td>
<td></td>
</tr>
<tr>
<td>MSB</td>
<td>46</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSB</td>
<td>1 24</td>
<td>Seventh binary group</td>
<td></td>
</tr>
<tr>
<td>MSB</td>
<td>52</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSB</td>
<td>1 32</td>
<td>Eighth binary group</td>
<td></td>
</tr>
<tr>
<td>MSB</td>
<td>62</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSB</td>
<td>0 0</td>
<td>Field / phase</td>
<td></td>
</tr>
<tr>
<td>MSB</td>
<td>68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSB</td>
<td>0 1</td>
<td>Logical zeros</td>
<td></td>
</tr>
<tr>
<td>MSB</td>
<td>70</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSB</td>
<td>1 1</td>
<td>Logical zeros</td>
<td></td>
</tr>
<tr>
<td>MSB</td>
<td>74</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSB</td>
<td>1 1</td>
<td>Logical zeros</td>
<td></td>
</tr>
<tr>
<td>MSB</td>
<td>78</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSB</td>
<td>1 1</td>
<td>Logical zeros</td>
<td></td>
</tr>
<tr>
<td>MSB</td>
<td>79</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 80 bits per frame:
- 26 time address bits
- 6 flag bits
- 32 binary group bits
- 16 sync. bits

All unassigned bits are set to logical zeros „0“.
8.12 VITC and LTC code word bit-definitions according to DIN EN 60461

<table>
<thead>
<tr>
<th>VITC bit number</th>
<th>Value (weight)</th>
<th>LTC bit number</th>
<th>Value (weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>(^1) VITC sync. bit</td>
<td>35</td>
<td>(^1) VITC sync. bit</td>
</tr>
<tr>
<td>1</td>
<td>(^0) VITC sync. bit</td>
<td>36</td>
<td>(^0) VITC sync. bit</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>6</td>
<td>LSB</td>
<td>7</td>
<td>LSB</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>i</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>9</td>
<td>MSB</td>
<td>7</td>
<td>MSB</td>
</tr>
<tr>
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<td>89</td>
<td>71</td>
</tr>
<tr>
<td>89</td>
<td>71</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

90 bits per frame:
- 26 time address bits
- 6 flag bits
- 32 binary group bits
- 8 VITC sync. bits
- 8 VITC CRC code bits
- All unassigned bits are set to logical zeros „0“.
8.13 Key-code and ARRI time-code for film

8.13.1 Key-code number information for 35 mm film

8.13.2 Key-code number information for 16 mm film

8.13.3 ARRI time-code schematic
8.14 VTR tape nomenclature
8.15 Multi-channel stereophonic systems

Reference-loudspeaker arrangement
with loudspeakers L/C/R and LS/RS (as in ITU-R BS.775-1)

Screen 1: Listening distance = 3H (2 $\beta_1 = 33^\circ$)
Screen 2: Listening distance = 2H (2 $\beta_2 = 48^\circ$)
H: Height of screen
B: Loudspeaker base-width

<table>
<thead>
<tr>
<th>Acoustic centre</th>
<th>Angle</th>
<th>Height</th>
<th>Inclination</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>0°</td>
<td>1.2m*)</td>
<td>0°**)</td>
</tr>
<tr>
<td>L, R</td>
<td>+/- 30°</td>
<td>1.2m</td>
<td>0°</td>
</tr>
<tr>
<td>LS, RS</td>
<td>+/- (100...120)°</td>
<td>&gt;1.2m</td>
<td>≤15°</td>
</tr>
</tbody>
</table>

*) depending on the shape and size of the screen

8.15.1 Reference-loudspeaker arrangement in accordance with ITU-R BS.775
8.16 Television reproduction resulting from different film picture-formats for separate transmission in 4:3 und 16:9

<table>
<thead>
<tr>
<th>Picture format (Film or video format)</th>
<th>Television receiver</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>4 : 3</strong></td>
</tr>
<tr>
<td></td>
<td><img src="image1" alt="Diagram 1.37:1" /></td>
</tr>
<tr>
<td>1.37 : 1 (35mm; Shoot+Protect)</td>
<td>2.5%B</td>
</tr>
<tr>
<td></td>
<td><img src="image3" alt="Diagram 1.37:1" /></td>
</tr>
<tr>
<td>1.37 : 1 (16/35mm; Archive)</td>
<td>2.5%B</td>
</tr>
<tr>
<td></td>
<td><img src="image5" alt="Diagram 1.37:1" /></td>
</tr>
<tr>
<td>1.66 : 1 (15:9) (S16/35mm)</td>
<td>8/9%H</td>
</tr>
<tr>
<td></td>
<td><img src="image7" alt="Diagram 1.37:1" /></td>
</tr>
<tr>
<td>1.78 : 1 (16:9) (Video)</td>
<td>12.5%H</td>
</tr>
<tr>
<td></td>
<td><img src="image9" alt="Diagram 1.37:1" /></td>
</tr>
<tr>
<td>1.85 : 1 (17:9) (35mm)</td>
<td>12%H</td>
</tr>
<tr>
<td></td>
<td><img src="image11" alt="Diagram 1.37:1" /></td>
</tr>
<tr>
<td>2.35 : 1 (35mm Cin.; compr.)</td>
<td>14%H</td>
</tr>
<tr>
<td></td>
<td><img src="image13" alt="Diagram 1.37:1" /></td>
</tr>
<tr>
<td>2.35 : 1 (35mm Cin.; 2.21 : 1)</td>
<td>20%H</td>
</tr>
<tr>
<td></td>
<td><img src="image15" alt="Diagram 1.37:1" /></td>
</tr>
</tbody>
</table>

(Details of picture-area loss and letter-box stripes in % of picture height H or picture width B)
### 8.17 Dimensions (in mm) of the shooting picture size, transmitted picture area, centre of interest and caption area (reproduced picture aspect-ratio 1.33:1)

<table>
<thead>
<tr>
<th></th>
<th>16 mm</th>
<th>35 mm</th>
<th>Slides</th>
</tr>
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<tbody>
<tr>
<td><strong>Film support</strong></td>
<td><strong>16 mm</strong></td>
<td><strong>35 mm</strong></td>
<td><strong>Slides</strong></td>
</tr>
<tr>
<td><strong>Shooting format</strong></td>
<td>1.37:1</td>
<td>1.37:1</td>
<td>1.5:1</td>
</tr>
<tr>
<td><strong>Shooting picture-area size</strong></td>
<td>$10.3 \pm 0.1 - 7.5 \pm 0.1$</td>
<td>$22 \pm 0.1 - 16 \pm 0.1$</td>
<td>$36 \pm 0.05 - 24 \pm 0.05$</td>
</tr>
<tr>
<td><strong>Transmitted picture area</strong></td>
<td>$9.35 \pm 0.05 - 7 \pm 0.05$</td>
<td>$20.12 \pm 0.1 - 15.1 \pm 0.1$</td>
<td>$28.6 \pm 0.2 - 21.5 \pm 0.2$</td>
</tr>
<tr>
<td><strong>Centre of interest (max.)</strong></td>
<td>$8.4 - 6.3$</td>
<td>$18.1 - 13.6$</td>
<td>$25.7 - 19.3$</td>
</tr>
<tr>
<td>Radius (max.)</td>
<td>0.23</td>
<td>0.5</td>
<td>0.7</td>
</tr>
<tr>
<td><strong>Caption area (max.)</strong></td>
<td>$7.9 - 5.9$</td>
<td>$17.1 - 12.8$</td>
<td>$24.3 - 18.3$</td>
</tr>
<tr>
<td>Radius (max.)</td>
<td>0.23</td>
<td>0.5</td>
<td>0.7</td>
</tr>
<tr>
<td>Film support</td>
<td>16-mm</td>
<td>35-mm</td>
<td>Slides</td>
</tr>
<tr>
<td>--------------</td>
<td>-------</td>
<td>-------</td>
<td>--------</td>
</tr>
<tr>
<td>Shooting format</td>
<td>1.66:1 (15.9)</td>
<td>1.78:1 (16.9)</td>
<td>1.66:1 (15.9)</td>
</tr>
<tr>
<td>Short designation</td>
<td>&quot;Super 16&quot;</td>
<td>&quot;Shoot-and-Protect&quot;</td>
<td>Video</td>
</tr>
<tr>
<td>Shooting picture size</td>
<td>12.25 ±0.05</td>
<td>22 ±0.2</td>
<td>21.95 – 12.35</td>
</tr>
<tr>
<td>Ref. edge-centre of picture</td>
<td>9 ±0.06</td>
<td>9 ±0.06</td>
<td>9 ±0.06</td>
</tr>
<tr>
<td>Transmitted picture area (max.)</td>
<td>12.2 – 6.66</td>
<td>21.11 – 11.87</td>
<td>21.11 – 11.87</td>
</tr>
<tr>
<td>Ref. edge-centre of picture</td>
<td>9 ±0.06</td>
<td>9 ±0.06</td>
<td>9 ±0.06</td>
</tr>
<tr>
<td>Centre of interest (max.)</td>
<td>11.6</td>
<td>19 – 10.7</td>
<td>19 – 10.7</td>
</tr>
<tr>
<td>Radius (max.)</td>
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<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Caption area (max.)</td>
<td>10.4 – 5.6</td>
<td>17.9 – 10.1</td>
<td>17.9 – 10.1</td>
</tr>
<tr>
<td>Radius (max.)</td>
<td>0.23</td>
<td>0.5</td>
<td>0.5</td>
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</table>

