

Hollywood's Proposals for Digital Cinema - Digital Projection of Heritage Film Content at Original Frame Rates.

In July 2005 the Digital Cinema Initiative, a group of five Hollywood studios, Disney, Fox, Paramount, Sony Pictures Entertainment, Universal and Warner Bros. Studios, (MGM was originally a member but subsequently pulled out), issued their proposals for Digital Cinema projection as a replacement for print film projection in cinemas. While it is ostensibly directed at Hollywood product the implications are clear . that this should be the basis of a world standard for all digital cinema. Currently (July 2007) the US Society of Motion Picture and Television Engineers standards committee, DC28, is considering the DCI proposal as the basis for a US standard, the precursor these days to an international standard.

The DCI document may be a fundamental turning point in cinema history, but it is quite unlike its predecessor, the Academy of Motion Picture Arts and Sciences specification of the Academy film format. That, written in 1932, described and standardized what was already happening in studios, laboratories and cinemas. The DCI specification described a process no one was yet using, using equipment and resolutions that did not exist on the market, and still don't - in effect a virtual concept.

Every film technical specialist in film archives needs to be familiar with this proposal as it seems likely that it will be adopted, maybe with a some limited changes, as the US standard, and already cinema chains and government ministries in several US and European states are funding D-cinema installations that broadly follow the DCI principles, and actively promoting the changeover in cinemas.

This approach is the prelude to the end of film as the cinema projection medium. Colour print film is cheap and used to make thousands of prints of some Hollywood films as a means of release worldwide within a just a few weeks to avoid piracy. The cost of making these many release prints and their transportation is vast, and securely encrypted data files are seen as a cost effective solution. Once the colour print film market collapses film laboratories will cease all low cost printing. Film may be retained a little longer as camera film.

The final digital print, received by the cinema and processed by a server before being presented to the projector is the DCP the Digital Cinema Package. Unlike a film print it can never be an archival preservation element: it is a compressed version of the original digital master, it may be encrypted and only accessible using a key with a time limit on its use, and it may be specifically designed for a server or even a specific cinema, and, above all, it suffers from all the preservation issues of being a digital file.

The DCI proposals are complex and comprise 158 pages of text, downloadable in its April 2007 version 1.1 from <http://www.dcimovies.com>. This is not a pipe-dream; this is a detailed and well-considered proposal to provide consistent high quality compressed digital projected images to the cinema, encrypted with secure keys, and a fee control system. Some of the specifications are optional, not mandatory, but it is the principle mandatory specifications that concern film archives.

- 1 Just two alternative resolutions are proposed for a single aspect ratio digital container (frame) of 1.896:1. These are 2048x1080 pixels (2K), and 4096x2160 pixels (4k).
- 2 The fixed aspect ratio of the digital frame has implications that have not yet been addressed . the way in which different aspect ratio images, e.g. Academy, 1.85:1, 2.35:1 scope etc, can be shown within this limitation. Scope images, for example, will have fewer pixels than 1.85. One implication is that Hollywood may be on the way to define aspect ratios for cinema images in the future which could be none of the traditional, or current, aspect ratios. This will create a quandary for film archives and cinémathèques as to how they show old formats and aspect ratio images using digital projection in the future. The modern commercial cinema world is only just itself waking up to this proposal. Once it is clear how the SMPTE view this issue the archives, and the FIAF Technical Commission, may have an opportunity to respond to the proposal.
- 3 Only two frames rates are proposed, 24 frames per second (for use with both 2 and 4k images) and 48 frames per second (for 2k only). The DCI proposal precludes the use of any other frame rate. It quickly became clear that the SMPTE DC28 committee was preparing to

accept this. This means that the digital projection of all other frame rate content (for example silent era films with rates from 16 to 23, recent 18fps, modern 25fps films and special high rate films such as 32fps must be reformatted, in one way or another, to 24 or 48 to be shown in a digital cinema.

This last issue concentrated the minds of the FIAF Technical Commission in March 2007 when we realized that DC28 considered that the DCI frame rates proposal should be retained. We prepared a paper very quickly, to present to SMPTE DC28 to make them aware of the problem. There was very little time to confer with anyone outside the Commission as we felt we needed to get our message across as quickly as possible. It would have been nice to have an agreed FIAF EC approved document but we were acutely aware that this would take so long for every viewpoint to be recognized that we would not have any influence on the specification. In the end the following document went to SMPTE DC28 under the signatures of the four Commission members that wrote the paper, Thomas Christensen, Mikko Kuutti, Nicola Mazzanti and Paul Read. We are grateful for the support and assistance of Paul Collard of Ascent Media, London, who as a member of the frame rates group of DC28 was our conduit to the SMPTE committee.

We are pleased to report that it was well received (despite some of its blunt language) and the SMPTE has made it available on their website. This does not mean that it will have the effect of including heritage frame rates in the final digital cinema projection standard . we wait to hear on that. It may be that film archives, specialist cinemas and cinémathèques will have to set up their own digital projection systems to recreate traditional cinema images, and at least one current European Union research project, EDCine, is considering this.

