

**Technical requirements for the reception of TV programs,
with the exception of news and public affairs programs**

Effective as of 1st January, 2018

The technical requirements for the reception of all TV programs in high definition (HD) and standard definition (SD), with the exception of programs intended for news and public affairs programs, are specified as follows.

- 1) Supplied materials must be recorded in HDCam, Digital Betacam or Betacam SP formats. Materials must be supplied without any defects and on the best-quality medium possible.
- 2) The recorded SD video signal follows the PAL 625/50 specification and must comply with the CCIR international recommendations. The HD video signal must be recorded in the 1080i25 format. (see also 13)
- 3) Audiosignal in Betacam SP format must be recorded by using Dolby NR system. A1 and A2 modulations must not be in mutual counter-phase.
- 4) The audio signal of the MONO version must be identical for both A1 and A2 channels. In the STEREO version, the following order must be adhered to:
 - A1 = L (Left channel)
 - A2 = R (Right channel)For two-channel recording the following applies:
 - A1 = primary audio modulation (Czech version)
 - A2 = secondary audio modulation (original version)

- 5) All supplied materials must meet the conditions with **EBU R128** recommendation:

- the audio signal shall generally be measured in its entirety, without emphasis on specific elements such as voice, music or sound effects;
- the measurement shall be made with a loudness meter compliant with both ITU-R BS.1770 and EBU Tech Doc 3341
- the Programme Loudness Level shall be normalised to a Target Level of -23 LUFS. The permitted deviation from the Target Level shall generally not exceed ± 1 LU for programmes where an exact normalisation to Target Level is not achievable practically;
- Maximum Permitted True Peak Level is -1 dBTP
- Recommended Loudness Range (LRA) is less than 20 LU.

The exception is sports and other special events, where, the peak signal level must not exceed -9 dBFS

- 6) Programs consisting of both music and speech must respect the balanced physiological perception of sound, i.e. music and spoken word must be perceived at an equal volume level. (See EBU-R128)
- 7) The offset (time shift) between the picture and sound must be subjectively imperceptible, according to EBU-R37-1997 recommendations it must not exceed 40 ms if sound gains time and 60 ms if sound is delayed after image.
- 8) All synchronization impulses, especially H and burst as well as chrominance signal, must remain in a consistent mutual time and phase relation. Extracting of lines or even absence of lines, and visible disturbances of modulation are unacceptable. The allowed shift (offset) of the picture against synchronization impulses is by 2 TV lines in vertical direction and by no more than 400 ns in horizontal direction against the blanking impulse.
- 9) Luminance signal Y must be within the range of -1% (- 0,007 V) to 103 % (0,721 V) against the level of black. The color range must fall within the area of valid RGB gamut, i.e. after decoding to RGB all color components must fit in the authorized range of - 5% to 105 %. Signals in HD definition must be kept in accordance with ITU-R BT.709-5 recommendations.

- 10) Preferred format of programs is 16:9 format, in HD definition, Figure 1a. In case that program is natively produced in UHD resolution, we prefer to provide UHD version according to specification described in Appendix 1.

In SD definition, programs are received in 16:9 format in anamorphic mode (Full Height Anamorphic), Figure 1b. A 16:9 letterbox must not be inserted in the master tape. The master tape must not contain areas with inserted black stripes in the left and right part of the picture as a consequence of conversion of formats, not even in single cuts.

Film wide-screen formats in HD definition are accepted in 16:9 format. In SD definition, programs received are in 16:9 anamorphic format. Black stripes in the upper and lower part of the Figure are in both cases acceptable, see Figure no. 2.

Recommended format proportion for commercial spots is 16:9 (16:9 anamorphic for SD).

Any deformation of shapes as a consequence of format conversion is unacceptable. In subsequent play-out and distribution of the program parts of the picture can never be deformed or removed. The format of the picture must not be changed for the entire time of post-production.

Subtitles and graphics must always be placed only in the active part of the picture signal. A safe range is specified in the EBU R95-2000 recommendation. For programs in 16:9, it is 5% under the upper or above the lower edge and 10% from the left or right edge. For programs in 4:3, it is necessary to keep the safe range at 10% from the edges.

All supplied HD masters must be 1080i25 (whether the original acquisition was 1080p25 or 1080i25). (Note: *This format is sometimes wrongly marked as 1080/50i – for example Avid Edits*). Also all digital special effects, moving subtitles and graphics must be in 1080i25 format so that undesirable vibrations of the picture are prevented.



