

## 1. SCOPE

This document recommends the format and quality of the video and audio associated with program material delivered to the Australian terrestrial television broadcast industry.

## 2. BACKGROUND

- 2.1. Program content delivered in Standard Definition (SD) may be subject to an up-conversion process to a High Definition (HD) resolution level. This places significant demands on the quality of the product especially with respect to spatial resolution. In the case of both up-conversion and down-conversion, it is essential that the luminance and chrominance values are transferred accurately from one resolution level to the other.
- 2.2. For digital transmission, the product will be subject to MPEG video encoding at high compression ratios. This places a significant demand on the quality of the program content with respect to video signal to noise ratio, image stability and freedom from artefacts which may waste data in the MPEG coding process.
- 2.3. With respect to the very important issue of Standards Conversion, it will be necessary in the transition to maintain the current situation of temporal artefact free conversions, from both film and video originated product.
- 2.4. Due to the continually advancing state of television technology, this documentation will evolve and will be added to and modified as required in the future.

## 3. DEFINITIONS

### 3.1. Standard Definition

- 3.1.1. Standard Definition is a 625 line, 25 frames per second, 2:1 interlaced signal produced in agreement with the specifications of ITU-R Recommendation BT 601<sup>1</sup>. The aspect ratio of the image shall be 16:9.

The associated audio signal should be a stereo pair, optionally encoded Dolby Surround (Pro Logic II), with the centre and surround information encoded into the  $L_t$  and  $R_t$  signals. For archival material a stereo pair or mono audio may be accepted.

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<sup>1</sup> The companion signal interface document is Recommendation ITU-R BT.656-5 *Interfaces 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*.

### 3.2. High Definition

- 3.2.1. High Definition is a signal produced in agreement with the specifications of ITU-R Recommendation BT. 709-6<sup>2</sup>.
- 3.2.2. The Aspect Ratio of the image shall be 16:9. The preferred video format for the exchange of program material is:
- 1125 lines total per frame
  - 1920 horizontal pixels by 1080 active lines
  - 25 frames per second, 2:1 interlace
- 3.2.3. The associated audio signal should be 6 discrete channels representing - Left / Right / Centre / Low Frequency Effects (LFE) / Left Surround / Right Surround<sup>3</sup>.
- These audio signals shall be carried on the video storage medium as discrete PCM channels, and clearly identified.
- The preferred minimum audio requirement should be a stereo pair, optionally encoded Dolby Surround (Pro Logic II), with the centre and surround information encoded into the  $L_t$  and  $R_t$  signals. Regular stereo ( $L_o$  and  $R_o$ ) is also acceptable.
- 3.2.4. Delivery of HD content in a High Dynamic Range image format should comply with the specifications for Hybrid Log Gamma found in Recommendation ITU-R BT.2100 *Image parameter values for high dynamic range television for use in production and international programme exchange*<sup>4</sup>.
- 3.2.5. Down conversion from a UHD HDR image format found in Recommendation ITU-R BT.2100 to the HD image format<sup>4</sup> Recommendation BT. 709-5 should be undertaken in accordance with ITU-R Report ITU-R BT.2446 *Methods for conversion of high dynamic range content to standard dynamic range content and vice-versa*.
- 3.2.6. Reference to UHD image formats should be undertaken in accordance with Recommendation ITU-R BT.2020 *Parameter values for ultra-high-definition television systems for production and international programme exchange*.

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<sup>2</sup> The companion signal interface document is Recommendation ITU-R BT.1120-9 *Digital interfaces for studio signals with 1920 x 1080 image formats*

<sup>3</sup> In an audio channel / track order as specified in SMPTE 320M

<sup>4</sup> Recommendation ITU-R BT.2100 specifies progressive image formats.

## **4. DELIVERY**

### **4.1. Standard Definition**

- 4.1.1. For Standard Definition product, the program shall be supplied on a 625-line 25 frame per second 2:1 interlace component digital delivery system. The delivery system is to be mutually agreed upon between the program distributor and the television network.

