Eastman Keykode Numbers Transfer Verification Films

By Donald Ver Ploeg

Eastman Keykode numbers (machine-readable bar code on motion-picture film that replicates the human-readable key numbers) have brought to film the same rapid addressability that time code brings to videotape. To take full advantage of this technology throughout the post-production process requires that Keykode numbers and video and audio time codes be correlated with frame and field accuracy. The 16mm and 35mm Eastman Keykode numbers transfer verification films have been developed to quickly analyze the entire bar-code reading system, from telecine transfer to off-line edit decision list. These test films will quickly identify most of the ambiguities that result in erroneous correlation between film bar code and time codes.

Eastman Keykode numbers can eliminate the tedious and error-prone task of reading numbers by eye (Fig. 1), and manual data entry is no longer necessary. Correlating these numbers with time code can bring film and video post-production closer together for the unique advantages both media offer.

In order for these closer film/video relationships (film origination and electronic editing) to work well, it is essential that the bar code be read correctly and correlated precisely with video and audio time codes. A breakdown can occur during telecine transfer when the data base is created, resulting in erroneous edit decision and negative cut lists. Unfortunately, these errors can go undetected until the negative cutter tries to match the film or the on-line auto-conform session is under way.

To resolve the problem, 16mm and 35mm Eastman Keykode numbers transfer verification films have been developed by Kodak (Fig. 2). It is now possible to analyze the accuracy of the entire bar-code reading system, from telecine transfer to off-line EDL, and quickly correct any reader discrepancies.

Presented at the 136th SMPTE Technical Conference in Los Angeles (paper no. 136-38) on October 13, 1994. Donald Ver Ploeg is with VP Communications, Pittsford, NY 14534, and a consultant to Eastman Kodak Co.

Applications

Keykode numbers transfer verification films offer a precise means to set up a telecine reader system to provide video dailies with accurate bar code and time code correlations. These films help the user to:

- Determine if the system is reading film bar code accurately.
- Calculate reader delays introduced by noise reduction, Scantrack, and other electronic systems.
- Determine the exact offsets needed when switching between 35mm and 16mm reader heads.
- Reestablish proper calibration and offsets following routine maintenance.
- Verify that the reader system references the correct 35mm zero-frame perforation.
- Determine how quickly the film footage encoder/time code generator updates after each splice in multiroll transfers.
- Check video editing systems for frame and field accuracy.
- Verify that the correct frames have been digitized for nonlinear video editing systems and that the pulldown sequence is correct.
- Check the accuracy of stand-alone computer matchback software.

Design and Content of the Test Films

The test films have been printed on color negative camera stock, the type of film that transfer houses handle most often. The 35mm film is 375 ft; the 16mm film is 190 ft.

The whole key number plus frame offset is prominently displayed in every frame of film. The lower half of each frame is open for the transfer facility to burn in Keykode numbers, time codes, feet, and frames from their reader system and character generator. Comparing the Keykode numbers being read from the film with those shown in the picture will verify the accuracy of the system (Fig. 3).

Five different key-number sequences are included in each film to test the system's ability to update on multiroll transfers. Segments 1 to 4 have ascend-

