



PBS

**TECHNICAL
OPERATING
SPECIFICATIONS**

SUBMISSION

2007 Edition

Preface

This 2007 TOS is the fourth in a series of modern Editions begun in 1995 and followed by revisions in 2000 and 2005. The 2007 Edition marks a departure from the past practice of combining all the documents into one master document. In recognition of the differing needs of the Public Television technical community, the 2007 Edition of the TOS is split into three master documents. They are:

- Technical Operating Specifications – Program Submission
- Technical Operating Specifications – Program Distribution
- Technical Operating Specifications – Appendices

The Program Submission master TOS document is intended for production organizations who are creating programs and interstitial material. It contains the TOS applicable for their needs along with a Recommended Practice.

The Program Distribution master TOS document is intended for organizations who are distributing programs and interstitial material to the PBS Member Stations and other using parties. It contains the TOS documents applicable for satellite transmission and encoder setup.

The Appendices master TOS document contains five individual appendices covering more technical details of the digital operating environment, legacy analog signals, signal nomenclature, and an extensive glossary.

Notable changes made in 2005 and continued in 2007 include:

- Elimination of VTR format types C, D2, D3, D5, SP, 3/4" & HD-D5.
- Elimination of SMPTE stereo leader.
- Elimination of Actimates signal insertion.
- Relaxation of vertical blanking to 480 lines (consistent with DV and MPEG-2).
- Addition of HDCam.
- Addition of language addressing lip-sync and dialog/music ratio audio issues.
- Phased expansion of audio dynamic range and requirement for dialnorm measurement.
- Emphasized requirement for audio channel 4
- An accompanying recommended practice with tips to help producers remain in compliance with the specifications.

Additional changes made in 2007 include:

- Dialog level change to -24 dBFS \pm 2 dB from -27 dBFS \pm 2 dB
- Dialnorm value changes from -27 to -24 for HD and from -27 to -31 for SD
- Expanded description of requirements for audio levels
- Change in VITC location
- Clarification of lip sync limits
- Changed "RGB" and "Red, Green, Blue" to "GBR" and "Green, Blue, Red" to reflect current industry practice and style because GBR more closely follows the component designations of Y, Pb, Pr and Y, Cb, Cr. This change does not affect performance.



TECHNICAL OPERATING SPECIFICATIONS

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TECHNICAL OPERATING SPECIFICATION

FOR PROGRAM SUBMISSION TO PBS AND OTHER DISTRIBUTORS

PBS ENTERPRISE TECHNOLOGY ADVISORY COMMITTEE

2007 Edition

1. GENERAL

This TOS provides standards for producing programs of a consistently high technical quality for delivery to PBS stations.

Program submissions not meeting these specifications may be rejected, requiring corrective action and delay in processing.

All programs must be judged to meet these specifications prior to submission by a qualified technician using professional digital measurement equipment.

For questions related to program submissions and this TOS, contact the Director, Media Operations Center at PBS.

2. VIDEO

2.1 *Video Image Quality*

2.1.1 All programs must be produced with modern component-digital acquisition and editing systems, with careful attention to technical detail throughout the acquisition and post-production process.

2.1.2 For standard definition, the image must have the high quality image resolution associated with modern 3-chip cameras and must not be derived from a smaller image area (such as the widescreen mode in some low cost DV cameras, which samples less than 480 vertical lines) except for special effects. The CCD chips must have at least a 1/3" diagonal with a minimum resolution of 640 x 480.

For high definition, the camera must use three CCD chips, each with at least a 1/2" diagonal and a minimum resolution of 1280 x 720.

For either standard or high definition under certain circumstances such as breaking news or other unscripted or unplanned events, less than full broadcast quality equipment may be used. However, efforts must be made to minimize the deficiencies inherent in lower quality image acquisition. For examples of procedures, see RP-1.

2.1.3 Programs submitted as "Digital Widescreen" must be principally content that was originally created in a minimum frame size of 720 x 480.

2.1.4 Programs submitted as "High Definition" must be principally content that was originally created in a minimum frame size of 1280 x 720.