Fig 1 Front page of the original DCI specification

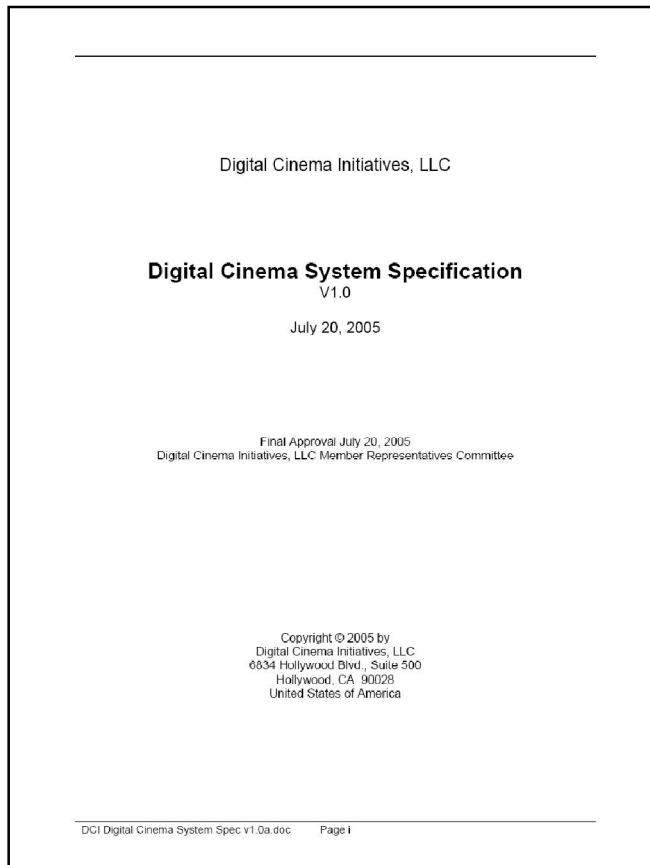
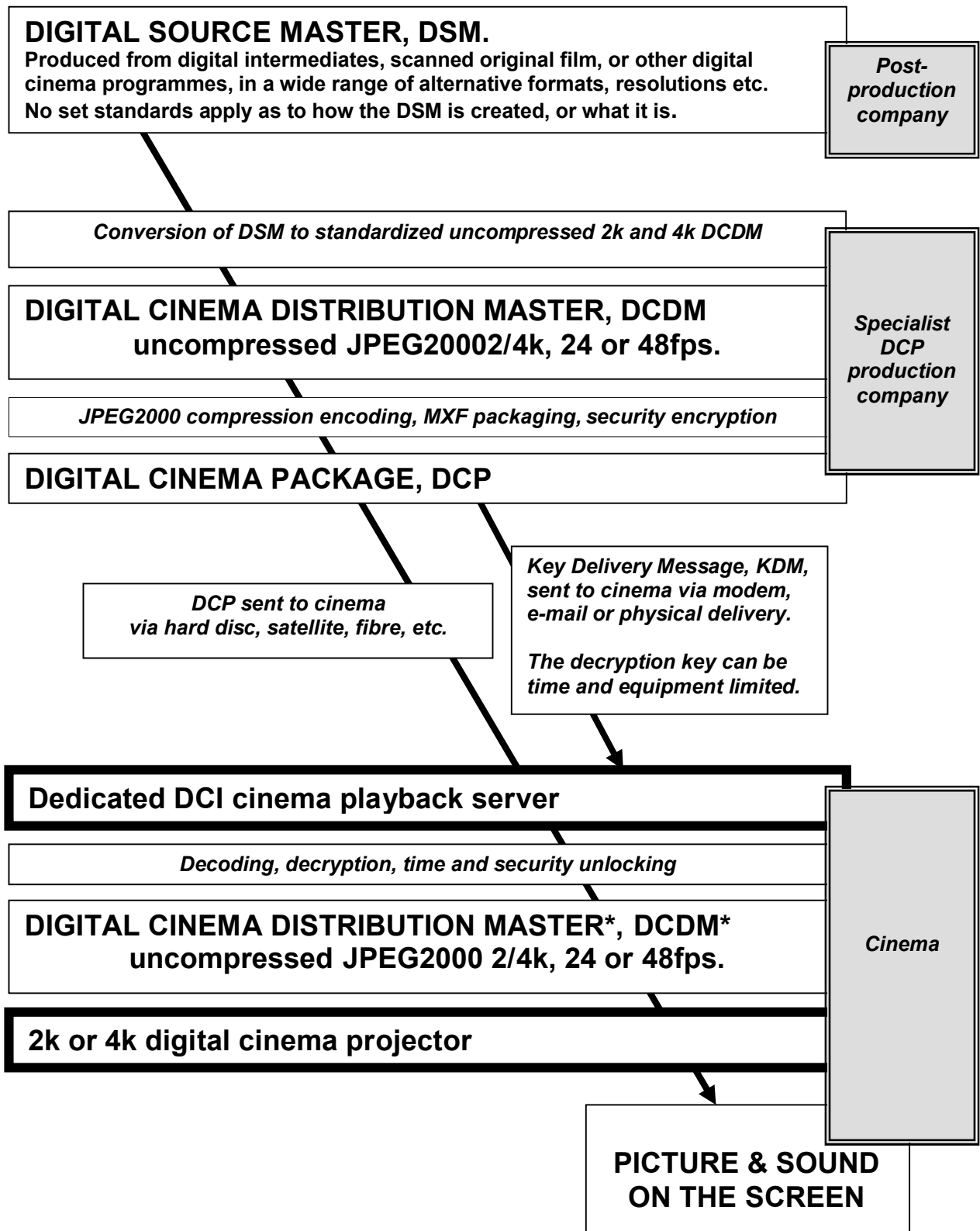


Fig 2 The DCI Digital Cinema System in brief



FRAMES RATES FOR DIGITAL CINEMA PROJECTION OF FILM ORIGINATED MATERIAL

Abstract

The Technical Commission of FIAF, *International Federation of Film Archives*, and technical specialists in ACE, *Association of European Film Archives*, strongly support a greater flexibility in frame rate than just 24 and 48fps for any standard for D-Cinema projection.

Background

Projection frame rates were not standardized until the 24fps 35mm Academy format in the late 1920s and by that time 24fps had become common for sound film. The lowest frame rate we know that was used routinely was 16fps, and silent films were projected at a wide range of rates from 16 to 24 or even more. The most frequent frame rate in the 1920s prior to sound on film is believed to be around 20fps. This fits with the subjective best frame rate for many silent features from that period.