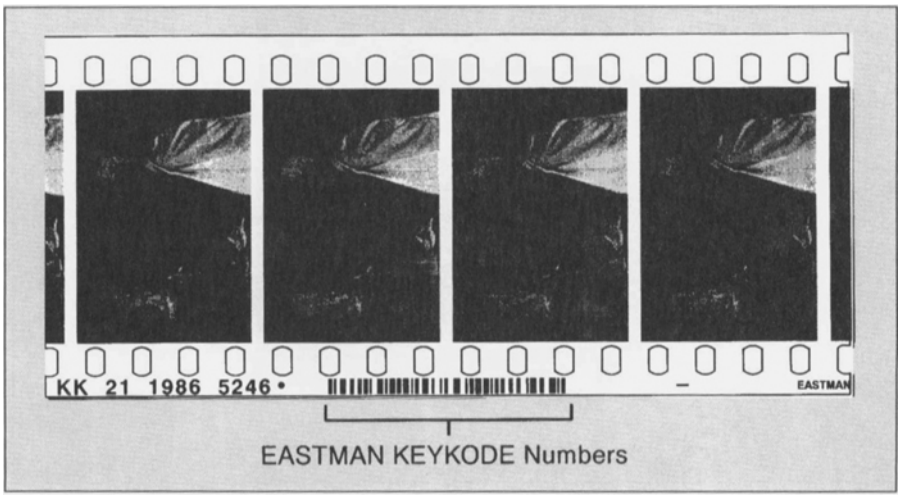

Figure 1. Human-readable and Keykode numbers.

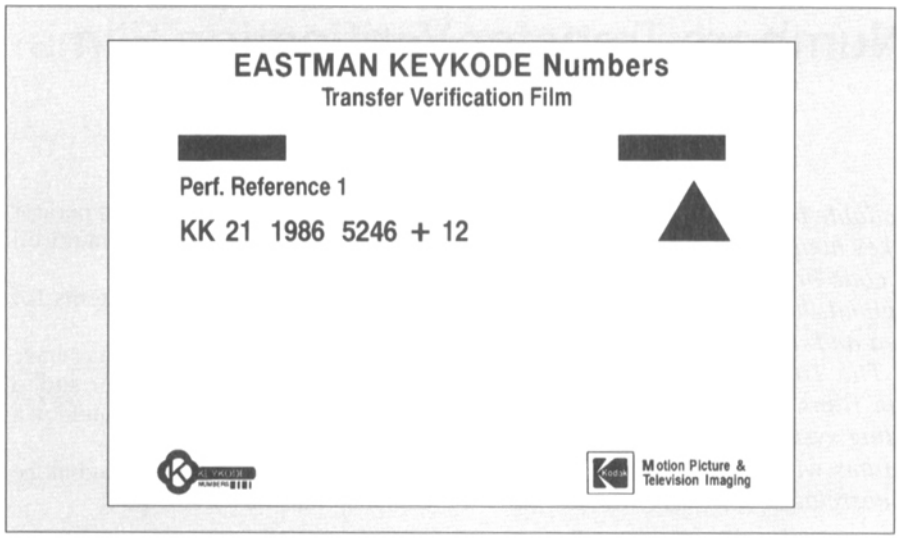

Figure 2. Typical frame of 35mm test film.

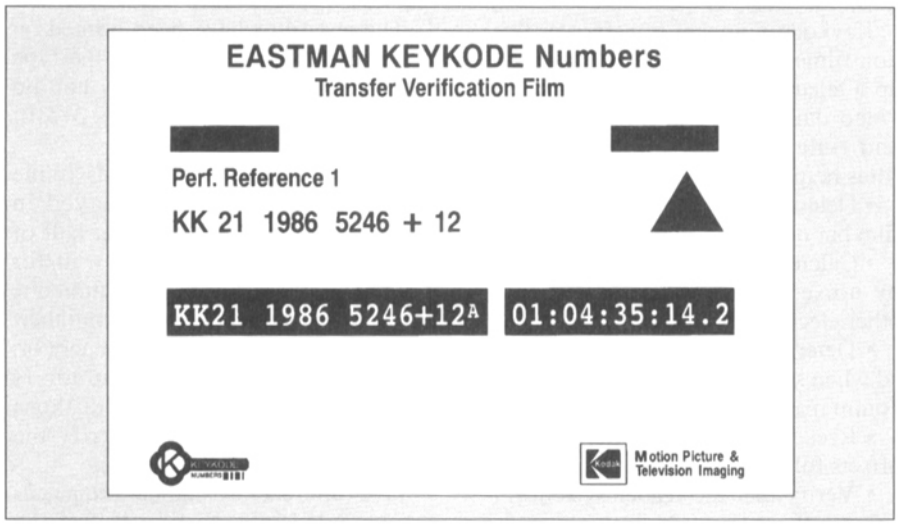

Figure 3. Test film showing key number and time code verification.