2.1.5 The image must be free of aliasing such as the artifacts associated with low cost scan conversion.

2.1.6 Compression artifacts must not be obvious when viewed on a professional standard-definition monitor for 4:3 shows, and when viewed on an HDTV monitor for widescreen shows.

2.1.7 Except in the case of clear archival justification, the image must be free of picture impairments associated with legacy analog equipment: lag, smear, scratches, dropouts, head switching, etc.

2.2 *Video Level*

2.2.1 Video levels must be measured with direct digital waveform monitoring equipment calibrated to represent video levels on the final submission.

2.2.2 The luminance level in black areas of the program must fall as low as 0%, but not below 0%. Objectionable black clipping must not be evident. Black setup is not allowed in any digital submissions. When measured as derived composite signal, the black level must not fall below 7.5 IRE units.

2.2.3 The luminance level in white areas of the program must reach as high as 100%, but not above 100%. Objectionable white clipping must not be evident. When measured as derived composite signal, the white level must not exceed 100 IRE units.

2.2.4 Derived standard definition NTSC peak chrominance plus luminance gamut must not exceed 120 IRE when measured with a flat filter on a digital waveform monitor.

Component digital derived GBR values must remain within the legal gamut of 0-700 millivolts.

2.3 Color Gamut

The allowable color gamut (range of values) for GBR signals in NTSC is 0-700 millivolts for Green, Blue, and Red.

Serial digital 601 signals provide an $Y C_b C_r$ component signal that can contain invalid colors when it is converted to GBR. Signals outside the GBR gamut range may lead to clipping, crosstalk or other distractions in encoders and other processing devices designed to operate within the legal gamut.

All G,B or R signals should lie inside the range -10 millivolts and 720 millivolts after an IRE filter has been applied. The resulting composite luminance signal should lie inside the range of -1 to 103 IRE.

A diamond arrow or equivalent display should be used to detect illegal gamut levels.

Programs with GBR Upper Gamut levels above 735 millivolts; and GBR Lower Gamut below -50 millivolts will be rejected and returned to the program producer for correction.

GBR gamut will be “legalized” to the -10 to 720 millivolt range when the final PBS package is created for distribution.

2.4 Video Blanking

2.4.1 Horizontal Blanking must not exceed the limits specified, per SMPTE standard:

Format	Maximum
480i (170M)	11.0 μ sec
1080i (240M)	3.94 μ sec

2.4.2 Full-screen content should fill the raster in each field as shown.

Format	Field 1	Field 2
480i	23-262	22-261 (285-524) *
1080i	21-560	21-560 (584-1123)

**This field 2 blanking represents common practice. In contrast, SMPTE RP202-2000 recommends lines 23-262*

2.4.3 The "letterboxing" of 16:9 content in a 4:3 raster is ideally performed as follows to allow subsequent inter-cutting of various letterbox programs with consistent blanking:

	Field 1	Field 2
480i 16:9 Letterbox	53-232	52-231 (315-494)

2.5 Field and Frame Rate

The field rate for both standard and high definition is 59.94 fields per second. The frame rate for both standard and high definition is 29.97 frames per second.

3. AUDIO

3.1 Audio Level

Digital metering must be set to meet the ballistic specifications for VU (IEC 60268-17) and Peak (IEC 60268-10, 10ms Attack, 1.7 sec. Decay). This metering, in conjunction with the dialnorm reading, will allow a producer to adhere to the audio requirements within the TOS.

3.1.1 The operating level for reference tone and legacy analog system calibration is -20 dBFS per SMPTE RP155.

3.1.2 Programs are to have average loudness levels that fall between -28 dBFS and -20 dBFS during the majority of a program as measured on a digital meter calibrated to the RMS/VU ballistic. Average loudness should not go above -17 dBFS at any point during the program.

3.1.3 Programs are permitted to have audio levels that regularly peak near but not above the following limits using a digital peak meter:

SD: -10 dBFS

HD: -3 dBFS.

3.1.4 Programs must be mixed using dialog level LAeq metering or subsequent ATSC standard method. They must have dialog levels with a value of -24 dBFS \pm 2 dB. Programs may have peak music or effects levels up to the level limits specified in 3.1.3 during moments of dramatic impact, as long as dialog levels are maintained as specified.