Figure 1: TV program in HD 16:9 format (a) and SD 16:9 anamorphic format (b)



Figure 2: Wide-screen film converted into HD 16:9 format (a) and SD 16:9 anamorphic format (b)

11) Tape based content delivery

11a) The cassette and its case must be marked by identical labels. The minimum scope of information on the labels must include:

- name of the company that produced the program
- name of the program (including number of the episode and the subhead)
- start and end of the program in LTC
- sound: mono, stereo, dual channel, Dolby Surround, Dolby E
- format of the picture: 16:9, 16:9 FHA (anamorphic), 16:9 letterbox, 4:3

Also, it is necessary to supply accompanying documents that will contain, in addition to the above, the length of adjustment signals and their level (data in LTC).

11b) The time and control code must be recorded in LTC track, with a parallel use of VITC.

11c) The signals of the recording must be spread out as follows:

- a) Adjustment section
 - Duration 90 s.
 - Picture – color bars PAL 100-0-75-0
 - Sound – reference tone pursuant to clause 6
- b) Lead-in section
 - 30s with the signal of black burst in the picture and with no sound
- c) Program section
 - beginning and ending of the program in LTC must be identical with the indication on the labeling of the program
- d) Lead-out section
 - 30s after the end of the program with black burst in the picture and with no sound

There must be continuous video signal in the sections black-program recording-black (b-c-d).

11d) For Betacam SP: Reference tone with the frequency of 1 kHz must be recorded in accordance with the recommendation of the manufacturer of the recording device, with saturation of 125nW/m. The values for modulation signal of the program, measured by a peak indicator, may exceed the reference level by + 6 dB. Extraordinary modulation peaks, measured by a peak indicator, may exceed the reference level by + 9 dB.

11e) For HDCam and Digital Betacam: Reference tone with the frequency of 1 kHz must be recorded in accordance with the level of

-18 dBFS, i.e. A/D and D/A converters must be set up so the difference of levels between the full code of converters and the reference tone amounts to 18 dB. The values for modulation signal of the program measured by an analog peak indicator may exceed the reference level by + 6 dB. Extraordinary modulation peaks measured by a peak analog indicator may exceed the reference level by + 9 dB. Preemphasis must not be used.

11f) For XDcam HD 422: The same conditions apply as for the HDcam (see 5b) but the disk must be recorded with the continuous LTC (like a tape), file recording is not allowed. Commercials, sponsorship and teleshopping are not allowed to supply on the XDCAM media.

12) File based content delivery

12a) **Prior to delivery** of a program on file (not on tape), the method of reception and interface must be individually specified with a supplier. Before regular deliveries commence from a specific supplier, a test transmission must be performed following which the compatibility of files with technical equipment of CET 21 is agreed upon.

12b) Video and sound in the delivered file must meet all the above mentioned conditions for sound and video signal. The video sampling should be 4:4:4 or 4:2:2 and the data reduction rate must not exceed 5:1. The only acceptable compression method is MPEG-2. No other sampling in the sound than - 48 kHz is allowed.

12c) All acceptable types of files are described in Appendix. 1. Ideal types for HD definition are Avid DNxHD 120 Mbit/s or Seachange MPEG2 50 Mbit/s long GOP or XDcam HD 422 50Mbit long GOP. For SD definition, the ideal format is Avid or XDcam 50 Mbit i-frame only.

12d) Further acceptable formats for news and current affairs

For the purposes of news and current affairs, permissible also would be video sampling 4:2:0 and 4:1:1. In the case of compression method MPEG 2 the minimum bit rate is 10 Mbit/s (long GOP). Further, compression methods DV 25, H.264 (minimum bit rate 3 Mbit/s) are allowed for the SD definition and for the HD definition compression methods HDV, H.264 (minimum bit rate 7 Mbit/s and AVCintra (card P2) are accepted. The order of half frames in all delivered video files must be upper/top Field First.

13) Allocation of audiotracks

In the delivered materials is necessary to comply with the prescribed order of audio tracks, which is shown in the following table. Other combinations of audio tracks are not allowed.