† Only standardized as a reproduction format

**) Not yet standardized
8.19 Reproduction of the most common wide-screen film formats on 16:9 monitors

- 1.78 : 1 (= 16:9, Video)
- 1.85 : 1 (= 17 : 9, Cinema wide-screen format USA)
- 2.00 : 1 (= Scanning format of 2.35:1, compromise format)
- 2.21 : 1 (= Scanning format of 2.35:1, ~ full width)
- 1.66 : 1 (= 15 : 9, Super 16, Cinema wide-screen format Europe)
### 8.20 Leader for 16-mm Television Film according to Specification 12/7

<table>
<thead>
<tr>
<th>Frame No. before 1st frame</th>
<th>No. of frames</th>
<th>Magnetic-sound film</th>
<th>Film image</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>at least 200</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>298 – 254</td>
<td>45</td>
<td></td>
<td></td>
<td>Blank film with frame bars for film title, reel, original, copy, with/without sound, etc.</td>
</tr>
<tr>
<td>253 – 251</td>
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<td></td>
<td></td>
<td>White frames</td>
</tr>
<tr>
<td>250</td>
<td>1</td>
<td></td>
<td>10</td>
<td>Mark for Rotosynstart, 100 frames before start-cross</td>
</tr>
<tr>
<td>249</td>
<td>1</td>
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<td></td>
<td>White frame</td>
</tr>
<tr>
<td>248 – 189</td>
<td>60</td>
<td></td>
<td></td>
<td>Black frames with frame bars for leader-coding with perforations</td>
</tr>
<tr>
<td>188 – 184</td>
<td>5</td>
<td></td>
<td></td>
<td>White frames for automatic start-cross identification</td>
</tr>
<tr>
<td>183 – 182</td>
<td>2</td>
<td></td>
<td></td>
<td>Black frames with frame bars</td>
</tr>
<tr>
<td>181</td>
<td>1</td>
<td></td>
<td></td>
<td>White frame for automatic start-cross identification</td>
</tr>
<tr>
<td>180 – 179</td>
<td>2</td>
<td></td>
<td></td>
<td>Black frames with frame bars</td>
</tr>
<tr>
<td>178</td>
<td>1</td>
<td></td>
<td>28</td>
<td>Magnetic sound – threading mark (white with black numeral)</td>
</tr>
<tr>
<td>177</td>
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<td>Black frame</td>
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<tr>
<td>176</td>
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<td>26</td>
<td>Optical sound – threading mark (black with white numeral)</td>
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<tr>
<td>175 – 163</td>
<td>13</td>
<td></td>
<td></td>
<td>Black frames with frame bars</td>
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<tr>
<td>162 – 151</td>
<td>12</td>
<td>TON</td>
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<td>White wedges, closing up over 12 frames</td>
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<tr>
<td>150</td>
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<td>Film-start cross (possibly with transmitting organization’s logo), Sound-start mark for magnetic-sound film (adhesive label)</td>
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<tr>
<td>149 – 127</td>
<td>23</td>
<td>Start</td>
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<td>Black frames with white vertical centre line 0.4 mm wide</td>
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<tr>
<td>126 – 124</td>
<td>3</td>
<td>5</td>
<td></td>
<td>Count-down marks (white numerals on black background)</td>
</tr>
<tr>
<td>123 – 102</td>
<td>22</td>
<td></td>
<td></td>
<td>Black frames with white vertical centre line 0.4 mm wide</td>
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<tr>
<td>101 – 99</td>
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<td>4</td>
<td></td>
<td>Count-down marks (white numerals on black background)</td>
</tr>
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<td>98 – 77</td>
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<td></td>
<td></td>
<td>Black frames with white vertical centre line 0.4 mm wide</td>
</tr>
<tr>
<td>76 – 74</td>
<td>3</td>
<td>3</td>
<td></td>
<td>Count-down marks (white numerals on black background)</td>
</tr>
<tr>
<td>73 – 52</td>
<td>22</td>
<td></td>
<td></td>
<td>Black frames with white vertical centre line 0.4 mm wide</td>
</tr>
<tr>
<td>51</td>
<td>1</td>
<td>2</td>
<td></td>
<td>Count-down mark (white numerals on black background)</td>
</tr>
<tr>
<td>50 – 49</td>
<td>2</td>
<td></td>
<td></td>
<td>1 kHz video frequency for pilot-tone start</td>
</tr>
<tr>
<td>48 – 26</td>
<td>23</td>
<td></td>
<td></td>
<td>Black frames with white vertical centre line 0.4 mm wide</td>
</tr>
<tr>
<td>25</td>
<td>1</td>
<td></td>
<td>1</td>
<td>“1” Mark on white circular ground, 6.5 mm Ø</td>
</tr>
<tr>
<td>24 – 1</td>
<td>24</td>
<td></td>
<td></td>
<td>Black frames with frame bars, no vertical centre line</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>Mark for cutting and fading-in 1st picture</td>
</tr>
</tbody>
</table>
### 8.21 Leader for 35-mm Television Film according to Specification 12/7

<table>
<thead>
<tr>
<th>Frame No. before 1st frame</th>
<th>No. of frames</th>
<th>Magnetic-sound film</th>
<th>Film image</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>250</td>
<td>1</td>
<td></td>
<td>Blank film with frame bars for film title, reel, original, copy, with/without sound, etc.</td>
<td></td>
</tr>
<tr>
<td>249</td>
<td>1</td>
<td></td>
<td>White frame</td>
<td></td>
</tr>
<tr>
<td>248 – 243</td>
<td>6</td>
<td></td>
<td>Replay symbols (Light background, black frame bars and figures) (see Part 1.6)</td>
<td></td>
</tr>
<tr>
<td>242 – 216</td>
<td>27</td>
<td></td>
<td>Black frames or name of the broadcasting or production organization in capital letters</td>
<td></td>
</tr>
<tr>
<td>215 – 213</td>
<td>3</td>
<td></td>
<td>White frames</td>
<td></td>
</tr>
<tr>
<td>212 – 183</td>
<td>30</td>
<td></td>
<td>Black frames with frame bars for leader-coding with perforations (2 holes per frame)</td>
<td></td>
</tr>
<tr>
<td>182 – 180</td>
<td>3</td>
<td></td>
<td>White frames for automatic start-cross identification</td>
<td></td>
</tr>
<tr>
<td>179</td>
<td>1</td>
<td></td>
<td>Frame with white-black step for automatic start-cross identification</td>
<td></td>
</tr>
<tr>
<td>178</td>
<td>1</td>
<td></td>
<td>Black frame with frame bars</td>
<td></td>
</tr>
<tr>
<td>177</td>
<td>1</td>
<td></td>
<td>Frame with black-white step</td>
<td></td>
</tr>
<tr>
<td>176</td>
<td>1</td>
<td></td>
<td>Frame with white-black step</td>
<td></td>
</tr>
<tr>
<td>175</td>
<td>1</td>
<td></td>
<td>Black frame with frame bars</td>
<td></td>
</tr>
<tr>
<td>174</td>
<td>1</td>
<td></td>
<td>White frame</td>
<td></td>
</tr>
<tr>
<td>173 – 172</td>
<td>2</td>
<td></td>
<td>Black frames with frame bars</td>
<td></td>
</tr>
<tr>
<td>171 – 163</td>
<td>8</td>
<td></td>
<td>Black frames with frame bars</td>
<td></td>
</tr>
<tr>
<td>162 – 151</td>
<td>12</td>
<td></td>
<td>White wedges, closing up over 12 frames</td>
<td></td>
</tr>
<tr>
<td>150</td>
<td>1</td>
<td></td>
<td>Film-start cross (possibly with transmitting organization’s logo), Sound-start mark for magnetic-sound film (adhesive label)</td>
<td></td>
</tr>
<tr>
<td>149 – 127</td>
<td>23</td>
<td></td>
<td>Black frames with white vertical centre line 0.85 mm wide</td>
<td></td>
</tr>
<tr>
<td>126 – 124</td>
<td>3</td>
<td></td>
<td>Count-down marks (white numerals on black background)</td>
<td></td>
</tr>
<tr>
<td>123</td>
<td>1</td>
<td></td>
<td>Black frame with white vertical centre line 0.85 mm wide</td>
<td></td>
</tr>
<tr>
<td>122</td>
<td>1</td>
<td></td>
<td>Magnetic sound – threading mark (white with black numeral)</td>
<td></td>
</tr>
<tr>
<td>121 – 102</td>
<td>20</td>
<td></td>
<td>Black frames with white vertical centre line 0.85 mm wide</td>
<td></td>
</tr>
<tr>
<td>101 – 99</td>
<td>3</td>
<td></td>
<td>Count-down marks (white numerals on black background)</td>
<td></td>
</tr>
<tr>
<td>98 – 77</td>
<td>22</td>
<td></td>
<td>Black frames with white vertical centre line 0.85 mm wide</td>
<td></td>
</tr>
<tr>
<td>76 – 74</td>
<td>3</td>
<td></td>
<td>Count-down marks (white numerals on black background)</td>
<td></td>
</tr>
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<td>73 – 52</td>
<td>22</td>
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<td>Black frames with white vertical centre line 0.85 mm wide</td>
<td></td>
</tr>
<tr>
<td>51</td>
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</tr>
<tr>
<td>48 – 26</td>
<td>23</td>
<td></td>
<td>Black frames with white vertical centre line 0.85 mm wide</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>1</td>
<td></td>
<td>“1” mark on white circular ground, 14 mm Ø</td>
<td></td>
</tr>
<tr>
<td>24 – 1</td>
<td>24</td>
<td></td>
<td>Black frames with frame bars, no vertical centre line</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td>Mark for cutting and fading-in 1st picture</td>
<td></td>
</tr>
</tbody>
</table>