In order to reduce the subjectively unsatisfactory screen flicker at frame rates of about 20fps or less, triple bladed shutters became more or less universal in the 1920s, effectively refreshing the screen image 48 times a second from a 16fps film and 60 times a second at a 20fps. After sound on film was established 16fps continued for silent film, both amateur and professional e.g. scientific filming, for all gauges and 18fps were introduced in the 1960s for Super 8. Specialized and limited distribution short-lived processes for the cinema did select some other rates, and 30, 32, 48 and 60 have been used on a number of occasions. 25fps became a European TV standard and today films that have been produced specifically for TV are still at 25fps and 30fps films made for US TV.

All public and private film archives and collections in Europe, the US and throughout the world hold significant numbers of movies that were shot at frame rates different from 24/48. These represent important actual and potential cultural and commercial values. Frame rates in a typical archive collection range from 16fps, 18, 22 for the bulk of productions of the Twenties, up to 32fps for special processes; in the case of Europe they also include a number of movies shot at 25fps, whenever they were mainly or also designed for TV exploitation.

Film archive holdings and frame rates

All national film archives, most commercial collections and many local film archives hold silent films (i.e. those requiring lower than 24fps projection) from before about 1930. It would take a considerable time to investigate the scale of these holdings as collection databases do not necessarily record the frame rates. It has therefore been necessary to make some interpretation. A few archives have been able to respond with some accuracy and over all it seems that silent films make up between 8 and 10% of the titles, at least in European national holdings. This seems to hold true for the Danish Film Archive, the UCLA Film & TV Archive, the National Film and Television Archive and Imperial War Museum in the UK, and the Cinémathèque Royale in Belgium.

For example, the Danish Film Archive, part of the Danish Film Institute, has 48,000 film titles, 3,845 are listed as mute, 2,700 of which represent the films made by Nordisk between 1906 and 1930.

Cinémathèque Royale, 55,000 film titles, about 4,000 of which are silent titles.

National Film and Television Archive, 150,000 film titles, about 10,000 silent titles

In every case the archives database may not record the frame rate, or the fact of Silent or Mute, and this prevents precise figures. The Danish Film Institute records for example that of its 48,359 titles, 3,845 are recorded as silent, 14,278 have a film gauge recorded and only 9,409 are listed as prints, thus the true figure for silent film is almost certainly much higher. We would expect a similar pattern in other archives. Information from other European archives follows the same general principle and we feel that we can use an 8% of total as a typical lowest proportion in Europe, and allowing for duplication perhaps as low as 5% of the overall film holding is silent.

There is no source of data for the world or even for the US or European total archive holdings for either film or video. In 1995 an EU project Map-TV listed 1,900 European archives almost all of which held both film and video, but no total in terms of footage, time or titles was ever made because many titles, especially cinema films, would be duplicated. Estimates of the number of unique silent feature film titles held in European archives alone vary from a low of 10,000 to a high of 25,000 have been made for this report.

25fps

During the investigation for this statement considerable holdings of 25fps archive film were reported. Most of this was 16mm newsfilm either colour negative mostly from Scandinavia and reversal film from every archive in Europe. A smaller proportion of 25fps 35mm material made as drama content for television also exists and this together with the 16mm reversal newsfilm is considered material of immense national cultural value, that will increasingly be displayed at high quality.

Film Festivals

Many film festivals across the world show silent, pre-1930, films almost always with an original, an extemporary, or a traditional sound track, and always at their proper and original display frame rate. Restorations always avoid frame rate conversions; many are quite obvious visual artefacts when seen on the big screen.

Held annually in Pordenone, Italy, for the last 25 years, **Le Giornate del Cinema Muto** shows only silent film, 408 titles in the 2006 event (see **Appendix 1** for this title list). The number of titles shown (at their correct and carefully estimated original speeds) over the last 25 years exceeds 7,000 at this event alone. When film prints are no longer replaceable these will become D-cinema events, to protect the film prints from deterioration.

Modern Projection of Silent Films at lower than 24fps

Some cinema projectors are capable of selecting 24 or 25fps. Cinematheques, film archives, specialist cinemas and art cinemas have 35mm projectors that have variable frame rates, in most cases continuously variable from less than 16fps to more than 32fps. These projectors have triple bladed shutters (as have all the best cinemas . double bladed shutters even at 24fps show some flicker) and can still be supplied new from almost all high quality projector manufacturers. Almost all 16mm projectors have two speeds 16fps and 24fps although specialist 16mm projectors used by TV companies and film laboratories have 25fps as well.

Chaplin, Keaton, Lloyd, von Stroheim, Murnau, Griffith, King Vidor and the early de Mille and Hitchcock films were all silent, that is without synchronized sound. Archives, cinematheques and specialist cinema intend to continue to show them as they were originally screened, without frame rate conversions. This is easily possible and currently done by digital projection now. A D-cinema standard that does not have that facility could be a backward step.

Digital Cinema for non-24fps film material

One collection planning to scan over 20,000hrs to a digital format soon, estimates that 16% of their content is from the silent era and of a wide range of frame rates, all less than 22fps. Large national collections in the US and Europe have many special formats that have non standard i.e. non 24fps frame rates. Archives, especially regional archives, and TV companies with film collections in Europe may have vast 16mm 25fps news film collections that make up over 80% of their film content.

