SMPTE RECOMMENDED PRACTICE — RP 48–1990

Lubrication of 16- and 8-mm Motion-Picture Prints

1. *Scope*

This practice recognizes that surface treatment of 16- and 8-mm motion-picture prints to reduce the film surface friction coefficient is needed to promote good projection performance. The use of such treatment should result in increased steadiness, reduction of noise in the projector gate, and less tendency toward perforation damage during projection.

2. *Specifications*

2.1 Some type of lubricant or treatment to reduce the film surface friction coefficient should be applied to the full width of the film on both the emulsion and support sides prior to the first projection.

2.2 Unless directed toward specific uses, as noted in 2.3, the lubricant or treatment should be removable by certain film-cleaning operations. If removed, the film should be relubricated or retreated prior to the next projection.

2.3 For specific types of projection equipment, particularly where cartridges or endless loops of film are involved, the manufacturer may recommend or require special methods, lubricants, or treatments especially suited to that equipment. In such cases, it is suggested that any nonrecommended lubricant or treatment which may be on the film be removed prior to application of the special lubricant or treatment.

2.4 The lubricant and solvent used should have no adverse effect on the film, and should be effective in prolonging the projection life of the print. Mineral oils (motor oil, projector oil) may dissolve and leach out the oil-soluble dyes in the film, and should not be used. Nonvolatile oils (mineral or silicone) may cause mottle or undesirable sticking together of the film surfaces, which may cause dirt particles to adhere to the film. Some materials may attack the film base or emulsion, or have an adverse effect on image stability or projection life. Avoid using solvents that are flammable or explosive, or that pose a health or environmental hazard (e.g., benzene or carbon tetrachloride).

3. *Measurement*

The method of measurement of the degree of lubrication shall be in accordance with American National Standard for Imaging Media (Film) — Lubrication on Films — Method for Determining, ANSI IT9.4-1988.

Appendix

(This Appendix is not part of the SMPTE Recommended Practice, but is included for information only.)

The coefficient of friction measured as specified in ANSI IT9.4-1988 does not necessarily correlate with actual projection life. To determine the efficiency of the lubricant, projection life (wear and tear) tests are recommended.

Overall lubrication of the film must be restricted to amounts of lubricant below the limit at which mottle, streaks, and other coating defects become visible upon projection. Film treatment by lubrication should not interfere with normal projection properties of the film.

Projection performance of processed motion-picture film is improved by lubrication when the coefficient of friction is controlled within the range that gives steady reproducible positioning of successive frames with the least strain on the perforations. Printer effectiveness can also be improved by lubricating the negative to facilitate a constant pitch relationship to the raw stock, and to minimize minor abrasions.

The tutorial paper by Frederick J. Kolb, Jr. and Edward M. Weigel, "Lubrication of Motion-Picture Film," published in the April 1965 issue of the Journal of the SMPTE (vol. 71: pp. 297-307), reviews the pertinent background, examines the processes and materials for lubrication, and describes several procedures of proven effectiveness.

Revision of RP 48-1984
Approved February 10, 1990

SMPTE RECOMMENDED PRACTICE — RP 98–1990

Measurement of Screen Luminance in Theaters

1. *Scope*

This practice specifies the procedure for a complete set of screen luminance measurements in theaters, intended to promote measured luminance uniformity that is widely acceptable to the audience.

2. *Measurement Conditions*

Projector operating conditions, photometer type, luminance level, spectral distribution, color temperature, stray light, and flicker shall be as specified in American National Standard for Motion-Picture Film—Screen Luminance and Viewing Conditions—Indoor Theater Projection, ANSI/SMPTE 196M-1986.

3. *Measurement Points on the Screen*

The screen shall be considered as being divided into thirds, both horizontally and vertically; thus, the screen is considered to be divided into nine equal-size rectangles. The measurement point shall be at the center of each rectangle.

4. *Measurement Locations in the Seating Area*

4.1 There shall be six measurement locations; three in the center row of the theater and three in the rear row of the theater.

4.2 The three locations within the row specified shall be left edge seat, right edge seat, and center seat. (If the center is an aisle, select the nearest aisle seat.)

4.3 At each measurement location, the photometer shall be at the eye level of the average seated audience (approximately 1.1 meters above the floor).

5. *Measurements*

Photometer readings shall be taken from each measurement location of each of the nine measurement points (a total of 54 readings).

6. *Luminance Range Limits*

For each of the six measurement locations, the following shall be true:

6.1 The reading at the center measurement point shall be as specified in ANSI/SMPTE 196M-1986 (16 ± 2 fL for review rooms and primary theaters, and 16 ± 4 fL for other theaters).