### **4.2. High Definition**

- 4.2.1. For High Definition program content the program shall be supplied on an 1125 line, 1080 active 25 frame per second 2:1 interlace format delivery system. The delivery system is to be mutually agreed upon between the program distributor and the television network.

### **4.3. Common Delivery Specifications**

- 4.3.1. The program shall be the full Texted version.
- 4.3.2. The audio content of the program shall be a final mix in the English language and in correct synchronisation with the video content. However, if required by a broadcaster an alternative language may be supplied.
- 4.3.3. The supplied program shall be free of extraneous material, such as closed caption and censorship classification indicators.
- 4.3.4. Alternatively, if textless material is supplied at the end of a program, it shall start at 1 minute from the end of the program and be identified on the program identification board at the head of the program.

## **5. VIDEO REQUIREMENTS**

### **5.1. Common Video Requirements**

- 5.1.1. The recorded image when displayed with the correct geometry has an aspect ratio of 16:9.

Distortion of the geometry of the original picture aspect ratio is not acceptable.

When the program has been derived from an original of aspect ratio wider than 16:9 then a letterbox of the image is permitted in order to reveal additional width. This letterbox shall not be deeper than 21:9.

- 5.1.2. Archival material may be accepted with a 4:3 aspect ratio.
- 5.1.3. All titles and essential information must fall into the safe areas defined in Annex A and Annex B.
- 5.1.4. Broadcasters seek to have signals encoded in the Recommendations BT.601 and BT.709 formats as a 10-bit stream specified as levels 0 – 1023. Maximum video levels of program material with reference to line-up signals shall be equivalent to 700 mV including an operational tolerance of + 25mV for luma (Y) and 700mV peak-to-peak for each colour difference signal for  $P_R$ ,  $P_B$  in the analogue domain. (Note this does not correspond to  $C_B$  and  $C_R$  in the digital domain). Whatever the combination of luminance and chrominance components the signal shall not produce an R.G.B. coded gamut error when measured by an appropriate instrument.
- Program black level shall not extend below blanking level (0mV luminance in the analogue domain).
- 5.1.5. The line-up colour bar test signal shall replay at the correct levels. Program video levels shall be consistent with line-up video levels.
- 5.1.6. If the program is made as a film product, then the supplied program shall be a true 625/25 or HD1125/25 frame transfer of that film. In other words, not a standards conversion. However, film product or other product mastered at 24 frames progressive should be converted to a 25-frame product by a 4% speed change and NOT by repeated frames. This latter conversion process should take place before delivery of the program to the Australian networks.
- 5.1.7. If the program is originated on film but post-produced in the 525/60 or HD 1125/60<sup>5</sup> domain then the supplied program shall be a standards conversion, via in the case of 525/60 the TK3:2, DEFT or Image FIT systems. In the case of an HD1125/60 original the supplied converted program shall be a standards conversion which ensures the elimination of temporal motion artefacts, normally by means of a 'Reverse Telecine' process producing a 24-frame product which must then be converted to a 25-frame product.
- 5.1.8. If the program is originated using electronic cameras in the 525/60 or HD 1125/60 domain, then the supplied program shall be a standards conversion via a 'Motion Vector Compensated' or phase correlation standards conversion system. Again, the object is the elimination of temporal motion artefacts.
- 5.1.9. If the program is a product from film the horizontal and vertical instability the rate of any picture movement shall not be subjectively annoying.

The film elements shall be clean and free of both surface dirt and printed dirt and shall not have any emulsion or base side damage.

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<sup>5</sup> HDTV 1125/60 is a generic description of any non 50Hz production system other than 24 frame progressive.

- 5.1.10. In all cases the program shall be of the highest quality suitable for television broadcast without further processing of the picture. The program quality of Standard Definition 601 level product shall be such that an acceptable up-conversion to a HD resolution level can be made.
- 5.1.11. Production techniques should consider field dominance. Field dominance problems become apparent on television picture monitors when the fields of an interlaced signal are presented in the wrong order. To mitigate this problem, correct field dominance must be indicated or agreed to by all parties. Field dominance' simply states whether the top/odd field or the bottom/even field is supposed to be shown first. For example, a dominance of 'top field first' would mean that the top field is displayed before the bottom field in a frame. 'Top field first' is the requirement in the context of this document.