**Leader 35-mm / 6 s run-up time**

- **Beginning of sound**
- **Direction of motion**
9. Appendix 1 – Technical Guidelines, Specifications and Standards

9.1 Sources of supply

**Technical Guidelines and Specifications**
Institut für Rundfunktechnik GmbH
Floriansmühlstr. 60
80939 München

Homepage: [http://www.irt.de/richtlinien](http://www.irt.de/richtlinien)
Telephone: +49-89-32399-384
Telefax: +49-89-32399-457

**EBU Documents:**
European Broadcasting Union
Ancienne Route 17A
1218 Grand-Saconnex / GE
Switzerland / Suisse

E-mail: puborder@ebu.ch
Homepage: [http://www.ebu.ch](http://www.ebu.ch)
Telephone: +41-22-717-2111
Telefax: +41-22-717-2200

**SMPTE Publications:**
Society of Motion Picture and Television Engineers
595 West Hartsdale Avenue
White Plains, New York 10607 USA

General E-Mail: smpte@smpte.org
Telephone: +1-914-761-1100
Telefax: +1-914-761-3115

**ITU Documents:**
International Telecommunication Union (ITU)
General Secretariat
Sales Service
Place des Nations
1211 Genève 20
Switzerland / Suisse

Homepage: [http://www.itu.int/publibase/itu-r/](http://www.itu.int/publibase/itu-r/)
Telephone: +41-22-7305111
Telefax: +41-22-7337256

**DIN Standards [Normen]/ISO Standards:**
Beuth Verlag GmbH
Burggrafenstr. 6
10787 Berlin

Homepage: [http://www2.beuth.de/](http://www2.beuth.de/)
Telephone: +49-30-2601-2260
Telefax: +49-30-2601-1260

**IEC Publications:**
VDE Verlag GmbH
Postfach 12 0143
10591 Berlin

E-Mail: vertrieb@vde-verlag.de
Homepage: [http://www.vde-verlag.de](http://www.vde-verlag.de)
Telephone: +49-30-348001-220
Telefax: +49-30-3417093
9.2 ADT, ZDF, ORF Guidelines

Handbuch Fernseh-Betriebsabwicklung in Deutschland
[Handbook of Television Operation Procedures in Germany]. This handbook contains all relevant details necessary for television operations.

Handbuch der Fernsehsystemtechnik
Beschreibung und Messung fernsehtechnischer Systeme
[Handbook of the television system technique; Description and measuring of television engineering systems]. Continuation of the specification No. 8/1.1: Guidelines for measurement of standard requirements on video devices.

IRT Richtlinie
Grundsätzliche Anforderungen an Magnettonanlagen und Richtlinien zu deren Einstellung
[IRT Guideline; Basic requirements on magnetic sound systems and guidelines for its alignment].

Regelwerk Fernsehproduktion
Strukturbestandteile des Austausch-Sets (Metadaten) für die Produktion
[Regelwerk television production; Structure components of the exchange-set (Metadata) for production]. This document makes provisions for mandatory and optional data elements for the exchange of programme relevant information.

9.2.1 Technical Guidelines 3/x – Sound engineering and sound recording

Technische Richtlinie 3/1-8/2
Allgemeine Richtlinien für Entwicklung, Fertigung und Lieferung von Studiogeräten, -systemen und -anlagen der Tonfrequenz- und Videofrequenztechnik
[Technical guideline 3/1-8/2; General guidelines for development, manufacturing and delivery of studio-devices, -systems and -equipments of the audio and video engineering]. This guideline contains requirements, specifications and recommendations for the development, manufacturing and delivery of devices, systems and equipments in sound and video engineering areas, the use of components and materials, the safety and operating rules to be considered and the documentation to be delivered.

Technische Richtlinie 3/4
Studio-Magnettonbänder
[Technical guideline 3/4; Studio magnetic sound tapes]. This guideline contains determinations for the assessment of operational suitability for tape deliveries (for types already known).

Technische Richtlinie 3/5
Tonregieanlagen
[Technical guideline 3/5; Sound control room equipment]. This guideline contains conditions, which are required for sound control systems in production and broadcasting. Sound control systems concerned can be stationary or transportable equipment.

Technische Richtlinie 3/6
Aussteuerungsmesser
[Technical guideline 3/6; Peak programme meters. In general, this guideline refers to peak programme meters for studio applications as they are in use at the German public broadcasters. The guideline deals with peak programme meters for both analogue and digital signals.
9.2.2 Technical Guidelines 8/x – Television studio engineering

Technische Richtlinie (Pflichtenheft) 8/1.1
*Richtlinien für die Messung der Pflichtenheftsbedingungen an Videogeräten*
[Technical guideline 8/1.1; Guidelines for the measurement of standard requirements on video devices]. In the past, technical guidelines have been developed for analogue devices and systems and have been designated and published as “standard specifications”. They are still valid indeed, but will be no longer maintained or updated. However, new guidelines concerning measurement techniques and measurement methods are determined in the “Handbuch der Fernsehsystemtechnik” (see above).

Technische Richtlinie 8/6.4
*Video-Magnetbänder (Oxyd) für das BETACAM-Format*
[Technical guideline 8/6.4; Video magnetic tape (Oxide) for the BETACAM format]. This guideline contains determinations for the assessment of operational suitability for tape deliveries.

Technische Richtlinie 8/9.1
*PAL-Coder (B, G/PAL nach ITU-R BT.471)*
[Technical guideline 8/9.1; PAL encoder (B, G/PAL in accordance with ITU-R BT.471)] This guideline makes provisions for specifications of PAL encoders.

Technische Richtlinie 8/9.2
*PAL-Decoder (B, G/PAL nach ITU-R BT.471)*
[Technical guideline 8/9.2; PAL decoder (B, G/PAL in accordance with ITU-R BT.471)] This guideline makes provisions for specifications of PAL decoders.

Technische Richtlinie 8 R 4
*Fernsehtext-Spezifikation*
[Technical guideline 8 R 4; Teletext specification]. This document describes the system parameters of the Teletext system.

Technische Richtlinie 8 R 7
*Richtlinie für eine einheitliche Fernsehbildwiedergabe*
[Technical guideline 8 R 7; Guideline for an uniform television image reproduction]. Generally, this guideline is valid for all television image reproduction equipment. In particular for those critical places, where picture quality assessment occurs (picture control, vision and sound monitoring, etc.) and where modifications will be performed if necessary (scenery design, image source adjustment, colour correction, etc.).

9.2.3 Technical guidelines 12/x – Television film

Technische Richtlinie 12/1
*Magnetfilm-Anlagen für Tonaufnahme und –wiedergabe*
[Technical guideline 12/1; Magnetic film equipment for sound recording and reproduction]. This guideline deals with magnetic film mechanisms for 35 mm and 17.5 mm magnetic sound film and 35 mm positive picture with magnetic sound track, as well as for magnetic film mechanisms for 16 mm magnetic sound film and 16 mm picture film with magnetic sound track.