6.2 The readings of the remaining eight measurement points shall not be greater than the reading of the center measurement point. The readings of the four corner measurement points shall not be less than 8 fL. The readings of the remaining four measurement points, above, below, left and right of the center, shall not be less than 10 fL.

6.3 Excluding the center measurement point, the remaining eight measurement points shall not differ by more than 4 fL.

Appendix

(This Appendix is not part of the SMPTE Recommended Practice, but is included for information only.)

A1. The use of gain screens can raise luminance levels for most of the audience and, at the same time, save energy. It should be pointed out, however, that with gain screens, the luminance as seen from front and side seats may not meet the level and distribution specified in ANSI/SMPTE 196M-1986. This lower luminance may be advantageous for the front seats because flicker can be objectionable in peripheral vision which is a factor for patrons seated very close to the screen.

A2. The rear seats in theaters without balconies normally will be within the luminance values obtained in the three readings in the center row, but more readings can be taken, if necessary, to properly curve and tilt a gain screen to obtain good pictorial quality for the maximum number of theater patrons. See *SMPTE Recommended Practice* RP 95-1989, Installation of Gain Screens, for guidance on curving gain screens.

Revision of RP 98-1981
Approved February 10, 1990

Proposed American National Standard

for motion-picture film—

magnetic audio records—two, three, four and six records on 35-mm and one record on 17.5-mm magnetic film

SMPTE 86

Revision, Redesignation and Consolidation of

ANSI PH22.86-1981, ANSI/SMPTE 108-1986 and ANSI/SMPTE 186-1986

1. Scope

This standard specifies the position, dimensions, reproducing speed, and identity of the two-, three-, four-, or six-track magnetic audio records on 35-mm magnetic film, and one single-track record on 17.5-mm magnetic film. It also specifies the assignment of records to the various tracks on the magnetic coating on the film in relation to the direction of film travel.

2. Referenced American National Standard

This standard is intended for use in conjunction with the following American National Standard:

ANSI/SMPTE 139-1986, Motion-Picture Film (35-mm)—Perforated KS

3. Audio Records

3.1 The lateral location and width of the magnetic audio records shall be as specified in the figures and tables.

3.2 The recordings shall be made so that the azimuth of the record is at an angle of 90° ± 3′ to the reference edge of the film.

3.3 The audio records shall be recorded in such a manner that they can be reproduced properly by reproducing heads whose gaps are positioned along a common plane and in line. The gap width for erase heads shall be a minimum of 10% wider than the gap width of the record being erased.

4. Reproducing Speed

The recordings shall be made and clearly identified so that the audio records will reproduce properly at 96 or 120 perforations per second, corresponding to 24 or 30 frames per second, respectively. 24 frames per second correspond to a linear speed of 18 in (457 mm) per second; 30 frames per second correspond to 22.4 in (570 mm) per second.

5. Assignments of Records

5.1 Formats of 17.5-mm usually result from slitting 35-mm film into two equal strips; in this case, the record adjacent to the perforation shall be the No. 1 record as specified in Fig. 2 and Table 2. This shall also be the No. 1 record if it is a single recording made for 35-mm film.

5.2 For monophonic recordings, the prime audio record shall be placed on track No. 1 for all formats.

5.3 The principal assignment for the two-track format (see Fig. 1) is for the prime audio record on track No. 1 and time code on track No. 2.

5.4 For stereophonic recordings, the track assignment shall be as follows:

Three-Track Format

1	2	3
Left	Center	Right

Four-Track Format

1	2	3	4
Left	Center	Right	(Surround)

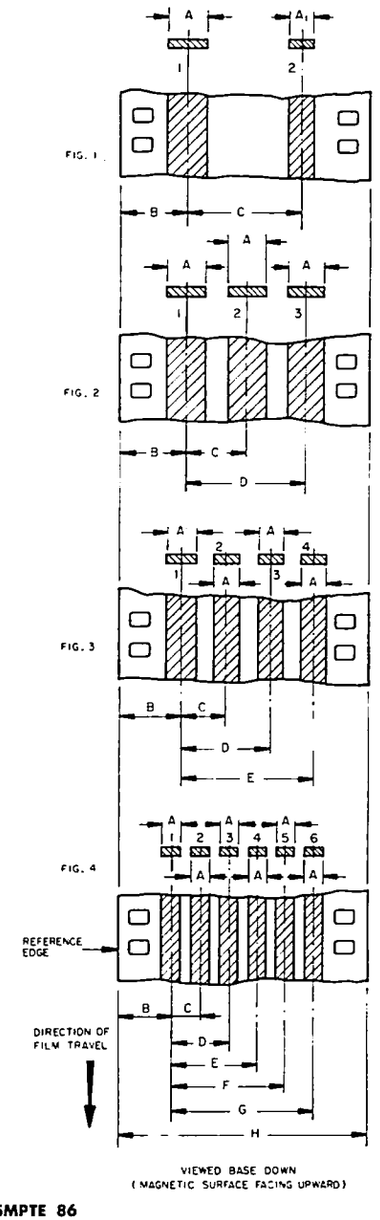


Table 1
Dimensions for Two Magnetic Audio Records (as shown in Fig. 1)

