The following document was drawn up on behalf of the Conference of Head of Television Operations (Fernsehbetriebsleiter-Konferenz, FSBL-K) by the working group "Television technical production guidelines" (TPRF). It represents the situation of the work accepted by the FSBL-K in November 2006.

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*Technical Guidelines, Specifications and Standards referred to in these Guidelines may be obtained from the sources listed in Para. 10.1.*
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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 (transmission and file) transfer 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 and ORF 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). In the context of new television systems it is known as SDTV (Standard Definition Television) designated by the term "576i/25" (576 active lines, interlaced, with 25 frames). Relevant specifications are laid down in ITU-R Recommendation BT.470 for the B/PAL and G/PAL systems. Specifications for the digital coding of video signals are laid down in Recommendation ITU-R BT.601 (Digital Studio Standard for SDTV, denoted by DSK 270, SDI or 601).

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

*Note:* All relevant details on operations procedures are contained in the "Handbuch Fernsehbetriebsabwicklung" (Television Operations Procedures Handbook).

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 and make-up**

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 and the studio's colour reproduction temperature (3200K).

*Note:* If, fluorescent set elements are wanted and used for artistic production reasons, e.g. in the area of light entertainment, allowance must be made for distinctly higher reflectance values and hence higher signal levels and overmodulation effects.
To avoid problems arising later on, care must be taken to ensure that the lighting in make-up rooms is equivalent to the studio lighting (the colour temperature of all lights used to be between 3100K and 3200K).

### 1.3 Picture formats 4:3 and 16:9

All programme items in SD (Standard Definition) television productions must be in the formats 4:3 or 16:9.

- The classic television format is 4:3 (1,33:1), or in other words 12:9; this refers to the ratio of the width of the picture to its height.
- The 16:9 (1,78:1) format is specific to television. TV programmes are increasingly being made in 16:9, independently of the definition, i.e. any questions of SD (Standard Definition) and HD (High Definition).

Care should be taken to ensure that productions should be shot "true to format", i.e. failing an explicit agreement to the contrary, programme items should not be made in "shoot and protect" mode.

**Note:** Relevant information and support assistance in the transition from the 4:3 picture format to 16:9 in SD TV production is to be found in the NDR publication "Das Breitbildbuch 2" (The Widescreen Book 2) and in the WDR publication "Das 16:9 Handbuch" (The 16:9 Handbook). All facets are treated, from shooting to transmission and archiving via editing, cutting, transfer, and design.

**Note:** Because of the differences in the way the 4:3 picture format is displayed on home equipment (set-top boxes and various display devices), it is already the case that distortion-free reproduction of picture geometry is only guaranteed when broadcasting in 16:9 full format.

**Note:** The basic background to the 4:3 and 16:9 picture formats is discussed in Annexes 9.1 to 9.5.

#### 1.3.1 Aspect Ratio

The active picture width is defined by the active analogue line length of 52µs. This corresponds to a digital line length of 702 pixels. In line with EBU Technical Recommendation R92 all calculations concerning the picture format (aspect ratio) are based on this figure. Further explanations under Paras. 2.1.7 and 2.1.11.

**Note:** Any process for calculating the aspect ratio based on 720 pixels image width may cause unwanted errors as regards picture geometry, centre of interest, and caption area.

#### 1.3.2 Format labelling

Examples of playback formats of picture sources in the aspect ratios 4:3 and 16:9 are shown in Annexes 9.2 and 9.3. For the sake of further clarity of identification and signalling the following labels have been defined for the various picture formats:

<table>
<thead>
<tr>
<th>No.</th>
<th>Picture format [labelling]</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>4:3</td>
<td>Denotes a 4:3 full format.</td>
</tr>
<tr>
<td>b</td>
<td>4:3 Letterbox</td>
<td>Denotes a 4:3 picture format in which black bands are added to the embedded widescreen format (16:9 or another ratio) in order to fill the 4:3 picture.</td>
</tr>
<tr>
<td>c</td>
<td>16:9 Full Format</td>
<td>Denotes a 16:9 full format.</td>
</tr>
<tr>
<td>d</td>
<td>16:9 Full Format (LB)</td>
<td>Denotes a 16:9 picture format in which other formats can also be embedded, with the addition of black bands in order to fill the 16:9 picture, e.g. a film scanned in Cinemascope.</td>
</tr>
</tbody>
</table>
Note: For television operations it is also necessary to provide the information required under Paras. 1.9 and 2.6 concerning any picture format conversions that may have been performed.

In particular, additional information on the 16:9 format is necessary in the case of:

- a 16:9 full format that has been generated from 4:3 material, or
- a 4:3 full format that has been generated from 16:9 material.

Providing this information is the only way to prevent any further detrimental conversion of the picture format later on in the production process.

1.3.3 4:3 Magazine items from 16:9 productions

As required under Para. 1.3, in each picture format production must be "true to format; i.e. only when explicitly agreed otherwise may the programme items be produced in "shoot and protect" mode. This can be the case when it is foreseeable from the outset that portions of a 16:9 production will also be used as magazine items (in 4:3 format). Here, shooting 16:9 in "shoot and protect" mode for the 4:3 format may be an appropriate solution.

At all events, in that case all the graphics must be prepared as 4:3 images in the centre of the 16:9 picture format. In production the centre of the 16:9 shots will be cut out in the 4:3 format ("centre-cut") and used in the magazines. An example of this is shown in Annex 9.5.

1.4 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 and the different forms of distribution 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.

1.5 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 9.6, must be observed. Safety margins on all sides of 5% of the transmitted picture must be allowed for in the 4:3 format, and 3.5% in the case of the 16:9 format.

The special requirements for the centre of interest in programme production on film are given in Para. 5.5.

1.6 Captions, lettering and graphics

If captions, lettering, and graphics are to be readable on all receivers, they must be prepared with appropriate care. To this end it is necessary for programme-makers to use only large, clear lettering (letters of 21/22 lines height and more have proved satisfactory). This also helps produce a television without barriers, i.e. to make it accessible to all users. This is a manifestation of the English concept of "acceptability". Freedom from barriers consequently addresses the handicapped in equal measure to all other users and creates added value for the whole television offer.

Captions, lettering and graphics for the 4:3 and 16:9 picture formats must lie within the limits of the caption area specified in Annex 9.6.

For picture format 4:3: 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 is given in Annex 9.6.1):

- In field 1: from line 45 to 289; and
- In field 2: from line 358 to 601.
- In analogue lines*: from 14.5 µs to 58.5 µs = 44 µs; and
- In digital lines*: from pixel 61 to pixel 658 = 598 pixels

For picture format 16:9 (in accordance with EBU R95): This allows for vertical safety margins of about 5% and horizontal safety margins of about 10% of the transmitted picture. Accordingly, the permissible vertical and horizontal extent of the caption area is within the range given below (a graphic presentation is given in Annex 9.6.2):
In field 1: from line 38 to 295; and
In field 2: from line 351 to 608.
In analogue lines*: from 15.7 µs to 57.3 µs = 41.6 µs; and
In digital lines*: from pixel 79 to pixel 640 = 562 pixels

* Line starting at middle of sync. pulse edge, line length 64 µs, transmitted picture from 10,5 µs to 62,5 µs = 52 µs
** Line starting at pixel 0, line length 864 pixels, transmitted picture from pixel 9 up to and including pixel 710 = 702 pixels

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.

1.7 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.

1.8 Pre-production planning
In order to obtain an optimum vision and sound quality, the video, audio, acoustic and lighting 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.

1.9 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 tapeless 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 8). The extent of this information is to be agreed with the client, e.g.
- Acquisition format,
- Picture format conversions occurred,
- Post-production processing systems involved,
- Data-reduction method (compression method) used,
- Reduction factors or data utilized,
- Interfaces used for the transfer.

1.10 Production and post-production processing standard
As a PAL signal is still being transmitted alongside the digital broadcast signals, 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 9.14) 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.

1.11 Authorised signal processing formats

In line with the recommendations of the EBU (Technical Statement D80), following a decision of the FSBL-K only the following signal processing formats are allowed for television programme production in ARD, ZDF, and ORF:

- the transparent DSK270 format in accordance with Recommendation ITU-R BT.601,
- the compression format DV-based in accordance with SMPTE 314M, and
- the compression format MPEG-2 422P@ML 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).

For specific production processes, e.g. video journalist (VJ), it is also possible – while respecting the restrictions and recommended conditions of application contained in EBU R116-2005 – to use:

- the compression format DV (DV-home) in accordance with DIN EN 61834-1,2,4 with a scanning raster of 4:2:0 (see Para. 1.12.3).


1.11.1 Particularities of 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 networked television production.

1.12 VTR formats

Part 3 of these Guidelines lists the relevant VTR formats; these work almost exclusively with implemented video compression (the exception is the D-5 Format):

- Digital Betacam own video compression, see 1.12.1
- D-5 transparent format DSK270 according to ITU-R BT.601
- DVCPRO DV-based compression at 25 Mbit/s (SMPTE 314M)
- Betacam SX own video compression, see 1.12.2
- DVCPRO50 DV-based compression at 50 Mbit/s (SMPTE 314M)
- IMX MPEG-2 422P@ML compression (EBU D94 and SMPTE 356M)
- DV-home DV compression with scanning raster 4:2:0 (DIN EN 61834-1,2,4)


1.12.1 Particularities of 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.

1.12.2 Particularities of Betacam SX

The Betacam SX recording format (Para. 3.5) is not standardised and uses its own internal compression process. This is not, however, authorised for television programme production in ARD, ZDF, and ORF outside the VTR.

1.12.3 Particularities of DV-home

The EBU R116 "The use of DV compression" recommends the following constraints concerning the use of consumer DV camcorders:
1. The use of consumer style camcorders in broadcasters’ operation should be limited to those instances where considerations of size, weight and disposability prevail over considerations of picture and sound quality.

2. For material that has been captured with consumer style camcorders, postproduction manipulation should be avoided so far as possible, except for any necessary simple editing.

3. If television programme material acquired by using consumer style camcorders must necessarily be subjected to intensive postproduction operations, it should be transferred onto a professional platform, e.g. 50 Mbit/s with a sampling raster of 4:2:2, before further treatment.

4. Concatenating DV-home (4:2:0) and DV-based (4:1:1) compression in professional acquisition should definitely be avoided as this results in loss of both horizontal and vertical chrominance resolution.

1.13 Tapeless recording systems

As this new edition of the present Technical Guidelines is being prepared it is already foreseeable that tapeless recording systems will used more and more in acquisition. These guidelines will be completed in a forthcoming edition in line with the corresponding relevance of possible systems together with the availability of reports of experience, standards, and acceptance guidelines.

1.14 Technical 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]).

For a correct assessment it is absolutely necessary that the real time relationship between the vision and sound signals of the programme material to be monitored should be presented on the monitoring equipment. To this end it may be necessary, for instance,

- when the picture is displayed on flat screens (because of internal delays in picture reproduction) to delay all associated sound signals correspondingly, or
- when monitoring Dolby E coded sound signals (delaying of sound reproduction as a result of decoding) to delay the associated vision signal to a corresponding extent

1.14.1 Vision monitoring

The ARD Technical Guidelines for a uniform television picture display (Technische Richtlinie 8 R 7) are to be respected.

Monitoring should be carried out in the standard of the production while maintaining the picture geometry. A 4:3 colour-control picture monitor should preferably be used for monitoring productions in 4:3 picture format and a 16:9 colour-control picture monitor for monitoring productions in widescreen (16:9 full format). The picture height should be the same as for the 4:3 colour-control monitor. In this way, possible artefacts, such as picture unsteadiness and film scratches in film productions can be more readily detected and assessed than in the case of reproduction on a 4:3 monitor. For assessing the technical picture quality, the optimum viewing distance of four times the picture height is to be maintained in every case.

In order to allow for the proliferation of modern flat screens in viewers’ homes, for all vision monitoring a 16:9 flat screen with a minimum diagonal of 42” is recommended. As all flat screens perform a scaling (conversion) of the TV raster, as well as de-Interlacing the TV signal (these screens work only with progressive display), when monitoring productions special attention must be paid to determining whether the representation of graphics elements, e.g., a ticker, is free from error. Guidelines for the reproduction of television pictures on such displays are only now being prepared. At the moment the plasma display (PDP) is the prime choice, because of its better overall characteristics. It should provide a real 50 Hz display and at least 720 vertical lines (HDready).

It must be ensured that the alignment of all the colour-control monitors is identical for the PAL input and for the analogue and digital component input. As a PAL signal is still being transmitted alongside the digital signals, it must be ensured during the monitoring of signals in analogue or digital component format that it is possible to obtain a correct PAL coding with the respective output signal (see also Para. 2.1.9). To this end, the observance of the RGB colour
space (see Annex 9.14) must be monitored with a suitable measuring instrument or monitor that indicates any violation of the colour space. Keeping within the RGB colour space guarantees correct signal reproduction in the case of MPEG distribution, such as DVB.

**Note:** The reproduction formats for picture sources with aspect ratios of 4:3 and 16:9 are shown in Annexes 9.2 und 9.3.

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. 2.14.9 and specific limits in the corresponding sections relating to the individual recording formats.

1.14.2 **Sound monitoring**

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).

1.14.2.1 Monitoring of items with discrete sound signals

The sound reproduction (mono, stereo or multi-channel) must be reproduced on top-quality, professional loudspeakers having a frequency response as linear as possible (see EBU Tech. 3276), as otherwise a professional-level sound assessment is not possible. For multi-channel sound a suitable listening installation, 5.1 loudspeaker monitoring (see EBU Tech. 3276 Supplement 1) is required.

Reproduction solely on TV or other consumer loudspeakers or systems is insufficient. It must be stressed that these do not make it possible to cover the highly varied listening situations in viewers' homes.

1.14.2.2 Monitoring items with coded sound signals

Multi-channel items supplied in coded form as a Dolby E-data stream, e.g. on tracks 3 and 4 of a VTR cassette, must be decoded for monitoring (see Annex 9.22.1). As in Dolby E-decoding the Dolby Metadata are not analysed, it is recommended that the discrete sound signal should be passed through a Dolby Digital encoder and decoder (see Annex 9.22.2) or the Dolby Digital path simulated with the aid of a suitable audio tool, such as Dolby DP 570, so that the Metadata are analysed (see Annex 9.22.3). In each case, the delay in the sound reproduction thereby introduced must be compensated by delaying the vision signal by a corresponding amount.

**Note:** If monitoring takes place with Dolby E decoded 5.1 signal, the following restrictions must nonetheless be observed:

- In this case the full dynamic range must always be monitored. The viewer at home, on the other hand, may narrow the range!
- Because the Metadata have not been analysed, the loudness of the signal in relation to other programmes cannot be assessed.
- It is not possible to listen to an automatic downmix of the 5.1 signal to mono/stereo/Dolby Surround.

For decoded linear sound signals, the listening installation mentioned under Para. 1.14.2.1 must be used in combination with a multi-channel-capable loudness meter.

1.15 **Monitoring of teletext subtitling [FT-UT]**

Monitoring of teletext subtitling is to be carried out by using a television receiver with teletext decoder corresponding to current television equipment technology.
1.16 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. The audio description must be mixed with the mono version and recorded on track 2. The stereo version is to be recorded on the same video tape in accordance with the sound track assignment tables under Para. 2.4.

1.17 Metadata

The conditions for the exchange of Metadata are contained in "Part 8 Metadata" of these guidelines.

1.18 Special requirements for the monitoring of programme items in file format

In principle, when monitoring programme items in file format three different aspects must be taken into account:

a) verification of the file format with reference to conformity with standards and the parameters of use fixed by the ARD, and

b) verification of the Essence format embedded in the file reference to conformity with standards and the parameters of use laid down by the ARD, and

c) audiovisual verification of Essence (vision, sound, teletext subtitles, and data).

1.18.1 Verification of the file format

The framework of the file format is to be verified using suitable technical tools (Analyser) for conformity with the standards and the parameters of use, laid down by the ARD.

Measuring guidelines are being developed in an EBU Working Group and when published are to be included in the present Guidelines as a reference.

Examples of suitable tools for the automatic analysis of the MXF file format and the Essence format are the IRT's MXF Analyser Professional and the Tektronix file analyser Cerify.

1.18.2 Verification of the Essence format

The framework of the Essence format is to be verified using suitable technical tools (Analyser) for conformity with the standards and the parameters of use, laid down by the ARD.

1.18.3 Verification of vision and sound

a) If the programme item to be verified already exists in file format, then the stored file must be played back by means of a suitable reproduction application (player) routed via appropriate real-time interfaces to the monitoring equipment specified in Para. 1.14 to 1.17.

b) If the programme item to be verified exists on video-tape, then the vision, sound, teletext subtitles, and data must be monitored on the basis of the file generated on playing-in (the result of re-recording the video tape).