Technische Richtlinie 12/2
*Magnetfilm 16 mm, 17.5 mm und 35 mm*
[Technical guideline 12/2; Magnetic film 16 mm, 17.5 mm and 35 mm]. This guideline describes the mechanical and electrical characteristics of magnetic film 16 mm, 17.5 mm and 35 mm.

Technische Richtlinie 12/7
*Richtlinie zur einheitlichen Festlegung des Start- und Endbandes für Fernsehfilm*
[Technical guideline 12/7; Guideline for an uniform determination of the leader and trailer for television film]. This guideline makes provisions for determinations concerning the design of...
the tape leader and trailer, as well as for the labelling of reels for 16 mm and 35 mm film. It also describes their usage for picture and magnetic film.

**Technische Richtlinie 12/10**

*Fernseh-Farbfilm (Technische Anforderungen, Messverfahren)*

[Technical guideline 12/10; Television colour film (Technical requirements, measurement methods)]. This guideline defines the technical requirements on television colour film (reversal and negative process film material as well as colour film copies). For the ascertaining of the characteristics and tolerance limits that, which are required for the exchange between raw film manufacturers and consumers, measuring and evaluation methods are indicated.

**9.2.4 HFBL-K Recommendations**

(HFBL-K: Conference of Chief Engineers of the Radio Services)

**HFBL-K Empfehlung 13IRT**

*Austausch digitaler Tonprogramme auf DAT-Kassetten*

[HFBL-K Recommendation 13IRT; Exchange of digital sound programmes on DAT cassettes]. This recommendation is based on EBU Recommendation R64 and supplemented by a recommendation for cassette finishing and an example for an accompanying text sheet.

**HFBL-K Empfehlung 15IRT**

*Headroom bei digitalen Tonsignalen*

[HFBL-K Recommendation 15IRT; Headroom for digital sound signals]. This recommendation is based on EBU Recommendation R68 and defines a headroom of 9 dB based on the reference level.

**HFBL-K Empfehlung 20RBT/AKAS**

*Richtlinien für die Messung von digitalen Geräten und Anlagen in der Audio-Technik*

[HFBL-K Recommendation 20RBT/AKAS; Guidelines for the measurement of digital devices and systems in audio engineering]. This recommendation provides a basis for the technical evaluation of digital audio components for broadcasters and manufacturers.

**9.2.5 Acceptance guidelines**

**ARD/ZDF-einheitliche Abnahmetoleranzen von Betacam-SP-Studioanlagen**

[ARD/ZDF uniform acceptance tolerances for Betacam-SP studio equipment]. The video and audio specifications defined for acceptance and alignment should guarantee optimal picture and sound quality even after multi-generation copies. They apply to Betacam-SP studio devices (Typ 60 and 70) with metal tape. The devices shall be generally optimised for metal tape.

**ARD-ZDF Abnahme-Richtlinien für digitale MAZ-Maschinen des Formats Digital Betacam**

[ARD-ZDF acceptance guidelines for digital VTR’s of the Digital Betacam format]. These guidelines provide uniform acceptance criteria for ARD and ZDF. The measurement parameters listed have been proved to be relevant by previous technical acceptance tests.

**ARD-ZDF Abnahme-Richtlinien für digitale MAZ-Maschinen des Formats D-5**

[ARD-ZDF acceptance guidelines for digital VTR’s of the D-5 format]. These guidelines provide uniform acceptance criteria for ARD and ZDF. The measurement parameters listed have been proved to be relevant by previous technical acceptance tests.

**ARD-ZDF DVCPRO-Abnahme-Richtlinien**

[ARD-ZDF DVCPRO acceptance guidelines]. These guidelines provide uniform acceptance criteria for ARD and ZDF.

**ARD-ZDF-ORF-tpc IMX-Abnahme-Richtlinien**

[ARD-ZDF-ORF-tpc IMX acceptance guidelines]. These guidelines provide uniform acceptance criteria for ARD, ZDF, ORF and tpc.
9.3 EBU

9.3.1 EBU Technical Statements - D

EBU Technical Statement D23

Timing relationship between the sub-carrier reference and the line synchronizing pulses for 625-line PAL television signals

This EBU Statement defines the Sc-H phase relationship, which is necessary to detect, without ambiguity, the PAL eight-field sequence of a video signal.

EBU Technical Statement D80

Compression in Television Programme Production

This EBU Statement contains statements concerning appropriate compression systems for television production.

EBU Technical Statement D82

M-JPEG in Future Networked Television Production

This EBU Statement concludes that for future networked TV production only the compression families DV-based compression or MPEG-2 4:2:2P@ML based compression are suitable. The M-JPEG compression is not suitable instead.

EBU Technical Statement D94

Use of MPEG 4:2:2P@ML compression standards and specific applications ranges in mainstream television production

EBU Statement concerning a uniform implementation of the MPEG-2 4:2:2P@ML compression in the TV production environment. It describes the D-10 (IMX) compatible variant of the compression MPEG-2 422@ML, 50 Mbit/s, I-frame.

9.3.2 EBU Technical Standard - N

EBU Technical Standard N10

Parallel interface for analogue component video signals

This Standard specifies the parameter of the analogue component signals Y, R-Y and B-Y, as well as the characteristics of the interface.

EBU Technical Standard N14

Reference signal for the synchronisation of 625-line digital television equipment

This Standard specifies a reference signal for the synchronisation of TV equipment. The signal can be used for synchronisation of analogue and digital devices.

EBU Technical Standard N22

The Broadcast Wave Format

This Standard specifies a file format for sound programme exchange.

9.3.3 EBU Technical Recommendation - R

EBU Technical Recommendation R37

The relative timing of the sound and vision components of a television signal

EBU Recommendation for permissible limits for the relative timing between the sound and the corresponding picture component of a television signal at the transmitter input.

EBU Technical Recommendation R38

Allocation of audio channels in analogue tape recording formats for international exchange of programmes

EBU Recommendation concerning the audio track allocation for the analogue video recording formats B, C, U-matic, Betacam, -SP and MII, for international programme exchange.
EBU Technical Recommendation R48

*Allocation of audio tracks on digital television recorders*

EBU Recommendation concerning the audio track allocation for digital video recording formats D-1, D-2, D-3, D-5, Digital Betacam, D-7 (DVCPRO), Betacam SX, D-9 (Digital-S), D-7 (DVCPRO50) and D-10 (IMX), for international programme exchange.

EBU Technical Recommendation R49

*Tape alignment leader for the exchange of television programmes*

EBU Recommendation concerning the design of a technical leader for the exchange of programme material on video tapes.

EBU Technical Recommendation R62

*Dominant field for 625-line 50-Hz video processing*

This EBU Recommendation makes provisions for the field dominance for video signals, where the change of picture material shall occur at the dominant field.

EBU Technical Recommendation R64

*Exchange of sound programmes as digital audio tape recordings*

This EBU Recommendation describes the parameter for the exchange of sound programmes using the professional version of the R-DAT format.

EBU Technical Recommendation R68

*Alignment level in digital audio production equipment and digital audio recorders*

This EBU Recommendation defines the “signal coding level” in digital audio systems.

EBU Technical Recommendation R71

*Labelling and identification of 16:9 aspect ratio television tape-recordings*

This EBU Recommendation makes provisions for a procedure for the designation of tapes that contain programmes with 16:9 aspect ratio.

EBU Technical Recommendation R74

*The vinegar syndrome and storage of cinefilm material*

This EBU Recommendation describes the vinegar syndrome and provides recommendations for the storage of cinefilm material.

EBU Technical Recommendation R81

*Recommended minimum information and preferred format for labels on television recordings for the international exchange of programmes*

This EBU Recommendation proposes an uniform labelling of video tapes (spools and cassettes) and their containers as well as for a record report and other programme and data carriers. One possible variant is, that the video cassette carries the barcode and tape number only, whereas the label on the container describes the programme content. The technical details are listed in a Record Report.

EBU Technical Recommendation R82

*Universal number and bar-code scheme for broadcast tapes, films and related media*

The IBTN system can be applied to any broadcast tape or related media and will enable them to be given a unique identity early in the production process. The IBTN representation in bar-code format means that broadcast tapes will be able to be scanned and identified as they move to and from facilities and broadcasters, and during transfers between broadcasters.

EBU Technical Recommendation R83

*Synchronisation of digital audio signals in a television environment*

This EBU Recommendation provides information concerning synchronisation of digital audio signals in a TV production environment.