Dimensions	Inches	Millimeters
A	0.200 $^{+\ 0.004}_{-\ 0.000}$	5.0 $^{+\ 0.1}_{-\ 0.0}$
A_1	0.150 $^{+\ 0.004}_{-\ 0.000}$	3.8 $^{+\ 0.1}_{-\ 0.0}$
B	0.339 ± 0.002	8.6 ± 0.05
C	0.725 ± 0.002	18.4 ± 0.05
H	1.377 ref	34.97 ref

Table 2
Dimensions for Three Magnetic Audio Records (as shown in Fig. 2)

Dimensions	Inches	Millimeters
A	0.200 $^{+\ 0.004}_{-\ 0.000}$	5.0 $^{+\ 0.1}_{-\ 0.0}$
B	0.339 ± 0.002	8.6 ± 0.05
C	0.350 ± 0.002	8.9 ± 0.05
D	0.700 ± 0.002	17.8 ± 0.05
H	1.377 ref	34.97 ref

Table 3
Dimensions for Four Magnetic Audio Records (as shown in Fig. 3)

Dimensions	Inches	Millimeters
A	0.150 $^{+\ 0.004}_{-\ 0.000}$	3.8 $^{+\ 0.1}_{-\ 0.0}$
B	0.314 ± 0.002	7.9 ± 0.05
C	0.250 ± 0.002	6.4 ± 0.05
D	0.500 ± 0.002	12.8 ± 0.05
E	0.750 ± 0.002	19.2 ± 0.05
H	1.377 ref	34.97 ref

Table 4
Dimensions for Six Magnetic Audio Records (as shown in Fig. 4)

Dimensions	Inches	Millimeters
A	0.100 ± 0.002	2.4 ± 0.05
B	0.289 ± 0.002	7.34 ± 0.05
C	0.160 ± 0.002	4.06 ± 0.05
D	0.320 ± 0.002	8.12 ± 0.05
E	0.480 ± 0.002	12.18 ± 0.05
F	0.640 ± 0.002	16.24 ± 0.05
G	0.800 ± 0.002	20.30 ± 0.05
H	1.377 ref	34.97 ref

Note: The metric values listed in the tables are not exact conversions and deviate from accepted conversion practices. They are based upon the practice of those countries using the metric system. Head assemblies made to either system of dimensions will, for all practical purposes, be interchangeable.

For two-track stereophonic records containing phase-related material, two adjacent tracks shall be used (preferably in the three-track format, see Fig. 2). These shall be clearly identified on all reels and containers, giving the format and the assignment of the tracks. Head tones shall only be placed on the two tracks containing audio program.

The two-track format (see Fig. 1) is specifically excluded for recording two-track stereophonic records.

5.5 Because of the diversity of practices applied in the use of the six-track format, track assignments shall be clearly identified with each roll of film. (All reels and containers shall indicate the format and assignment of the tracks.)

6. Supplementary Records

Supplementary records for recording time and control codes and other ancillary signals shall be located as shown in Fig. 5 and Table 5.

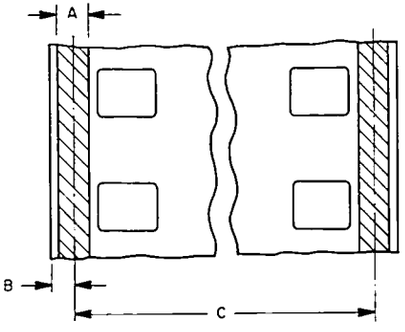


Fig. 5
Supplementary Records

Table 5

Dimensions	Inches	Millimeters
A	$0.045 \begin{smallmatrix}+0.004\\-0.000\end{smallmatrix}$	$1.14 \begin{smallmatrix}+0.10\\-0.00\end{smallmatrix}$
B	0.038 ± 0.002	0.97 ± 0.05
C	1.310 ± 0.002	33.27 ± 0.05

Appendix

(This Appendix is not part of the SMPTE Standard, but is included for information only.)

A1. Record Width

The width of the recorded area must be measured with great care because it relates directly to the calculation of flux per unit track width.

When the recording head gap is narrower than the width of the coating or stripe, there is a measurement complication involving both the uncertainties in viewing the track and in determining the fringing effect.

If the recording head is available, the track width is best measured indirectly by measuring the gap width and adding to this dimension twice the thickness of the test record magnetic coating. This correction will usually be 0.0003 to 0.0006 in (8 to 15 μm).