## **5.2. Standard Definition**

- 5.2.1. For Standard Definition the video signal shall be a 625 total lines, 576 active lines, 25 frames per second, 2:1 interlace signal produced in accordance with ITU-R Recommendation BT. 601.
  - 1. Vertical and Horizontal blanking shall be in accordance with ITU-R Recommendation BT. 1848. The active digital picture line width is 720 pixels producing what is commonly called 'Narrow' blanking. For product produced purely in the digital domain this is the preferred blanking. Reference to Annex A of this Operational Practice indicates that only the central 720 pixels will normally reach the display.

The centre of the picture should retain its position throughout all production processes unless there are creative reasons to deliberately do otherwise. The horizontal centre of the image is located between pixels 359 and 360. The vertical centre of the image is located midway between line 167 of field 1 and line 479 of field 2.

- 5.2.2. For programs transferred into the digital component domain from archival material originated in a composite PAL or NTSC format, care is necessary to ensure that any burst to chroma phase errors do not exceed 5° since these errors cannot be corrected on playback.

## **5.3. High Definition**

- 5.3.1. For High Definition the video signal shall be an 1125 total lines, 1080 active lines by 1920 pixels horizontally, 25 frames per second, 2:1 interlace signal produced in accordance with ITU-R Recommendation BT. 709-6.

## **6. SUBJECTIVE VIDEO QUALITY**

### **6.1. Common Subjective Video Quality**

- 6.1.1. Picture quality appreciation and production grading shall be made in a Review Room which meets SMPTE recommendations for that purpose including an illuminant D65 monitor surround.
- 6.1.2. The picture black level shall appear to be subjectively correct with respect to content, free of any noticeable black crushing, compression or clipped dark areas.
- 6.1.3. Low key scenes shall have sufficient contrast and APL (average picture level) to appear acceptable under typical domestic viewing conditions.
- 6.1.4. Picture white areas where detail is required shall appear normal and free of noticeable highlight compression.
- 6.1.5. The transient (edge) response shall be crisp and clean - free of any noticeable horizontal or vertical pre-shoot, overshoot, ringing, smear/streak, echoes, or telecine afterglow errors.
- 6.1.6. Moire and fixed pattern noise shall not be visible.
- 6.1.7. Any video noise shall be fine grained (i.e., high frequency) and not visible at normal viewing distances. However, the use of MPEG encoding does require an image which is not only noise free but also free of artifacts such as film dirt or scratches or unwanted image movement.

Note: Excessive use of noise reduction will cause motion artefacts and a noticeable loss of resolution. The amount of noise reduction should only be sufficient to minimise noise.

- 6.1.8. The colour balance of the image shall be basically neutral when displayed on a monitor adjusted for 6500K.

## 6.2. Standard Definition

- 6.2.1. Standard Definition images shall be viewed on a correctly calibrated equivalent grade 1 display<sup>6</sup>, of at least 60cm diagonal and viewed at approximately 5 times picture height.
- 6.2.2. Standard Definition images must be judged critically with respect to their capacity for up-conversion. A high quality ITU-R Recommendation BT. 601 level product can produce acceptable HD level material - equally, poor to average BT.601 level product will not produce acceptable HD level material.

## 6.3. High Definition

- 6.3.1. High Definition images shall be viewed on a correctly calibrated grade 1 display of at least 100cm diagonal and viewed at approximately 3 times picture height. The light emitters shall have ITU-R Recommendation BT. 709-6 colorimetry.