EBU Technical Recommendation R86

*Scanned image area dimensions from films for television*

This EBU Recommendation specifies the dimensions of area to be scanned from 16mm and 35mm motion picture films. Its purpose is to be a reference document for harmonising the areas used in film cameras, film projectors, telecines and test films for television purposes.
EBU Technical Recommendation R91
Track allocations and recording levels for the exchange of multichannel audio signals
This EBU Recommendation defines the track allocation and recording levels for the exchange of multichannel audio programme material.

EBU Technical Recommendation R92
Active picture area and picture centring in analogue and digital 625/50 television systems
This EBU Recommendation describes the active picture area (in pixel) and the picture centring for analogue and digital 625/50 Hz television systems.

EBU Technical Recommendation R96
Formats for production and delivery of multichannel audio programmes
This EBU Recommendation contains uniform proceedings concerning multichannel audio programme material and for the generation of a stereo/mono compatible version.

9.3.4 EBU Technical Document – Tech.

EBU Technical Document 3218
Colour Telecines Methods of measurement and specification
This document provides basic information concerning the adjustment, alignment and use of telecines.

EBU Technical Document 3276
Listening conditions for the assessment of sound programme material: monophonic and two-channel stereophonic

EBU Technical Document 3276, Supplement 1
Listening conditions for the assessment of sound programme material: Supplement 1 multichannel sound

EBU Technical Document 3279
International Broadcast Tape Number (IBTN) and barcode labels
The IBTN enables a clear identification of tapes or other transport media for programmes, from origination via distribution to archiving, and also for the exchange with other organisations.

EBU Technical Document 3283
Measurements in digital component television studios
This document provides basic guidelines for the measurements in digital audio and video systems.

9.4 SMPTE

9.4.1 SMPTE - Standards

SMPTE Standard 305M
Serial Data Transport Interface
This Standard specifies a data stream protocol used for the transport of packetized data over the SDTI interface within a studio production environment.

SMPTE Standard 314M
Data Structure for DV-Based Audio, Data and Compressed Video – 25 and 50 Mb/s
This Standard defines the DV-based data structure for the interface of digital audio, subcode data, and compressed video for the following parameters of the 625/50 system: 4:1:1 image sampling structure, 25 Mb/s data rate, and 4:2:2 image sampling structure, 50 Mb/s data rate.
SMPTE Standard 321M
Data Stream Format for the Exchange of DV-Based Audio, Data and Compressed Video over a Serial Data Transport Interface
This Standard defines the format of the data stream for the synchronous exchange of DV-based audio, data, and compressed video (whose data structure is defined in SMPTE 314M and SMPTE 370M) over the interface defined in SMPTE 305M.

SMPTE Standard 322M
Format for Transmission of DV Compressed Video, Audio and Data over a Serial Data Transport Interface
This Standard specifies the data structure and the transmission format of DV compressed video, audio, and data over a serial data transport interface SDTI [SMPTE 305M].

SMPTE Standard 326M
SDTI Content Package Format – (SDTI-CP)
This Standard specifies the format for the transport of content packages (CP) on the serial digital transport interface (SDTI).

SMPTE Standard 332M
Encapsulation of Data Packet Streams over SDTI (SDTI-PF)
This Standard defines an open procedure for the transport of data packet streams over the SDTI interface according to SMPTE 305M.

SMPTE Standard 335M
Metadata Dictionary Structure
The metadata dictionary structure defined in this Standard covers the use of Metadata for all types of Essence (video, audio, and data in their various forms).

SMPTE Standard 336M
Data Encoding Protocol using Key-Length-Value
This Standard defines an octet-level data encoding protocol for representing data items and data groups.

SMPTE Standard 356M
Type D-10 Stream Specifications – MPEG-2 4:2:2P@ML for 525/60 and 625/50
This Standard specifies the compression constraints and bit-stream characteristics of a MPEG-2 video elementary stream operating at bit rates up to 50 Mb/s.

SMPTE Standard 360M
General Exchange Format (GXF)
This Standard describes a file format that can be used to move simple clips or compound clips. It also describes how file transfer protocol (FTP) can be used for the transfers.

SMPTE Standard 365M
12.65-mm Type D-10 Format for MPEG-2 Compressed Video – 525/60 and 625/50
This Standard includes the specifications for the recording format D-10 (IMX).

SMPTE Standard 377M
Material Exchange Format (MXF) - File Format Specification
This Standard is under development at present. The overall specification will also comprise other standards, which specify the packing of different Essenz types and user Metadata, as well as necessary constraints on complexity for specific usages. In addition, two Engineering Guidelines are under development in order to provide assistance during the introduction phase.

9.4.2 SMPTE – RP Recommended Practise

SMPTE Recommended Practice RP 210 SMPTE
Metadata Dictionary Registry of Metadata Element Description
This Metadata dictionary contents practice defines a registry of Metadata element descriptions for association with Essence or other Metadata. A full explanation is contained in SMPTE 335M.
9.5 ITU-R

9.5.1 ITU-R BR.

Recommendation ITU-R BR.408-7
\textit{International exchange of sound programmes recorded in analogue form}
This ITU Recommendation makes provisions for the exchange of sound programmes, which are recorded in analogue form, for the 6.3 tape, recorded at 38.1 cm/s or 19.05 cm/s.

Recommendation ITU-R BR.1215
\textit{Handling and storage of television and sound recordings on magnetic tape}
This ITU Recommendation provides information concerning the proper handling and storage of magnetic tapes.

9.5.2 ITU-R BS.

Recommendation ITU-R BS.646-1
\textit{Source encoding for digital sound signals in broadcasting studios}
This ITU Recommendation specifies the sampling frequency of 48 kHz for the coding, including recording, and the usage in TV studios.

Recommendation ITU-R BS.775-1
\textit{Multichannel stereophonic sound system with and without accompanying picture}
This ITU Recommendation describes an universal multi channel stereo sound system, with and without corresponding picture material, within a defined hierarchy.

9.5.3 ITU-R BT.

Recommendation ITU-R BT.470
\textit{Conventional Television Systems}
This ITU Recommendation specifies the characteristics of conventional television systems (standard television) for 525- and 625-line-systems.

Recommendation ITU-R BT.471
\textit{Nomenclature and description of colour bar signals}
This ITU Recommendation contains information concerning the colour bar signal, which is suitable for the technical leader amongst others.

Recommendation ITU-R BT.601
\textit{Studio Encoding Parameters of Digital Television for Standard 4:3 and Wide-Screen 16:9 Aspect Ratios}
This ITU Recommendation makes provisions for the specifications of digital coding of video signals. It specifies the digital studio-standard, which is also expressed by the terms – transparent, 601, SDI, etc. Within ARD/ZDF guidelines the German term “DSC 270, Digitale Serielle Komponenten mit 270 Mbit/s” is usually used.

Recommendation ITU-R BT.656
\textit{Interface for digital component video signals in 525-line and 625-line television systems operating at the 4:2:2 level of Recommendation ITU-R BT.601 (Part A)}
This ITU Recommendation specifies the interface for the exchange of digital component signals according to ITU-R BT.601
9.6 DIN

Deutsche Norm DIN ISO 69
16-mm-Film Kinematographie
[16 mm Film Cinematography]. This Norm defines the cutting and perforation dimensions for 16 mm film and 16 mm magnetic film.

Deutsche Norm DIN 15502-2
Film 35 mm, Bildgrößen, Wiedergabe für Fernsehzwecke, Bildseitenverhältnis 1.33:1
[Film 35 mm, Picture size, Reproduction for TV purposes, Picture aspect ratio 1.33:1]. This Norm is valid for non-anamorphic picture reproduction for TV purposes of film 35 mm with a picture aspect ratio of 1.33:1. By means of dated and undated references, this Norm contains specifications from other publications. These normative references are quoted on the appropriate place within the text and the relevant publications are listed subsequently. In case of undated references, the last edition of the publication concerned is valid.

Deutsche Norm DIN 15531
Kerne für Kinefilm und Magnetfilm, Filmkerne, Zwischenkerne Anwendungsbereich
[Bobbins for Cinema film and Magnetic film, Film bobbin, Adaptor bobbins, Application area]. This Norm contains dimensions and designations of bobbins for cinema film and magnetic film. It is also valid for adaptor bobbins.

Deutsche Norm DIN 15540-1
Film 17.5 mm und Film 35 mm, Klebestellen 35 mm überlappt
[Film 17.5 mm and Film 35 mm, Splices 35 mm overlapped]. This Norm makes provisions for the requirements on overlapped splices for film 35 mm.