If the recording head is unavailable, the record may be made visible by the use of a carbonyl iron supension. Care should be taken to apply the minimum amount sufficient to make the recording visible, so that the developed image is not wider than the actual recorded area.

A2. Reproducing Head Gap Width

If precision measurements or calibration is to be made on magnetic audio records made in accordance with this standard, reproducing head gaps of the same width or wider than the recorded track must be used to prevent edge effects or fringing.

A3. Erase Heads

Erasing head gaps used to erase the records specified in this standard should be substantially wider than the record specified.

A4. Magnetic Coating

The dimensions of the magnetic coating are not specified, but shall be wide enough to permit placement of the audio records in accordance with the appropriate formats in this standard. If the recordings are made on striped motion-picture stock, the width of the stripes shall be at least 0.010 in (0.25 mm) beyond both edges of each record.

Proposed American National Standard

for television—

three-channel parallel component analog video interface

SMPTE 253

1. Scope

This standard defines the physical characteristics of an interface and the parameters of the signals carried across that interface, using three parallel channels for the interconnection of equipment operating with analog component video signals. The signals carried across this interface have a typical scanning structure of 525 lines, 59.94 fields/sec, 2:1 interlace, and 4:3 aspect ratio.

The signal characteristics are defined by either of two gamma-corrected component sets: a luminance video and two accompanying color-difference signals, or a set of green, blue, and red, G′ B′ R′ (hereafter defined as GBR), primary video signals.

The intended uses of this interface are:

To interconnect the elements of parallel analog component video subsystems, using the same component sets, within larger component or composite plants. Three-channel component editing and post-production suites are examples of such subsystems.

To interconnect equipment into complete, self-contained analog component systems of relatively small size.

This standard applies to signals carried on the connectors described in Sec. 8 and may not apply to component signals carried on other types of connectors.

2. Referenced Documents

This standard is intended for use in conjunction with the following documents:

SMPTE RP 125-1984, Bit-Parallel Digital Interface for Component Video signals

CCIR Recommendation 471-1, Nomenclature of Colour Bar Signals

CCIR Recommendation 601-1, Encoding Parameters of Digital Television for Studios

CCIR Report 624-3, Characteristics of Television Systems

3. Video Components

3.1 Blanking Level. Blanking level is defined as the level during the clamp period shown in Figs. 1 and 2 and detail Y-Y in Fig. 3.

3.2 Signals. The three channels of the interface are designated to carry specific signals as shown in Table 1.

Table 1
Signals

Channel	GBR Set	YP_BP_R Component Set	
1	G	Luminance	Y
2	B	Scaled B-Y	P_B
3	R	Scaled R-Y	P_R

3.3 GBR Component Set. This component set, as shown in Fig. 1, originates as equiband and gamma-corrected GBR primary signals from a picture video source, such as a camera or telecine, or as synthetically generated GBR video from a character generator, graphics generator, or test-signal generator. These video signals are positive going, and each shall have a maximum peak