For reasons of efficiency, it should be possible, using an appropriate application, to play the file via suitable real-time-capable interfaces while it is being generated. In this way the file can be generated and monitored in a single step.

*Note*: If the programme item is only monitored at the VTR output, any errors introduced when the file is generated will not be detected!
2. Conditions common to television production

The provisions in this Part are basically relevant to television production on video tape (Part 3) and tapeless systems (Part 4). However, exceptions and anomalies may exist.

2.1 Vision signals

The timing reference for the input function of video recording machines and tapeless 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 9.7 and 9.8).

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 9.9).

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

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 9.10). 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 Fernsehsystem-technik].

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 respective standards to be complied with are given in Part 3 (video tape) or in Part 4 (tapeless systems).

Annex 9.12 shows the fundamental relationship between the SDI interface and the SDTI interface.

Annex 9.13 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, DVCPROS0, Dig. S) SMPTE 321M;
2.1.5 Field sequence (dominant field)
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 in distribution and transmission. 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
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 and 2.1.4
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 9.11).

Analogue vision signals have a nominal active line length of 52 µs. This corresponds to 702 pixels (sample 9 up to and including 710) within the nominally active 720 pixels in accordance with ITU-R BT.601. The vision signal must be at least 699 pixels in length (51.75µs) within these limits. If present, additional active pixels outside these limits must be a complement to the main picture (see Para. 2.1.11).

Note: 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 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 (E'Y, E'Cr, E'Cb) signals and digital (Y, Cr, Cs) 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/Cb/Cr 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 ensured 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 9.14). A detailed explanation of this problem is given in Technical Guidelines 8/1.1, Para. 1.13.2 [Technische Richtlinien 8/1.1, Para 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

For the generation and conversion of digital vision signals, it should be noted in particular that:

- ITU-R Recommendation ITU-R BT.601 specifies the pixel basis of digital picture signals as 720 pixels per active line and 576 active lines per frame.
- ITU-R Recommendation BT.470 specifies a line length of 52 µs for analogue picture signals. This corresponds to 702 pixels of the digital picture signal.

Because of this, it is imperative, therefore, that for digital vision signals a pixel basis of 702 pixels times 576 lines must imperatively be complied with in order to generate/calculate a correct aspect ratio (4:3 or 16:9) (see also Paras. 9.11 and 2.1.7).

When vision signals are generated on another pixel basis, e.g. from computers with 640 x 480 pixels, they must, in each case, already be converted into the correct television pixel format at the point of production (by the supplier). No disturbance in the vision signal or variations in the picture format must occur in this conversion into the correct television pixel basis.

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. Rules for file-based exchange are still in preparation.
2.2.1 Teletext subtitles [FT-UT]

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

It is of prime importance that the subtitle data be recorded on the same tape.

For programme exchanges on tapes, the subtitle data must be recorded on the same tape.

a) Recording of teletext subtitles via analogue interfaces

For simultaneous recording of teletext subtitles 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 subtitle must be carried on at least lines 20/21 as well as 333/334. In addition to this, the teletext subtitles can also be carried on those lines that should be used for the transmission of the normal teletext sequence.

b) Recording of teletext subtitles via digital interfaces

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

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 subtitling in the same signal domain as the original.

2.3 Sound signals

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 Hz for the alignment level. In order to avoid sub-harmonic of the audio sampling frequency (48 kHz), a frequency f=997 Hz for the alignment level of digital signals sources is used.

2.3.1 Time difference between vision and sound

In principle, there should be no time difference between the vision and sound signals.

Nonetheless, if unavoidable errors have to be accepted, e.g., in the case of live broadcasts with digital effects or the use of digital wireless camera systems, it is not possible as a rule to fully compensate for all sources of error.

Note: When wireless cameras and non-delayed cabled cameras are being used simultaneously, the sound should in general be delayed in such a way that the time difference between vision and sound to the wireless camera is less than to the cabled camera. Here, too, the principle is that advanced sound is more disturbing than lagging sound.

Care should be taken that, even in these cases, the tolerances laid down in EBU Technical Recommendation R37 for the end of a complete production chain (at the transmitter input) must not be exceeded:

- the sound must not be more than 40 ms in advance of the picture,
- the sound must not be more than 60 ms behind the picture.

In general it should be borne in mind that even apparently slight differences in duration between vision and sound in individual steps in the production chain can have a cumulative impact. Hence, everyone involved is responsible for ensuring that the time-difference between vision and sound in their section/part within the production chain is as small as possible. No single section, device, or production step must use up the whole of the tolerances. This point should be consistently borne in mind during recording, processing, and transmission.

In line with Technical Recommendation R37 it is therefore recommended that, whenever possible, precautions should be taken to minimize any time-difference between vision and sound. The time-difference between vision and sound at any point should lie between the following limits:
• the sound must not be more than 5 ms in advance of the picture,
• the sound must not be more than 15 ms behind the picture.

If a significant time-difference between vision and sound should occur in a production, this must immediately be minimized. Automatic correction techniques should preferably be used for this purpose.

2.3.2 Synchronisation of sound signals

EBU Technical Recommendation R83 contains the provisions concerning the synchronisation of digital audio signals in a television production environment. It also provides that all sound signals should be locked to the video clock signal.

If coded sound signals, e.g. Dolby E, are stored, copied or transmitted together with the vision signal, they must not exhibit any time-difference with respect to the frame – they must be synchronous (±0 frame) to the vision signal.

2.3.3 Analogue sound signals

a) Permitted maximum level

The permitted maximum level corresponds to the studio level.

Permitted maximum level = +6 dBu = 1.55 V<sub>rms</sub>

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<sub>rms</sub>

2.3.4 Digital sound signals

<table>
<thead>
<tr>
<th>Digital</th>
<th>Analogue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clipping Level</td>
<td>+15 dBu*</td>
</tr>
<tr>
<td>Maximum Programme Level</td>
<td>+6 dBu*</td>
</tr>
<tr>
<td>Reference Level</td>
<td>-3 dBu*</td>
</tr>
<tr>
<td>-18 dBFS**</td>
<td></td>
</tr>
<tr>
<td>-9 dBFS**</td>
<td>0 dB</td>
</tr>
<tr>
<td>0 dBFS**</td>
<td>-9 dB</td>
</tr>
</tbody>
</table>

*) 0 dBu = 0.775 V<sub>rms</sub>
**) 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 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.

### 2.3.5 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 tapeless system.

### 2.4 Sound track assignment

The sound track assignment status must be clearly indicated for all productions: e.g. on the VTR record card or tape label, or in the Metadata.

The following tables contain the rules for the sound track assignment.

#### 2.4.1 Sound track assignment for 2-track VTR for programme exchange

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

<table>
<thead>
<tr>
<th></th>
<th>Mono (1)</th>
<th>Stereo (2)</th>
<th>Two-channel sound (3)</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>Cue</td>
<td>free</td>
<td>free</td>
<td>free</td>
</tr>
</tbody>
</table>

(1) According to EBU R48, existing international sound, e.g. playback or copying in sports items, is recorded on Audio 2.

(2) If necessary, Stereo Dolby Surround may be recorded in coded form. Such productions must be clearly marked as "Dolby-Surround", e.g. on the VTR record card or tape label, or in the Metadata. The indications Lt (Left total) and Rt (Right total) must be used for the labeling of the track allocation.

(3) Audio description is a special case of a two-channel programme. The German programme sound with added description of scenes is broadcast on the second channel instead of the otherwise usual original foreign-language version. See also Para. 1.16 Audio description/"Hörfilm".
2.4.2 Sound track assignment for broadcast items

Because of the large number of possible variants, there are no plans at the moment to compile, as an aid to practical use, a list of track assignments for the various requirements of television studio production, e.g. the recording of live transmissions, feeds, and multi-channel productions.

Therefore, the track assignment to be used is to be agreed with each customer. For formats with eight sound tracks, the variants laid down in Para. 2.4.3 are to be given preference.

The track assignment for broadcast items is standardised for tracks 1 to 4 and applies to:

- all VTR formats having four audio channels,
- the first four audio channels of all VTR formats having more than four audio channels, e.g. IMX with eight,
- all transfers from file-based systems.

\[\begin{array}{|c|c|c|c|c|}
\hline
\text{Audio} & \text{Mono}^{(1)} & \text{Stereo} & \text{Stereo + Dolby E} & \text{Two-channel sound/} \\
&&&& \text{Audio description} \\
\hline
1 & \text{Programme sound} & \text{Stereo}^{(2)} \text{ (left)} & \text{Stereo}^{(2)} \text{ (left)} & \text{German version} \\
& & & & \text{(mono)} & \text{German version} \\
& & & & \text{(mono)} \\
\hline
2 & \text{Programme sound}^{(1)} & \text{Stereo}^{(2)} \text{ (right)} & \text{Stereo}^{(2)} \text{ (right)} & \text{Original version or} \\
& & & & \text{Audio description}^{(3)} \\
& & & & \text{(mono)} \\
\hline
3 & \text{Int. sound} & \text{Int. sound left or} & \text{Dolby E}^{(4)} \text{ (opt. with Int. sound on} & \text{German version} \\
& & \text{Foreign language} & \text{channel 7/8)} & \text{(left)} \\
& & \text{left} & & \text{German version} \\
& & & & \text{(left),} \\
& & & & \text{or another foreign} \\
& & & & \text{language or int. sound} \\
& & & & \text{(left)} \\
\hline
4 & \text{Int. sound} & \text{Int. sound right or} & \text{Dolby E}^{(4)} \text{ (opt. with Int. sound on} & \text{German version} \\
& & \text{foreign language} & \text{channel 7/8)} & \text{(right)} \\
& & \text{right} & & \text{(right),} \\
& & & & \text{or another foreign} \\
& & & & \text{language or int. sound} \\
& & & & \text{(right)} \\
\hline
5-8 & - & - & - & - \\
\hline
\end{array}\]

(1) **Warning:** On library tapes with monophonic audio signals the tracks may be assigned differently.

(2) If necessary, Stereo Dolby Surround may be recorded in coded form. Such productions must be clearly marked as "Dolby Surround", e.g. on the VTR record card or tape label, or in the Metadata. The indications Lt (Left total) and Rt (Right total) must be used for the labeling of the track allocation.

(3) Audio description is a special case of a two-channel programme. The German programme sound with added description of scenes is transmitted on the second channel instead of the otherwise usual original foreign-language version. Audio channels 3 and 4 can be assigned the original version (left/right) in German or a foreign-language version. See also Para. 1.16 Audio description/"Hörfilm".

(4) **Warning:** Productions with Dolby E must be clearly marked as "Dolby E", e.g. on the VTR record card or adhesive label or in the Metadata. If a Dolby E signal is encoded from a multi-channel source, in which channels 7 And 8 are also assigned to, for instance, international sound or stereo, then this coded Dolby E signal must be recorded with 20-bit resolution. In this case it is not permissible to record with a resolution of 16 bits!
2.4.3 Sound track assignment variants for formats having eight sound tracks

The introduction of formats having eight or more sound tracks and of multi-channel production has resulted in a large number of possible variants of sound track assignment for the various requirements of television production.

For transmission tapes and transfers from file-based systems, the assignment of the first four sound tracks is laid down in Para. 2.4.2

In addition to this, for preference the sound track assignments set out in the following table should be used for other applications:

- The variant "Stereo, international sound + Dolby E", for instance, for the recording of live sports transmissions with Dolby E, in which the international sound must also be recorded alongside the stereo and Dolby E for proper subsequent use.
- The variant "Two-channel sound/Audio description with international sound, stereo and Dolby E" for productions with Audio description multi-channel sound with multiple utilisation.
- The variant "Stereo + multi-channel" for the studio recording of uncoded multi-channel sound for subsequent processing.

<table>
<thead>
<tr>
<th>Audio 1</th>
<th>Stereo (1) (left)</th>
<th>Two-channel sound (1) Audio description international sound, Stereo + Dolby E</th>
<th>Stereo (4) (left)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Audio 2</td>
<td>Stereo (1) (right)</td>
<td>Original version/ Audio description (2) (mono)</td>
<td>Stereo (4) (right)</td>
</tr>
<tr>
<td>Audio 3</td>
<td>international sound left or foreign language left</td>
<td>international sound left</td>
<td>multi-channel - L</td>
</tr>
<tr>
<td>Audio 4</td>
<td>international sound right or foreign language right</td>
<td>international sound right</td>
<td>multi-channel - R</td>
</tr>
<tr>
<td>Audio 5</td>
<td>---</td>
<td>German version (left)</td>
<td>multi-channel - C</td>
</tr>
<tr>
<td>Audio 6</td>
<td>---</td>
<td>German version (right)</td>
<td>multi-channel - LFE</td>
</tr>
<tr>
<td>Audio 7</td>
<td>Dolby E (3)</td>
<td>Dolby E (3)</td>
<td>multi-channel - LS</td>
</tr>
<tr>
<td>Audio 8</td>
<td>Dolby E (3)</td>
<td>Dolby E (3)</td>
<td>multi-channel - RS</td>
</tr>
</tbody>
</table>

(1) If necessary, Stereo Dolby Surround can be recorded in coded form. as "Dolby Surround", e.g. on the VTR record card or tape label, or in the Metadata. The indications Lt (Left total) and Rt (Right total) must be used for the labeling of the track allocation.

(2) Audio description is a special case of a two-channel programme. The German programme sound with added description of scenes is transmitted on the second channel instead of the otherwise usual original foreign-language version. Audio channels 3 and 4 can be assigned the original version (left/right) in German or a foreign-language version. See also Para. 1.16 Audio description/"Hörfilm".

(3) Warning: Productions with Dolby E must be clearly marked as "Dolby E", e.g. on the VTR record card or adhesive label or in the Metadata. If a Dolby E signal is coded from a multi-channel source, in which channels 7 and 8 are also assigned to, for instance, international sound or stereo, then this coded Dolby E signal must be recorded with 20-bit resolution. In this case it is not permissible to record with a resolution of 16 bits!

(4) When recording the uncoded channels of multi-channel sound in a television production environment, it is necessary to record the stereo-compatible version on tracks 1 and 2.
2.5 Time-code

2.5.1 Linear time-code (LTC)
The 80-bit time-code must comply with the specifications given in DIN EN 60461 (see Annex 9.17 for code-word structure).

On video tape the LTC must be recorded on the track specified for that purpose in the format used. Usually this is the longitudinal time-code track (exceptions DVCPRO and DVCPRO50, q.v.). The record current is to be so adjusted that an increase in 1 dB in the input level raises the output voltage by 0.5 dB (measured with an RMS voltmeter).

2.5.2 Time-code in the vertical blanking (VITC)
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.

The 90-bit time-code must comply with the specifications given in DIN EN 60461 (for relationship between VITC and LTC: see Annex 9.18).

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.

2.5.3 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".

2.5.4 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.

2.6 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 tapeless 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 8), e.g.

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

2.7 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.2.3.5 in these Guidelines.

2.8 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. 2.8.1 and 2.9, Table 2.10 and Paras. 2.11, 2.12 and 2.13.
2.8.1 Technical leader for video tape

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 produced on video tape. 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.

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 2.10).

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 2.4.

2.8.2 Technical leader for tapeless systems (NLE, server)

Because of operational working procedures with file-based systems, a technical leader is of only marginal significance as regards technical features and furthermore creates handling problems. Therefore, a technical leader is not recommended for exchanges of television productions in the case of tapeless systems (NLE, server).

At all events, in a hybrid production environment (tape and file) the following provisions must be observed:

a) Programme material from a video tape is played into a file-based production unit, e.g. a server or NLE system, via video/audio interfaces without a technical leader. Consequently, special attention must be paid to ensure correctly balanced video and audio signals.

b) If programme material is played out from a file-based production unit, e.g. a server or NLE system, via video/audio interfaces on to video tape, then a technical leader matching this video signal (e.g. level) must be recorded from another source. In this case it must be clearly indicated on the cassette and the VTR record card that the technical leader was not recorded from the same source as the programme material.

c) If programme material is exported from a file-based production unit, e.g. a server or NLE system, via file transfer, it is not prefaced by a technical leader. In this case only the "programme material" is transferred (see also Para.7.1 "Exchange of content").
2.9 Sequence and details for leader, programme and trailer

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

2.9.2 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.

2.9.3 In order that the transmission material should be of immaculate quality, the number of copying and re-encoding operations required is to be kept to a minimum.

For television productions on video tape the following considerations also apply:

2.9.4 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.