3.1.5 Producers must maintain music and effects levels sufficiently below dialog to insure that a wide variety of viewers can understand the dialog upon first viewing, in home conditions with high ambient noise and moderate program levels.

3.2 Audio Quality

3.2.1 The audio mix must be free of audible clipping and other distortions.

3.2.2 The audio mix must be free of obvious noise.

3.3 Audio Phasing & Synchronization

3.3.1 Audio timing and phase must remain consistent across all channels and tracks.

3.3.2 Audio/video synchronization (lip sync) must appear to be correct during the program itself. During the program countdown, or by any in-service measurement technique adopted in the future, audio cannot lead or lag video by more than one half frame. See Figure 1.

3.4 Audio Channel/Track Assignments

3.4.1 Normal Configuration.

Chnl/Track	Assignment
1	Left or Mono
2	Right or Mono
3	Descriptive Video or Mono
4	Secondary Language or Mono

Audio assignments are for the first 4 tracks of a server or VTR. Servers or VTRs with more than 4 tracks shall not have audio on tracks higher than track 4.

3.4.2 Programs may be encoded without special notice using Dolby Pro-Logic with Lt/Rt replacing the normal stereo audio on channels/tracks 1 & 2.

3.4.3 Dolby E encoding is not permitted on standard definition programs. High definition programs may be encoded using Dolby E in place of DVI/Second Language on tracks 3 & 4, using the following track assignments. The producer must insure that the encoded Dolby signal is recorded on tape one frame advanced from the recorded video. This is accomplished by delaying video and audio Tracks 1 and 2 by two frames. The delay shall be accomplished with methods external to the VTR. Thus, all audio signals will be in sync with video when played back through a normal Dolby E decoder on an HDCam VTR in its default configuration.

Dolby E 5.1 Surround Configuration

Chnl/Track	Assignment
1	Left Stereo, Mono, or Left Total
2	Right Stereo, Mono, or Right Total
3	Dolby E (see next table)
4	Dolby E (see next table)

Channel/Track 3 and 4 Dolby E Assignments

Ch 1	Left Front
Ch 2	Right Front
Ch 3	Center
Ch 4	Low Frequency Effects
Ch 5	Left Surround
Ch 6	Right Surround
Ch 7	DVI (Mono or Left), Stereo Left, Mono
Ch 8	SAP, DVS (Right) Stereo Right, Mono

4. Ancillary Information

4.1 Time Code

4.1.1 Drop-Frame time-code per SMPTE 12M must be present on the longitudinal track with identical VITC recorded as follows:

Format	Field 1	Field 2
480i	16 & 18	16 & 18 (279 & 281)

Note: The above is NOT the Sony Digital BetaCam default for VITC location. The HDW-2000 VTRs (HD Cam) record VITC on line 9 of the HANC and LTC on line 10 of the HANC, and both assignments are fixed.

4.1.2 The recording should begin with timecode starting at 00:58:30:00, with 01:00:00:00 being the start of program material. The timecode must increment without interruption from the beginning of the tape until 30 seconds after the final program segment.

4.2 Closed Captioning

4.2.1 For standard definition submissions, Closed Captioning data must be encoded as specified in CEA-608-C. In particular:

4.2.1.1 The primary language captioning data stream must be carried in the Primary Synchronous Caption Service (CC1) on field 1 of line 21.

4.2.1.2 The optional secondary captioning data stream must be carried in the Secondary Synchronous Caption Service (CC3) on field 2 of line 21.

4.2.1.3 Line 21 waveform timing specifications must be in compliance with CEA-608-C Table 2 (“Line 21 Waveform Timing”)

4.2.1.4 The analog equivalent of the Data Bit High shall be 50±2 IRE (357±14 mV)

4.2.1.5 The analog equivalent of the Data Bit Low shall be between 0 and 2 IRE (0 and 14 mV)

4.2.2 For High Definition submissions, CEA-708-C captions with "608 compatibility bytes" must be carried in the ancillary data space (ANC) per SMPTE 334M-2000. The captioning ANC data must be present on line 9.

5. VIDEOTAPE SUBMISSION

Until file program submission standards are set the following standards are in effect.