Three quotes from archivists in the FIAF TC illustrate the depth of their concerns:

Quote: *“Clearly, one option that makes sense is to adopt the option of 'any positive number' as frame rate..... from the standpoint of an SMPTE standard, which is also supposed to be time-proof and this would take into consideration legacy frame rate, **and** future developments. There is no reason why such an option should be disruptive as a "practical" standard for new releases – it's just a matter of deciding that we all go for 24 **for the time being**. A solution with few fixed speeds does not solve the problem – not for future nor the current odd frame rates, nor for legacy.*

Quote: *“We might also add that silent shooting speeds and projection speeds have never been constant. In other words we do not just need various frame rates; we really need them variable along the timeline. A real nuisance (although not impossible to arrange along an MXF timeline, I guess), but at least a need we share with new productions with EFX-oriented variable frame rates.”*

Quote: *“The restoration of one of the earliest sound films in Finland turned out to be at 20.5 fps, and this is quite an accurate spec since it is based on the running speed of a gramophone record synced to the picture. We had to resort to frame interpolation to produce a new 35 mm print @ 24 fps, but it is in these cases digital could have performed more flexibly than film, if the standard will bend enough, that is. A continuously variable rate would be the perfect solution”.*

Archives intend to maintain their film projectors as long as they can but when digital projection in the cinema becomes more or less universal film stocks and film laboratories will no longer exist. Film laboratories capable of making new prints of old formats and archive film are already absent from many countries world wide. In consequence digital techniques are already used for archive film access and restoration and will become universal within a few years. Thus digital cinema projection is already being developed by film archives and national film theatres and cinematheques. None of these use data formats played from servers because silent films can be more easily shown at their original frame rates when run from HD tape. The image quality of silent films shown in ~~standard~~ cinemas on digital projection this way is better than showing a film version with stretch printing to create a 24fps version, and better than digital frame rate conversions especially for awkward rate changes such as 17, 18, 20 and 22 to 24fps.

It is true that archives have not yet addressed the issue of whether the DCI proposal and therefore any SMPTE standard proposal will be suitable for them. However it is clear that just 24 and 48fps will not provide any route they will be able to use unless all their material is converted to one or the other. The Technical Commission of the International Federation of Film Archives do not consider this is a sensible situation, as it may, probably will, lead to lower quality on the screen than using a tape input to the projector!

A better solution would be to permit a range of unitary frame rates, from say 16 to 32fps, plus 48 and 60, as a minimum requirement. Archives cannot understand why the SMPTE seems unwilling to accept this situation . it would make no difference to planned conventional cinema distribution and display, as intended by DCI, but allow for future developments (which are bound to occur) and as the jpeg2000 format is eminently suited to a wide range of alternative frame rates, avoid the need for archives and specialist cinemas to create their own data based system.

Alternative scenarios

FIAF TC expects the archives to generate their own system if one does not become available which is flexible enough to meet the needs for Digital projection of archival movies. The DCI proposal has many merits in terms of the file format and its processing, and greater flexibility would avoid a lot of additional effort, and, many observers believe, a need to change it to suit changing needs, very soon.

Many large archives as well as commercial film and video collections are about to spend their own, lottery and government money on transferring their film and tape to data formats. In the case of film this will be to provide access to the content, in the case of tape to hopefully extend the content life as well as to make the content accessible. Digital projection will be a major method to achieve this access. It seems likely, especially if there is an SMPTE standard proposal that serves the archives needs and the specialist cinema needs (as well as the current cinema industry), that the SMPTE approach will become universal. As it is archives are already planning the use of digital storage and access management systems for huge content stores. jpeg2000 and MXF is already widely accepted as the major and likely choice, but the DCI type approach is currently viewed as a narrow subset, suitable only for current production, in a bigger picture, where output to DVD, internet, broadcast, digital cinema for all originating formats and frame rates, VOD, etc are others.

We are concerned that the SMPTE may be missing an opportunity to create a more universal and flexible process, and if that is the case then it will be inevitable that another parallel system will arise.

Cinemas intending to run both SMPTE proposed DCDM/DCP+ systems and more flexible multi-frame rate systems will find a way for the two servers to co-exist, or for the server to provide alternative routes to the projector. The FIAF TC does not see this as a technical or practical problem, but it will inevitably diminish the value of a standard.

Appendices

In addition to the 2006 Pordenone silent film festival title list in Appendix 1, Appendix 2 has two tables, one showing the range and relationships between historic colour systems, the other historic formats held in film archives with their frame rates.

(EDITORS NOTE: These appendices were not included in the version of this paper published in the Journal of Film Preservation due to their considerable size, but are made available here as sent to SMPTE.)

In conclusion

The Technical Commission of FIAF, *International Federation of Film Archives*, and technical specialist in ACE, *Association of European Film Archives*, strongly support a greater flexibility in frame rate any standard for D-Cinema projection.

They are particularly concerned that by limiting frame rate to 24 and 48 fps only . as currently proposed . D-Cinema standard will fail to respond to all the current and expected needs of content owners. Such a decision might have a negative impact on a range of issues, specifically:

1 Limiting commercial and cultural distribution of archival content.

A D-Cinema standard limited to 24 and 48 fps will force content owners of silent, European TV content and specialist films to operate frame conversions that are costly, time consuming and inevitably present visible digital artefacts. This will inevitably reduce the distribution of assets, indirectly curtailing the benefits of a transition to D-Cinema.

2 Limiting the adoption of a unique D-Cinema standard. If the approved standard will be limited to a frame rate of 24/48 fps, the fact that it cannot cope efficiently with the whole range of technical requirements of content owners might lead to the emergence of other, non-standard solutions (which may never be fully standardised). This scenario is a source of serious concern.

3 **Limiting future applications and developments.** It is also a concern that a D-Cinema specification should be able to meet not only the current requirements of digital projection, but also be open to future applications and developments, and a too narrowly defined mandatory frame rate might lead to future revisions of the standard, with potential problems in backwards compatibility. Two final quotes from colleagues:

Quote: *“We are concerned that SMPTE may not be addressing the entire problem in its avoidance of an obvious issue that will only have to be resolved by either changing the standard eventually, or by one section of the cinema exhibition industry creating a parallel system.”*

Quote: *“It is a pity that SMPTE does not recognize the fact that cinema is more than 75 years old, and that many modern films are being shot on 25 fps these days to ensure a good TV playback.”*

**Technical Commission, International Federation of Film Archives (FIAT TC).
Association of European Cinematheques (ACE)**

Signatories include representative of FIAF, FIAT TC and ACE.