2.9.5 Each recording ends with the last frame (frozen picture) or with black for at least 10 s without sound.

2.9.6 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.

2.9.7 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.

2.9.8 The first sound should begin three 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.

2.9.9 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.

2.9.10 If a programme is divided into more than one tape, each tape must have a technical leader in accordance with Para. 2.8.

The beginning and end of Tape 1 must be in accordance with Paras. 2.9.1, 2.9.2 and 2.9.3.

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.

2.9.11 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. 2.9.1, 2.9.2 and 2.9.3.

2.9.12 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.
## 2.10 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>Additional sound tracks</th>
<th>Time-code</th>
<th>Control-track signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEADER</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alignment leader</td>
<td>At least 60 s</td>
<td>Alignment signal (1)</td>
<td>997 Hz (6) ref. level (3, 7)</td>
<td>997 Hz (6) ref. level (3, 7)</td>
<td>997 Hz (6) or Dolby E data stream</td>
<td>Interruption or discontinuity in time-code possible</td>
<td></td>
</tr>
<tr>
<td>IDENTIFICATION leader</td>
<td>At least 15 s</td>
<td>Picture-format identification 4:3/16:9 (2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cue-up leader</td>
<td>8 s</td>
<td>Black (5) or Identification</td>
<td>Silence or Identification</td>
<td>Silence or Identification</td>
<td>Silence or Identification</td>
<td>Continuous</td>
<td>Continuous</td>
</tr>
<tr>
<td></td>
<td>2 s</td>
<td>Black (5)</td>
<td>Silence</td>
<td>Silence</td>
<td>Silence</td>
<td>(4)</td>
<td></td>
</tr>
<tr>
<td>Programme (4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10:00:00:00 (see 2.9.1)</td>
<td></td>
</tr>
<tr>
<td>Run-out trailer</td>
<td>At least 10 s</td>
<td>Black (5)</td>
<td>Silence</td>
<td>Silence</td>
<td>Silence</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Suitable alignment signals are described in Para. 2.11.3.
2. A signal for picture-format identification is described in Para. 2.13.
3. Reference level: see under "2.3. Sound signals".
   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 analogue sound-signal sources, a frequency f = 1000 Hz is used instead of f = 997 Hz.
7. For specifications for sound track identification and assignment with Dolby E coded signals see Para. 2.12.
2.11 Alignment signals for the technical leader

Because of operational requirements as regards ease of audiovisual control of live links, together with the synchronism of audio and video, the static colour bar (details can be obtained from the May 2003 edition of the present Guidelines) must be replaced by a colour bar with moving elements and supporting audio signals. A corresponding colour bar is specified in EBU Tech 3305 "Digital Television Test Pattern Sequence for Operational Use". In addition, the Vistek alignment signal "VALID" was introduced for alignment of transmission paths. Both signals are suitable as alignment signals for vision and sound in the technical leader of stored programme material.

2.11.1 Alignment signal in accordance with EBU Tech 3305

This alignment signal specifically intended for operational applications. It consists of a static element and two motion elements in order - in conjunction with the associated audio signals - to enable a simple audiovisual check of live links and of the synchronism of audio and video.

The alignment signal was deliberately designed in order to enable low-cost implementation. It does not contain any circular elements, so the complete test sequence can be built up from only 32 stored television lines. In this way, an implementation in all signal sources is supported. This alignment signal is particularly suitable for implementation in mobile equipment, such as camcorders.

The basic structure is given in Annex 9.15.

2.11.2 Vistek's line-up signal VALID

This alignment signal was specifically designed general measuring purposes, and also in particular for the measurement of the time-difference between vision and sound. The complete measuring system consists of a generator and an associated analyser. The VALID alignment signal is made up of a video and an audio component. Alongside the audiovisual check on synchronism of audio and video it also enables measurement techniques to be used.

In accordance with an FSBL-K Recommendation, this system is to be used in all OB vans.

The basic structure is given in Annex 9.16.

2.11.3 Recording the alignment signal

In recording the alignment signal via the respective video input (composite colour video signal, analogue components, SDI or SDTI) the provisions given under Para. 2.1 are to be observed.

2.12 Audio alignment signals for the technical leader

A suitable audio signal for the digital recording of sound tracks with linear sound signals is an audio signal with a frequency of f=997 Hz with a reference level of -18 dBFS.

For recording sound tracks with coded audio signals, e.g. Dolby E, this should be signalled in the technical leader. Instead of the 997 Hz audio signal the idling data stream of a Dolby E encoder is recorded.

Note: Because of the increasing use of multiple sound tracks, e.g. multi-channel sound, it is advantageous to introduce a track identifier in the technical leader. A suitable labelling method, e.g. using different interruption patterns in the audio signal on the individual track, still has to be defined.

2.13 Identification of the 4:3 and 16:9 picture formats in the technical leader

In order to ensure a clear identification of the recorded picture format on replay, a marking must be superimposed in the case of productions in 16:9 format. Optionally, a marking may also be superimposed in the case of productions in 4:3 format.

The following possibilities for identifying the picture format are available with the two video alignment signals recommended in Para. 2.11:

- In the case of the alignment signal as specified in EBU Tech 3305 (see Annex 9.15), the picture format can be indicated in a text area in the right-hand part of the upper third of the frame. The correctness of the display can be verified by means of a square element in the left-hand part of the upper third of the frame.
In the case of the alignment signal VALID (see Annex 9.16) the picture format can be identified by a caption in the middle of the picture area. In all cases the characters must be of sufficient size that a clear identification can be made even with a relatively small picture monitor.

Note: If, during a transition period, only the static colour bar signal is available, the characters 16:9 must be superimposed in the middle of the 75% red area in the lower third of the frame. Optionally, in the case of productions in 4:3 format the characters 4:3 may be superimposed in the same place.

Additionally, the superimposition of a circle provides a simple and rapid method of recognizing the relevant picture format.

2.14 Special technical requirements for production on video tape

2.14.1 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.

2.14.2 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.

2.14.3 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].

2.14.4 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].

2.14.5 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].

2.14.6 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].

2.14.7 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].

2.14.8 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. 2.14.9 and 1.14.1 in these Guidelines).

2.14.9 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:

<table>
<thead>
<tr>
<th>Colour</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>Good condition in replay channel. Very low error rate. All tape faults can be corrected.</td>
</tr>
<tr>
<td>Yellow</td>
<td>An increased error rate in one or more replay channels. All tape faults can still be corrected, but there may already be a problem.</td>
</tr>
</tbody>
</table>
**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. 6.4).

### 2.15 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 9.20 (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.

Recordings in aspect ratio 16:9 must be clearly labelled. An example of labelling is given in EBU Technical Recommendation R71.

### 2.16 Handling and storage of video tapes

#### 2.16.1
Methods of handling and storing video tapes should take into consideration SMPTE Engineering Guideline EG 44 and ITU-R Recommendation BR.1215.

#### 2.16.2
In principle, video tapes (reels or cassettes) are to be stored only in containers that are suitable for archive storage.

#### 2.16.3
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.
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"

This recording format is no longer utilized in TV production. Rules for this recording format, e.g. concerning the re-use of library cassettes, may be found in the Mai 2003 edition of the present Guidelines.

### 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. 2.14.9.

#### 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:

- \(-11 \text{ dBr} = -20 \text{ dBFS} = -5 \text{ dBu}\),
- \(+9 \text{ dBr} = 0 \text{ dBFS} = +15 \text{ dBu}\).

### 3.2.7 Assignment of tracks

The assignment of the four sound tracks is set out in Para. 2.4.2.

### 3.2.8 Time-code

The parameters for the recording of the LTC (Longitudinal Time Code) and the VITC (Vertical Interval Time Code) are set out in Para. 2.5.

### 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:

- Picture format, e.g. 16:9 (see for this Para. 1.3),
- Sound track assignment, e.g. with Dolby E (see for this Paras. 4.2 and 4.3).

Additional identification in accordance with Paras. 2.13 (picture-format identification), 2.15 (VTR-tape nomenclature) and 1.9 (Information on the production chain) is strongly recommended.

The labels are to be stuck on the appropriate label area on the cassette (not on the edge).

### 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. 2.14.9.

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.

In general, recordings are made in the 10-Bit mode. In exceptional cases the use of the 8-Bit mode must be agreed separately.

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.

3.3.6 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:

\[-9 \text{dBr} = -18 \text{dBFS} (-3 \text{dBu}).\]

3.3.7 Assignment of tracks

The assignment of the four sound tracks is set out in Para. 2.4.2.

3.3.8 Time-code

The parameters for the recording of the LTC (Longitudinal Time Code) and the VITC (Vertical Interval Time Code) are set out in Para. 2.5.

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:

- Picture format, e.g. 16:9 (see for this Para. 1.3),
- Sound track assignment, e.g. with Dolby E (see for this Paras. 4.2 and 4.3).

Additional identification in accordance with Paras. 2.13 (picture-format identification), 2.15 (VTR-tape nomenclature) and 1.9 (Information on the production chain) is strongly recommended.

The labels are to be stuck on the appropriate label area on the cassette (not on the edge).
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:

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

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. 2.14.9.

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
The assignment of the four sound tracks is set out in Para.2.4.1.

3.4.9 Time-code
The parameters for the recording of the LTC (Longitudinal Time Code) and the VITC (Vertical Interval Time Code) are set out in Para. 2.5.

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.

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. Particular care is to be taken that there is clear identification of productions:

- Picture format, e.g. 16:9 (see for this Para. 1.3),
- Sound track assignment, e.g. with Dolby E (see for this Paras 4.2 and 4.3).

Additional identification in accordance with Paras. 2.13 (picture-format identification), 2.15 (VTR-tape nomenclature) and 1.9 (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:
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 SR5-1P calibration tape corresponds to:

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

3.5.7  Assignment of tracks

The assignment of the four sound tracks is set out in Para. 2.4.2.

3.5.8  Time-code

The parameters for the recording of the LTC (Longitudinal Time Code) and the VITC (Vertical Interval Time Code) are set out in Para. 2.5.

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:

- Picture format, e.g. 16:9 (see for this Para. 1.3),
- Sound track assignment, e.g. with Dolby E (see for this Paras. 4.2 and 4.2).

Additional identification in accordance with Paras. 2.13 (picture-format identification), 2.15 (VTR-tape nomenclature) and 1.9 (Information on the production chain) is strongly recommended.

The labels are to be stuck on the appropriate label area on the cassette (not on the edge).

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

3.6.1  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.

3.6.2  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.2.14.9.

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

The parameters of the four sound tracks are set out in Para. 2.4.1.

3.6.9 Time-code

The parameters for the recording of the LTC (Longitudinal Time Code) and the VITC (Vertical Interval Time Code) are set out in Para. 2.5
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.

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. Particular care is to be taken that there is clear identification of productions:

- Picture format, e.g. 16:9 (see for this Para. 1.3),
- Sound track assignment, e.g. with Dolby E (see for this Paras. 4.2 and 4.3).

Additional identification in accordance with Paras. 2.13 (picture-format identification), 2.15 (VTR-tape nomenclature) and 1.9 (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

International Standard IEC 62289 and DIN Standard EN 62289 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 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. 2.14.9.
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)

The assignment of the eight sound tracks is set out in Paras. 2.4.2 and 2.4.3.

3.7.10 Time-code

The parameters for the recording of the LTC (Longitudinal Time Code) and the VITC (Vertical Interval Time Code) are set out in Para. 2.5.

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:

- Picture format, e.g. 16:9 (see for this Para. 1.3),
- Sound track assignment, e.g. with Dolby E (see for this Paras. 4.2 and 4.3).

Additional identification in accordance with Paras. 2.13 (picture-format identification), 2.15 (VTR-tape nomenclature) and 1.9 (Information on the production chain) is strongly recommended.

The labels are to be stuck on the appropriate label area on the cassette (not on the edge).
4. **Television production on tapeless 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 tapeless systems for the production of television programmes operate with data reduction, that is to say that the source material is recorded on supports that are not tape-based, e.g. hard disk, optical disk, fixed store, after going through a bit-rate reduction process (compression).

In each case of on-line working with tapeless 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.
- If transmission-ready items are played out directly from servers, then the provisions set out in Part 7 “File-based exchange” apply.
- At the present time, tapeless recording systems are being introduced in the area of acquisitions. These will only be included in these Guidelines when transmission-ready items are prepared on these supports.

4.1 **Authorised signal processing formats**

Only the signal processing formats set out in Para. 1.11 are authorised for television production on tapeless systems:

- 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.

While respecting the recommended rules of application (see Para. 1.12.3):

- The compression format DV in accordance with DIN EN 61834-1,2,4 with a scanning raster of 4:2:0., used however only for certain production processes, e.g. video journalist, while respecting the restrictions set forth in EBU R116-2005.

4.1.1 **On-line processing**

On the basis of EBU Technical Statement D80, the following systems are recommended for the different areas of tapeless 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. For specific production process it is possible to use the compression format DV Home with a data rate of 25 Mbit/s, while respecting the recommended rules of application (see Para. 1.12.3).

d) Special areas

For economic considerations the compression format DV Home (implemented preponderantly in consumer equipment) with a data rate of 25 Mbit/s is increasingly being used in other production areas as well, such as long-term documentaries. In order to ensure an acceptable level of quality, the recommended rules of application are to be observed in each case (see 1.12.3).

4.1.2 Particularities

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.

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.

*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 tapeless systems that work with the M-JPEG compression. If productions are made using tapeless 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.

4.1.3 Special case of off-line working

If tapeless 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 standardised in document SMPTE 377. The AAF file format is at present being developed through the "Advanced Authoring Association".

4.2 Vision signal processing

In principle, for the production of television programmes using tapeless 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.
- Generation and processing of vision signals in the correct format as laid down in Para. 2.1.11 Annex 9.11 shows the relationship between analogue and digital blanking, with the effect on line length.
- 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.

4.3 Sound signal processing

In principle, for the production of television programmes using tapeless 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 tapeless 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.

4.4 Transfer of programme material into tapeless systems

4.4.1 Transfer from video tapes

The material should be played through a data-transparent interface, such as SDTI, preferably in native form (compressed data, without additional recoding). If this is not possible, as when the compression format of the video tape and NLE or server are different, the transfer must be performed in the DSK270 domain via an SDI.

In transferring sound signals, preference should be given to digital sound connections such as AES/EBU, SDI with embedded audio or SDTI.

4.4.2 Importing files

See provisions under Para. 4.5.2.

4.5 Transfer of programme material from tapeless 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. 4.1.2, 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. 4.1.2, 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. 1.9, 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,
• Picture format conversions occurred,
• 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. 2.8.1 under notice of Para. 2.8.2.

4.5.2 Exporting files

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

• The signal processing format, see Paras. 1.11 and 7.2.1;
• The exchange of Metadata, see Paras. 1.9, 1.17 and Part 8;
• The structure (operational pattern) of MXF, see Para. 7.2.2.

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 networks the provisions of the "Richtlinie für das Video-Filetransfersystem der ARD" [Guidelines for the ARD Video File Transfer System] are to be observed. These specify the MXF file format (SMPTE 377M). In this connection, there are also corresponding requirements to be agreed, relating to:

- The signal processing format, see Paras. 1.11 and 7.2.1;
- The exchange of Metadata, see Paras. 1.9, 1.17 and Part 8;
- The structure (operational pattern) of MXF, see Para. 7.2.2.

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

For the exchange of graphics material and graphics sequences it is important that the both the system - e.g. Photoshop, AfterEffects or Quicktime Movies - and the format – e.g. TIFF, BMP, JPEG, etc - should be agreed between the customer and the 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, MPEG-4, 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

Provisions governing exchanges via the video file-transfer system for the ARD, ZDF, and ORF are set out in Part 8 "Metadata" of the present Guidelines.

Until a definitive specification is available for other areas, 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 a 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 8756 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 9.19).

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 9.27 and 9.28).

*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:

35-mm film     DIN 15 502, Part 2     (1.33:1 aspect-ratio)
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.

EBU Technical Recommendation R86 is intended to be a reference document for the harmonisation of the use for television production of the shooting picture area in film cameras, film projectors, film scanners, and test films.

5.5.1 Reproduction in the 4:3 aspect-ratio

See Annex 9.23 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 9.24.

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, 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 9.25).

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 or in wide-screen format, 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 (WSS) within line 23, 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


35-mm Camera picture gate ("Cinema wide-screen format 16:9"), transmitted picture area and centre of interest in 16:9 TV format
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 5.5.2.1), 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 9.23).

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 9.23).

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 9.23).

Super-16 Camera picture gate (1.66:1), transmitted picture area (in accordance with EBU proposal) and centre of interest in 16:9 TV format

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 SDTV television systems – aspect ratios 4:3 and 16:9
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 SDTV 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.