5.1 Formats & Stock

5.1.1 The condition of the tape stock and equipment used for the recording must provide video and audio playback at PBS with no digital “hits” that exceed error correction. (The Digital BetaCam playback should show no “yellow” or “red” error rate indication throughout the recording.)

5.1.2 All programs must be submitted on one or more of the following formats. Other digital videotape formats may be accepted with prior approval but will incur a dubbing charge.

Image Format	Tape Format
SD 4:3	Digital BETACAM
SD 16:9	Digital BETACAM
HD	HDCAM (1080i)

5.2 Tape Complement & Labeling

5.2.1 Each submitted format must include an identical master and backup with matching time code. When both high definition and standard definition tapes are submitted, each must be supplied with a backup tape.

5.2.2 Maximum program segment length is 120 minutes. Programs exceeding this length must be delivered on multiple cassettes with a logical break point and no overlap.

5.2.3 The program master must arrive at PBS containing a completed producer's technical evaluation in the tape case.

5.2.4 The tape container and cassette labels must indicate the following:

- Master or Backup designation.
- Program series or title.
- Reel number, if applicable (e.g., Reel *n* of *m*)
- Episode title and number.
- PBS Media Inventory number
- Program length (Hrs. Min. Sec.).
- Multi-channel audio track assignments.
- Closed Captioning if applicable.

5.3 Leader and trailer specifications

5.3.1 The recording must begin with 60 seconds of digital color bars per SMPTE EG1 and operating level tone on all audio channels.

5.3.2 The recording must continue with a 20 second visual slate containing the series name, sub title, episode, producer name and audio channel compliment.

5.3.3 The recording must continue with a countdown clock keyed over the slate beginning precisely 10 seconds before the program. Each clock change will indicate the beginning of a second, coinciding with a single frame of 400 Hz audio tone and single frame of white circle for lip-sync test, followed by 29 frames of silence and absence of white circle.

5.3.4 The number "2" must be the last number to appear, with 54 frames (1.8 seconds) of black and 59 frames of silence before the beginning of the program.

5.3.5 The recording continues with the program per PBS Red Book content specifications.

5.3.6 The recording continues and concludes with at least 30 seconds of black and silence.

6. LIVE AND NEAR-LIVE SUBMISSION

6.1 Redundancy requirements

6.1.1 Program producers planning to deliver their program live (or "near-live", meaning within a period of four hours prior to air where there would be no time to deliver the program via other means) to PBS are required to obtain a redundant, diverse path for such a program feed.

6.1.2 This means the producer must secure diverse fiber feeds from different common carriers (preferred), a fiber path and a satellite path, or dual satellite feeds for the feed into PBS. This is at the producer's expense.

6.1.3 Program producers or providers are required to provide a fully redundant backup circuit for all live programs (since there is no "other means" possible) and are required to provide a backup but are allowed flexibility in the method for near-live shows where alternatives can be found.

7. FILE SUBMISSION

Standards for program submission to PBS by file transfer are under development.