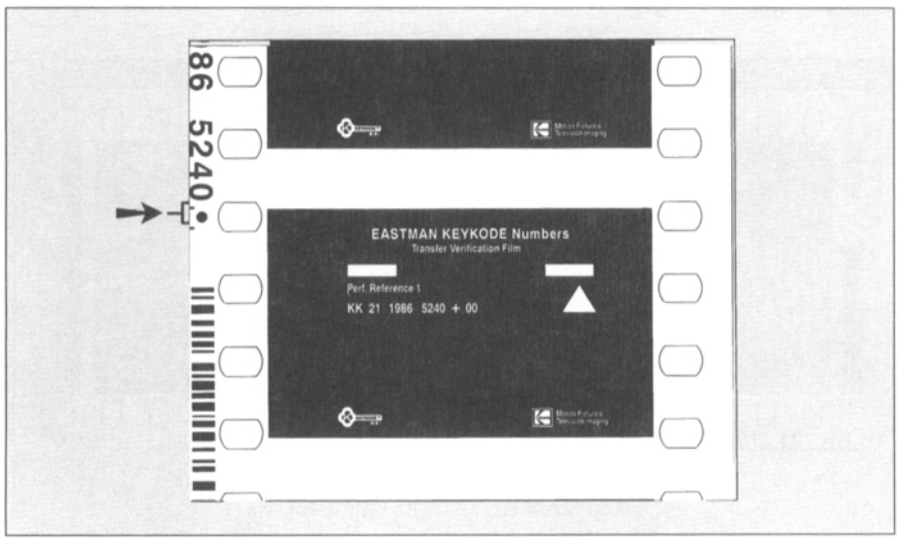

Figure 4. Film showing zero-frame perf reference.

ing numbers in the normal read position. Keykode numbers in segment 5 are descending and on the opposite side of the film, just as they would appear on negative that has been rewound prior to shooting. This provides a further test for dual-reading bar-code heads.

The zero-frame perf reference (the perforation with the dot that identifies the key-number frame) changes with each of the first four segments (Fig. 4). Segment 1 has the reference dot on perf 1 (top of the frame). On the following three segments, the dot references the subsequent three perforations, i.e., perf reference 4 (bottom of frame) for segment 4. The perf reference is displayed in every frame of the 35mm test film. For reader systems that identify the zero-frame perforation, the film provides a reference to determine if that identification is accurate.

Using the Test Films

Primary use of the films is to verify that the entire system is aligned and calibrated to read Keykode numbers from the film and record them on the video daily and/or computer disk with total frame, field, and time-code integrity (Fig. 5).

The basic procedure would be to:

- Transfer the test roll on a telecine like any other roll of negative film.
- Burn the key numbers into the video daily from the Keykode reading system in the space provided.
- Compare these with the numbers shown in the test film to determine if the system is reading accurately. If the numbers do not agree, it will be readily apparent how many frames the film-to-tape transfer is out of sync.

Frame Identification

Four alternating shapes are displayed to the right of the key number — triangle, square, circle, diamond — one shape per frame. This precise pattern is maintained throughout each test film. There is no discontinuity even across the five different film segments. With these changing shapes it is possible to see if the film footage encoder or telecine controller is identifying frames and fields accurately. This also shows whether the correct fields have been digitized for nonlinear editing systems and if the pulldown sequence is correct.