5.7 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 Magnetic-sound film supports
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.

Relevant specifications for this procedure are to be found in the May 2003 edition of TPRF.

5.8.2 Digital sound supports
As magnetic-sound film supports are becoming less and less important, all sound versions may, subject to agreement, be stored on time-coded digital sound supports. It must be clear, from the labelling of the sound supports and the accompanying documentation, how the tracks are assigned in the case of multi-track recording.

5.8.3 Packing, adhesive labels, and technical assessment reports for film and sound materials
Relevant provisions governing these points are to be found in the May 2003 edition of TPRF.
6. **Sound (Mono / Stereo / Multi-channel)**

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.

6.1 **Formats**

6.1.1 **Mono**

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.

6.1.2 **Stereo**

Multi-channel / Dolby-Surround: When making stereophonic productions it is imperative to ensure mono compatibility. The control is effected at the mixing stage, and not at the 90° filter. The following statements can be made about the degree of correlation between two channels:

<table>
<thead>
<tr>
<th>Type of signal</th>
<th>Degree of correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mono</td>
<td>1</td>
</tr>
<tr>
<td>Stereo (optimal)</td>
<td>0.3 … 0.7</td>
</tr>
<tr>
<td>Left and right unrelated</td>
<td>0</td>
</tr>
<tr>
<td>Stereo (out of phase)</td>
<td>-0.3 … -0.7</td>
</tr>
<tr>
<td>Mono (out of phase)</td>
<td>-1</td>
</tr>
</tbody>
</table>

*Note:* In a stereo signal the degree of correlation may also briefly become negative. However, if the degree of correlation should remain for a longer period in the negative range, it must be assumed that a channel is out of phase.

6.1.3 **Two-channel sound**

Two-channel sound denotes a technique employing two independent audio channels. In television production, the two available channels are used for transmitting the original and the dubbed version of a film.

Audio description is a special case of a two-channel programme. The German programme sound with added description of scenes is transmitted on the second channel instead of the otherwise usual original foreign-language version. Audio channels 3 and 4 can be assigned the original version (left/right) in German or a foreign-language version. See also Para. 1.16 Audio description/“Hörfilm”.

6.1.4 **Multi-channel – Dolby-Surround**

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.

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. The indications Lt (Left total) and Rt (Right total) must be used for the labeling of the track allocation.

For Surround productions, it is desirable to include an announcement in the trailer, together with a note for the viewer in teletext.

6.1.5 Multi-channel – discrete

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 9.21, in accordance with ITU-R Recommendation BS.775-1) is the five-channel stereophony which is described as a 5.0 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.

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 (see Para. 6.5.3.1).

For broadcasting purposes a mono-compatible stereo version is also necessary in every 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. Various procedures are being tried out at the present time by bodies such as IRT, ORF, WDR and manufacturers. Pending a definitive decision, refer to ITU-R BS.775-1. The equation for the downmix from 5.0 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>1.0 L</td>
<td>0.0 R</td>
<td>0.7 C</td>
<td>0.7 LS</td>
</tr>
<tr>
<td>R' =</td>
<td>0.0 L</td>
<td>1.0 R</td>
<td>0.7 C</td>
<td>0.0 LS</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.

For multi-channel productions, it is desirable to include an announcement in the trailer, together with a note for the viewer in teletext.
6.2 Modulation control – Dynamic range

6.2.1 Principles

6.2.1.1 Alignment signal

The alignment signal relates to all channels in the system considered (mono, stereo, multi-channel). 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. Therefore, the difference between full-scale and alignment level must amount to 18 dB (in accordance with EBU Technical Recommendation R68).

Note: The alignment signal relates to all channels in the system being used (mono, stereo, multi-channel) See also in this connection Paras. 2.3.3 and 2.3.4 of these Guidelines for a detailed description of the relationships.

6.2.1.2 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 'QPPM').

Note: In addition, for control of peak levels, fast programme meters (\( t_i = 0 \) ms or "exact sample") are to be recommended, as only these detect individual too-high peaks which may otherwise in certain circumstances be clipped and hence lead to disturbances. If necessary, a production may be checked with domestic content monitor complying with DIN IEC 60268.

6.2.1.3 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, measured with a programme meter according to Specifications 3/6 [Pflichtenheft 3/6] having an integration time \( t_i \) von 10 ms (Quasi Peak Programme Meter 'QPPM'). 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 QPPM.

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.

Note: The Recommendation refers to the sound channel of the system being used (mono, stereo, multi-channel) with the maximum level in each case.

6.2.1.4 Dynamic range of system, programme, signal and reproduction

If we consider linear PCM systems, the dynamic range of the system or the signal-to-noise ratio is a calculable, measurable static system parameter which is identical for all the audio channels of the system being used (mono, stereo, multi-channel). The system's dynamic range is as a rule dependent on the quantisation. A 16-bit system, for instance, provides a system dynamic range op 98 dB, a 20-bit system one of 122 dB (referred to 0 dBFS and the RMS quantization noise).

The programme dynamic range is that which can actually be used for transmitting the wanted signal. It is limited, amongst other things, by the 9-dB headroom and a 20-dB footroom (level difference between the signal noise and the minimum signal level).

The signal dynamic range is the difference between the maximum and minimum levels of the wanted signal, whereby, for instance, the maximum signal range of the production applies to the relevant sound channel having the highest minimum wanted signal level of the system used (mono, stereo, multi-channel).

The reproduction dynamic range refers to the sound level produced on reproduction. The measured reproduction dynamic range is defined as the difference between the maximum and
minimum levels of the wanted signal resulting from the sum of all sound channels of the system used (mono, stereo, multi-channel). It follows from this, that no direct conclusions as to the reproduction dynamic range can be drawn from the modulation or from the resultant signal dynamic range.

### 6.2.2 Production

The original dynamic range must take into account the technical limitations of the transmission system and must be restricted to an appropriate signal dynamic range or reproduction dynamic range in a way that corresponds to the director's artistic intentions. Making allowance for the restricted system dynamic range of analogue propagation and for the listener's reproduction conditions, the signal dynamic range of the monophonic and stereophonic sound signals must not exceed 40 dB.

The audio engineering equipment must comply with the requirements of Technical Guideline 3/5 "Sound control room equipment" and the Alignment Guidelines "Basic requirements for audio tape equipment and guidelines for its alignment" [Pflichtenhefte 3/5 "Tonregieanlagen" and Einstellrichtlinie "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.

The maximum achievable dynamic range is determined in the first place by the technical limits of transmission, whereby the corresponding headroom (9 dB, measured with a QPPM) and an adequate footroom of 20 dB (difference in level between system noise and minimum Signal level) is maintained.

In the production of television programmes, the loudness balance between individual programme elements (speech, music, and noises, special effects etc.) merits special consideration. The loudness balance does not depend solely on the modulation control or the level ratios, but also on the technical processing of the sound signal, such as, for instance, the use of compression. The sound mix must always be balanced so as to favour the intelligibility of speech. In this connection, experience has shown that, for reasons of loudness balance, speech should not be kept more than 6 dB below the loudest programme section for any length of time.

It must be pointed out that severe sudden changes in loudness, including those between programme sequences and advertising blocks, are avoided by consistent use of the QPPM (analogue and digital) and observance of the 9-dB headroom recommendation.

A suitable loudness meter is helpful in optimising the loudness balance.

For information: in achieving a satisfactory loudness balance within a production, and between different productions, the maximum QPPM levels recommended below are to be taken as underlying target values:

**Note:** It should be borne in mind that, while the maximum QPPM level comes close to the subjective impression of loudness, it is not in principle a measure of loudness. This is why the QPPM maximum values given must in future be complemented by corresponding loudness levels. The IRT has already developed prototypes of a suitable loudness meter!
Target values *
(Reference QPPM -9 dB dBFS)

<table>
<thead>
<tr>
<th>Sound Support</th>
<th>dB</th>
<th>dBFS</th>
<th>dBu</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spoken-word items not of an artistic nature</td>
<td>0</td>
<td>-9</td>
<td>+6</td>
</tr>
<tr>
<td>Off-screen announcements</td>
<td>0</td>
<td>-9</td>
<td>+6</td>
</tr>
<tr>
<td>Music having a narrow dynamic range</td>
<td>-3…-6</td>
<td>-12…-15</td>
<td>+3…0</td>
</tr>
<tr>
<td>Music having a wide dynamic range</td>
<td>0</td>
<td>-9</td>
<td>+6</td>
</tr>
<tr>
<td>Advertising (heavily compressed)</td>
<td>-6</td>
<td>-15</td>
<td>0</td>
</tr>
</tbody>
</table>

* Note: The recommended target values are given in column 1 as maximum QPPM levels referred to -9 dBFS (permitted maximum level). In order to avoid misunderstandings, the corresponding QPPM levels for digital [dBFS] and analogue [dBu] levels are also indicated. The relationship between analogue and digital reference levels is discussed in detail in Para. 2.3.4.

6.3 Synchronization of foreign-language productions

In general, foreign-language productions with international-sound versions are to be supplied on a digitally time-coded video data support. Sound tracks are to be assigned as set out in Para. 2.4.

Separate sound supports may only be supplied after agreement between both sides.

6.4 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 9.17).

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. Because of reductions in sound quality occasioned by cascade effects, compression processes must be avoided as far as possible in the whole production chain. In cases where compression processes are unavoidable (e.g. Dolby E), care should be taken to ensure that as few recoding operations as possible have to be performed.

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. 6.4.2). 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 as 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. 2.3.4 "Digital sound signals" of these Guidelines must be respected.

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

In the case of purely audio exchange formats, not video tape formats, the 5.0 system or the 5.1 system is to be used for the supply and exchange of programme material with multi-channel sound signals, in line with EBU Technical Recommendation R91 (see Para. 6.1.5 and Annex 9.21), with the following track assignments:

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>R</td>
<td>C</td>
<td>LFE (if available)</td>
<td>LS or MS(-3dB)</td>
<td>RS or MS(-3dB)</td>
<td>A (if available)</td>
<td>B (if available)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Sound signal</th>
<th>5.0</th>
<th>5.1</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></td>
<td>x</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></td>
<td>x</td>
</tr>
<tr>
<td>A</td>
<td>Left (two - channel stereo)</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>B</td>
<td>Right (two - channel stereo)</td>
<td></td>
<td>x</td>
</tr>
</tbody>
</table>

(*) With a single-channel surround signal (in place of LS and RS signals).
### 6.4.2 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>Timecode***</th>
<th>Start –ID*</th>
<th>Modulation type</th>
<th>Programme</th>
<th>Channel assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>(H:M:S:F)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>09:58:00:00</td>
<td></td>
<td>Silence Leader</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10:00:00:00</td>
<td>-01-</td>
<td>Mono</td>
<td>Programme part 1</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 Left</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Channel 2 Right</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Two channel</td>
<td>Channel 1 German programme sound</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Channel 2 Original programme sound or Audio-description</td>
<td></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** -ID-</td>
<td>End of Programme part n</td>
<td></td>
<td></td>
</tr>
<tr>
<td>At least 10 s</td>
<td></td>
<td>Silence Leader</td>
<td></td>
<td>Trailer</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.
*** Optional Timecode in Aux-area
6.5 Sound encoding for production, postproduction, and distribution

6.5.1 Modulation control for coded audio signals – Dolby E, Dolby Digital

For coded audio signals, Dolby E and Dolby Digital (AC3), there are other considerations with reference to modulation control and useful dynamic range.

In the case of multi-channel productions broadcast in Dolby Digital coding, it is theoretically possible to exploit the complete dynamic range in the discrete 5.1 signal up to 0 dBFS (measured with a PPM, 0 ms, sample accurate). This, however, should only be permitted where there is no possibility of overmodulation. If this cannot be guaranteed, then the provisions of Para. 6.2 “Modulation control – dynamic range” must absolutely be respected.

**Warning:** In the case of live productions or recordings, in order to avoid overmodulation the individual channels must be controlled with 9 dB headroom, i.e. to a maximum of –9 dBFS (measured with a QPPM), just as in the case of stereo productions (see Para. 6.2). This also applies to the re-use, e.g. a new mixdown, of Dolby E decoded sound signals.

So as to achieve an unchanging sound volume in a domestic situation, what is called the "Dialogue Level" is specified in the Metadata during production (also termed Dialnorm or Dialogue Normalization). This value lies between 0 and –31 dB and defines the dialogue level, i.e. the level for speech, and is used by the decoder in order to adapt the loudness level. If the value is set correctly in all Dolby Digital productions, the viewer is given a balanced reproduction level for speech in different kinds of programme. The modulation control itself, however, remains unaffected by this.

The dynamic range can be restricted if necessary in the viewer’s home in the AC3 decoder (night mode). The corresponding characteristic is likewise defined in the Metadata during production.

6.5.2 Dolby E

Dolby E is an audio data stream for professional use, with a capability of transporting, coupled with the video, up to eight compressed audio channels, associated Metadata and a time-code by means of an existing stereo PCM infrastructure.

**Warning with respect to incidental monitoring.** The Dolby E signal is a maximum level (0 dBFS) coded data stream, not a sound signal. **No modifications of any kind,** such as level corrections or sampling rate changes, must be made.

Dolby E was developed specifically for the transport of multi-channel sound within and between broadcasting organisations. Dolby E is therefore the appropriate process for the exchange and distribution of multi-channel sound, especially in connection with video, at every moment before actual transmission. Dolby E can hold up to eight discrete sound channels (up to eight individual sound programmes), including individual Metadata for each of the sound programmes. The up to eight sound channels can be distributed via an AES3 channel in an existing infrastructure for digital stereo or recorded on two sound tracks of a digital video recorder. All eight sound channels, including the Metadata, are coded at the usual data rate of 1.92 Mbit/s (corresponding to a word size of 20 Bits and a 48 kHz sampling rate). The audio channels may have a bandwidth of 20 kHz and a dynamic range of up to 110 dB. If a word size of only 16 Bits is available, six audio channels can be transported or recorded in the Dolby E format.

In contrast to Dolby Digital (AC-3), Dolby E can handle many (up to ten) cascaded operations, i.e. multiple encoding/decoding cycles, without perceptible artefacts being produced. In addition, the integration of the SMPTE time-code and the framework structure of Dolby E ensures that audio and video remain synchronised throughout postproduction and distribution.

Dolby E is a professional system developed exclusively for use in postproduction and conventional transmission infrastructures. The sound never reaches the consumer in the Dolby E format. Such decoders are not included in domestic equipment. Before transmission, the multi-channel sound signal has to be recoded either into the Dolby Digital format (the preferred method at present, as this is also supported by all domestic equipment permitting the reception of multi-channel sound in DVB) or the DTS format.
6.5.3 Dolby Digital

The Dolby Digital format is supported by all multi-channel receivers on the market and all DVB set-top boxes (STBs) possessing a digital audio interface. The available data rate range is 56 - 640 kbit/s. Warning: for reasons of complexity, older multi-channel receiver models do not support 640 kbit/s. In the DVD Standard the highest data rate specified was 448 kbit/s. At 192 kbit/s for a 2.0 signal, Dolby Digital is also Dolby Surround compatible.

For a 5.1 signal the target rate is between 384 and 448 kbit/s.
- The main channels (1 to 5) support a frequency range of 3 Hz to 20 kHz, whereby the upper limit can be determined by the user.
- The optional LFE channel has a bandwidth of 3 Hz to 120 Hz.
- Resolution of the audio sample: 16, 20 or 24-bit resolution is supported.
- The data rate can be determined by the user.

Dolby Digital is not suitable for the distribution of multi-channel sound in the context of professional postproduction work in television organisations:
- Multiple codings should be avoided, as Dolby Digital was optimised for low bitrates and high bitrates are not supported.
- Dolby Digital frames differ from video frames as regards length.
- Dolby Digital is therefore not suitable for editing if the video signal has to be subsequently processed.

6.5.3.1 LFE

The LFE signal (low-frequency enhancement) typically has a bandwidth of less than 80 Hz and is optionally used for low-frequency effects. It is hence not a sub-woofer signal in the conventional sense, containing the low-frequency components of the normal audio signal.

According to SMPTE, in production the LFE channel should be reserved for those programme elements with extremely low frequencies and very high levels whose absence on reproduction does not detract from the artistic integrity of the programme.