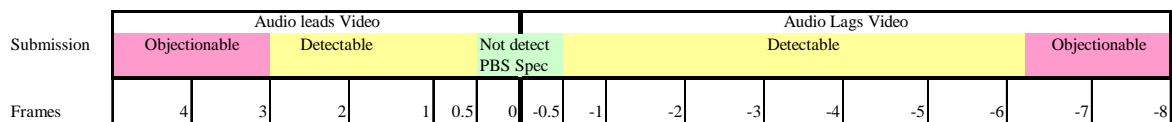


Figure 1 - Audio and Video Lead/Lag Specification

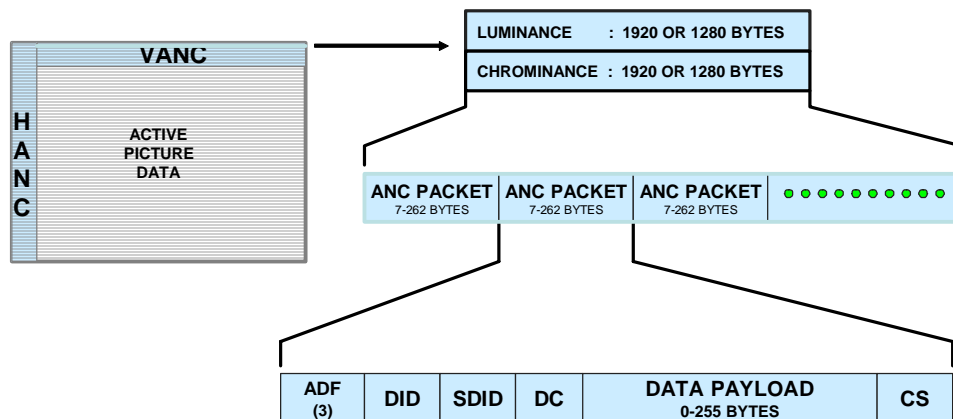


Figure 2 - VANC Data Format per SMPTE 334M (Courtesy of CBS)



Producers Technical Evaluation Form

Series:		
Title:		
Episode Title:		
Episode Number:		Producer:
Media Inventory #	NOLA:	Air Date:
Program Start: TC ___hrs___mins___secs___frms	Program End: TC ___hrs___mins___secs___frms	Program Duration: TC ___hrs___mins___secs___frms
Audio: <input type="checkbox"/> Stereo <input type="checkbox"/> DVI <input type="checkbox"/> 5.1 Surround <input type="checkbox"/> 2 nd Lang.	Closed Captions: <input type="checkbox"/> 608 <input type="checkbox"/> Secondary CC <input type="checkbox"/> 708	Format: <input type="checkbox"/> SD 480i 4:3 <input type="checkbox"/> SD 480i 16:9 Anamorphic <input type="checkbox"/> HD 1080i

Video

1. _____ Video Image Quality
2. _____ Video Levels
3. _____ Color Gamut
4. _____ Video Blanking
5. _____ Field and Frame Rate

Audio

6. _____ Program Reference Level
7. _____ Average / Peak Level and Ratio
8. _____ Dialog Level/DialNorm Value
9. _____ Audio Quality
10. _____ Phase and Synchronization

Audio Channel/Track Assignments

Trk1 _____ Trk2 _____ Trk3 _____ Trk4 _____
 5.1 _____ 5.1+2 (LT/RT Total, DVI or 2nd Lang.) _____

Time Code

_____ Continuous Drop Frame Time Code _____ LTC _____ VITC

Leader and Trailer

_____ Reference Bars & Tone _____ PBS Logo
 _____ Slate & Countdown _____ Run out

Comments:

Technical Evaluation By: _____ Date: _____

Guide to Producers Technical Evaluation Form

All program submissions to PBS are required to meet the quality and operating specifications as set forth in the PBS Technical Operating Standard TOS-1. This form is intended to provide a standardized format to promote adherence to the TOS. It is a requirement found in TOS-1.5.2.3 that all programs be evaluated by the program producer, that this form be completed indicating TOS compliance and that it should be included with all videotape submissions to PBS intended for distribution.

It is expected that this evaluation is performed by a qualified technician using professional measurement equipment as necessary to verify compliance.

The following is intended as a guide in completing this form.

Series, Title, Episode Title, Episode Number, Producer, Media inventory # and NOLA are to be completed and indicated as in TOS-1.5.2.4. These fields where applicable must match exactly the tape and container labels as well the Orion Database entries.

Program Start: This field contains the defined program start (first video or audio) of the program. Entered as the drop frame Time code value on the tape. (TOS-1.5.3.5 and the PBS Red Book content specification).

Program End: This field contains the defined program end (last video or audio) of the program. Entered as the drop frame Time code value on the tape. (TOS-1.5.3.5 and the PBS Red Book content specification).

Program Duration: This field contains the defined program Total Running Time of the program in hours, minutes, seconds, and frames. This time should equal to the Program End Time less the Program Start Time (TOS-1.5.3.5 and the PBS Red Book content specification).

Audio: Audio content (Stereo, 5.1 Surround, DVS & SAP) are to be completed indicating the content on the tape. Content must conform to TOS-1.3.4 Audio Channel/Track Assignments and also be indicated in the Audio Channel/Track Assignments section of the form.