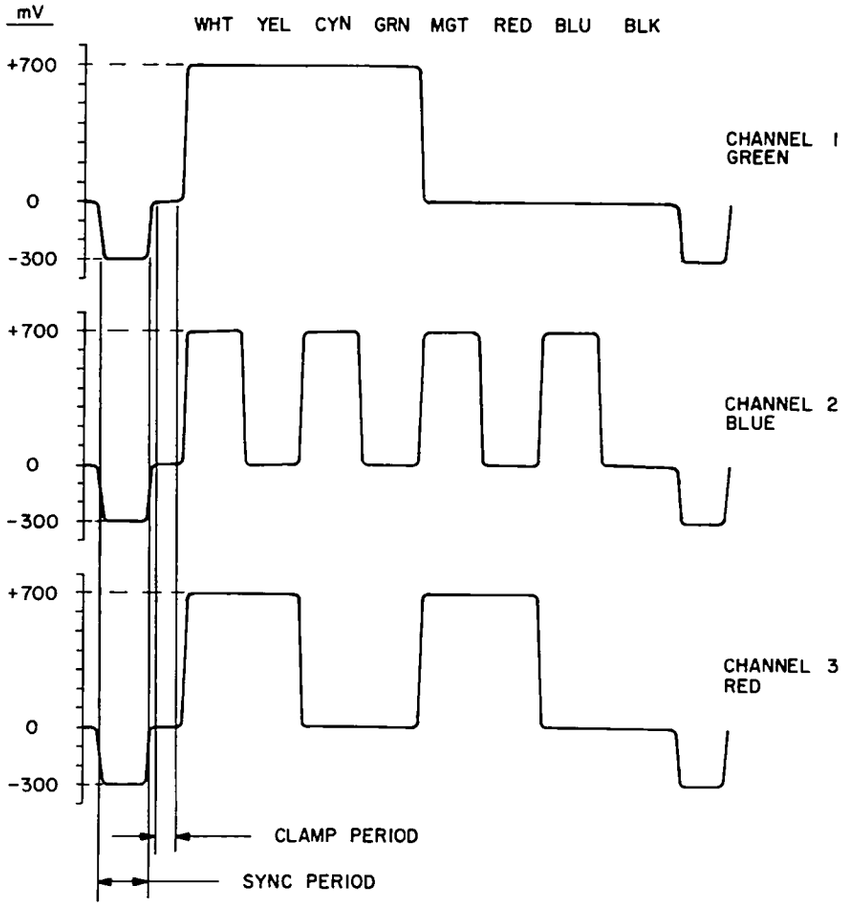


Fig. 1
GBR Component Set
100/0/100/0 Color Bar Example

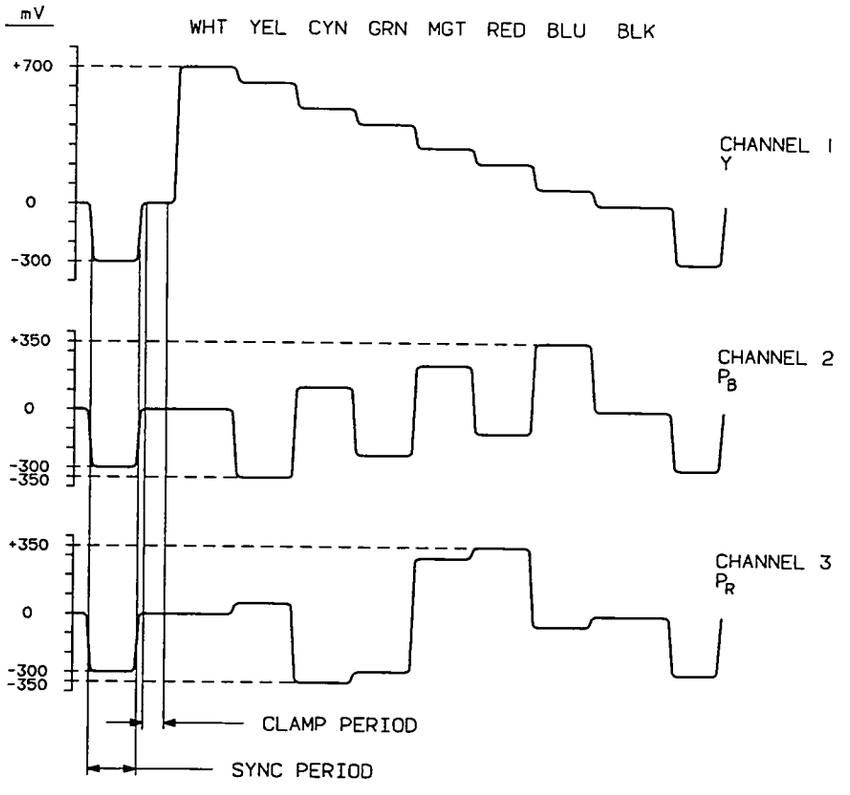


Fig. 2
YP_BP_R Component Set
100/0/100/0 Color Bar Example

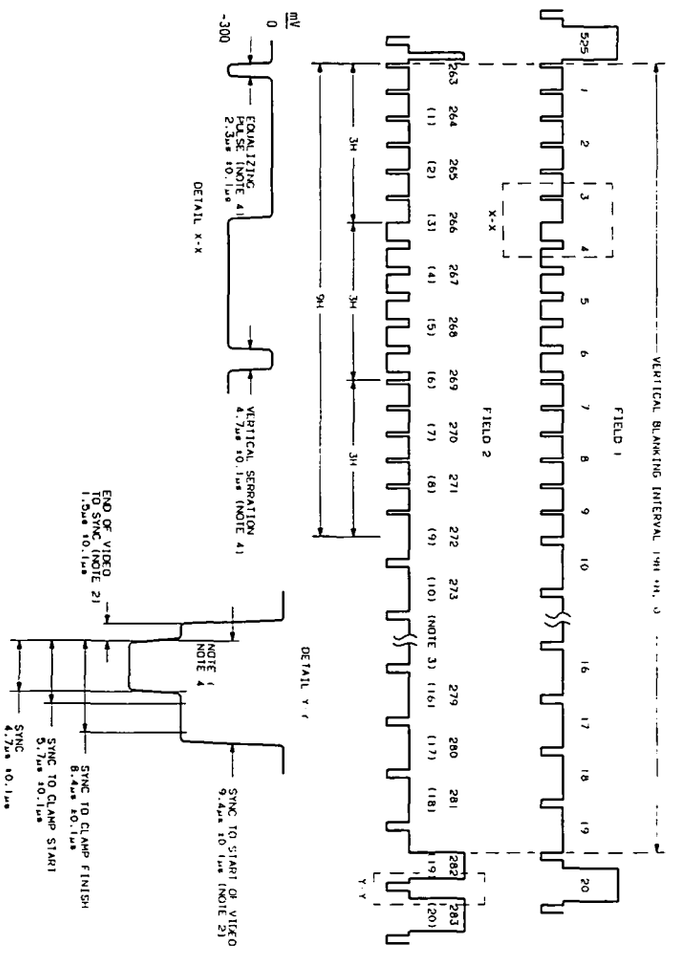


Fig. 3
Sync Timing

Notes:

1. The 50-percent point of the leading edge of sync serves as the timing reference for all signals.
2. End of video to sync and sync to start of video are measured between 20-percent point of peak video amplitude and 50-percent point of sync leading edge.
3. Numbers shown in parentheses are line numbers in field 2 used in earlier practices.
4. Rise and fall times of all pulses shall be 140 ns ± 20 ns.

level of 700 mV from blanking level with zero setup. (See Appendix A1.) Each shall have a negative-going sync pulse of amplitude 300 mV from blanking level that conforms to the timing requirements of Fig. 3. The sync on G is intended as the primary timing reference for the GBR component set.

3.4 YP_BP_R Component Set. The luminance and color difference signals (YP_BP_R), shown in Fig. 2, can be derived from the original GBP primary signals (excluding sync). The picture portion of the luminance and the color-difference signals are first formulated according to the basic equations:

$$Y = 0.299R + 0.587G + 0.114B$$

$$B\text{-}Y = -0.299R - 0.587G + 0.886B$$

$$R\text{-}Y = 0.701R - 0.587G - 0.114B$$

The resulting three component signals are additionally specified by the following:

3.4.1 Luminance Y. For 700 mV each of G, B, and R primary video signals, the matrixed Y signal has a peak video amplitude of 700 mV from blanking level, with zero setup. Luminance has derived or added negative-going sync of 300 mV from blanking level that conforms to the timing requirements of Fig. 3. This sync is intended as the primary timing reference for the YP_BP_R component set.

3.4.2 Color Difference Signal P_B. P_B is amplitude scaled B-Y according to:

$$P_B = \frac{B\text{-}Y}{1.772}$$

After such scaling, the P_B signal shall have a maximum peak amplitude of ± 350 mV about blanking level.

The P_R signal is a bipolar video signal and has a negative-going sync of 300 mV from blanking level that conforms to the timing requirements of Fig. 3. The dc level of P_R during the clamp period shown in Fig. 2 shall be at black level.