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March 2007

For Appendices see over.

APPENDIX 1

Le Giornate del Cinema Muto 2006

Indice dei titoli / Title list for the October 2006 showings.

- ADELE ROWLAND, %STORIES IN SONG+, 51; 8Z
ADVENTURES OF MAYA, [THE], = BIENE MAJA UND IHRE ABENTEUER, DIE
AESOP, %FILM FABLES (serie/series), 45; 10R, 12R, 13R
AGE OLD STORY, 148; 9R, 12R
AGONIA SUI GHIACCI = WAY DOWN EAST
ALBUM MERVEILLEUX, Lq 100; 7R
%AMERICA, %NATIONAL GAME+(canzone/song), 30
AMICI DELLA %ACCADEMIA DEGLI UFFICIALI, GLI = VENNERNE FRA OFFICERSSKOLEN
AMORE SULLE LABBRA = TRUE HEART SUSIE
ANITROCCOLO EROICO, Lq= UGLY DUCKLING, THE (1931)
ANNABELLE BUTTERFLY DANCE, 120; 11Z
ANNIE OAKLEY, 120; 11Z
ARREST OF A PICKPOCKET, [THE], 116; 11Z
ARTIST, %BREAKTHROUGH, AN = KUNSTNERS GENNEMBRUD, EN
%AT THE TEN-CENT MOVIE SHOW+(canzone/song), 26
ATLANTIS, 55; 8Z
AUSTERNPRINZESSIN, DIE, 24; 14Z
AVALANCHE, THE = LAVINEN
BADEN VERBOTEN (1903) = BAINNADE INTERDITE
BADEN VERBOTEN (1906), 151; 11Z
BAINNADE INTERDITE, 151; 11Z
BARGAIN, THE, 78; 14Z
BARNET SOM VELGØRER, 69; 14Z
BATTLE OF SAN JUAN, 121; 11Z
BATTLE OF SAN JUAN HILL = BATTLE OF SAN JUAN
BATTLE OF THE SOMME, 20; 11Z, 12R
BEDRAGET I DØDEN, 64; 12Z
BELLE ET LA BÊTE, LA, 124; 11Z
BIENE MAJA UND IHRE ABENTEUER, DIE, 131; 12Z
BIG PARADE, THE, 48; 10Z
BIRDS IN THE SPRING, 40; 11Z
BIRDS OF A FEATHER, 38; 9Z
BLADE AF SATANS BOG, 60; 10Z
BORED GAMES, 148; 9R, 12R
BOTTOM OF THE SEA, THE, 132; 10Z
BOXING KANGAROO, 117; 11Z
BOXING MATCH, 118; 11Z
BRANDING BROADWAY, 75; 9Z
BROADWAY LOVE, 128; 8Z
BRONCHO BILLY, %ADVENTURE, 132; 10Z
BUSH CINDERELLA, THE, 133; 11Z
BY THE SEA = VED HAVET
CABBY, %DREAM, THE, 105; 14Z
CABIRIA (1914), 108; 7Z
CABIRIA (1914; 1931) 108; 13Z
CACCIA AL LEONE = LØVEJAGTEN
CALL OF CTHULHU, THE, 148; 9R, 12R
CAMILLE = KAMELIADAMEN
CANDLE AND THE MOTH, THE = EVANGELIEMANDENS LIV
CARMENCITA [NO. 2], 119; 11Z
CHILD AS BENEFACTOR, THE = BARNET SOM VELGØRER
CHRYSANTHÈMES, LES, 101; 7R
%CINEMATOGRAPH, THE+(canzone/song), 27
CIRCULAR PANORAMA OF THE AMERICAN FALLS, 122; 11Z
CIRCULAR PANORAMIC VIEW OF NIAGARA FALLS, 122; 11Z
CIVILIZATION (1916; 1931), 77; 13Z
CLOWN, IL = KLOVNNEN
CLOWN, THE = KLOVNNEN
%COME OUT OF THE KITCHEN MARY ANN+(canzone/song), 27
COMMESSA, LA = EKSPEDITRICEN
CONTRO CORRENTE = HAIL THE WOMAN
CORONATION OF KING CHARLES IV AND QUEEN ZITA, THE = IV. KÁROLY KIRÁLY ÉS ZITA KIRÁLYNÉ ÖFELSÉGEIK MEGKORONÁZÁSA BUDAPESTEN 1916. ÉVI DECEMBER 30-ÁN.
CORSE DI BANJICA, LE = TRKE NA BANJICI
COURSE À LA PERRUQUE, LA, 151; 13Z
COWARD, THE, 74; 8Z
CROSSED SWORDS = VENNERNE FRA OFFICERSSKOLEN
DADDY DON, 147; 9R, 12R
DEAD MAN, %CHILD, A = BEDRAGET I DØDEN
DECEIVED IN DEATH = BEDRAGET I DØDEN
DÉS MAGIQUES, LES, 103; 12Z
DESERTER, THE, 74; 8Z
DICK RICH AND HIS SYNCO-SYMPHONISTS, 51; 8Z
DOMESTIC DIFFICULTIES, 43; 10R, 12R, 13R
DON JUANS OVERMAND, 67; 13Z
DON JUAN, %SUPERIOR = DON JUANS OVERMAND
DOS BUSCADORES DE ORO, LOS = TO GULDGRAVERE, DE
DR. GAR EL HAMA I = BEDRAGET I DØDEN
DR. GAR EL HAMA; OR, THE DAREDEVIL CRIMINAL = BEDRAGET I DØDEN
IL DOTTOR GAR EL HAMA, I = BEDRAGET I DØDEN
DREAM CAFÉ = JIMMY CLEMONS IN %DREAM CAFÉ+
DREAM OR TWO AGO, A, 129; 13Z
DREAM, THE, 77; 13Z
DUE CERCATORI D'ORO = TO GULDGRAVERE, DE
DUEL BETWEEN WOMEN, A = RIVALINDER
EARL BURTNETT AND HIS BILTMORE HOTEL ORCHESTRA (1927), 50; 8Z
EARL BURTNETT AND HIS BILTMORE HOTEL ORCHESTRA (1928), 51; 8Z
EASY STREET, 156; 13R
EKSPEDITRICEN, 70; 14Z
END OF THE WORLD, THE = VERDENS UNDERGANG
ERIK IL GRANDE = LAST PERFORMANCE, THE
EVANGELIEMANDENS LIV, 63; 12Z
EXCELSIOR = HIMMELSKIBET
FAMILY GROUP, 117; 11Z
FARO NELLA TEMPESTA, IL = OUT YONDER
FÉE AUX PIGEONS, LA, 101, 152; 7R, 14Z
FÉE PRINTEMPS, LA, 152; 7Z
FELIX FLIRTS WITH FATE, 44; 10R, 12R, 13R
FELIX THE CAT (serie/series), 44; 10R, 12R, 13R
FELIX THE CAT GETS REVENGE, 44; 10R, 12R, 13R
FELIX THE CAT KEPT ON WALKING, 45; 10R, 12R, 13R
FELIX THE CAT TRIPS THROUGH TOYLAND, 44; 10R, 12R, 13R
FELIX TRIFLES WITH TIME, 45; 10R, 12R, 13R
FEMALE RIVALS = RIVALINDER
FÊTE À JOSÉPHINE, LA, 152; 10Z
FIAMMA, LA = FLAMME, DIE
FIGARO ET L'AUVERGNAT, 124; 11Z
FILM SUR LE MONTAGE, 133; 10R
FINE DEL MONDO, LA = VERDENS UNDERGANG