Closed Captions: The presence of captioning and format as outlined in TOS-1.4.2 is to be indicated. Secondary Captions (i.e. Spanish on CC3) if also present need to be noted.

Format: Video format is to be indicated as described in TOS-1.5.1.2.

Video and Audio: Sections 1 - 10 are to be completed to indicate a Pass/Fail compliance with the applicable TOS sections as referenced. Items, if inconsistent with the TOS must be noted in the "Comments" section.

1. **Video Image Quality:** TOS-1.2.1 (Resolution, Widescreen, HD, Aliasing, Compression Artifacts and Archival material).
2. **Video Levels:** TOS-1.2.2 (Black Luminance, White Luminance and Peak Levels).
3. **Color Gamut:** TOS-1.2.3 (Color Gamut for Encoded NTSC).
4. **Video Blanking:** TOS-1.2.4 (Horizontal, Vertical blanking and Letterbox specification).

5. **Field and Frame Rate:** TOS-1.2.5 (Field/Frame of 59.97/29.97).
6. **Program Reference Level:** TOS-1.3.1.1 (Reference tone of -20dBfs).
7. **Average / Peak Level and Ratio:** TOS-1.3.1.2 & 3 (Loudness between -28 & -20 dBFS, Peak audio maximum of -10 or -3 dBFS for SD or HD, respectively).
8. **Dialog Level/DialNorm Value:** TOS-1.3.1.4 (Dialog Level of -24 dBFS +/-2 dB. If Dolby E the DialNorm metadata must be -24, equal to the measured Dialogue Level).
9. **Audio Quality:** TOS-1.3.2 (Audio Distortion, Clipping & Noise).
10. **Phase and Synchronization:** TOS-1.3.3 is adhered. (Audio Phase and Lip Sync).

Audio Channel/Track Assignments – Information detailing the Audio Channel and Track Assignments is entered following the allowed configurations in TOS-1.3.4. Indicate if the tracks are Mono, ST L, ST-R, DVS or 2nd Language. If the submission is High Definition and 5.1 Surround, tracks 3 & 4 should indicate Dolby E and whether it is 5.1 or 5.1 +2 channels.

Time Code: Confirmation that matching drop frame time code is present as both LTC and VITC as specified in TOS-1.4.1

Leader and Trailer

Reference Bars & Tone: Confirmation that reference level bars and tone exist as specified in TOS-1.5.3.1.

Slate & Countdown: Confirmation that the Slate and Countdown conform in timing, content and format as specified in TOS-1.5.3.2 and 5.3.3 respectively.

PBS Logo: Indicate the PBS Logo conforms to the current PBS Red Book specifications.

Run out: Indicate run out occurs in black and silence for 30 seconds as specified in TOS-1.5.3.6.

Comments: Any item requiring special handling or found to be inconsistent with the TOS must be noted. If uncorrectable exceptions or inconsistencies with the TOS are present in the program, it is strongly advised that the producer contact the Director, Media Operations Center at PBS prior to submission.

The name of the person performing the evaluation should be written or printed legibly in the space provided as well as the date of the evaluation. It may also be desired to indicate the VTR, Edit bay or other equipment used in the evaluation process for reference if necessary.

RECOMMENDED PRACTICE

FOR PROGRAM SUBMISSION TO PBS AND OTHER DISTRIBUTORS

A SUPPLEMENT TO THE TECHNICAL OPERATING SPECIFICATIONS

PBS ENTERPRISE TECHNOLOGY ADVISORY COMMITTEE

2007 Edition

1. GENERAL

Designate an individual with managerial authority within the production process to be responsible for programs meeting the specification.

Provide adequate equipment and training to editors, audio sweetening engineers and evaluating technicians.

Insure that adequate time exists in the production schedule for technical evaluations and error correction.

2. VIDEO

2.1 *Video Image Quality*

2.1.1 Use professional digital cameras, VTRs, editing and monitoring equipment. Leave picture monitors in the "underscan" mode at all times.

2.1.2 Do not use the "widescreen mode" on inexpensive DV cameras that simply scale a 360 line raster up to 480 lines. The resulting low resolution and aliasing is unacceptable.