Bass management of AC3 decoders

The LFE signal is not considered as part of the downmix in the decoders (as shown in the block diagram of the AC3 Decoder). However, on the receiver side (AC3 decoder) the reproduction level of the LFE signal is raised by 10 dB. In TV production this factor is taken into account by following determination:
- The production itself is carried out without any influence of the level. Only at the transition into the Dolby-world the level reduction takes place. By that, problems are prevented in particular during sound monitoring via different listening-paths.
6.5.4 DTS

DTS (Digital Theater Sound), originally found only in the cinema, but then later also on DVD video, was incorporated in the DVB Standard a year ago as an additional optional audio system. Theoretically, therefore, DTS has the same status in DVB as Dolby Digital. DTS makes it possible to transmit a 5.1 or even a 6.1 multi-channel sound signal in a single data stream, in the second case including a rear sound channel, with sampling rates of 44.1, 48 or 96 kHz. In this, the new DTS ES 96/24 format is backwards-compatible with the normal DTS format. DTS is a scalable format which, because of its scalability, can be not only used for actual transmission, but also for production, postproduction, and distribution. The source format can have a sampling rate of not only 44.1/20 bits, but also 48, 88.2, 96 or even 192 kHz and a word size of up to 24 bits. The bitrate range is 64 kbit/s for a mono channel up to a maximum of 4.5 Mbit/s for a 6.1 multi-channel audio signal. In comparison, the maximum bitrate in Dolby Digital is only 640 kbit/s. Since January 2004 the first DVBSTBs capable of receiving a DTS signal and looping it through the connected multi-channel receivers have been on the market. All present-day multi-channel receivers support the DTS format. In the case of older multi-channel sets it is not possible to guarantee that a DTS decoder is installed.

Note: Apart from Sveriges Radio, no other European broadcasting organisation is at present using the DTS system.

6.6 Metadata

Cascaded transmission links with Dolby E and Dolby Digital allow the end-to-end transport of Metadata. The data contain various information about the sound (copyright, Content, characteristics, format, coding, etc.). The Metadata are matched to the different circumstances of a production and decided by the sound engineer before coding. They make it possible to configure the decoder for optimum reproduction with reference to individual differences in the listener’s wishes and listening conditions.

Important control parameters for reproduction in the home are:

- Dialogue level (“dialnorm”),
- Dynamic range control,
- Downmix information.

Along side these consumer parameters there are also what are termed “professional” parameters, that are contained in the Dolby E data stream but not in the Dolby Digital data stream.

6.6.1 Dialogue normalisation

With the aid of the parameter “Dialogue Level” it is possible to ensure on the transmission side that the listener is provided with a balanced reproduction level for different kinds of programming (music, announcements, action film, talk show) or programme sources (TV, set-top box, DVD player). The Dialogue Level is the long-term A-weighted average level of the programme. Based on this, a Dolby decoder normalises the average level to the value desired at the transmitter and correspondingly preset at the encoder. This has the effect of a volume level controlled at the transmitter end, but without affecting the modulation control.

6.6.2 Dynamic Range Control

Dynamic Range Control (DRC) Metadata are used in the decoder to compress all audio channels in accordance with the dynamic range desired by the listener. With this it is possible to influence the compression behaviour during production or before distribution.
7. File-based exchange

The ARD has decided to introduce the exchange of items of native video material by means of file transfer in the context of news and current affairs. Apart from the technical aspects, this is also planned to cover operational integration between the Land broadcasting organizations, taking into consideration the ARDaktuell newsroom and the ARD studio in the capital.

“Guidelines for the ARD’s video file transfer system” have been published concerning this conversion and to provide a basis for understanding. The relevant provisions for the exchange of programme items contained in these Guidelines are to be observed. Some important points and further operational provisions or rules are given below as extracts.

7.1 Exchange of Content

Finished programmes, individual items, sequences, raw material, and excerpts are permitted in file exchange. The first phase of implementation is to cover items (up to about five minutes in length) and excerpts (“Klammerteile” -- selected passages from a programme or item).

Temporally continuous Content is exchanged in one file. In the case of compilations of excerpts, this means that every single excerpt is exchanged as a separate file. For the purpose of exchanging multiple materials (i.e. material in connection with rough cut lists), it is specified that the requested elements should be exchanged as independent items. In order to ensure that the transferred files are clearly assigned, an unambiguous identifier (order-ID) is assigned to each order. The format of the order-ID can be obtained from the Regelwerk Fernsehproduktion.

7.1.1 Operational rules

As explained in Para. 2.8.2, material is exchanged without a technical leader. The file Content begins with the first frame and ends with the last frame of the programme material to be exchanged. This applies both to the starting phase, in which the programme material to be exchanged is played into the file transfer system via an SDI video interface by means of a play-in application, and to the case of a direct coupling of an IT-based production system to the video file transfer system.

In addition, it is specified that the transferring broadcasting organisation should transfer the complete “programme”, i.e. a recording of a broadcast is transferred with all segments of a transmission, such as the sponsor’s name, opening credits, programme, end credits, copyright notice, trailer, etc. This ensures that the receiving broadcasting organisation always has all segments available in case of need.

7.2 Recommendation for the use of the MXF file format

The broadcasting organisations have agreed to use for their exchanges the MXF file format in accordance with the current SMPTE specifications. The MXF file format transferred by a broadcasting organisation must comply with the agreed transfer guidelines as laid down in Annex A.1 of the guidelines for the video file transfer system. Amongst others, these include the following provisions:

7.2.1 Essence Container

The MXF Generic Container is to be used. It is sent in the compression process of the production. The authorised compression processes are:

- MPEG 422P/ML (SMPTE S356, EBU-D94),
- DV-based/DV-based50 (SMPTE S314),
- DV (includes MiniDV and DVCAM).

Note: In the case of MiniDV, audio/video is not locked. In addition, the sampling rate of the audio signals may differ from that authorized in television production.

The audio track assignment must be compatible with the relevant video tape format (see Para. 2.4 of these Guidelines).

In the case of formats of the DV family this is ensured by the fixed relation of audio and video in the DIF stream.
In the case of D10 (IMX) the channels of the "8-Channel AES-3 Element" are assigned in accordance with the implementation of the e-VTR.

For the exchange of data that are not embedded in the video signal (e.g. subtitles) further provisions are required. These data that are at present carried separately can be transmitted in MFX in their own data track with time-code coupling to the audio and video content.

For the moment the specification for the exchange of subtitles is still in the preparatory stage.

7.2.2 Operational pattern

It is provided that temporally continuous individual objects should be transferred in separate files.

Video, audio, and data are to be exchanged in multiplexed form (compound). This ensures that the exchanged MXF files are streaming-capable. For this reason, **Operational Pattern 1a is provided for exclusively.**
8. Metadata

8.1 Principles of exchange

For the exchange of television productions on video tape (transfer or the exchange of tape) the VTR card provides the basis for the exchange of the associated information (Metadata). Of course, the introduction of IT-based production systems is making electronic exchange from system to system necessary. This applies both to the programme material (video, audio, subtitles) and the information itself.

As the exchange of information between IT-based systems, e.g. the video file transfer system (see Part 7 "File-based exchanges"), takes place strictly at machine level, it must be regulated in the smallest detail. This applies not only to the procedure, i.e. the interfaces and protocols employed, but also, in particular, the significance and the description of the information. For only if the information is specified precisely can it be put into a receiving system, retrieved, and interpreted without ambiguity, without human intervention.

The "Regelwerk Fernsehproduktion" was developed in a joint study by the Chief Engineers of the ARD broadcasting organisations and the ZDF to provide a basis for the exchange of information relevant to production in an IT-based production environment.

8.2 Regelwerk Fernsehproduktion - FSP

The "Regelwerk Fernsehproduktion" contains the requirements for the exchange of production-relevant information. It defines the requisite data elements, which are organised into "mandatory" and "optional". In addition it contains descriptive examples adapted to the circumstances of the individual broadcasting organisations.

*Note:* In the following, the relevant information is given in tabular form together with an "example" and the corresponding reference in the Regelwerk Fernsehproduktion.

8.3 Exchange of Metadata - manual procedure

In the initial phase the programme material to be exchanged is played into the video file transfer system via an SDI video interface by means of a play-in application. In this case the supplying organisation can make its own appropriate decisions, within the specified framework (Regelwerk FSP), as regards the extent of the information made available.

However, the following information (mandatory information) is to be provided in every case:

<table>
<thead>
<tr>
<th>Regelwerk FSP – Mandatory information:</th>
<th>Example:</th>
<th>Regelwerk FSP - No.:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programme category</td>
<td>&quot;Item&quot;</td>
<td>3.3.1</td>
</tr>
<tr>
<td>Title</td>
<td>&quot;Oktoberfest&quot;</td>
<td>3.3.2</td>
</tr>
<tr>
<td>Receiving organisation</td>
<td>&quot;ARD-SZ&quot;</td>
<td>3.3.7</td>
</tr>
<tr>
<td>Receiving department</td>
<td>&quot;Playback&quot;</td>
<td>3.3.8</td>
</tr>
<tr>
<td>Supplying organisation</td>
<td>&quot;BR&quot;</td>
<td>3.3.9</td>
</tr>
<tr>
<td>Video material duration</td>
<td>&quot;00:00:23:10&quot;</td>
<td>3.3.16</td>
</tr>
<tr>
<td>Sound track assignment audio1-8</td>
<td>&quot;Track 1: Stereo left&quot;</td>
<td>3.3.22</td>
</tr>
<tr>
<td></td>
<td>&quot;Track 2: Stereo right&quot;</td>
<td></td>
</tr>
</tbody>
</table>

In addition, the following optional information may be provided:
In the starting phase the programme relevant Metadata are entered via an input template (see Annex 9.21) in the play-in application. The technical Metadata must also be entered via the data bank display (Annex 9.29). The aim is to have a uniform system so that Metadata can be entered directly via an input template.

8.4 Exchange of Metadata – automatic procedure

In cases where an IT-based production system is directly coupled to the video file transfer system, the information specified in the Regelwerk Fernsehproduktion is to be provided.

This information is to be divided into two groups. The "mandatory" group comprises all that information which must be exchanged in every case. The "optional" group comprises information which, while it is not absolutely necessary to the exchange, may nonetheless be of interest and may even be needed in certain conditions.

The items of information contained in the March 2005 Edition are given below, grouped in categories. The detailed descriptions and definitions, together with indications of the range of values, are to be taken from the current version of the Regelwerk FSP in every case.

*Note:* Additional operational requirements for the exchange of Metadata are detailed in Para.7.2.2 "Metadaten und Austausch-Schema" (Metadata and exchange schematic) of the "Richtlinie für das Video-Filetransfersystem der ARD".

8.4.1 Overview of mandatory information

<table>
<thead>
<tr>
<th>Regelwerk FSP – Mandatory information:</th>
<th>Example:</th>
<th>Regelwerk FSP - No.:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programme category</td>
<td>&quot;Item&quot;</td>
<td>3.3.1</td>
</tr>
<tr>
<td>Title</td>
<td>&quot;Oktoberfest&quot;</td>
<td>3.3.2</td>
</tr>
<tr>
<td>Subtitle</td>
<td>&quot;Ferris wheel&quot;</td>
<td>3.3.3</td>
</tr>
<tr>
<td>Utilisation in (higher-level title)</td>
<td>&quot;Munich&quot;</td>
<td>3.3.4</td>
</tr>
</tbody>
</table>
**Identifiers:**
- Archive number
- Production identifier
- Data set identification number
- ARD-SZ playback number
- ...

<table>
<thead>
<tr>
<th>Order ID</th>
<th>&quot;BR_WE802543&quot;</th>
<th>3.3.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receiving organisation</td>
<td>&quot;ARD-SZ&quot;</td>
<td>3.3.7</td>
</tr>
<tr>
<td>Receiving department</td>
<td>&quot;Playback&quot;</td>
<td>3.3.8</td>
</tr>
<tr>
<td>Supplying organisation</td>
<td>&quot;BR&quot;</td>
<td>3.3.9</td>
</tr>
<tr>
<td>Supplying department</td>
<td>&quot;Aktuell&quot;</td>
<td>3.3.10</td>
</tr>
<tr>
<td>Transfer start date/time</td>
<td>&quot;01/10/2006 18:55:00&quot;</td>
<td>3.3.11</td>
</tr>
<tr>
<td>Responsible organisation</td>
<td>&quot;BR&quot;</td>
<td>3.3.12</td>
</tr>
<tr>
<td>Responsible department</td>
<td>&quot;Aktuell&quot;</td>
<td>3.3.13</td>
</tr>
<tr>
<td>Editorial notes</td>
<td>&quot;Interview on Ferris wheel accident&quot;</td>
<td>3.3.14</td>
</tr>
</tbody>
</table>

**Technical descriptions of the material to be exchanged:**

<table>
<thead>
<tr>
<th>Regelwerk FSP - mandatory information:</th>
<th>Example:</th>
<th>Regelwerk FSP - No.:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timecode start</td>
<td>&quot;10:00:00:00&quot;</td>
<td>3.3.15</td>
</tr>
<tr>
<td>Video material duration</td>
<td>&quot;00:02:39:06&quot;</td>
<td>3.3.16</td>
</tr>
<tr>
<td>Technical notes</td>
<td>&quot;Sound ends after end of video&quot;</td>
<td>3.3.17</td>
</tr>
<tr>
<td>Video material (Essence) Identification</td>
<td>&quot;Spoken filename&quot;</td>
<td>3.3.18</td>
</tr>
<tr>
<td>Aspect ratio</td>
<td>&quot;6:9&quot;</td>
<td>3.3.19</td>
</tr>
<tr>
<td>Teletext subtitles</td>
<td>&quot;No&quot;</td>
<td>3.3.20</td>
</tr>
<tr>
<td>Audio status</td>
<td>&quot;Stereo&quot;</td>
<td>3.3.21</td>
</tr>
<tr>
<td>Sound track assignment Audio1-8</td>
<td>&quot;Track 1: Programme sound left&quot;</td>
<td>3.3.22</td>
</tr>
<tr>
<td></td>
<td>&quot;Track 2: Programme sound right&quot;</td>
<td></td>
</tr>
</tbody>
</table>
### 8.4.2 Overview of optional information

#### Description of content of the material to be exchanged:

<table>
<thead>
<tr>
<th>Regelwerk FSP – Optional information:</th>
<th>Exchange with BMF Attributes:</th>
<th>Regelwerk FSP - No.:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Editor/author person forename, surname</td>
<td>&quot;Editor:B. Musterfrau&quot;</td>
<td>3.3.23</td>
</tr>
<tr>
<td>Editor/author contact street, town …</td>
<td>&quot;<a href="mailto:musterfrau@brnet.de">musterfrau@brnet.de</a>&quot;</td>
<td>3.3.24</td>
</tr>
<tr>
<td>Restrictions on use</td>
<td>&quot;None&quot;</td>
<td>3.3.25</td>
</tr>
<tr>
<td>Description of content</td>
<td>&quot;Statements by …“</td>
<td>3.3.26</td>
</tr>
<tr>
<td>Presentation text</td>
<td>&quot;Yesterday evening …“</td>
<td>3.3.27</td>
</tr>
<tr>
<td>Language</td>
<td>&quot;German“</td>
<td>3.3.28</td>
</tr>
<tr>
<td>Age rating</td>
<td>&quot; No restriction“</td>
<td>3.3.38</td>
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#### Technical description of the material to be exchanged:

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<th>Regelwerk FSP - No.:</th>
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</thead>
<tbody>
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<td>&quot;25:1“</td>
<td>3.3.30</td>
</tr>
<tr>
<td>Field rate</td>
<td>&quot;50:1“</td>
<td>3.3.31</td>
</tr>
<tr>
<td>Interlace ratio</td>
<td>&quot;2“</td>
<td>3.3.32</td>
</tr>
<tr>
<td>Video signal</td>
<td>&quot;digital / YCbCr&quot;</td>
<td>3.3.33</td>
</tr>
<tr>
<td>Video compression</td>
<td>&quot;D10 (MPEG-2 422P@ML)&quot; &quot;50 Mbit/s“</td>
<td>3.3.34</td>
</tr>
<tr>
<td>Medium type</td>
<td>&quot;IMX“</td>
<td>3.3.35</td>
</tr>
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<td>Colour</td>
<td>&quot;colour“</td>
<td>3.3.36</td>
</tr>
<tr>
<td>Clean feed</td>
<td>&quot;yes“</td>
<td>3.3.37</td>
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9. Annexes

9.1 Picture formats: shooting, screen, presentation and transmission formats

**Shooting format**
Picture format used in shooting
Determined by: producer, director, editorial office

**Screen format**
Picture format of the picture display device (monitor, display)
Determined by: manufacturer, purchaser

**Presentation format**
Picture format of the picture presented
Determined by: functionalities of picture display device

**Transmission format**
Picture format of the transmission path
Determined by: broadcasting organisation, programme directorate, editorial office