3.4.3 *Color Difference Signal P_R. P_R is amplitude* scaled R-Y according to:

$$P_R = \frac{R\text{-}Y}{1.402}$$

After such scaling, the P_R signal shall have a maximum peak amplitude of ± 350 mV about blanking level.

The P_R signal is a bipolar video signal and has a negative-going sync of 300 mV from blanking level that conforms to the timing requirements of Fig. 3. The dc level of P_R during the clamp period shown in Fig. 2 shall be at black level.

4. Impedance

Equipment using this interface shall have nominal 75-ohm input and output impedances

5. Clamping and Signal DC Content

The clamp period shown in Figs. 1 and 2 and detail Y-Y in Fig. 3 may be used as a dc level clamp reference.

The average dc level of any properly terminated signal specified herein shall not exceed ± 1 volt.

6. Component Timing

The three component video signals GBR or YP_BP_R should be simultaneous in real time.

7. Timing and Amplitude Control Reference Signals

Optional timing and amplitude control signals are currently under study.

8. Connector and Cable

Two different connector implementations are permissible under this standard. The preferred implementation incorporates a single cable and connector arrangement carrying all three parallel signals. The secondary implementation utilizes three separate BNC connectors carrying the three parallel signals. This section describes the preferred implementation.

8.1 Connector. The connector consists of three BNC-style inserts mounted in a rectangular housing. Latching is accomplished by two latch posts and receptacles, internal to the connector. Additional posts are utilized for polarizing and reinforcing purposes.

This standard defines the dimensions and tolerances necessary to permit the interconnection of plug and socket connectors that contain three inserts:

The plug interface is decribed in Fig. 4.

The socket interface is described in Fig. 5.

The pin and socket are derived from Mil Spec. No. Mil-C-39012C and are described in Figs. 4 and 5.

Individual insert positions in each mating connector shall be marked with G, B, and R, respectively, as shown in Figs. 4 and 5. These position identifications correspond to the cable coding.