## 7. AUDIO REQUIREMENTS

### 7.1. Standard Definition

- 7.1.1. For Standard Definition programs, the preferred audio shall be a Dolby Surround (Pro Logic II) encoded stereo pair ( $L_t$  and  $R_t$ ). Regular stereo ( $L_o$  and  $R_o$ ) is also acceptable. The L and R stereo pair shall have a combined loudness measuring -24 LKFS across representative sections of the program. Refer to [OP-59](#) for loudness measurement and management techniques.
- 7.1.2. For Stereo recordings: Track 1 shall carry the left channel  
Track 2 shall carry the right channel  
If used: Track 3 shall carry M and E left  
Track 4 shall carry M and E right

If the M and E is a mono recording, it shall be carried on Track 3. For a Mono soundtrack, the program sound shall be dual recorded in phase on both tracks 1 and 2.

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<sup>6</sup> Advice on set-up of Grade 1 monitors is available in Report BT.2129 *User requirements for a Flat Panel Display (FPD) as a Master monitor in an HDTV programme production environment* (<http://www.itu.int/pub/R-REP-BT.2129>) and Recommendation BT.2022 *General viewing conditions for subjective assessment of quality of SDTV and HDTV television pictures on flat panel displays* (<http://www.itu.int/rec/R-REC-BT.2022/en>)

- 7.1.3. All audio recordings shall have the correct basic 'in phase' relationship between channels on both line-up tone and program content (program content will dynamically produce varying phase relationships).
- 7.1.4. Any supplied 5.1 audio shall be mixed in such a way that it will create an acceptable downmix to 2.0 stereo  $L_t$  and  $R_t$ , if required, using industry standard downmix parameters. Refer Free TV [OP-60](#) for advice on down mixing of soundtracks.
- 7.1.5. Correct relative synchronisation of M and E to final mix tracks shall be maintained at all times.
- 2. The alignment level shall be minus 20 dB with respect to the onset of digital clipping i.e., minus 20 dBFS (SMPTE RP155). The EBU standard of minus 18 dBFS will also be accepted.
- 7.1.6. The True Peak recorded program level as measured with a BS-1770-3 compliant loudness meter, shall be no greater than -2dBTP

## **7.2. High Definition**

- 7.2.1. For High Definition product, the audio should consist of a 5.1 channel soundtrack, containing 6 discrete channels representing Left / Right / Centre / Low Frequency Effects (LFE) / Left Surround / Right Surround.

The minimum audio requirement should be a Dolby Surround (Pro Logic II) encoded stereo pair ( $L_t$  &  $R_t$ ); however, regular stereo ( $L_o$  &  $R_o$ ) is also acceptable. The average dialog level on the  $L_t$  and  $R_t$  shall have a loudness measuring -24 LKFS across the duration of the program.

An Audio Described version of the program may be requested from the supplier. The preferred audio channel layout is listed below. This does not preclude other audio channel layouts which may be mutually agreed between the parties.



7.2.2. The preferred audio track layout shall be as follows:

Track 1	L <sub>t</sub> (Full Stereo Mix)
Track 2	R <sub>t</sub> (Full Stereo Mix)
Track 3	Left Front (5.1 mix)
Track 4	Right Front (5.1 mix)
Track 5	Centre (5.1 mix)
Track 6	LFE <sup>7</sup> (5.1 mix)
Track 7	Left Surround (5.1 mix)
Track 8	Right Surround (5.1 mix)
Track 9	Audio Description (Broadcast Mix L <sub>t</sub> )
Track 10	Audio Description (Broadcast Mix R <sub>t</sub> )
Track 11	Audio Description (Receiver Mix; i.e. Narration only)
Track 12	Audio Description (Receiver Mix; i.e. Narration only)
Track 13	L <sub>t</sub> M+E
Track 14	R <sub>t</sub> M+E
Track 15	MOS (or freely assigned)
Track 16	MOS (or freely assigned)