FIORE DELLA SOLA, IL = LOVE FLOWER, THE
 FISKERLIV I NORDEN = FISKERLIV I NORDEN
 FISKERLIV I NORDEN, 67; 14Z
 FLAMING SWORD, THE = VERDENS UNDERGANG
 FLAMME, DIE, 137; 8R
 FLEURS ANIMÉES, LES, 101, 152; 7R, 9Z
 FLIGHT FROM THE SERAGLIO, THE = FLUGTEN FRA
 SERAILLET
 FLOWERS AND TREES, 39; 9Z
 FLUGTEN FRA SERAILLET, 63; 12Z
 FRIENDS FROM THE OFFICERS' ACADEMY, THE =
 VENNERNE FRA OFFICERSSKOLEN
 FRÜHLINGSFEE, DIE = FÉE PRINTEMPS, LA
 FUGA DALL'HAREM = FLUGTEN FRA SERAILLET
 GEKREUZTE KLINGEN = VENNERNE FRA
 OFFICERSSKOLEN
 GIOVANE RAJAH, IL = YOUNG RAJAH, THE
 GIRL WHO STAYED AT HOME, THE, 81; 8Z
 GLACES MERVEILLEUSES, LES, 106; 14Z
 GOAT, THE, 156; 10R, 12R
 GOING PLACES = SHAW & LEE IN 'GOING PLACES'+
 GOLDEN CLOWN, THE = KLOVNEN
 GOOD NIGHT VALENTINO, 127; 8Z
 GRAND GUIGNOL (serie/series), 140; 13Z
 GRANDE BATTAGLIA ALLA SOMME, LA = BATTLE OF
 THE SOMME
 GRANDE PARATA, LA = BIG PARADE, THE
 GRANDE PROBLEMA, IL = GREATEST QUESTION, THE
 GREAT FEATURE IN THE MAKING, A, 93; 14Z
 GREAT LION HUNT = LØVEJAGTEN
 GREATEST QUESTION, THE, 86; 9Z
 HAIL THE WOMAN, 76; 12Z
 HAM WHAT AM, THE = JAY C. FLIPPEN IN 'THE HAM
 WHAT AM'+
 HAND OF FATE, THE = PRÆSTEN I VEJLBY
 HAUNTED CURIOSITY SHOP, THE, 98; 7R
 HAUNTED HOTEL, THE, 101; 7R
 HILL PARK MYSTERY, THE = NEDBRUDTE NERVER
 HIMMELSKIBET, 61; 11Z
 'HIS CUTE MOVING PICTURE MACHINE'+
 (canzone/song), 27
 HOMER'S ODYSSEY; OR, THE ADVENTURES OF
 ULYSSES = ODISSEA, Lq
 HOMME MYSTÉRIEUX, Lq 104; 13Z
 HORNBACKER-MURPHY FIGHT, 120; 11Z
 HOUDINI STUNTS, 102; 9Z
 HOUDINI, DE BOEIEKONING, 102; 9Z
 HOUDINI, L'ILLUSIONISTA = HOUDINI, DE
 BOEIEKONING
 HOUDINI, THE ESCAPOLOGIST = HOUDINI, DE
 BOEIEKONING
 HOW THE PROFESSOR FOOLED THE BURGLARS, 121;
 11Z
 HÚSAR DE LA MUERTE, EL, 18; 9Z
 HUSSAR OF DEATH, THE = HÚSAR DE LA MUERTE,
 EL
 HVIDE SLAVEHANDEL, DEN, 56; 9Z
 HVIDE SLAVEHANDEL I, DEN = HVIDE
 SLAVEHANDEL, DEN
 HVIDE SLAVEHANDELS SIDSTE OFFER, DEN, 56; 9Z
 HVIDE SLAVINDE, DEN, 55; 9Z
 IDOL DANCER, THE, 91; 12Z
 IDOLO DANZANTE, Lq = IDOL DANCER, THE
 IMBARCATO A FORZA = SHANGHAI'ET!
 IMMAGINI DI GUERRA = KRIGSBILLEDER
 IN RIVA AL MARE = VED HAVET
 IN THE HANDS OF IMPOSTORS = HVIDE
 SLAVEHANDELS SIDSTE OFFER, DEN
 IN THE HANDS OF SHARKERS = SHANGHAI'ET!
 IN THE PRIME OF LIFE = EKSPEDITRICEN
 INCORONAZIONE DEL RE CARLO IV E DELLA
 REGINA ZITA, Lq = IV. KÁROLY KIRÁLY ÉS ZITA
 KIRÁLYNÉ ÖFELSÉGEIK MEGKORONÁZÁSA
 BUDAPESTEN 1916. ÉVI DECEMBER 30-ÁN.
 INGANNATO IN PUNTO DI MORTE = BEDRAGET I
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 INGE LARSEN, 138; 13Z
 INNOCENCE OF LIZETTE, THE, 130; 8Z
 IS SPIRITUALISM A FRAUD? THE MEDIUM EXPOSED =
 MEDIUM EXPOSED? OR A MODERN
 SPIRITUALISTIC SÉANCE, THE
 ISOLA DEL JAZZ, Lq = MUSIC LAND
 ISOLA DEL TERRORE, Lq = TERROR ISLAND
 JACK WHITE AND HIS MONTREALERS, 51; 8Z
 JAGD NACH DER PERÜCKE, DIE = COURSE À LA
 PERRUQUE, LA
 JANS & WHELAN, 'TWO GOOD BOYS GONE
 WRONG', 51; 8Z
 JAPONAISERIE, 100; 7R
 JAY C. FLIPPEN IN 'THE HAM WHAT AM', 51; 8Z
 JEST, THE, 140; 13Z
 JIMMY CLEMONS IN 'DREAM CAFÉ', 50; 8Z
 JOHN REDMOND, THE EVANGELIST =
 EVANGELIEMANDENS LIV
 JOSEPHINES GEBURTSTAG = F TE À JOSÉPHINE, LA
 KAMELIADAMEN, 68; 14Z