8.2 Cable. The recommended cable consists of three individual, insulated, coded coaxial cables, all housed in a nonmetallic jacket. Typical construction and electrical specifications are outlined in Appendix A2. Each individual coax shall adhere to the following specifications (metric values are for reference only):

8.2.1 Impedance: 75 ohms nominal
Return loss: minimum 25 dB, 100 kHz to 30 MHz

8.2.2 Velocity of propagation: 78% ± 1.5%

8.2.3 Transit time of the individual cable assembly (per cable) shall be 1.31 nanoseconds/ft ± 0.02 ns/ft (4.3 ns/m ± 0.1 ns/m).

8.2.4 Crosstalk between coaxial conductors in a 300-ft (91-m) length cable shall be no more than —70 dB at 10 MHz.

8.2.5 Each individual coax within this cable shall be uniquely coded to identify the following signals:

Coax 1: Color green or letter G
Coax 2: Color blue or letter B
Coax 3: Color red or letter R

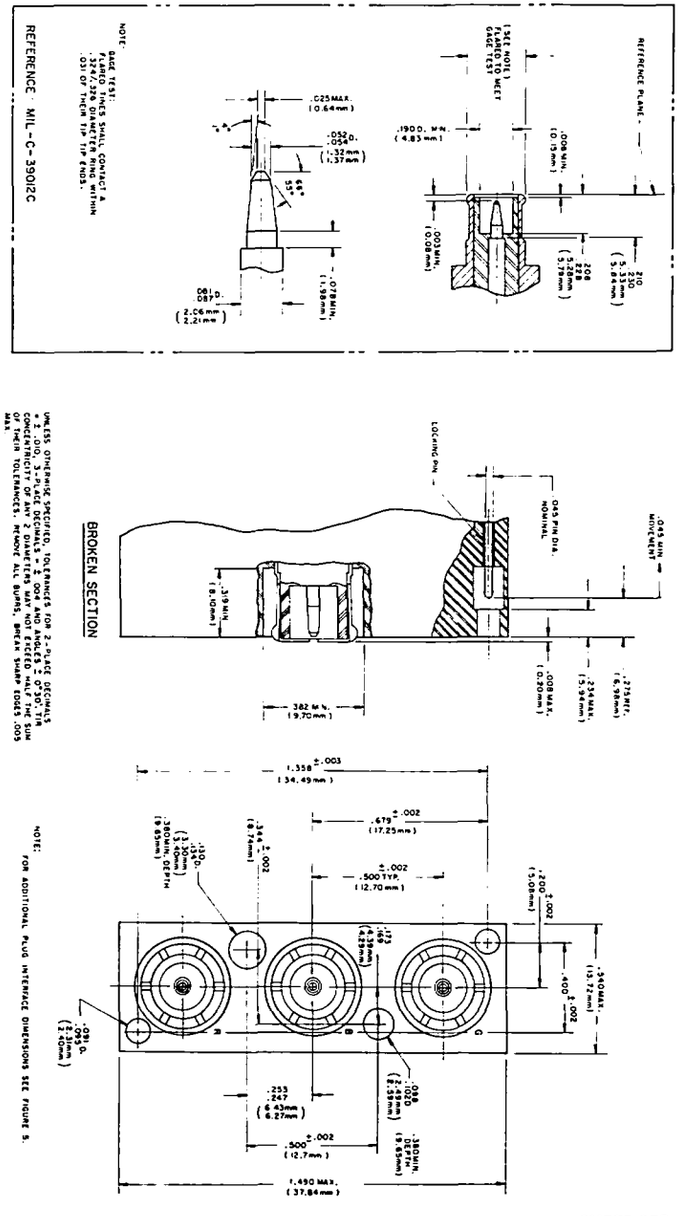
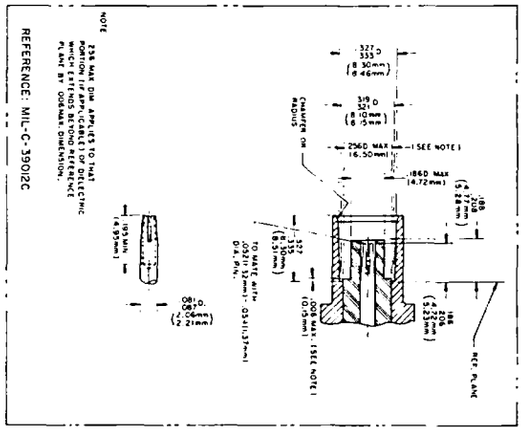
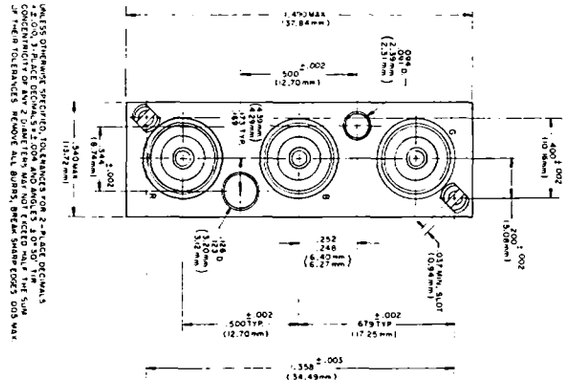