7.2.3. On the output of a playout server, all audio shall remain in sync with its associated video.

## 8. SUBJECTIVE AUDIO QUALITY

- 8.1. The overall quality shall be pleasing and free of any audible noise or spurious signals (e.g., hum, buzz, distortion, wow, flutter, or excessive sibilance) when monitored in a noise free environment on an essentially flat wide-band speaker system.
- 8.2. The tonal balance, bass to mid-range to treble shall be pleasing and natural.
- 8.3. Stereo and multichannel program material shall have the correct spatial relationships between audio and picture content (such as left-right or front-rear).
- 8.4. Program audio shall be in synchronisation with the picture content.
- 8.5. Any supplied 5.1 audio shall be mixed in such a way that it will create an acceptable downmix to 2.0 stereo L<sub>t</sub> and R<sub>t</sub>, if required, using industry standard downmix parameters. Refer Free TV [OP-60](#) for advice on down mixing of soundtracks.
- 8.6. Dynamic Range of audio using Dolby Digital AC-3 coding is not to be processed. Rather the appropriate meta-data 'DYNRNG' and 'DIALNORM' should be included so that the viewer can choose the nature of the reproduced audio. Refer Free TV Operational Practice [OP-59](#).

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<sup>7</sup> Note on LFE use/misuse: The LFE channel should be used as intended; as an occasional low frequency special effects channel only, and not simply for bass that is filtered off from the main channels.

## 9. SEQUENCE OF ALIGNMENT SIGNALS

- 9.1. Due to the wide differences in practices between different parts of the world and between production houses, this section is intended to provide only a general guide relating to the essential elements of the recorded signal format.
- 9.2. At the start of the recording there shall be a minimum 60 seconds of an alignment video signal consisting of colour bars of either 100/0/100/0 or 100/0/75/0 content. This signal shall occupy at least half the picture height. The 100/0/100/0 signal is preferred.
- 'Matrix' type alignment signals which meet the intent of the above are acceptable.
- 9.3. Simultaneously with the video alignment signal, an alignment level (as specified by SMPTE RP155) audio tone of 1000Hz shall be recorded in phase on all tracks intended to carry program content.
- 9.4. Following the alignment signal there shall be recorded for a minimum of 30 seconds a Visual Identification. This identification shall contain:
- Program Title
  - Episode
  - Production Number
  - Production House Name
  - Date of Recording
  - Audio Status incl. track assignment and content i.e., Stereo Lt/Rt, PCM 5.1 Audio on Tracks 3 through 8 etc.
  - Durations; both total and individual segments if applicable
  - Audio loudness level or compliance (-24 LKFS)
  - Audio Description
  - Aspect Ratio (including any letterboxed or pillar-boxed area)
  - Protected Aspect Ratio
  - Presence of Textless material at tail
- 9.5. Following the visual identification, a countdown to program start may be recorded. This countdown should be at least 10 seconds in duration going to black following the 2 second indicator.
- 9.6. Continuity of Recorded Signals. There shall be continuity of recorded signals from a point at least 30 seconds before program start. Video black and silence shall continue for at least 10 seconds following the end of the program.

## **10. CLOSED CAPTIONS – STANDARD DEFINITION**

- 10.1. The Australian Standard for closed captioning is for the data to be carried on line 21/334 for a 625/25 signal. The data format is in accordance with ETSI EN 300 742. Caption data shall be distributed, transmitted and monitored according to the requirements of Free TV Australia Operational Practice [OP-42](#).
- 10.2. Identification of the presence of closed caption information is necessary on the program content.
- 10.3. A Command to clear down any existing caption shall be included in the first two (2) seconds of a program. A Command to clear down shall also be included two (2) seconds before the end of a program.

## **11. CLOSED CAPTIONS – HIGH DEFINITION**

- 11.1. Carriage of closed captions for High Definition shall be in accordance with the requirements of Free TV Australia Operational Practice [OP-47](#) and SMPTE Registered Disclosure Document RDD 8.

A Command to clear down any existing caption shall be included in the first two (2) seconds of a program. A Command to clear down shall also be included two (2) seconds before the end of a program.