 KLOVNEN, 19, 60; 10Z
 KRIGSBILLEDER, 62; 11Z
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 KVINDEDUEL, EN = RIVALINDER
 LADY AND THE BOAT, THE, 118; 11Z
 LADY WITH THE CAMELLIAS, THE = KAMELIADAMEN
 LAGO INCANTATO, IL = WATER SLAVE BABIES
 LANDING AT LOW TIDE, 118; 11Z
 LAST APPEAL, THE, 140; 13Z
 LAST OF THE LINE, THE, 75; 10Z
 LAST PERFORMANCE, THE, 106; 14Z
 LAST VICTIM OF THE WHITE SLAVE TRADE, THE =
 HVIDE SLAVEHANDELS SIDSTE OFFER, DEN
 LAUNCH OF THE HMS ALBION, AT BLACKWELL, THE,
 118; 11Z
 LAVINEN, 59; 9R
 LEAVES FROM SATAN'S BOOK = BLADE AF SATANS
 BOG
 LEBENDE BLUMEN = FLEURS ANIMÉES, LES
 LÈVRES COLLÉES, 152; 12Z
 LIESJES ONSCHULD = INNOCENCE OF LIZETTE, THE
 LIEUTENANT'S LAST FIGHT, THE, 75; 9Z
 LIFE OF THE EVANGELIST = EVANGELIEMANDENS LIV
 LIFE OF THE NORDIC FISHERMAN = FISKERLIV I
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 LIGHTHOUSE KEEPER, THE, 76; 12Z
 LION HUNT, THE = LØVEJAGTEN
 LION HUNTING = LØVEJAGTEN
 LIVELY AFFAIR, A, 141; 11Z
 LOST AND FOUND = LOST AND FOUND ON A
 SOUTH SEA ISLAND
 LOST AND FOUND ON A SOUTH SEA ISLAND
 (frammento/fragment), 142; 11Z
 LOUISE BROOKS: LOOKING FOR LULU, 36; 11R, 11R
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 MAGIC EXTINGUISHER, THE, 98; 7R
 MAGIC SWORD; OR, A MEDIAEVAL MYSTERY, THE, 99; 7R
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 MAHARADJAHENS YNDLINGSHUSTRU
 MARCELINE, THE WORLD-RENOWNED CLOWN OF
 THE N.Y. HIPPODROME, 122; 11Z
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 MASCHERE RUSSE = YOU NEVER KNOW WOMEN
 MASTER MYSTERY, THE (trailer) = HOUDINI, DE
 BOEIENKONING
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 DIE
 MEDIUM EXPOSED? OR A MODERN SPIRITUALISTIC
 SÉANCE,THE, 104; 13Z
 MEISTER DER LIEBE, EIN = DON JUANS OVERMAND
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 MÉTAMORPHOSES DU PAPILLON, 104; 12Z
 MÉTAMORPHOSES DU ROI DE PIQUE, 100; 7R
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 MISS EUROPE = PRIX DE BEAUTÉ
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 MONTMARTRE = FLAMME, DIE
 MORRISSEY AND MILLER NIGHT CLUB REVUE,THE,
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 MOVIE TRIP THROUGH FILMLAND,A, 143; 13Z
 %MOVING PICTURE HERO (OF MY HEART),THE+
 (canzone/song), 28
 MUSIC LAND, 40; 12Z
 MUTT & JEFF (serie/series), 43; 10R, 12R, 13R
 NAVE DEL CIELO, LA = HIMMELSKIBET
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 NEW BAR ROOM [SCENE], 121; 11Z
 ODISSEA, Lq 107; 7Z
 OLD MILL,THE, 40; 14Z
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 OSWALD THE LUCKY RABBIT (serie/series), 46; 10R,
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 OUT OF THE INKWELL (serie/series), 43; 10R, 12R, 13R
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 PARAPLUIE FANTASTIQUE, LE, 99; 7R
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 KEATON, 156; 10R, 12R
 PAUL MERTON\$ SILENT CLOWNS [2]: CHARLES
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 LLOYD, 156; 8R
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 PERFORMING ANIMALS, 117; 11Z
 PICCOLO BENEFATTORE, IL = BARNET SOM