Deutsche Norm DIN 15545
Film 35 mm, Bildgrößen, Wiedergabe Bildseitenverhältnis 1.66:1
[Film 35 mm, Picture size, Reproduction picture aspect ratio 1.66:1]. This Norm is valid for anamorphic filming and reproduction using film 35 mm. The anamorphic factor is 2, i.e. by means of an anamorphic attachment the length of the horizontal image side is pressed to the half during filming and copying, but stretched to the twofold during reproduction, compared to the image reproduction of the basic lens only. The basic lens determines the image scale in the vertical for the negative and positive, only. The aspect ratio for the anamorphic stretched and projected picture is 2.35:1 (Cinemascope method).

Deutsche Norm DIN 15552-1
Magnetfilm 17.5 mm und 35 mm, Material, Äußere Aufmachung
[Magnetic film 17.5 mm and 35 mm, Material, Appearance]. This Norm is valid for magnetic film 17.5 mm with single-sided perforation and magnetic film 35 mm with dual-sided perforation and magnetic layer.

Deutsche Norm DIN 15552-3
Magnetfilm 17.5 mm und 35 mm, Magnetfilm 17.5 mm mit einseitiger Perforation, Zweispur-Tonaufzeichnung mit einer Kennspur
[Magnetic film 17.5 mm and 35 mm, Magnetic film with single-sided perforation, dual-track sound recording with an identification track]. This Norm defines frame rate, position and dimensions of the magnetic sound tracks for the recording and replay of single-track and dual-track sound recordings on magnetic film 17.5 mm with single-sided perforation according to DIN 15655 Part 1, and magnetic film 35 mm with dual-sided perforation.
Deutsche Norm DIN 15576-5

Angaben für Kine- und Magnetfilme, Angaben auf Aufklebern für Filmendosen und –
schachteln für Filmsendekopien im internationalen Austausch

[Details for Cinema films and Magnetic films, Details on labels for film cans and film boxes for film transmission copies for international exchange]. This Norm is valid for labels on film cans and film boxes of film transmission copies and original material with combined or separate sound recording for international exchange. The label also includes the designation in English language.

Deutsche Norm DIN 15602-2

Film 16 mm, Bildgrößen, Wiedergabe für Fernsehzwecke, Bildseiten-Verhältnis 1,33:1

[Film 16 mm, Picture size, Reproduction for TV purposes, Picture aspect ratio 1.33:1]. This Norm is valid for non-anamorphic picture reproduction for TV purposes of film 16 mm with a picture aspect ratio of 1.33:1 (identical with ISO 69).

Deutsche Norm DIN 15638

Magnetfilm 16 mm mit einseitiger Perforation, DIN-Bezugsfilme BF 16 A und BF 16 F

[Magnetic film 16 mm with single-sided perforation, DIN reference films BF 16A and BF 16F]. This Norm considers DIN reference films BF 16A for the adjustment of tracks 1 and 2 according to DIN 15655 Part 3 and/or the picture positive edge track according to DIN 15681 Part 1, as well as the DIN reference film BF 16F for the adjustment of track 1, 2 and K according to DIN 15655 Part 3 for magnetic film mechanism.

Deutsche Norm DIN 15653-1

Film 16 mm, Klebestellen, überlappt

[Film 16 mm, Splices, overlapped]. This Norm is valid for overlapped splices on film 16 mm according to DIN 15601. It is valid for splices on single-stripped as well as for multi-stripped arranged film negatives, film positives and reversal materials.

Deutsche Norm DIN 15655

Magnetfilm 16 mm mit einseitiger Perforation, Material, Äußere Aufmachung

[Magnetic film 16 mm with single-sided perforation; Material, Exterior appearance]. This Norm is valid for magnetic film 16 mm, single-sided perforated with magnetic layer.

Deutsche Norm DIN 15655-3

Magnetfilm 16 mm mit einseitiger Perforation, Zweispur-Tonaufzeichnung mit einer
Kennspur

[Magnetic film 16 mm with single-sided perforation, Dual-track sound recording with an identification track]. This Norm defines frame rate, position and dimensions of the magnetic sound tracks and magnetic heads for the recording and replay of single-track and dual-track sound recording, as well as for an identification track on magnetic film 16 mm with single-sided perforation according to DIN 15655 Part 1.

Deutsche Norm DIN 15655-4

Magnetfilm 16 mm mit einseitiger Perforation; Mechanische und Elektroakustische
Anforderungen

[Magnetic film 16 mm with single-sided perforation; Mechanical and electro-acoustical requirements].

Deutsche Norm DIN 15910-2

Magnetköpfe; Elektrische und magnetische Kenndaten mit Einflussgrößen; Mess-
bedingungen (Spaltversatz bei Zweikanal-Tonaufzeichnungen)

[Magnetic heads; Electrical and magnetic characteristics with influence factors; Measuring conditions (azimuth misalignment of two channel sound recordings)].

Deutsche Norm DIN 15975-1

Bildsynchrone Tonaufzeichnung auf wiederbeschreibbarer 130-mm-magneto-optischer
Disk (MOD 130) - Teil 1: Grundlegende Anforderungen. (MOD-Platten für den digitalen
Programmaustausch)

[Synchronous sound recording on re-recordable 130 mm magneto optical disk (MOD 130) – Part 1: Basic requirements. (MOD disks for digital programme exchange).
Deutsche Norm DIN 15996
Elektronische Laufbild- und Tonbearbeitung in Film-, Video- und Rundfunkbetrieben, Anforderungen an den Arbeitsplatz
[Electronic processing for moving pictures and sound in film, video, radio and broadcast organisations; Requirements on the working place]. This Norm applies to the requirements on working places and its environment for programme production in the above areas.

Deutsche Norm DIN IEC 60268
Elektroakustische Geräte
[Electro-acoustical Equipment]. This Norm provides the definition of the characteristics of electro-acoustical equipment, the comparison of that equipment and the definition of its appropriate usage by listing the characteristics, which are necessary for its technical description.

Deutsche Norm DIN EN 60461
Zeit- und Steuercode für Videobandgeräte
[Time and control code for video tape recorders]. This Norm is the German translation of IEC 60461 and includes the specifications of the digital time and control code for use in television, film and corresponding sound systems for 30, 25 and 24 frames per second.

Deutsche Norm DIN EN 60961
Videoband-Kassettensystem mit Schrägspurlaufzeichnung auf Magnetband 12,65 mm (0,5in); L-Format
[Helical-scan video tape cassette system using 12.65 mm (0.5in) magnetic tape on type L]. This Norm provides the German translation of IEC 961 and contains the specifications for the video recording format Betacam / Betacam SP.

Deutsche Norm DIN EN 61119-3
DAT Kassetten
[DAT cassettes]. This Norm specifies the DAT cassettes for professional use.

Deutsche Norm DIN EN 61119-5
Digitales Tonband-Kassetten-System
[Digital Audio Tape Cassette System]. This Norm specifies the DAT System for professional use.

Deutsche Norm DIN EN 61835
Videokassettenlaufzeichnung mit Schrägspurlaufzeichnung digitaler Komponentensignale auf Magnetband 12,65 mm (0.5 in) D-5-Format
[Helical-scan digital component video cassette recording system using 12.65 mm (0.5 in) magnetic tape – Format D-5]. This Norm is the German translation of IEC 61835 and contains the specifications for the video recording format D-5.

Deutsche Norm DIN EN 61904
Videokassettenlaufzeichnung mit Schrägspurlaufzeichnung digitaler Komponentensignale auf Magnetband 12,65 mm; verbunden mit Datenkompression (Digital-L-Format)
[Helical-scan digital component video cassette recording format using 12.65 mm magnetic tape and incorporating data compression (Format digital-L)]. This Norm is the German translation of IEC 61904 and contains the specifications for the video recording format Digital-L (Digital Betacam).

Deutsche Norm DIN EN 62071
Videokassettenlaufzeichnung mit komprimierter digitaler Schrägspurlaufzeichnung auf Magnetband 6,35 mm – Format D-7
[Helical-scan compressed digital video cassette recording system using 6.35 mm magnetic tape – Format D-7]. This Norm is the German translation of IEC 62071 and contains the specifications for the video recording format D-7 (DVCPRO/50).
9.7 IEC

International Standard IEC 60961
Helical-scan video tape cassette system using 12.65 mm (0.5in) magnetic tape on type L
This Standard contains the specifications for the video recording format Betacam SP.

International Standard IEC 61834-1
Helical-scan digital video cassette recording system using 6.35 mm magnetic tape for consumer use (525-60, 625-50, 1125-60 and 1250-50 systems) - Part 1: General specifications
This Standard contains the specifications for cassettes, modulation method, magnetization, basic system data, etc., for the digital non-broadcast format DV.