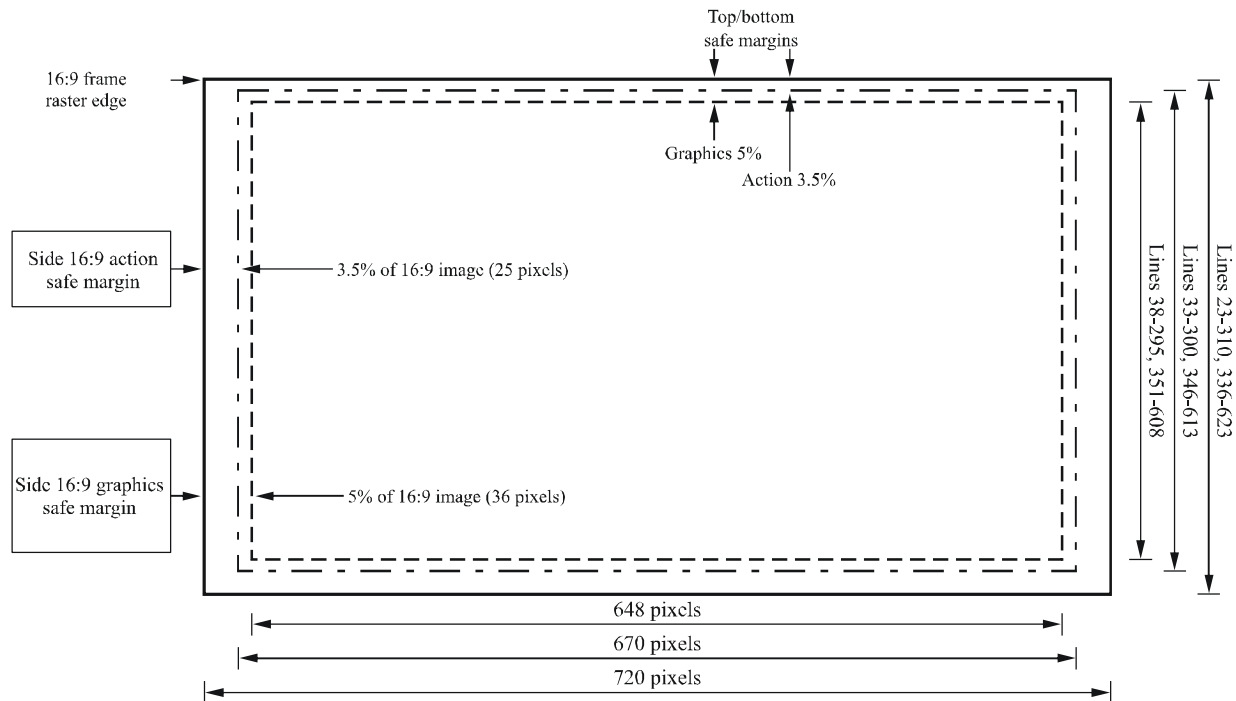
## **Annex A.**

### **1. SDTV - SAFE ACTION AND SAFE GRAPHIC AREAS**

- 1.1. The recommended 'Safe Action' and 'Safe Graphic' areas are defined by the following diagram.
- 1.2. The active video line length is defined as a nominal 720 pixels which represents normal digital active line length (refer to Clause 5.2.2 above).
- 1.3. The overscan of displays is assumed to be a maximum of 7% of overall picture width or height i.e., 3.5% at each edge but any one picture edge should not exceed 4% of total picture width or height.
- 1.4. Figure 1 - Widescreen shoot to protect the 16:9 full image (this is equivalent to a protected aspect ratio of 16:9).

This indicates the safe areas of a 16:9 widescreen display.