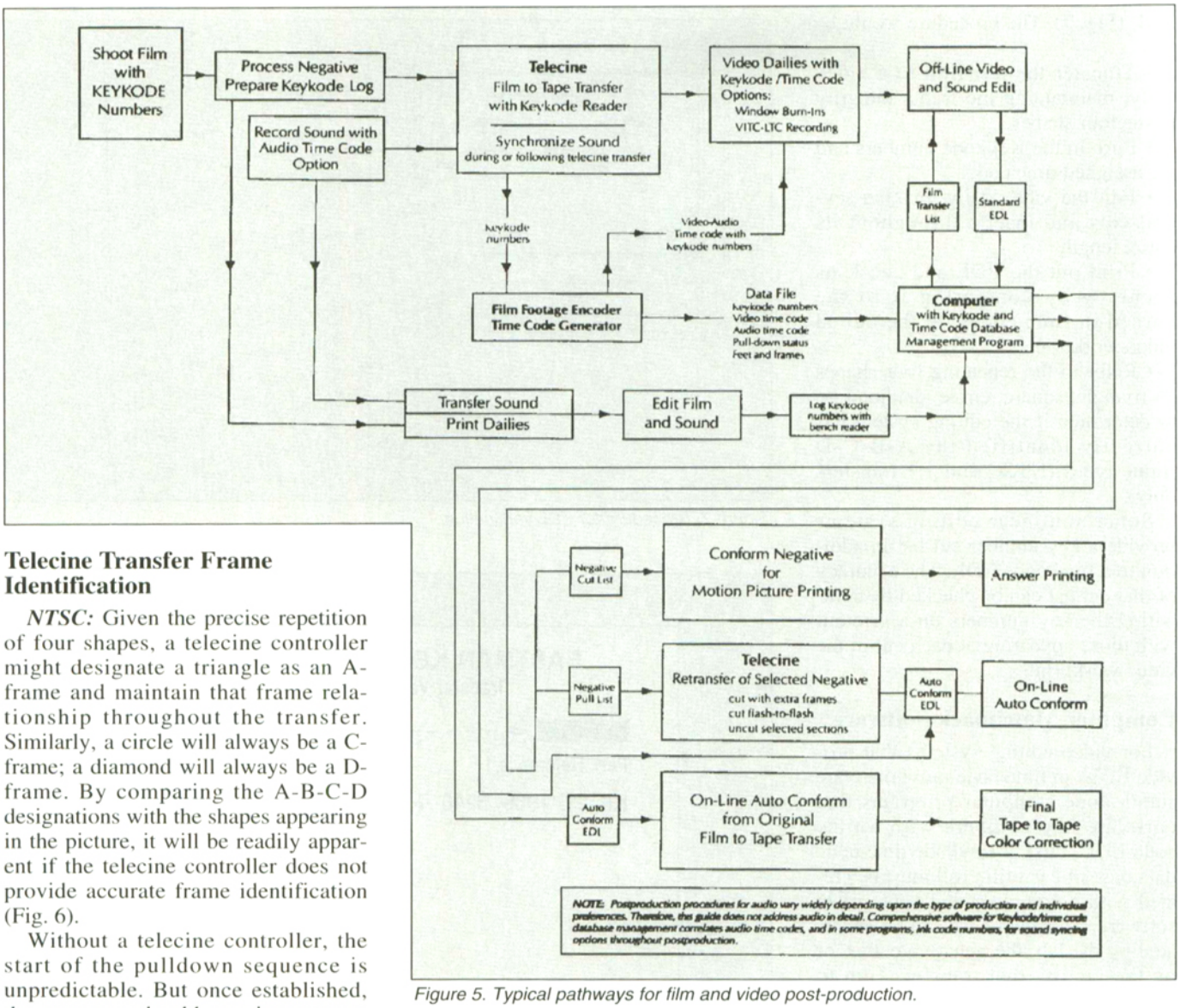

Figure 5. Typical pathways for film and video post-production.

Telecine Transfer Frame Identification

NTSC: Given the precise repetition of four shapes, a telecine controller might designate a triangle as an A-frame and maintain that frame relationship throughout the transfer. Similarly, a circle will always be a C-frame; a diamond will always be a D-frame. By comparing the A-B-C-D designations with the shapes appearing in the picture, it will be readily apparent if the telecine controller does not provide accurate frame identification (Fig. 6).

Without a telecine controller, the start of the pulldown sequence is unpredictable. But once established, the sequence should remain constant. Example: if a circle is an A-frame, it should continue as such unless the transfer is interrupted.