2.1.3 When producing a "Widescreen" program, acquire primarily widescreen content, and do not up-convert the smaller 360 lines of a 4:3 image. The resulting low resolution is unacceptable. Any up-conversions should use high-end equipment and avoid the poor quality of many non linear editor scaling algorithms.

2.1.4 When producing a HDTV program, acquire primarily HDTV content. Occasional up-conversion should use high-end equipment and avoid the poor quality of many non linear editor de-interlacing/scaling algorithms.

2.1.5 Use a high quality aspect ratio converter for any letterbox functions.

2.1.6 Use compression equal to, or better than, a single generation of DV compression. If possible, use DV50 or IMX compression.

2.1.7 When producing either a standard or high definition program under certain circumstances such as breaking news or other unscripted or unplanned events, less than full broadcast quality equipment may be used. However, efforts must be made to minimize the deficiencies inherent in lower quality image acquisition. Examples of practices to minimize the deficiencies include: minimize fast action motion, provide adequate lighting, and avoid shots that require a lens with wide angle or short depth of field.

2.2 *Video Level*

2.2.1 Connect a professional digital waveform monitor to the editing system digital output. Connect the picture monitor output of the waveform monitor to the GBR input of the edit room color monitor, and configure it to flash alarms when levels are exceeded.

2.2.2 Make sure operators understand that neither component analog nor component digital signals have "setup". If it appears to have setup something is set or adjusted wrong. Adjust cameras and editor input settings for proper black levels without clipping.

2.2.3 Adjust cameras and editor input settings for proper white levels without clipping. Apply level (color) correction as needed to make levels consistent. Consider use of a "legalizer" in the final release process.

2.3 Color Gamut

See TOS-1, Section 2.3

2.4 Video Blanking

Monitor video throughout the edit process with the picture monitor in underscan, watching for excessive horizontal or vertical blanking. Regularly check

3. AUDIO

3.1 Audio Level

3.1.1 Make sure audio metering is calibrated to the SMPTE standard of -20 dB full scale digital for the "operating" level. This is not common practice in semi-pro audio, where levels are often pushed closer to full scale digital. For example, Final Cut Pro has meters and default tone settings corresponding to -12 dB full scale, requiring an adjustment of the tone each time it is used, and making the meters marginally useful. External meters may be required to solve limitations of editing software.

3.1.2 Use an audio limiter if needed, to insure level peaks do not exceed -10 dBFS for SD programs and do not exceed -3 dBFS for HD or Widescreen programs.

3.1.3 Procure equipment that can measure dialnorm (such as the Dolby LM100) and provide adequate training. Mix to the standard dialog level of -24 ± 2 dB.

Use digital metering set to meet the ballistic specifications for VU (IEC 60268-17) and Peak (IEC 60268-10, 10ms Attack, 1.7 sec. Decay). This metering, in conjunction with the dialnorm reading, will allow a producer to adhere to the audio requirements within the TOS.

3.1.4 Make sure the final mix is performed by a skilled technician who is unbiased by prior work. Make sure this audio technician is trained to understand the effect of mixing fatigue which often results in music and effects levels being set too high. After hearing a program countless times, the technician's judgment can become impaired. The final mix must compensate for the phenomena of mix-engineer fatigue, caused by long periods of repetitive listening.

3.2 Audio Phasing & Synchronization

3.2.1 Provide phase scopes (X-Y for two-channel, or more elaborate scopes for multi-channel) and associated training to all audio technicians.

3.2.2 When doing the final evaluation, listen with headphones comparing the audio timing of all program audio channels, not just program audio.

3.2.3 To prevent lip sync problems, insure that an audio delay accompanies every video frame synchronizer and digital effects device. Watch for creeping lip sync issues throughout the production and dubbing process. At this point in the production process there is no reason to have anything but zero error in the timing of audio and video.

Be aware that LCD and Plasma displays have latency in video processing - in some models as much as four frames. Use of these displays for checking lip-sync must be accompanied by an audio delay adjusted to equal the display latency.

4. References

Please refer to the following documents for more detailed specifications:

4.1 TOS Documents

4.1.1 TOS 1

4.1.2 Appendices 1-5