**FIGURE 1**  
**16:9 shoot-to-protect the 16:9 full image, 625-line interlaced scan**



1848-01

## **FREE TV AUSTRALIA OPERATIONAL PRACTICE OP-30**

QUALITY SPECIFICATION FOR THE INTERNATIONAL AND NATIONAL EXCHANGE OF PROGRAMS IN SDTV AND HDTV FORMATS

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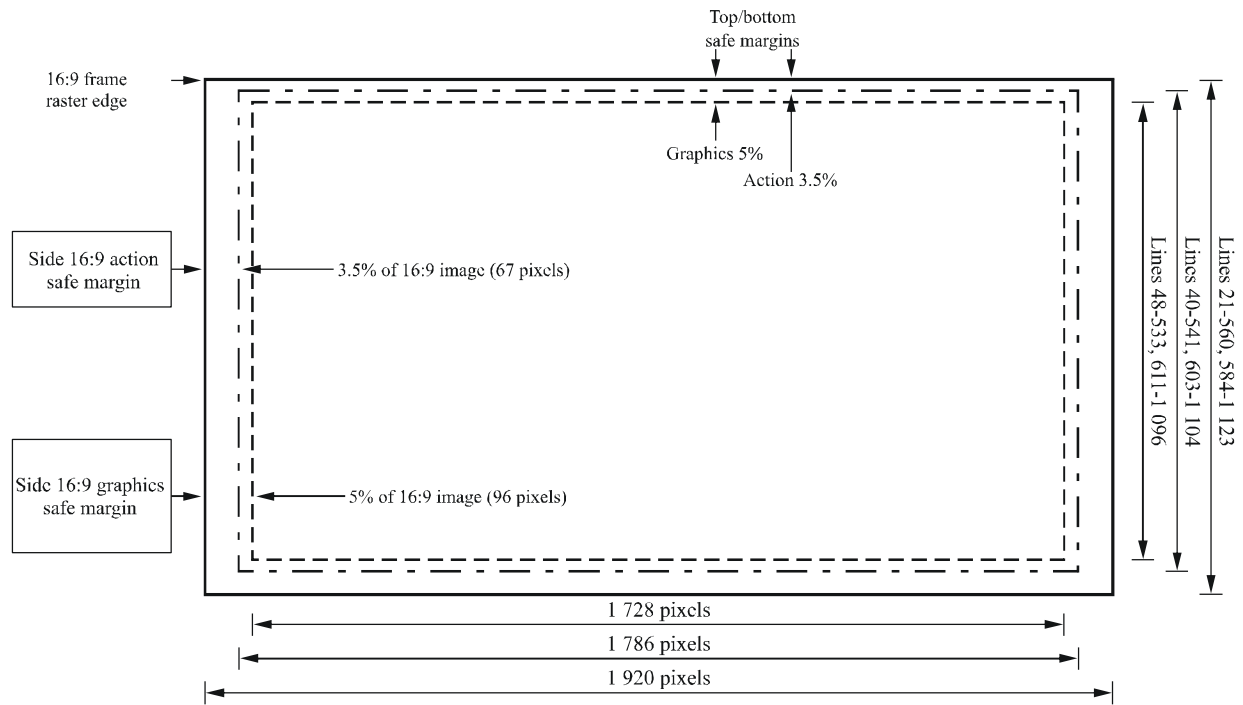
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### **Annex B.**

#### **1. HDTV – SAFE ACTION AND SAFE GRAPHIC AREAS**

- 1.1. The recommended HDTV 'Safe Action' and 'Safe Graphic' areas are defined by the following diagram.
- 1.2. Figure 1 is the HD transmission situation, 16:9 Shoot to Protect 16:9, with a line length of 1920 pixels (refer to Clause 5.3.1 above). The safe areas are calculated to this base.
- 1.3. The overscan of displays is assumed to be 7% of overall picture width or height (i.e. 3.5% at each edge) but any one picture edge should not exceed 4% of total picture width or height.

**FIGURE 1**  
**16:9 shoot-to-protect the 16:9 full image, 1 080-line interlaced scan**



1848-04

## Annex C

### 1. Audio Levels and Loudness

This annex provides advice on the relationship of this OP and Free TV Australia [OP-59](#) *Measurement & management of loudness in soundtracks for television broadcasting*.

The elements of a soundtrack, namely dialogue, music and effects are subject to various processes during production. Where these elements sit in the final soundtrack, with respect to audio levels and loudness, is the result of a final mix and effectively it is here that the loudness of the soundtrack will be principally influenced.

Most sound track pre-final mix elements are passed through devices such as *equalisers* and *compressors*, which are designed to enhance their *presence* i.e. to make them sound “up close” or brighter or more immediate. This is referred to as “processing”.