PAL: For film-to-tape transfers at 25 frames/sec (common practice), the frame relationship is 1:1. The test film can be used in all aspects. For 24:25 frame/sec transfers, the pulldown sequence is eleven A-frames followed by one B-frame, then eleven "mixed" C-frames followed by one D-frame. Consequently, a given shape in the test film cannot be assigned to one particular frame type.

Edit Decision List (EDL) Verification

The test films can be used as a source to verify the accuracy of an

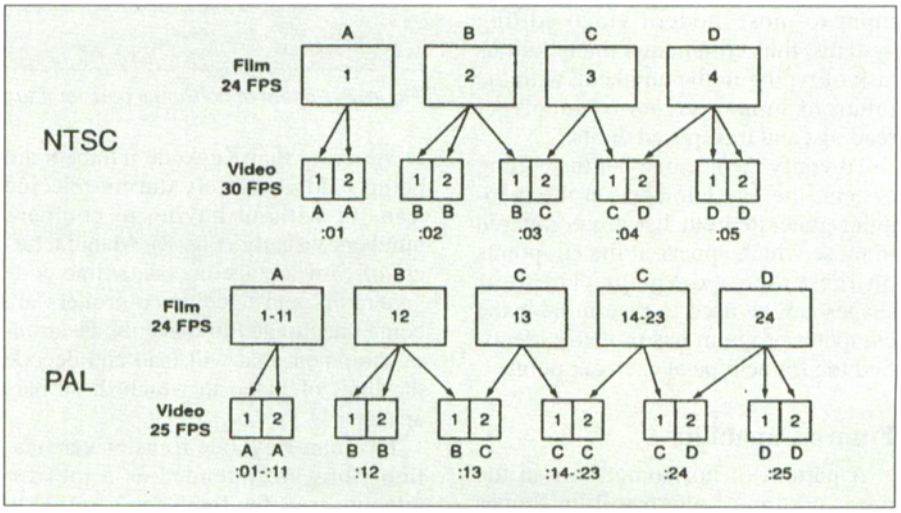

Figure 6. Frame and field pulldown relationships for NTSC and PAL transfers.

EDL (Fig. 7). The procedure would be to:

- Transfer the test film to a video daily, maintaining the frame integrity of the four shapes.
- Burn in the Keykode numbers and the assigned time code.
- Edit the video daily, making several cuts and inserts throughout its entire length.
- Print out the EDL and check its accuracy by comparing it to the burned-in time codes on the edited video workprint.
- Refer to the repeating four shapes — triangle, square, circle, diamond — to determine if the editing system has correctly identified the A-B-C-D frame types (NTSC and 1:1 transfers only).

Some nonlinear editing systems provide a key number cut list in addition to a time code EDL. The accuracy of that cut list can be checked by comparing the key numbers on a printout with those appearing at each cut in the video workprint.

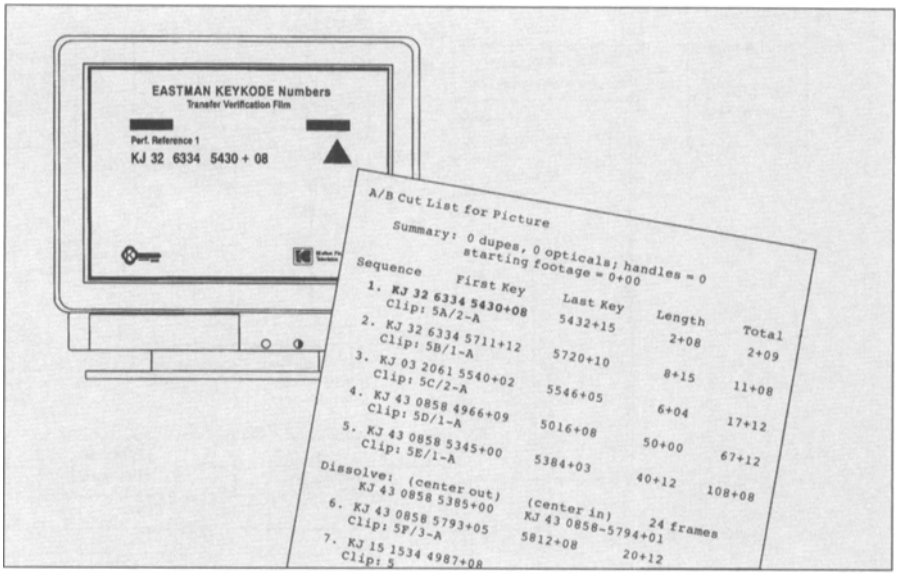

Figure 7. Procedure for EDL verification.