- 4:3 Format
- 16:9 Full Format
- 4:3 Letterbox
- 16:9 Full Format (LB)
9.2 Picture formats: Analogue transmission and reception

### Analogue transmission

- **4:3**
  - [Diagram]

### Presentation format

- **4:3 Display**
  - [Diagram]
  - 16:9 Display
    - 16:9 full format (horizontal distortion)
    - (vertical cropping and loss of resolution)

- **4:3 Letterbox**
  - [Diagram]

- **4:3 Display**
  - „Letterbox“

- **16:9 Display**
  - 4:3 presentation
  - 16:9 Blow up / zoom (loss of resolution)
9.3 Picture formats: Digital transmission and reception

<table>
<thead>
<tr>
<th>Digital transmission</th>
<th>Presentation format</th>
</tr>
</thead>
<tbody>
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<td><strong>4:3</strong></td>
<td><strong>4:3 Display</strong></td>
</tr>
<tr>
<td><img src="image" alt="4:3 Display" /></td>
<td><img src="image" alt="4:3 Display" /></td>
</tr>
<tr>
<td><strong>16:9 Full Format</strong></td>
<td><strong>4:3 Display</strong></td>
</tr>
<tr>
<td><img src="image" alt="16:9 Display" /></td>
<td><img src="image" alt="4:3 Display" /></td>
</tr>
<tr>
<td><strong>16:9 Display</strong></td>
<td><strong>16:9 Display</strong></td>
</tr>
<tr>
<td><img src="image" alt="16:9 Display" /></td>
<td><img src="image" alt="16:9 Display" /></td>
</tr>
</tbody>
</table>

Set-top box

- **4:3** Display
- **16:9** Display
- **4:3** Blow-up / zoom (vertical cropping and loss of resolution)
- **4:3** full format (pillar boxes)
- **16:9** full format
- **16:9** full format
### 9.4 Picture formats: Incorporation of 4:3 material in a 16:9 production

<table>
<thead>
<tr>
<th>4:3-material</th>
<th>16:9-production</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="4:3 original picture" /> &quot;Retaining picture content&quot;</td>
<td><img src="image2" alt="16:9 cut-out" /> &quot;middle&quot;</td>
</tr>
<tr>
<td><img src="image3" alt="16:9 cut-out" /> &quot;fixed or tracking&quot;</td>
<td><img src="image4" alt="Pan-scan" /></td>
</tr>
<tr>
<td><img src="image5" alt="4:3 original picture" /></td>
<td><img src="image6" alt="Direct" /></td>
</tr>
<tr>
<td><img src="image7" alt="Centre" /></td>
<td><img src="image8" alt="Adapted to scene content!" /></td>
</tr>
<tr>
<td><img src="image9" alt="Horizontally stretched" /></td>
<td><img src="image10" alt="Embedded in graphics!" /></td>
</tr>
<tr>
<td><img src="image11" alt="Distorted presentation!" /></td>
<td></td>
</tr>
</tbody>
</table>
9.5 Picture formats: Incorporation of 16:9 material in a 4:3 production

<table>
<thead>
<tr>
<th>16:9 material</th>
<th>4:3 production</th>
</tr>
</thead>
<tbody>
<tr>
<td>4:3 cut-out „middle“</td>
<td>Centre</td>
</tr>
<tr>
<td>4:3 cut-out „fixed or tracking“</td>
<td>Adapting to scene content!</td>
</tr>
<tr>
<td>16:9 original picture „Retaining picture content“</td>
<td>Letterbox!</td>
</tr>
<tr>
<td>16:9 original picture</td>
<td>Horizontally squeezed</td>
</tr>
</tbody>
</table>

Caution! Distorted presentation!
9.6 Transmitted picture area, centre of interest and caption area (4:3 and 16:9)

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

9.6.2 Transmitted picture area, centre of interest and caption area in 16:9 picture format
9.7 Characteristics of the B and G PAL systems [1]

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

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

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

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

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

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

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 9.7 and 9.8 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.
9.10 Modulation range for luminance and chrominance in accordance with ITU-R

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

Representation form "A" referring to 8 Bit, and "B" referring to 10 Bit

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Decimal</th>
<th>Hexadecimal</th>
<th>Binary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excluded</td>
<td>766.3 mV</td>
<td>255.75 (1023)</td>
<td>FF.C (3FF)</td>
</tr>
<tr>
<td>Excluded</td>
<td>765.9 mV</td>
<td>255.00 (1020)</td>
<td>FF.0 (3FC)</td>
</tr>
<tr>
<td>Peak white</td>
<td>700.0 mV</td>
<td>235.00 (940)</td>
<td>EB.0 (3AC)</td>
</tr>
</tbody>
</table>

**Fig. 2: 10-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**

Representation form "A" referring to 8 Bit, and "B" referring to 10 Bit

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Decimal</th>
<th>Hexadecimal</th>
<th>Binary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excluded</td>
<td>396.9 mV</td>
<td>255 FF</td>
<td>1111 1111</td>
</tr>
<tr>
<td>Max. positive</td>
<td>395.0 mV</td>
<td>250 F0</td>
<td>1111 0000</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Decimal</th>
<th>Hexadecimal</th>
<th>Binary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excluded</td>
<td>395.2 mV</td>
<td>255.75 (1023)</td>
<td>FF.C (3FF)</td>
</tr>
<tr>
<td>Excluded</td>
<td>394.8 mV</td>
<td>255.00 (1020)</td>
<td>FF.0 (3FC)</td>
</tr>
<tr>
<td>Max. positive</td>
<td>395.0 mV</td>
<td>240 F0</td>
<td>1111 1000</td>
</tr>
</tbody>
</table>

**Fig. 5: 10-Bit luminance modulation range in accordance with Rec. ITU-R BT.601**

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Decimal</th>
<th>Hexadecimal</th>
<th>Binary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excluded</td>
<td>1.0 mV</td>
<td>0.00 (00)</td>
<td>0000 0000.00</td>
</tr>
<tr>
<td>Excluded</td>
<td>-51.1 mV</td>
<td>0.00 (00)</td>
<td>0000 0000.00</td>
</tr>
<tr>
<td>Peak white</td>
<td>700.0 mV</td>
<td>235.00 (940)</td>
<td>EB.0 (3AC)</td>
</tr>
</tbody>
</table>

**Fig. 6: 8-Bit chrominance modulation range in accordance with Rec. ITU-R BT.601**

Representation form "A" referring to 8 Bit, and "B" referring to 10 Bit

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Decimal</th>
<th>Hexadecimal</th>
<th>Binary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excluded</td>
<td>-397.7 mV</td>
<td>0.75 (3)</td>
<td>C.C (013)</td>
</tr>
<tr>
<td>Excluded</td>
<td>-396.9 mV</td>
<td>0.00 (0)</td>
<td>0000 0000.00</td>
</tr>
<tr>
<td>Excluded</td>
<td>-395.0 mV</td>
<td>0.00 (0)</td>
<td>0000 0000.00</td>
</tr>
<tr>
<td>Excluded</td>
<td>-394.8 mV</td>
<td>0.00 (0)</td>
<td>0000 0000.00</td>
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</tbody>
</table>
9.11 Digital and analogue horizontal blanking

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

9.12.1 Embedding of the SDTI header in the SDI frames

9.12.2 Embedding of the SDTI data in the SDI frames
9.13 Relationship between relevant video-compression formats and digital video recording formats
9.14 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.

$$E'_{CR} = 0.71(E'_R - E'_Y)$$
$$E'_{CB} = 0.56(E'_B - E'_Y)$$
9.15 Video alignment signal (test sequence) as specified in EBU Tech 3305

9.15.1 Test pattern with Motion Element One (transmission alive check)

9.15.2 Test pattern with Motion Element Two (audio/video delay check)

Legend:
1. Underlying colour bars with red area
2. Geometrical square element for the indication of the aspect ratio
3. Pattern which marks the centre of the picture
4. Ramp signal with 10 bit resolution
5. Two “End of Line Pulses” at each end, which mark both the analogue and digital horizontal blanking
6. The first and last active line of each field are White lines, where the White signal element starts with the first “End of Line Pulse” and ends with the last “End of Line Pulse”
7. Reserved area for the insertion of visual information, e.g. source identification such as 4:3 or 16:9, time code, etc.
8/9 Motion Sequence 1 consists of a narrow, centre-marked horizontal bar, which is moved vertically up and down
10/11 Motion Sequence 2 consists of two broad bars whose horizontal length oscillates at a defined frequency. When they meet in the centre, a short white bar is inserted for the duration of one frame
9.16 The Vistek VALID video alignment signal

9.16.1 Typical VALID generator 4:3 video output

9.16.2 Typical VALID generator 16:9 video output

Legend:
1 Corner markings
2 Picture aspect ratio (picture format) of source
3 Rotating marker (comet tail)
4 Colour bars with reduced horizontal width
5 Blanking marks
6 Pulse and bar signal
7 Arbitrary text for identification, user-specific
9.17 Code-Format of the 80-bit Time-code according to DIN EN 60461

<table>
<thead>
<tr>
<th>Time address (weight)</th>
<th>LTC bit number.</th>
<th>Start of the code word</th>
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<tbody>
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<td>Units of frames</td>
<td></td>
<td></td>
</tr>
<tr>
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<td>0</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>3</td>
<td></td>
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<tr>
<td>LSB 4</td>
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<td>First binary group</td>
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<tr>
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<td></td>
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<td>6</td>
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<tr>
<td>Tens of frames</td>
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<td></td>
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<td>8</td>
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</tr>
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<td>Colour frame flag</td>
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<td>Flag 27</td>
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<td>Binary group flag 2</td>
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<td>8</td>
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<td>Tens of hours</td>
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<td>Flag 58</td>
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<td>Binary group flag 1</td>
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<tr>
<td>Flag 59</td>
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<td>Field / phase</td>
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<tr>
<td>LSB 60</td>
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</table>

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

The unassigned bits are set to logical zeros „0“. 
### 9.18 VITC and LTC code word bit-definitions according to DIN IEC 60461

<table>
<thead>
<tr>
<th>VITC bit number</th>
<th>Value (weight)</th>
<th>Value (weight)</th>
<th>LTC bit number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>&quot;1&quot; VITC sync. bit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>&quot;0&quot; VITC sync. bit</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>First Binary group</td>
<td>LSB</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>LSB</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>4</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>&quot;1&quot; VITC sync. bit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>&quot;1&quot; VITC sync. bit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>&quot;1&quot; VITC sync. bit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>&quot;1&quot; VITC sync. bit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>&quot;1&quot; VITC sync. bit</td>
<td></td>
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<tr>
<td>6</td>
<td>&quot;1&quot; VITC sync. bit</td>
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<tr>
<td>5</td>
<td>&quot;1&quot; VITC sync. bit</td>
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<tr>
<td>4</td>
<td>&quot;1&quot; VITC sync. bit</td>
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<tr>
<td>3</td>
<td>&quot;1&quot; VITC sync. bit</td>
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</tr>
<tr>
<td>2</td>
<td>&quot;1&quot; VITC sync. bit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>&quot;1&quot; VITC sync. bit</td>
<td></td>
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<tr>
<td>10</td>
<td>&quot;1&quot; VITC sync. bit</td>
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<tr>
<td>9</td>
<td>&quot;1&quot; VITC sync. bit</td>
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<tr>
<td>8</td>
<td>&quot;1&quot; VITC sync. bit</td>
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<tr>
<td>7</td>
<td>&quot;1&quot; VITC sync. bit</td>
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<tr>
<td>6</td>
<td>&quot;1&quot; VITC sync. bit</td>
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<tr>
<td>5</td>
<td>&quot;1&quot; VITC sync. bit</td>
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<tr>
<td>4</td>
<td>&quot;1&quot; VITC sync. bit</td>
<td></td>
<td></td>
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<tr>
<td>3</td>
<td>&quot;1&quot; VITC sync. bit</td>
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<td></td>
</tr>
<tr>
<td>2</td>
<td>&quot;1&quot; VITC sync. bit</td>
<td></td>
<td></td>
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<tr>
<td>1</td>
<td>&quot;1&quot; VITC sync. bit</td>
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<tr>
<td>10</td>
<td>&quot;1&quot; VITC sync. bit</td>
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<tr>
<td>9</td>
<td>&quot;1&quot; VITC sync. bit</td>
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<tr>
<td>8</td>
<td>&quot;1&quot; VITC sync. bit</td>
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<td></td>
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<tr>
<td>7</td>
<td>&quot;1&quot; VITC sync. bit</td>
<td></td>
<td></td>
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<tr>
<td>6</td>
<td>&quot;1&quot; VITC sync. bit</td>
<td></td>
<td></td>
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<tr>
<td>5</td>
<td>&quot;1&quot; VITC sync. bit</td>
<td></td>
<td></td>
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<tr>
<td>4</td>
<td>&quot;1&quot; VITC sync. bit</td>
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<td></td>
</tr>
<tr>
<td>3</td>
<td>&quot;1&quot; VITC sync. bit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>&quot;1&quot; VITC sync. bit</td>
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<tr>
<td>1</td>
<td>&quot;1&quot; VITC sync. bit</td>
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<tr>
<td>10</td>
<td>&quot;1&quot; VITC sync. bit</td>
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<tr>
<td>9</td>
<td>&quot;1&quot; VITC sync. bit</td>
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<tr>
<td>8</td>
<td>&quot;1&quot; VITC sync. bit</td>
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<tr>
<td>7</td>
<td>&quot;1&quot; VITC sync. bit</td>
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<tr>
<td>6</td>
<td>&quot;1&quot; VITC sync. bit</td>
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<tr>
<td>5</td>
<td>&quot;1&quot; VITC sync. bit</td>
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</tr>
<tr>
<td>4</td>
<td>&quot;1&quot; VITC sync. bit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>&quot;1&quot; VITC sync. bit</td>
<td></td>
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</tr>
<tr>
<td>2</td>
<td>&quot;1&quot; VITC sync. bit</td>
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<tr>
<td>1</td>
<td>&quot;1&quot; VITC sync. bit</td>
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<tr>
<td>10</td>
<td>&quot;1&quot; VITC sync. bit</td>
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<td>9</td>
<td>&quot;1&quot; VITC sync. bit</td>
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<td>8</td>
<td>&quot;1&quot; VITC sync. bit</td>
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<tr>
<td>7</td>
<td>&quot;1&quot; VITC sync. bit</td>
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<tr>
<td>6</td>
<td>&quot;1&quot; VITC sync. bit</td>
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<tr>
<td>5</td>
<td>&quot;1&quot; VITC sync. bit</td>
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<td></td>
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<tr>
<td>4</td>
<td>&quot;1&quot; VITC sync. bit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>&quot;1&quot; VITC sync. bit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>&quot;1&quot; VITC sync. bit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>&quot;1&quot; VITC sync. bit</td>
<td></td>
<td></td>
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<tr>
<td>10</td>
<td>&quot;1&quot; VITC sync. bit</td>
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<tr>
<td>9</td>
<td>&quot;1&quot; VITC sync. bit</td>
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<tr>
<td>8</td>
<td>&quot;1&quot; VITC sync. bit</td>
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<tr>
<td>7</td>
<td>&quot;1&quot; VITC sync. bit</td>
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<td>6</td>
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<td>5</td>
<td>&quot;1&quot; VITC sync. bit</td>
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<td></td>
</tr>
<tr>
<td>4</td>
<td>&quot;1&quot; VITC sync. bit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>&quot;1&quot; VITC sync. bit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>&quot;1&quot; VITC sync. bit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>&quot;1&quot; VITC sync. bit</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".
9.19 Key-Code and ARRI time-code for film

9.19.1 Key-code number information for 35 mm film

9.19.2 Key-code number information for 16 mm film

9.19.3 ARRI time-code schematic
9.20 VTR tape nomenclature

<table>
<thead>
<tr>
<th>Work stage</th>
<th>Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recording</td>
<td>Original VT</td>
</tr>
<tr>
<td>NLE</td>
<td>Off-line copy</td>
</tr>
<tr>
<td>On-line editing</td>
<td>Editing original</td>
</tr>
<tr>
<td>Colour correction</td>
<td>CCR-original</td>
</tr>
<tr>
<td>Captioning</td>
<td>Master tape</td>
</tr>
<tr>
<td>Teletext Sub-titling</td>
<td>Master VT</td>
</tr>
<tr>
<td>Transmission copy</td>
<td>Transmission tape</td>
</tr>
</tbody>
</table>
9.21 Multi-channel stereophonic systems

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

Screen 1: Listening distance = 3H (2β1 = 33°)
Screen 2: Listening distance = 2H (2β2 = 48°)