International Standard IEC 61834-2
Helical-scan digital video cassette recording system using 6.35 mm magnetic tape for consumer use (525-60, 625-50, 1125-60 and 1250-50 systems) - Part 2: SD format for 525-60 and 625-50 systems
This Standard specifies the content, format and recording method of the recorded data blocks, which contain audio, video and system data, for 525- and 625-line systems of the digital non-broadcast format DV.

International Standard IEC 61835
Helical-scan digital component video cassette recording system using 12.65 mm (0.5 in) magnetic tape – Format D-5
This Standard contains the specifications for the video recording format D-5.

International Standard IEC 61904
Helical-scan digital component video cassette recording format using 12.65 mm magnetic tape and incorporating data compression (Format digital-L)
This Standard contains the specifications for the video recording format Digital Betacam.

International Standard IEC 62071
Helical-scan compressed digital video cassette recording system using 6.35 mm magnetic tape – Format D-7
This Standard contains the specifications for the video recording format D-7 (DVCPRO/50).

International Standard IEC 62289
Helical-scan digital video cassette recording format using 12.65 mm magnetic tape and incorporating MPEG-2 compression – Format D-10
This Standard contains the specifications for the video recording format D-10 (IMX).

9.8 ISO

ISO/IEC 10089 - Information technology
130 mm rewritable optical disk cartridge for information interchange

ISO 1223 - Cinematography
Picture areas for motion-picture films for television, Position and dimensions

ISO 2907 - Cinematography
Maximum projectable image area on 35mm motion-picture film, Position + dimensions

ISO 8758 - Cinematography
Photographic control and data records on 16 mm and 35 mm motion-picture film and prints, Dimensions and location
### 10. Appendix 2 – Abbreviations used in this guideline

<table>
<thead>
<tr>
<th>A</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAF</td>
<td>Advanced Authoring Format (File format of the Advanced Authoring Association)</td>
</tr>
<tr>
<td>AAi</td>
<td>Authorized Address Identifier (SDTI Signal, SMPTE 305M)</td>
</tr>
<tr>
<td>AES</td>
<td>Audio Engineering Society</td>
</tr>
<tr>
<td>A/D</td>
<td>Analogue / Digital</td>
</tr>
<tr>
<td>ADAT</td>
<td>Digital eight channel audio recording format</td>
</tr>
<tr>
<td>ADF</td>
<td>Auxiliary Data Flag (SDTI signal, SMPTE 305M)</td>
</tr>
<tr>
<td>AKAS</td>
<td>Arbeitskreis Audiosystemtechnik (working group on audio system technique)</td>
</tr>
<tr>
<td>ARD</td>
<td>Arbeitsgemeinschaft der öffentlich-rechtlichen Rundfunkanstalten der BRD (Association of public-service broadcasting organisations of the Federal Republic of Germany)</td>
</tr>
<tr>
<td>AVI</td>
<td>Audio Video Interleave (audio video file format - video for windows)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Blue</td>
</tr>
<tr>
<td>B</td>
<td>Picture width (film picture formats)</td>
</tr>
<tr>
<td>B</td>
<td>Loudspeaker base-width (multi channel stereo systems)</td>
</tr>
<tr>
<td>B</td>
<td>Black (colour space)</td>
</tr>
<tr>
<td>B/PAL</td>
<td>PAL, system B according to Recommendation ITU-R BT.470</td>
</tr>
<tr>
<td>B-Y</td>
<td>Analogue colour difference signal (colloquial)</td>
</tr>
<tr>
<td>BWF</td>
<td>Broadcast Wave Format (audio file format, EBU N22)</td>
</tr>
<tr>
<td>BKSTS</td>
<td>British Kinematograph Sound and Television Society</td>
</tr>
<tr>
<td>BMP</td>
<td>Bitmap (graphic format)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>C</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>Chrominance signal</td>
</tr>
<tr>
<td>C</td>
<td>Centre (multichannel stereo systems)</td>
</tr>
<tr>
<td>C_b</td>
<td>Colour difference signal (digital)</td>
</tr>
<tr>
<td>C_r</td>
<td>Colour difference signal (digital)</td>
</tr>
<tr>
<td>CCR</td>
<td>Colour correction</td>
</tr>
<tr>
<td>CCVS</td>
<td>Composite colour video signal</td>
</tr>
<tr>
<td>cf.</td>
<td>confer</td>
</tr>
<tr>
<td>Cin.</td>
<td>Cinemascope</td>
</tr>
<tr>
<td>Compr.</td>
<td>Compromise format</td>
</tr>
<tr>
<td>CRC</td>
<td>Cyclic Redundancy Check (SDI and SDTI signal)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>D</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>D/A</td>
<td>Digital / Analogue</td>
</tr>
<tr>
<td>dB</td>
<td>Decibel</td>
</tr>
<tr>
<td>dBu</td>
<td>Decibel referring to the voltage of 0.775 V&lt;sub&gt;ms&lt;/sub&gt;-</td>
</tr>
<tr>
<td>d BFS</td>
<td>Decibel Full Scale referring to the clip level</td>
</tr>
<tr>
<td>dB r</td>
<td>Decibel referring to the relative voltage level</td>
</tr>
<tr>
<td>DID</td>
<td>Data ID (SDTI signal, SMPTE 305M)</td>
</tr>
<tr>
<td>DIF</td>
<td>Digital InterFace (structure of the DV-based compression)</td>
</tr>
<tr>
<td>Dig. S</td>
<td>Digital S, recording format</td>
</tr>
<tr>
<td>DIN</td>
<td>Deutsche Industrie Norm (German Industries Standard)</td>
</tr>
<tr>
<td>DLR</td>
<td>DeutschlandRadio</td>
</tr>
<tr>
<td>DSK270</td>
<td>Digital Serielle Komponenten, 270 Mbit/s</td>
</tr>
<tr>
<td>DV</td>
<td>Video compression scheme according to IEC 61843</td>
</tr>
<tr>
<td>DV-based</td>
<td>Video compression scheme according to SMPTE 314M</td>
</tr>
<tr>
<td>DVB</td>
<td>Digital Video Broadcasting</td>
</tr>
<tr>
<td>DVCAM</td>
<td>Digital video recording format using DV compression, 25Mbit/s</td>
</tr>
<tr>
<td>DVCPRO</td>
<td>Digital video recording format (D-7) using DV-based compression, 25Mbit/s</td>
</tr>
<tr>
<td>DVCPRO50</td>
<td>Digital video recording format (D-7) using DV-based compression, 50Mbit/s</td>
</tr>
<tr>
<td>DMS-1</td>
<td>Data Modelling Scheme</td>
</tr>
<tr>
<td>D-1</td>
<td>Digital video recording format without compression, 19 mm tape</td>
</tr>
<tr>
<td>D-5</td>
<td>Digital video recording format without compression, 12.65 mm tape</td>
</tr>
<tr>
<td>D-7</td>
<td>Digital video recording format using compression, (DVCPRO or DVCPRO 50)</td>
</tr>
<tr>
<td>D-10</td>
<td>Digital video recording format using compression, (IMX)</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
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</tr>
<tr>
<td>DCT</td>
<td>Discrete Cosines Transformation</td>
</tr>
<tr>
<td>DVE</td>
<td>Digital Video Effects</td>
</tr>
<tr>
<td>DAT</td>
<td>Digital Audio Tape</td>
</tr>
<tr>
<td>EAV</td>
<td>End of Active Video (SDI and SDTI Signal)</td>
</tr>
<tr>
<td>EBU</td>
<td>European Broadcasting Union</td>
</tr>
<tr>
<td>EMU</td>
<td>Electro Magnetic Compatibility</td>
</tr>
<tr>
<td>EMV</td>
<td>Elektromagnetische Verträglichkeit (Electro Magnetic Compatibility)</td>
</tr>
<tr>
<td>E'Y</td>
<td>Analogue gamma pre-corrected voltage level of the luminance signal</td>
</tr>
<tr>
<td>E'CR</td>
<td>Analogue gamma pre-corrected voltage level of the colour difference signal (red component)</td>
</tr>
<tr>
<td>E'CB</td>
<td>Analogue gamma pre-corrected voltage value of the colour difference signal (blue component)</td>
</tr>
<tr>
<td>E'S</td>
<td>Analogue gamma pre-corrected voltage value of the blue signal</td>
</tr>
<tr>
<td>E'G</td>
<td>Analogue gamma pre-corrected voltage value of the green signal</td>
</tr>
<tr>
<td>E'R</td>
<td>Analogue gamma pre-corrected voltage value of the red signal</td>
</tr>
<tr>
<td>EDL</td>
<td>Edit Decision List</td>
</tr>
<tr>
<td>ES</td>
<td>Elementary Stream</td>
</tr>
<tr>
<td>etc.</td>
<td>et cetera (and so forth)</td>
</tr>
<tr>
<td>ETSI</td>
<td>European Telecommunications Standards Institute</td>
</tr>
<tr>
<td>FS</td>
<td>Fernseh(en) (television)</td>
</tr>
<tr>
<td>FT-UT</td>
<td>Fernsehtext-Untertitel (videotext sub-title)</td>
</tr>
<tr>
<td>FT</td>
<td>Tens of frames (ARRI time code)</td>
</tr>
<tr>
<td>FU</td>
<td>Unit of frames (ARRI time code)</td>
</tr>
<tr>
<td>FM</td>
<td>Frequency modulation</td>
</tr>
<tr>
<td>G</td>
<td>Green</td>
</tr>
<tr>
<td>G/PAL</td>
<td>PAL, System G according to Recommendation ITU-R BT.470</td>
</tr>
<tr>
<td>GXF</td>
<td>General Exchange Format (audio video file format)</td>
</tr>
<tr>
<td>H</td>
<td>Height of screen (multi channel stereo systems)</td>
</tr>
<tr>
<td>HFBL-K</td>
<td>Hörfunk-Betriebsleiter-Konferenz (Conference of Chief Engineers of the Radio Services)</td>
</tr>
<tr>
<td>HDTV</td>
<td>High Definition Television</td>
</tr>
<tr>
<td>HT</td>
<td>Tens of hours (ARRI time code)</td>
</tr>
<tr>
<td>HU</td>
<td>Unit of hours (ARRI time code)</td>
</tr>
<tr>
<td>ID</td>
<td>Identifier</td>
</tr>
<tr>
<td>I.E.</td>
<td>id est</td>
</tr>
<tr>
<td>IEC</td>
<td>International Electrotechnical Commission</td>
</tr>
<tr>
<td>IMX</td>
<td>Digital video recording format (D-10) using MPEG compression, 50Mbit/s</td>
</tr>
<tr>
<td>IRT</td>
<td>Institut für Rundfunktechnik (Research and Development Institute of ARD, ZDF, DLR, ORF and SRG/SSR)</td>
</tr>
<tr>
<td>IS</td>
<td>International Sound</td>
</tr>
<tr>
<td>ISO</td>
<td>International Organization for Standardization</td>
</tr>
<tr>
<td>IT</td>
<td>Internationaler Ton (international sound)</td>
</tr>
<tr>
<td>ITU-R</td>
<td>International Telecommunication Union - Radio</td>
</tr>
<tr>
<td>ITU-R BR</td>
<td>ITU-R, Sound and television recording</td>
</tr>
<tr>
<td>ITU-R BS</td>
<td>ITU-R, Broadcasting service (sound)</td>
</tr>
<tr>
<td>ITU-R BT</td>
<td>ITU-R, Broadcasting service (television)</td>
</tr>
<tr>
<td>JPEG</td>
<td>Joint Picture Expert Group (compression scheme for single pictures)</td>
</tr>
<tr>
<td>K</td>
<td>Kelvin (colour temperature)</td>
</tr>
</tbody>
</table>
### L
- **L**: Left
- **LFE**: Low Frequency Extension (multi channel stereophonic system)
- **LS**: Left - Surround
- **LSB**: Least Significant Bit
- **LTC**: Linear Time Code