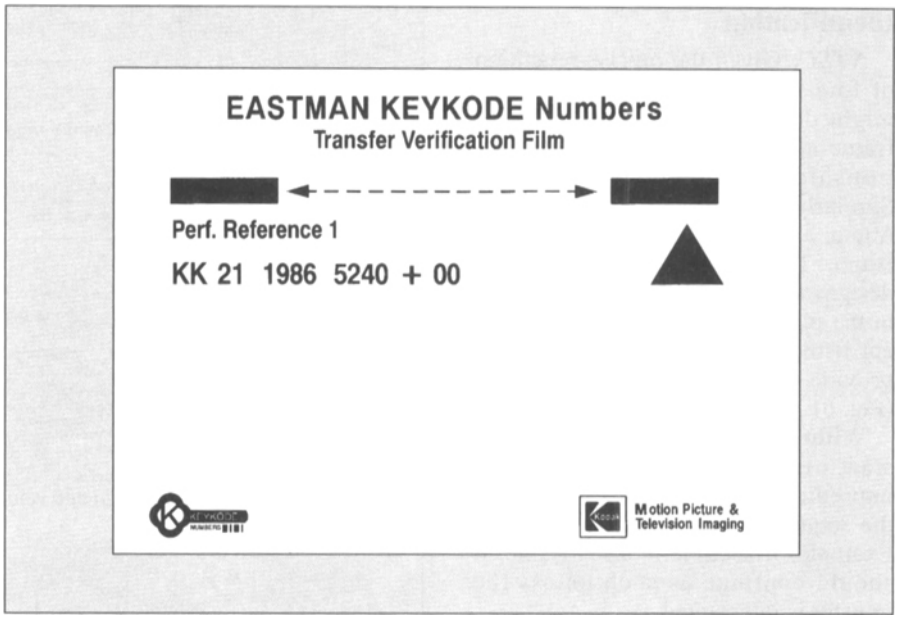

Figure 8. Pattern of horizontal bars for future automatic verification.

Computer Matchback Software

For video editing systems that provide EDLs in time code only, there are stand-alone computer programs that correlate key numbers with a time code EDL. First, a Keykode/time code data base of each film roll must be created with a computer and appropriate software. This data base can be generated by the lab, the negative cutter, or by the facility that transfers film to video dailies. The data base, usually on floppy disk, can provide direct input to most modern video editing systems, thus eliminating the laborious task of typing in the numbers, with the inherent human errors of incorrect readings and transposed digits.

To verify the accuracy of the editing system, the key numbers on the computer-generated cut list are compared to those which appear at the cut points on the video workprint. The four shapes can be used to determine if the computer program has properly identified the frame type at each cut point.

Future Capability

A pattern of horizontal bars in the upper portion of alternate film frames will offer the potential for automatically verifying that Keykode numbers are being read accurately during telecine transfer without having to compare numbers visually (Fig. 8). Manufacturers of film footage encoders/time code generators and telecine controllers are being encouraged to make the electronic equipment that will read and decode the lines of video in which these bars appear.

Eastman Keykode transfer verification films are intended as a tool for telecine transfer facilities to quickly determine if they are reading Keykode numbers accurately and providing transfers with proper Keykode/time code correlations.

Acknowledgments

The author gratefully acknowledges the generous contributions to this program by Sony Pictures High Definition Center and Du Art Film and Video. He also thanks Optimus, Inc.; Avid Technology, Inc.; Evertz Microsystems, Ltd.; Skotel Corp.; and Time Logic, Inc., for their valuable input and review.