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

9.21.1 Reference-loudspeaker arrangement in accordance with ITU-R BS.775
9.22 Monitoring Dolby E coded audio signals

9.22.1 Monitoring items with coded audio signals without analysis of Metadata

9.22.2 Monitoring items with coded audio signals with analysis of Metadata – using Dolby Digital encoder and decoder

9.22.3 Monitoring items with coded audio signals with analysis of Metadata – using an appropriate audio tool
9.23 Television reproduction resulting from different film picture-formats for separate transmission in 4:3 und 16:9

<table>
<thead>
<tr>
<th>Picture format</th>
<th>Television receiver</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Film or video format)</td>
<td>4 : 3</td>
</tr>
<tr>
<td>1,37 : 1</td>
<td>2,5%B 11%H</td>
</tr>
<tr>
<td>(35mm, Shoot + Protect)</td>
<td></td>
</tr>
<tr>
<td>1,37 : 1</td>
<td>2,5%B 8/9%H</td>
</tr>
<tr>
<td>(16/35mm, Archive)</td>
<td></td>
</tr>
<tr>
<td>1,66 : 1 (15:9)</td>
<td>12,5%H 11%H</td>
</tr>
<tr>
<td>(S16/35mm)</td>
<td></td>
</tr>
<tr>
<td>1,78 : 1 (16 : 9)</td>
<td>12%H 11%B</td>
</tr>
<tr>
<td>(Video)</td>
<td></td>
</tr>
<tr>
<td>1,85 : 1 (17 : 9)</td>
<td>12%H 2%B</td>
</tr>
<tr>
<td>(35mm)</td>
<td></td>
</tr>
<tr>
<td>2,35 : 1</td>
<td>14%H 6%H</td>
</tr>
<tr>
<td>(35mm Cin.; compr.)</td>
<td></td>
</tr>
<tr>
<td>2,35 : 1</td>
<td>11%B 6%B</td>
</tr>
<tr>
<td>(35mm Cin.; 2,21 : 1)</td>
<td></td>
</tr>
</tbody>
</table>

(Details of picture-area loss and letter-box stripes in % of picture height H or picture width B)
### 9.24 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>Film support</th>
<th>16 mm</th>
<th>35 mm</th>
<th>Slides</th>
</tr>
</thead>
<tbody>
<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>$10,3^{\pm0,1} - 7,5^{\pm0,1}$</td>
<td>$22^{\pm0,1} - 16^{\pm0,1}$</td>
<td>$36^{0,5} - 24^{0,5}$</td>
</tr>
<tr>
<td><strong>Transmitted picture area</strong></td>
<td>$9,35^{10,05} - 7^{10,05}$</td>
<td>$20,12^{10,1} - 15,1^{10,1}$</td>
<td>$28,6^{10,2} - 21,5^{10,2}$</td>
</tr>
<tr>
<td><strong>Centre of interest (max.)</strong></td>
<td>8,4 - 6,3 0,23</td>
<td>18,1 – 13,6 0,5</td>
<td>25,7 – 19,3 0,7</td>
</tr>
<tr>
<td><strong>Caption area (max.)</strong></td>
<td>7,9 - 5,9 0,23</td>
<td>17,1 – 12,8 0,5</td>
<td>24,3 – 18,3 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><strong>Shooting format</strong></td>
<td>1.66:1 (1:9.9)</td>
<td>1.78:1 (1:9.9)</td>
<td>1.66:1 (1:9.9)</td>
</tr>
<tr>
<td><strong>Short designation</strong></td>
<td>&quot;Super 16&quot;</td>
<td>&quot;Shoot-and-Protect&quot;</td>
<td>Video</td>
</tr>
<tr>
<td><strong>Shooting picture size</strong></td>
<td>12.35 (\frac{22}{10}) - 7.42 (\frac{22}{10})</td>
<td>21.96 - 12.36</td>
<td>22 (\frac{22}{10}) - 12.8 (\frac{22}{10})</td>
</tr>
<tr>
<td><strong>Ref. edge-centre of picture</strong></td>
<td>12.2 - 6.66</td>
<td>21.11 - 11.87</td>
<td>21.11 - 11.87</td>
</tr>
<tr>
<td><strong>Transmitted picture area (max.)</strong></td>
<td>11 - 6.2</td>
<td>19 - 10.7</td>
<td>19 - 10.7</td>
</tr>
<tr>
<td><strong>Ref. edge-centre of picture</strong></td>
<td>0.23</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td><strong>Centre of interest (max.)</strong></td>
<td>10.4 - 6.8</td>
<td>17.9 - 10.1</td>
<td>17.9 - 10.1</td>
</tr>
<tr>
<td><strong>Radius (max.)</strong></td>
<td>0.23</td>
<td>0.6</td>
<td>0.6</td>
</tr>
</tbody>
</table>

*1 Only standardized as a reproduction format  ** Not yet standardized
9.26 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)
### 9.27 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>1 – 200</td>
<td></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>298 – 254</td>
<td>45</td>
<td>Black</td>
<td></td>
<td>Black frames or name of the broadcasting or production organization in capital letters</td>
</tr>
<tr>
<td>253 – 251</td>
<td>3</td>
<td>White</td>
<td></td>
<td>White frames</td>
</tr>
<tr>
<td>250</td>
<td>1</td>
<td>10</td>
<td></td>
<td>Mark for Rotosynstart, 100 frames before start-cross</td>
</tr>
<tr>
<td>249</td>
<td>1</td>
<td>White</td>
<td></td>
<td>White frame</td>
</tr>
<tr>
<td>248 – 189</td>
<td>60</td>
<td>Black</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>White</td>
<td></td>
<td>White frames for automatic start-cross identification</td>
</tr>
<tr>
<td>183 – 182</td>
<td>2</td>
<td>Black</td>
<td></td>
<td>Black frames with frame bars</td>
</tr>
<tr>
<td>181</td>
<td>1</td>
<td>White</td>
<td></td>
<td>White frame for automatic start-cross identification</td>
</tr>
<tr>
<td>180 – 179</td>
<td>2</td>
<td>Black</td>
<td></td>
<td>Black frames with frame bars</td>
</tr>
<tr>
<td>178</td>
<td>1</td>
<td>28</td>
<td></td>
<td>Magnetic sound – threading mark (white with black numeral)</td>
</tr>
<tr>
<td>177</td>
<td>1</td>
<td>Black</td>
<td></td>
<td>Black frame</td>
</tr>
<tr>
<td>176</td>
<td>1</td>
<td>26</td>
<td></td>
<td>Optical sound – threading mark (black with white numeral)</td>
</tr>
<tr>
<td>175 – 163</td>
<td>13</td>
<td>Black</td>
<td></td>
<td>Black frames with frame bars</td>
</tr>
<tr>
<td>162 – 151</td>
<td>12</td>
<td>TON</td>
<td></td>
<td>White wedges, closing up over 12 frames</td>
</tr>
<tr>
<td>150</td>
<td>1</td>
<td></td>
<td></td>
<td>Film-start cross (possibly with transmitting organization’s logo), Sound-start mark for magnetic-sound film (adhesive label)</td>
</tr>
<tr>
<td>149 – 127</td>
<td>23</td>
<td>Start</td>
<td></td>
<td>Black frames with white vertical centre line 0.4 mm wide</td>
</tr>
<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>
</tr>
<tr>
<td>101 – 99</td>
<td>3</td>
<td>4</td>
<td></td>
<td>Count-down marks (white numerals on black background)</td>
</tr>
<tr>
<td>98 – 77</td>
<td>22</td>
<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>&quot;1&quot;</td>
<td></td>
<td>&quot;1&quot; 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>0</td>
<td>1</td>
<td></td>
<td></td>
<td>Mark for cutting and fading-in 1st picture</td>
</tr>
</tbody>
</table>

**Leader 16-mm / 6 s run-up time**

- **Beginning of sound**
- **Direction of motion**
9.28 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></td>
<td></td>
<td>at least 200</td>
<td></td>
<td>Blank film with frame bars for film title, reel, original, copy, with/without sound, etc.</td>
</tr>
<tr>
<td>250</td>
<td>1</td>
<td></td>
<td></td>
<td>Mark for Rotosynstart, 100 frames before start-cross</td>
</tr>
<tr>
<td>249</td>
<td>1</td>
<td></td>
<td></td>
<td>White frame</td>
</tr>
<tr>
<td>248 – 243</td>
<td>6</td>
<td></td>
<td>N</td>
<td>Replay symbols (Light background, black frame bars and figures) (see Part 1.6)</td>
</tr>
<tr>
<td>242 – 216</td>
<td>27</td>
<td></td>
<td></td>
<td>Black frames or name of the broadcasting or production organization in capital letters</td>
</tr>
<tr>
<td>215 – 213</td>
<td>3</td>
<td></td>
<td></td>
<td>White frames</td>
</tr>
<tr>
<td>212 – 183</td>
<td>30</td>
<td></td>
<td></td>
<td>Black frames with frame bars for leader-coding with perforations (2 holes per frame)</td>
</tr>
<tr>
<td>182 – 180</td>
<td>3</td>
<td></td>
<td></td>
<td>White frames for automatic start-cross identification</td>
</tr>
<tr>
<td>179</td>
<td>1</td>
<td></td>
<td></td>
<td>Frame with white-black step for automatic start-cross identification</td>
</tr>
<tr>
<td>178</td>
<td>1</td>
<td></td>
<td></td>
<td>Black frame with frame bars</td>
</tr>
<tr>
<td>177</td>
<td>1</td>
<td></td>
<td></td>
<td>Frame with black-white step</td>
</tr>
<tr>
<td>176</td>
<td>1</td>
<td></td>
<td></td>
<td>Frame with white-black step</td>
</tr>
<tr>
<td>175</td>
<td>1</td>
<td></td>
<td></td>
<td>Black frame with frame bars</td>
</tr>
<tr>
<td>174</td>
<td>1</td>
<td></td>
<td></td>
<td>White frame</td>
</tr>
<tr>
<td>173 – 172</td>
<td>2</td>
<td></td>
<td></td>
<td>Black frames with frame bars</td>
</tr>
<tr>
<td>171</td>
<td>1</td>
<td></td>
<td>21</td>
<td>Optical sound – threading mark (black with white numeral)</td>
</tr>
<tr>
<td>170 – 163</td>
<td>8</td>
<td></td>
<td></td>
<td>Black frames with frame bars</td>
</tr>
<tr>
<td>162 – 151</td>
<td>12</td>
<td></td>
<td></td>
<td>White wedges, closing up over 12 frames</td>
</tr>
<tr>
<td>150</td>
<td>1</td>
<td></td>
<td>10</td>
<td>Film-start cross (possibly with transmitting organization’s logo), Sound-start mark for magnetic-sound film (adhesive label)</td>
</tr>
<tr>
<td>149 – 127</td>
<td>23</td>
<td></td>
<td></td>
<td>Black frames with white vertical centre line 0.85 mm wide</td>
</tr>
<tr>
<td>126 – 124</td>
<td>3</td>
<td></td>
<td>5</td>
<td>Count-down marks (white numerals on black background)</td>
</tr>
<tr>
<td>123</td>
<td>1</td>
<td></td>
<td></td>
<td>Black frame with white vertical centre line 0.85 mm wide</td>
</tr>
<tr>
<td>122</td>
<td>1</td>
<td></td>
<td>28</td>
<td>Magnetic sound – threading mark (white with black numeral)</td>
</tr>
<tr>
<td>121 – 102</td>
<td>20</td>
<td></td>
<td></td>
<td>Black frames with white vertical centre line 0.85 mm wide</td>
</tr>
<tr>
<td>101 – 99</td>
<td>3</td>
<td></td>
<td>4</td>
<td>Count-down marks (white numerals on black background)</td>
</tr>
<tr>
<td>98 – 77</td>
<td>22</td>
<td></td>
<td></td>
<td>Black frames with white vertical centre line 0.85 mm wide</td>
</tr>
<tr>
<td>76 – 74</td>
<td>3</td>
<td></td>
<td>3</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 0.85 mm wide</td>
</tr>
<tr>
<td>51</td>
<td>1</td>
<td></td>
<td>2</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 0.85 mm wide</td>
</tr>
<tr>
<td>25</td>
<td>1</td>
<td></td>
<td>1</td>
<td>“1” mark on white circular ground, 14 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>1</td>
<td></td>
<td></td>
<td>Mark for cutting and fading-in 1st picture</td>
</tr>
</tbody>
</table>

Leader 35-mm / 6 s run-up time

Direction of motion

Page 92
9.29 Possibilities for entering Metadata for the video file transfer system

9.29.1 Input template of the play-in application for the video file transfer system

9.29.2 Databank readout of the database manager for the video file transfer system
10. **Appendix 1 – Technical Guidelines, Specifications and Standards**

10.1 **Sources of supply**

**Technical Guidelines and Specifications**

[Technische Richtlinien]: Institut für Rundfunktechnik GmbH
Floriansmühlstr. 60
80939 München

E-mail: gierlinger@irt.de
Home page: http://www.irt.de/richtlinien
Telephone: +49-89-32399-391
Telefax: +49-89-32399-200

**EBU Documents:**

European Broadcasting Union
Ancienne Route 17A
1218 Grand-Saconnex / GE
Switzerland / Suisse

E-mail: miles@ebu.ch
Home page: http://www.ebu.ch/technical
Telephone: +41-22-717-2743
Telefax: +41-22-717-2710

**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
Home page: http://smpte.org/smpte_store/standards/
Telephone: +1-914-761-1100
Telefax: +1-914-761-3115

**ITU Documents:**

International Telecommunication Union (ITU)
Publication Sales
Place des Nations
1211 Genève 20
Switzerland / Suisse

E-mail: sales@itu.int
Home page: http://www.itu.int/publications
Telephone: +41-22-730 6141
Telefax: +41-22-730 5194

**DIN Standards [Normen]/ISO Standards:**

Beuth Verlag GmbH
Burggrafenstr. 6
10787 Berlin

E-mail: info@beuth.de
Home page: 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
Home page: http://www.vde-verlag.de
Telephone: +49-30-348001-220
Telefax: +49-30-3417093
10.2 ARD, ZDF, ORF Guidelines

Technische Richtlinien zur Herstellung von Fernsehproductionen von ARD, ZDF und ORF
Ausgabe Mai 2003

[Technical Guidelines for the Production of Television Programmes for ARD, ZDF and ORF, May 2003 edition]. This edition was valid up to the publication of the present Guidelines. It can be consulted at www.irt.de/richtlinien/archiv.

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.

Einstellrichtlinie Magnettonanlagen (Alignment guidelines for magnetic sound systems)
Grundsätzliche Anforderungen an Magnettonanlagen und Richtlinien zu deren Einstellung
[IRT Guideline; Basic requirements for magnetic sound systems and guidelines for their alignment].

Richtlinie für das Video-Filetransfersystem der ARD
[Guidelines for the ARD Video File Transfer System]. A common basis of understanding for the conversion of parameters and further procedures for the exchange of items of native video material by means of file transfer.

Regelwerk Fernsehproduktion
Metadaten für den Austausch
[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.

NDR Publikation „Das Breitbildbuch 2“ (NDR publication: The Widescreen Book 2)
Assistance manual for the changeover from 4:3 to 16:9.

WDR Publikation „Das 16:9 Handbuch“ (WDR Publication: The 16:9 Handbook)
Assistance manual for the changeover from 4:3 to 16:9.

10.2.1 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 3/5
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.
10.2.2 Technical Guidelines (Pflichtenheft) 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 8/9.1
**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.).

10.2.3 Technical guidelines 12/x – Television film

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.

10.2.4 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.

10.2.5 Acceptance guidelines

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 criterions 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 criterions 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 criterions for ARD and ZDF.

ARD-ZDF-ORF-tpc IMX-Abnahme-Richtlinien
[ARD-ZDF-ORF-tpc IMX acceptance guidelines]. These guidelines provide uniform acceptance criterions for ARD, ZDF, ORF and tpc.

10.3 EBU

10.3.1 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.

10.3.2 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 E’Y, E’C'R, E’C’B, 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.

10.3.3  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 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 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 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 R95

Television Production for 16:9 Widescreen: Safe Areas

This Recommendation specifies the centre of interest and the caption area for the 16:9 aspect ratio.

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.

EBU Technical Recommendation R116

The use of DV compression with a sampling raster of 4:2:0 for professional acquisition

Recommendation and restrictions for the use of DV compression and DV consumer equipment in professional television production.

10.3.4 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 3283

Measurements in digital component television studios

This document provides basic guidelines for the measurements in digital audio and video systems.

EBU Technical Document 3305

Digital Television Test Pattern Sequence for Operational Use

Describes a video alignment signal (with associated audio signals) with motion elements for the audiovisual checking of "live" lines and audio/video synchronism.