Number of audio tracks	Audio label	Audio tracks order
1 audio track	Mono	A1: CZ Mono
2 audio tracks	Stereo	A1, A2: CZ Stereo
	Dual	A1: CZ Mono; A2: Orig Mono
4 audio tracks	Stereo CZ + mix bez hudby	A1, A2: CZ Stereo, A3, A4: mix bez hudby
	Stereo CZ + Orig.	A1, A2: CZ Stereo, A3, A4: Orig Stereo
	Stereo CZ + M&E	A1, A2: CZ Stereo, A3, A4: M&E
	Stereo CZ + Stereo CZ	A1, A2: CZ Stereo, A3, A4: : CZ Stereo
	Stereo CZ + Dolby E	A1, A2: CZ Stereo, A3, A4: Dolby E data
8 audio track	Stereo CZ + Dolby E + Orig + M&E	A1, A2: CZ Stereo, A3, A4: Dolby E data; A5, A6: Orig; A7,A8: M&E
	Stereo CZ + Dolby E + Orig	A1, A2: CZ Stereo, A3, A4: Dolby E data; A5, A6: Orig; A7,A8: empty
	Stereo CZ + Dolby E + M&E	A1, A2: CZ Stereo, A3, A4: Dolby E data; A5, A6: empty ; A7,A8: M&E
	Stereo CZ + Orig + M&E	A1, A2: CZ Stereo, A3, A4: empty ; A5, A6: Orig; A7,A8: M&E
	Stereo CZ + Audio 5.1	A1, A2: CZ Stereo, A3-A8: Audio 5.1

Channels order for surround sound (Audio 5.1)

audio 5.1						
order	1	2	3	4	5	6
audio channel	left	right	centre	LFE	left surround	right surround

Channels order for DolbyE signal

dolbyE								
order	1	2	3	4	5	6	7	8
audio channel	left	right	centre	LFE	left surround	right surround	stereo left	stereo right

Detailed Technical Specifications

accepted formats

Specification	Profile SD1	Profile SD2	Profile HD1	Profile HD2	Profile UHD
General					
Profile Name/description	SD IMX30	SD IMX50	XDCAM HD 422	DNxHD120	XAVC
Main viewing environment	TV	TV	TV	TV	TV
File Container	MXF OP1a	MXF OP1a	MXF OP1a	MXF OP1a	MXF OP1a
Preferred Encoder/Transcoder software or hardware	Telestream	Telestream	Telestream	Telestream	-
Can audio be received separately?	no	no	no	no	no
Video					
Video Codec	MPEG-2 (D10)	MPEG-2 (D10)	MPEG-2	DNxHD120	H.264
Video Bitrate in Mbps	30 Mbps	50 Mbps	50 Mbps	120 Mbps	<i>Long GoP</i> 200 Mbps (2160p/25) 250Mbps (2160p/50) <i>I-Frame only</i> 250 Mbps (2160p/25) 500Mbps (2160p/50)
CBR or VBR?	CBR	CBR	CBR	CBR	CBR
Keyframe	I-Frame only	I-Frame only	GOP (M=3,N=12)	I-Frame only	I-Frame only or GOP
Open or Closed GOP	-	-	closed	-	-
Aspect Ratio	16:9FHA / 4:3	16:9FHA / 4:3	16:9 / 4:3PB	16:9 / 4:3PB	16:9
Required resolution if source resolution is:					
3840 X 2160					x
1920 X 1080			x	x	
720 X 576 (16X9)					
720 X 608 (16X9)	x	x			
16 X 9 anamorphic flag	yes	yes	-	-	-
If letterbox, remove black bars? (results in lower vertical resolution)	yes	yes	-	-	-
Colorspace	4:2:2	4:2:2	4:2:2	4:2:2	4:2:2
Time code	EBU SOM 00:00:00:00	EBU SOM 00:00:00:00	EBU SOM 00:00:00:00	EBU SOM 00:00:00:00	EBU SOM 00:00:00:00
Frame rate (fps)	25	25	25	25	25/50
Interlaced	yes	yes	yes	yes	no
Field Order (if interlaced)	Top Field First	Top Field First	Top Field First	Top Field First	-
Overlays	No	No	No	No	-

Detailed Technical Specifications

accepted formats

Specification	Profile 1	Profile 2	Profile 3	Profile 4	Profile 5
Audio					
Multiple Audio streams	yes	yes	yes	yes	yes
Audio Container	AES3	AES3	AES3	AES3	AES3
Audio Codec	PCM (EBU) DolbyE	PCM (EBU) DolbyE	PCM (EBU) DolbyE	PCM (EBU) DolbyE	PCM (EBU) DolbyE
Number of Channels and Layout	see section 13)	see section 13)	see section 13)	see section 13)	see section 13)
Bit depth	16/20/24	16/20/24	16/20/24	16/20/24	16/20/24
Sample rate in KHz	48	48	48	48	48