Material that has been compressed will sound louder, even though there is no increase in volume. This is because compression of a soundtrack raises the energy content of the sound by reducing the dynamic range (i.e., the difference between the loudest and softest levels of the sound) thereby making it more dense.

Many modern processors are not calibrated in dB, have constantly varying compression ratios and are likely to be multi-band devices which apply different amounts of compression in different frequency bands. This makes it difficult for soundtrack producers to accurately measure and quantify how much compression is applied to a soundtrack. However, prior to the final mix it is recommended that every effort should be made to ensure that the nature of any compression or equalisation used is such that the result does not produce a soundtrack with a loudness characteristic which is incompatible with program material.

Broadcasters provide the following advice and recommendations for definition of a compression profile related to any processing applied AFTER the final mix. Figure 1 provides a diagrammatic representation of this simple profile. In all cases the loudness of the final mix should be measured using a ITU-R BS-1770-3<sup>8</sup> compliant loudness meter to ensure conformance to the -24 LKFS loudness level.

If any further peak limiting were to be necessary, it would be provided automatically by the transmission processor.

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<sup>8</sup> Loudness measurements made on BS.1770-2 and BS.1770-3 meters are identical



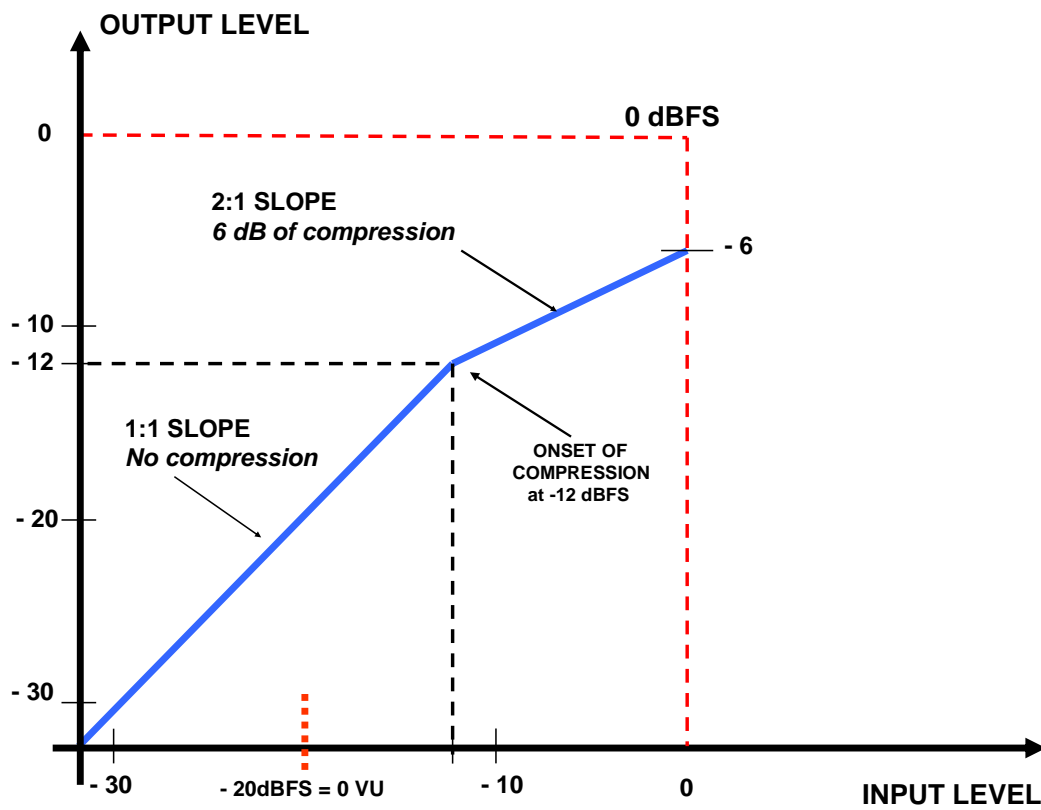


Figure 1