10.4 SMPTE

10.4.1 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  
*SSTI 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 322M  
*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 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 Essence 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.

10.4.2 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.

10.5 ITU-R

10.5.1 ITU-R BR.

Recommendation ITU-R BR.1215  
*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.
10.5.2 ITU-R BS.

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

Recommendation ITU-R BS.775-1
*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.

10.5.3 ITU-R BT.

Recommendation ITU-R BT.470
*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
*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
*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
*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.

10.6 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 IEC 268 (German Standard DIN IEC 268)
*Elektroakustische Geräte (Electroacoustic devices)*
This standard concerns the determination of the properties of electroacoustic devices, the comparison of such devices, and the determination of their appropriate use by listing the characteristics required for a technical specification.

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 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 the filming picture size of 1.37:1 according to DIN 15502 Sheet 1, and the reproduction with an aspect ratio of 1.66:1 for wide-screen presentation by means of picture area masking.

Deutsche Norm DIN 15546
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 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 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 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 15910-2
Magnetköpfe; Elektrische und magnetische Kenndaten mit Einflussgrößen; Messbedingungen (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 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 61834-1

Videokassettenystem mit digitaler Schrägsputaufzeichnung auf Magnetband 6,35 mm für den Heimgebrauch - Teil 1: Allgemeine Festlegungen

[Recording - Helical-scan digital video cassette recording system using 6.35 mm magnetic tape for consumer use - Part 1: General specifications]

This standard is the German translation of the international standard IEC 61834-1 and specifies cassettes, modulation methods, magnetisation, basic system data, etc. for the digital home recorder format DV.

Deutsche Norm DIN EN 61834-2

Videokassettenystem mit digitaler Schrägsputaufzeichnung auf Magnetband 6,35 mm für den Heimgebrauch - Teil 2: SD Format für die Systeme 525-60 und 625-50

[Recording - Helical-scan digital video cassette recording system using 6.35 mm magnetic tape for consumer use – Part 2: SD format for 525-60 and 625-50 formats]

This standard is the German translation of the international standard IEC 61834-2 and specifies content, format, recording methods of the recorded data blocks containing audio, video, and system data for 525 and 625-line systems in the digital home recorder format DV.

Deutsche Norm DIN EN 61834-4

Videokassettenystem mit digitaler Schrägsputaufzeichnung auf Magnetband 6,35 mm für den Heimgebrauch – Teil 4: Datenpakete – Übersicht und Inhalt

[Recording - Helical-scan digital video cassette recording system using 6.35 mm magnetic tape for consumer use – Part 4 Data packets – overview and content]

This standard is the German translation of the international standard IEC 61834-4 and contains provisions for the digital home recorder format DV.
Deutsche Norm DIN EN 61835
Videokassettenaufzeichnung mit Schrägspuraufzeichnung 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
Videokassettenaufzeichnung mit Schrägspuraufzeichnung 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
Videokassettenaufzeichnung mit komprimierter digitaler Schrägspuraufzeichnung 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).

Deutsche Norm DIN EN 62289
Videokassettenaufzeichnung-Videokassettenystem mit digitaler Schrägspuraufzeichnung auf Magnetband 12,65 mm und eingeschlossener MPEG-2-Kompression — Format D-10 [Video recording - Helical-scan digital video cassette recording format using 12,65 mm magnetic tape and incorporating MPEG-2 Compression - Format D-10]. This standard is the German translation of the international standard IEC 62289 and contains the specifications for the recording format D-10.

10.7 IEC
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).

10.8 ETSI
ETSI Standard ETS 300 294
Wide Screen Signalling - WSS
This standard contains the specifications for the WSS signal in line 23.

10.9 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
11. Appendix 2 – Abbreviations used in these Guidelines

A

**AAF** Advanced Authoring Format (File format of the Advanced Authoring Association)

**AAI** Authorized Address Identifier (SDTI Signal, SMPTE 305M)

**AC3** Audio coding in Dolby Digital

**A/D** Analog / Digital

**ADAT** Digitales Achtkanal Audio Aufzeichnungsformat

**ADF** Auxillary Data Flag (SDTI Signal, SMPTE 305M)

**AES** Audio Engineering Society

**AKAS** Arbeitskreis Audiosystemtechnik (working group on audio system technique)

**ARD** Arbeitsgemeinschaft der öffentlich-rechtlichen Rundfunkanstalten der BRD (Association of public-service broadcasting organisations of the Federal Republic of Germany)

**ARD-SZ** ARD Sende-Zentrum (ARD Playout Center)

**ARRI** Firm's name, Arnold and Richter

**AVI** Audio Video Interleave (audio video file format - video for windows)

B

**B** Blue

**B** Picture width (film picture formats)

**B** Loudspeaker base-width (multi channel stereo systems)

**Betacam** Brand name of VTR systems

**Betacam SP** Analogue VTR format

**Betacam SX** Digital VTR format

**BKSTS** British Kinematograph Sound and Television Society

**BMF** Broadcast Metadata Exchange Format, Datenmodel zum Austausch von Informationen in der FS-Produktion

**BMP** Bitmap (graphic format)

**B/PAL** PAL, system B according to Recommendation ITU-R BT.470

**BR** Bayerischer Rundfunk (German public service broadcaster)

**BWF** Broadcast Wave Format (audio file format, EBU N22)

**B-Y** Analogue colour difference signal (colloquial)

C

**C** Chrominance signal

**C** Centre (multichannel stereo systems)

**C_B** Colour difference signal (digital)

**C_R** Colour difference signal (digital)

**CCR** Colour correction

**CCVS** Composite colour video signal

**cf.** confer (=compare)

**Cin.** Cinemascope

**Compr.** Compromise format

**CRC** Cyclic Redundancy Check (SDI and SDTI signal)

D

**D-1** Digital video recording format without compression, 19 mm tape

**D-5** Digital video recording format without compression, 12.65 mm tape

**D-7** Digital video recording format using compression, (DVCPRO or DVCPRO 50)

**D-10** Digital video recording format using compression, (IMX)

**D/A** Digital / Analogue

**DAT** Digital Audio Tape

**dB** Decibel

**dBS** Decibel Full Scale referring to the clip level

**dB** Decibel referring to the relative voltage level

**dBu** Decibel referring to the voltage of 0.775 V_{rms}

**DCT** Discrete Cosines Transformation

**DID** Data ID (SDTI signal, SMPTE 305M)

**DIF** Digital InterFace (structure of the DV-based compression)

**Digital Betacam** Digital video recording format without compression, 12.65 mm tape
Dig. S Digital S, recording format
DIN Deutsche Industrie Norm (German Industries Standard)
DLR DeutschlandRadio
DMS-1 Data Modelling Scheme
Dolby Firm's name, manufacturer (at present market leader) of hardware and software for audio
AUDIO Audio data stream for the professional use of multi-channel sound
Dolby Digital Audio data stream for the transmission of multi-channel sound
Dolby DP 570 Equipment designation, multi-channel audio tools
DRC Dynamic Range Control
DSK270 Digital Serielle Komponenten, 270 Mbit/s
DTS Digital Theater Sound, denotes a multi-channel sound system by the Californian firm of the same name: Digital Theater Systems, Inc.
DTS-ES DTS-Extended Surround
DV Video compression scheme according to IEC 61843
DV-based Video compression scheme according to SMPTE 314M
DVB Digital Video Broadcasting
DVBSTBs Digital Video Broadcasting Set Top Boxes
DVCAM Digital video recording format using DV compression, 25Mbit/s
DVCPRO Digital video recording format (D-7) using DV-based compression, 25Mbit/s
DVCPRO50 Digital video recording format (D-7) using DV-based compression, 50Mbit/s
DVD Digital Versatile Disc
DVE Digital Video Effects
DV-home Video compression scheme, 25 Mbit/s according to IEC 61834

E
- $E'_Y$ Analogue gamma pre-corrected voltage level of the luminance signal
- $E'_C$ Analogue gamma pre-corrected voltage level of the colour difference signal (red component)
- $E'_B$ Analogue gamma pre-corrected voltage value of the colour difference signal (blue component)
- $E'_R$ Analogue gamma pre-corrected voltage value of the red signal
- EAV End of Active Video (SDI and SDTI Signal)
- EBU European Broadcasting Union
e.g. For example
- EDL Edit Decision List
- EMC Electro Magnetic Compatibility
- EMV Elektromagnetische Verträglichkeit (Electro Magnetic Compatibility)
- ES Elementary Stream
- etc. et cetera (and so forth)
- ETSI European Telecommunications Standards Institute

F
- FM Frequency modulation
- FS Fernseh(en) (television)
- FSBL-K Fernsehbetriebsleiter-Konferenz (Conference of Head of Television Operations)
- FT-UT Fernsehtext-Untertitel (videotext subtitle)
- FT Tens of frames (ARRI time code)
- FU Unit of frames (ARRI time code)

G
- G Green
- G/PAL PAL, System G according to Recommendation ITU-R BT.470
- GXF General Exchange Format (audio video file format)

H
- H Height of screen (multi channel stereo systems)
- HFBL-K Hörfunk-Betriebsleiter-Konferenz (Conference of Chief Engineers of the Radio Services)
- HD High Definition
- HDTV High Definition Television
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>HT</td>
<td>Tens of hours (ARRI time code)</td>
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<tr>
<td>HU</td>
<td>Unit of hours (ARRI time code)</td>
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<tr>
<td>ID</td>
<td>Identifier</td>
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<tr>
<td>i.e.</td>
<td>id est</td>
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<tr>
<td>IEC</td>
<td>International Electrotechnical Commission</td>
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<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>
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<tr>
<td>IS</td>
<td>International Sound</td>
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<tr>
<td>ISO</td>
<td>International Organization for Standardization</td>
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<tr>
<td>IT</td>
<td>Internationaler Ton (international sound)</td>
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<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>
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<tr>
<td>K</td>
<td>Kelvin (colour temperature)</td>
</tr>
<tr>
<td>L</td>
<td>Left</td>
</tr>
<tr>
<td>LB</td>
<td>Letter Box</td>
</tr>
<tr>
<td>LFE</td>
<td>Low Frequency Enhancement (multi channel stereophonic system)</td>
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<tr>
<td>LowRes</td>
<td>Low Resolution</td>
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<tr>
<td>LS</td>
<td>Left - Surround</td>
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<tr>
<td>LSB</td>
<td>Least Significant Bit</td>
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<tr>
<td>LTC</td>
<td>Linear Time Code</td>
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<tr>
<td>Lt</td>
<td>Left total</td>
</tr>
<tr>
<td>MAZ</td>
<td>Magnetische Aufzeichnung (VTR, video tape recorder)</td>
</tr>
<tr>
<td>max.</td>
<td>maximum</td>
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<tr>
<td>Mbit/s</td>
<td>Megabit per second</td>
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<tr>
<td>Mg</td>
<td>Magenta</td>
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<tr>
<td>MHz</td>
<td>Megahertz</td>
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<tr>
<td>MiniDV</td>
<td>Short name for the small DV videokassette</td>
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<tr>
<td>M-JPEG</td>
<td>Motion-Joint Picture Expert Group (compression scheme for picture sequences)</td>
</tr>
<tr>
<td>mm</td>
<td>Millimetre</td>
</tr>
<tr>
<td>MOD</td>
<td>Magneto Optical Disk</td>
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<tr>
<td>MoMa</td>
<td>Morgen-Magazin (Morning Magazine)</td>
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<tr>
<td>MPEG-1</td>
<td>Motion Picture Expert Group-1 (compression standard)</td>
</tr>
<tr>
<td>MPEG-2</td>
<td>Motion Picture Expert Group-2 (compression standard)</td>
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<tr>
<td>MPEG-4</td>
<td>Motion Picture Expert Group-4 (compression standard)</td>
</tr>
<tr>
<td>4:2:2P@ML</td>
<td>four:two:two profile at main level (variant of the MPEG-2 compression)</td>
</tr>
<tr>
<td>ms</td>
<td>Millisecond</td>
</tr>
<tr>
<td>MS</td>
<td>Monophonic Surround, (middle/side signal or surround signal in mono)</td>
</tr>
<tr>
<td>MSB</td>
<td>Most Significant Bit</td>
</tr>
<tr>
<td>MT</td>
<td>Tens of minutes (ARRI time code)</td>
</tr>
<tr>
<td>MU</td>
<td>Unit of minutes (ARRI time code)</td>
</tr>
<tr>
<td>MXF</td>
<td>Material eXchange Format (audio video file format according to SMPTE 377M)</td>
</tr>
<tr>
<td>NDR</td>
<td>Norddeutscher Rundfunk (German public service broadcaster)</td>
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<tr>
<td>NLE</td>
<td>Non Linear Editing</td>
</tr>
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<td>OMF</td>
<td>Open Media Framework (audio video file format)</td>
</tr>
<tr>
<td>ORF</td>
<td>Österreichischer Rundfunk (Public Broadcasting Organisation of Austria)</td>
</tr>
</tbody>
</table>
P
P AL Phase Alternating Line system
Pixel Picture element
PCM Pulse Code Modulation
PDP Plasma Display Panel
P/META EBU working group on Metadata
PPM Peak Programme Meter

Q
QPPM Quasi Peak Programme Meter
Quicktime Audio video file format (MacOS, Quicktime for Windows)

R
R Right
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
RS Right – Surround (multi channel stereophonic system)
Rt Right total
R-Y Analogue colour difference signal (colloquial)

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
SDTV Standard Definition Television
SEPMAG Separated Magnetic Track
SMPTE Society of Motion Picture Television Engineers
SRG/SSR Schweizerische Radio- und Fernsehgesellschaft (Swiss Broadcasting Corporation)
SR5-1P Audio- Alignment tape from Sony
ST Tens of seconds (ARRI time code)
SU Unit of seconds (ARRI time code)
S16 Super 16

T
T Clock period
TASCAM Company- and Product name (TEAC Audio Systems Corporation Of America)
TC Time Code
TIFF Tagged Image File Format (Graphic format))
tpc Technical Production Center (Zürich), an enterprise of the SRG/SSR
TPRF Technische Produktions-Richtlinien Fernsehen (Technical Production Guidelines Television)
TS Transport Stream
TV Television

U
UB User Bit (ARRI time code)
UMID Unique Material Identifier
USER-BITS User specific bits within the time code signal
USS Uniform Symbology Specification (Barcode Font)

V
V Voltage
VALID Brand name of a test signal from Vistek
VAUX Video Auxiliary Data
VDE Verband Deutscher Elektrotechniker (Association of German Electrotechnicians)
<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
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<tbody>
<tr>
<td>VFM 3680 KM</td>
<td>Audio alignment tape from Panasonic</td>
</tr>
<tr>
<td>VFM 5180 JR</td>
<td>Audio alignment tape from Panasonic</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>Vrms</td>
<td>Voltage root mean square</td>
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<tr>
<td>Vpp</td>
<td>Voltage peak to peak</td>
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<tr>
<td>VPS</td>
<td>Video Programme System</td>
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<tr>
<td>VT-Master</td>
<td>Videotape-Master</td>
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<tr>
<td>VTR</td>
<td>Video Tape Recorder</td>
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<th>Description</th>
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<tr>
<td>Wh</td>
<td>White</td>
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<tr>
<td>WDR</td>
<td>Westdeutscher Rundfunk (German public service broadcaster)</td>
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<td>WSS</td>
<td>Wide Screen Signalling</td>
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<tr>
<td>Y</td>
<td>Luminance signal</td>
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<tr>
<td>Yl</td>
<td>Yellow</td>
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<tr>
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<th>Description</th>
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<tr>
<td>ZDF</td>
<td>Zweites Deutsches Fernsehen (Germany's national Public Television Broadcaster ZDF)</td>
</tr>
<tr>
<td>ZR5-1P</td>
<td>Audio alignment tape from Sony</td>
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<tr>
<th>Term</th>
<th>Description</th>
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<tr>
<td>µs</td>
<td>Microsecond</td>
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</table>
Access to Guidelines and Working Group Findings of

[ARD] [ZDF] [ORF] [SRG/SSR] [NOB] [tpc]

[http://www.irt.de/richtlinien]

**Guidelines and Working Group Findings**

Staff members of public service broadcasting organisations (ARD, ZDF, ORF, SRG/SSR, NOB, tpc) do NOT need to register. It is possible for this user group to log on directly with their CN e-mail address. The exact procedure can be obtained from the instructions supplied or from the adjoining "help" function.

External users must first register for one of the two subscription options (valid state of December 2006: 50 EUR / 250 EUR a year plus VAT).

As a registered user, please log on in order to request the desired documents in pdf-format by e-mail.