Fig. 4
Plug Interface





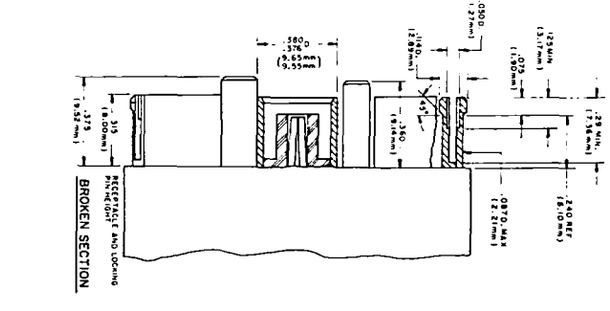


Fig. 5
Socket Interface

Appendix

(This Appendix is not part of the American National Standard, but is included for information only.)

A1. Color Bar and Other Reference Level Considerations

The scaling chosen for the standard parallel component set Y, P_B, and P_R is based upon 100% reference levels *(700 mV video) of each of the GBR primaries.*

Therefore, for 100% color bar signals produced from original 700 mV G, B, and R bar waveforms, the video excursions of the Y, P_B, and P_R each shall be 700 mV.

When other color bar levels are used, the Y, P_B, and P_R components will track one another, and the GBR set, with equal amplitudes.

Thus the normalized levels for each of the three components *are defined as:*

Normalized level for 100/0/100/0 color bars = 700 mV (CC1R Recommendation 471-1)

Normalized level for *75/0/75/0* color bars = 525 mV

This chosen scaling and reference level thus ensures equal excursions for each of the video component signals Y, P_B, and P_R when the levels of the original GBR color bar primary set are equal to each other, regardless of their *absolute amplitudes. It also yields equal peak-to-peak* amplitudes, i.e., Y, P_B, and P_R are a tracking set from a level viewpoint.

The nomenclature P_B has been chosen to specify that this signal is a scaled version of the original matrixed B-Y signal and to further distinguish this from the scaled and offset C_B component that is specified in CC1R Recommendation 601-1 and SMPTE RP 125-1984.

Since the B-Y signal takes on values between +620.2 mV and —620.2 mV, that is 1240.4 mV peak-to-peak, and since the desired range of P_B is ± 350 mV (700 mV p-p), B-Y must be scaled by

$$\frac{700}{1240.4} = \frac{1}{1.772}$$

The nomenclature P_R has also been chosen to specify that this signal is a scaled version of the original matrixed R-Y signal and to further distinguish this from the scaled and offset C_R *component specified in CC1R 601-1 and* SMPTE RP 125-1984 digital component specifications.

Since the R-Y signal takes on values between + 490.7 mV and — 490.7 mV, that is 981.4 mV peak-to-peak, and since the desired range of P_R is ± 350 mV (700 mV p-p), R-Y must be scaled by

$$\frac{700}{981.4} = \frac{1}{1.402}$$

A2. Guidelines to Cable Design

The following are typical design parameters intended only as a general guide to implementation of the standard:

Typical cable dimensions in inches (in millimeters) unless otherwise specified:

Inner conductor: No. 26 AWG 0.019 ± 0.001 (0.48 ± 0.03)

Dielectric: Foam polyolefin 0.090 O.D. ± 0.003 (2.29 ± 0.08)

Shield No. 1: Polyester aluminum foil 0.096 O.D. ± 0.004 (2.44 ± 0.10)

Shield No. 2: Braided tinned copper 0.114 O.D. ± 0.005 (2.90 ± 0.13), with 90% minimum coverage

Jacket, each coax:

Option 1: Nylon 0.007 (0.18) nominal thickness; 0.125 O.D. ± 0.005 (3.18 ± 0.13)

Option 2: PVC 0.015 (0.38) nominal thickness; 0.144 O.D. ± 0.005 (3.66 ± 0.13)

Jacket, Outer 0.35 (8.9) to 0.40 O.D. (10.2)

Cable lay of three coaxes: 2.67 revolutions/ft (8.8 revolutions/m)

Typical Cable Electrical Characteristics:

Capacitance of each coax: 17.5 pF/ft ± 1 pF/ft (57 pF/m ± 3 pF/m)

Maximum attenuation at 30 MHz at 30 ft (9 m) —10.8 dB

Center conductor dc resistance: 0.0415 ohms/ft, maximum (0.136 ohms/m)