### M
- **MAZ**: Magnetische Aufzeichnung (VTR, video tape recorder)
- **max.**: maximum
- **Mbit/s**: Megabit per second
- **Mg**: Magenta
- **MHz**: Megahertz
- **M-JPEG**: Motion-Joint Picture Expert Group (compression scheme for picture sequences)
- **mm**: Millimetre
- **MPEG-2**: Motion Picture Expert Group-2 (compression standard)
- **4:2:2P@ML**: four:two:two profile at main level (variant of the MPEG-2 compression)
- **MOD**: Magneto Optical Disk
- **ms**: Millisecond
- **MS**: Monophonic Surround, (middle/side signal or surround signal in mono)
- **MSB**: Most Significant Bit
- **MT**: Tens of minutes (ARRI time code)
- **MU**: Unit of minutes (ARRI time code)
- **MXF**: Material eXchange Format (audio video file format according to SMPTE 377M)

### N
- **NLE**: Non Linear Editing

### O
- **ORF**: Österreichischer Rundfunk (Public Broadcasting Organisation of Austria)
- **OMF**: Open Media Framework (audio video file format)

### P
- **PAL**: Phase Alternating Line system
- **PALplus**: A PAL compatible transmission system for the picture aspect ratio 16:9
- **Pixel**: Picture element
- **P/META**: EBU working group on Metadata
- **PPM**: Peak Programme Meter

### Q
- **Quicktime**: Audio video file format (MacOS, Quicktime for Windows)

### R
- **R**: Red
- **RBT**: Rundfunk-Betriebstechnik GmbH (Community institution of some public-service broadcasting organisations of the ARD and the ZDF)
- **Real-Video**: Internet Streaming Format
- **RGB**: Red Green Blue
- **R-Y**: Analogue colour difference signal (colloquial)
- **RS**: Right - Surround (multi channel stereophonic system)
- **R**: Right

### S
- **s**: Second
- **SAV**: Start of Active Video (SDI and SDTI signal)
- **Sc-H**: sub-carrier-to-line-sync phase relationship
- **SDI**: Serial Digital Interface
- **SDTI**: Serial Data Transport Interface
- **SDTI-CP**: SDTI Content Package
- **SMPTE**: Society of Motion Picture Television Engineers
- **SEPMAG**: Separated Magnetic Track
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>SRG/SSR</td>
<td>Schweizerische Radio- und Fernsehgesellschaft (Swiss Broadcasting Corporation)</td>
</tr>
<tr>
<td>ST</td>
<td>Tens of seconds (ARRI time code)</td>
</tr>
<tr>
<td>SU</td>
<td>Unit of seconds (ARRI time code)</td>
</tr>
<tr>
<td>S16</td>
<td>Super 16</td>
</tr>
<tr>
<td><strong>T</strong></td>
<td></td>
</tr>
<tr>
<td>T</td>
<td>Clock period</td>
</tr>
<tr>
<td>TC</td>
<td>Time Code</td>
</tr>
<tr>
<td>TIFF</td>
<td>Tagged Image File Format (Graphic format)</td>
</tr>
<tr>
<td>tpc</td>
<td>Technical Production Center (Zürich), an enterprise of the SRG/SSR</td>
</tr>
<tr>
<td>TPRF</td>
<td>Technische Produktions-Richtlinien Fernsehen (Technical Production Guidelines Television)</td>
</tr>
<tr>
<td>TS</td>
<td>Transport Stream</td>
</tr>
<tr>
<td>TV</td>
<td>Television</td>
</tr>
<tr>
<td><strong>U</strong></td>
<td></td>
</tr>
<tr>
<td>UB</td>
<td>User Bit (ARRI time code)</td>
</tr>
<tr>
<td>USER-BITS</td>
<td>User specific bits within the time code signal</td>
</tr>
<tr>
<td>UMID</td>
<td>Unique Material Identifier</td>
</tr>
<tr>
<td>USS</td>
<td>Uniform Symbology Specification (Barcode Font)</td>
</tr>
<tr>
<td><strong>V</strong></td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>Voltage</td>
</tr>
<tr>
<td>$V_{rms}$</td>
<td>Voltage root mean square</td>
</tr>
<tr>
<td>$V_{pp}$</td>
<td>Voltage peak to peak</td>
</tr>
<tr>
<td>VAUX</td>
<td>Video Auxiliary Data</td>
</tr>
<tr>
<td>VDE</td>
<td>Verband Deutscher Elektrotechniker (Association of German Electro Technicians)</td>
</tr>
<tr>
<td>VITC</td>
<td>Vertical Interval Time Code</td>
</tr>
<tr>
<td>VISC</td>
<td>Vertical Interval Subcarrier Reference</td>
</tr>
<tr>
<td>VPS</td>
<td>Video Programme System</td>
</tr>
<tr>
<td>VT-Master</td>
<td>Videotape-Master</td>
</tr>
<tr>
<td><strong>W</strong></td>
<td></td>
</tr>
<tr>
<td>Wh</td>
<td>White</td>
</tr>
<tr>
<td>WSS</td>
<td>Wide Screen Signalling</td>
</tr>
<tr>
<td><strong>Y</strong></td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td>Luminance signal</td>
</tr>
<tr>
<td>YI</td>
<td>Yellow</td>
</tr>
<tr>
<td><strong>Z</strong></td>
<td></td>
</tr>
<tr>
<td>ZDF</td>
<td>Zweites Deutsches Fernsehen (Germany's national Public Television Broadcaster ZDF)</td>
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**Special signs**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>µs</td>
<td>Microsecond</td>
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