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 POOR JAKE\$ DEMISE, 128; 11Z
 %POOR PAULINE+(canzone/song), 28
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 POSLEDNÍ PREDSTAVENÍ = LAST PERFORMANCE,THE
 PRÆSTEN I VEJLBY, 67; 13Z
 PREFERISCO L\$ASCENSORE = SAFETY LAST!
 PRETE DI VEJLBY, IL = PRÆSTEN I VEJLBY
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 YNDLINGSHUSTRU
 PRINCIPESSA DELLE OSTRICHE, LA =
 AUSTERNPRINZESSIN, DIE
 PRIX DE BEAUTÉ, 34; 12Z
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 REGINA DI MARECHIARO, LA = SOLE
 REVELERS,THE, 50; 8Z
 RIVALI, LE = RIVALINDER
 RIVALINDER, 58; 9R
 RIVALI,THE, 147; 9R, 12R
 ROBBER\$ BRIDE,THE = RØVERENS BRUD
 ROBBER\$ SWEETHEART,THE = RØVERENS BRUD
 ROCKS OF LIFE,THE = LAVINEN
 ROI DES DOLLARS, LE, 101; 7R
 RØVERENS BRUD, 68; 14Z
 RUTH DENNIS, 121; 11Z
 SAFETY LAST!, 17; 8Z
 SANDBAD, DAS, 152; 8Z
 SANDOW [NO. 2], 119; 11Z
 SCALING THE ALPS, 46; 10R, 12R, 13R
 SCARLET DAYS, 88; 10Z
 SCHIAVA BIANCA, LA = HVIDE SLAVINDE, DEN
 SEELE EINES TOTEN, DIE = KUNSTNERS
 GENNEMBRUD, EN
 SHADOW PLAYS = LAVINEN
 SHANGHAIED = SHANGHAI\$T!
 SHANGHAI\$T!, 57; 9Z
 SHATTERED NERVES = NEDBRUDTE NERVER
 SHAW & LEE IN %GOING PLACES+ 51; 8Z
 SHOPGIRL,THE = EKSPEDITRICEN
 SIGNORA DALLE CAMELIE, LA = KAMELIADAMEN
 SHOW,THE, 115; 13Z
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 INCORPORATION, 79; 8Z
 SILLY SYMPHONIES (serie/series), 37; 7Z, 9Z, 11Z, 12Z,
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 SKIPPING DOGS (?) = PERFORMING ANIMALS
 SKY SCRAPPERS, 46; 10R, 12R, 13R
 SKY-SHIP,THE = HIMMELSKIBET
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 SOUL OF THE VIOLIN,THE = KUNSTNERS
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 SOUNDS OF SILENTS, THE = WILLY SOMMERFELD .
 DER STUMMFILMPIANIST
 STOLEN MOMENTS, 125; 8R, 13R
 STORIES IN SONG = ADELE ROWLAND,%STORIES IN
 SONG+
 STORY OF THE KELLY GANG,THE
 (frammenti/fragments), 143; 11Z
 STRAATDANSERESJE, HET = DREAM OR TWO AGO,A
 SUBSTITUTIONS, 98; 7R
 SUPERUOMO DI DON GIOVANNI, IL = DON JUANS
 OVERMAND
 SUPPLIZIO DEL TAM-TAM, IL = LOST AND FOUND
 ON A SOUTH SEA ISLAND
 SUCCESSO DELL\$ARTISTA, IL = KUNSTNERS
 GENNEMBRUD, EN
 TAUBENFEE, DIE = FÉE AUX PIGEONS, LA
 TEMPTATIONS OF THE GOLD FIELDS = TO
 GULDGRAVERE, DE
 TERROR ISLAND, 103; 9Z
 %HAT\$ A REAL MOVING PICTURE FROM LIFE+
 (canzone/song), 29
 TO GULDGRAVERE, DE, 68; 14Z
 TRAPPED, 43; 10R, 12R, 13R
 TRATTA DEGLI UOMINI DI MARE, LA =
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 TRATTA DELLE SCHIAVE BIANCHE, LA = HVIDE
 SLAVEHANDEL, DEN
 TRIP TO MARS,A = HIMMELSKIBET

TRKE NA BANJICI, 145; 14R
 TRUE HEART SUSIE, 16, 83; 7Z
 TWO FORTY-NINERS,THE = TO GULDGRAVERE, DE
 TWO GOLD DIGGERS,THE = TO GULDGRAVERE, DE
 TWO GOOD BOYS GONE WRONG = JANS &
 WHELAN,%WO GOOD BOYS GONE WRONG+
 TYPHOON,THE, 76; 10Z
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 UGLY DUCKLING,THE (1939), 41; 12Z
 ULRICH OF CILLI AND LADISLAUS HUNYADI = ULRIH
 CELJSKI I VLADISLAV HUNJADI
 ULRICO CILLEY E LADISLAO HUNJADI = ULRIH
 CELJSKI I VLADISLAV HUNJADI
 ULRIH CELJSKI I VLADISLAV HUNJADI, 144; 14R
 ULTIMA VITTIMA DELLA TRATTA DELLE SCHIAVE
 BIANCHE, Lq= HVIDE SLAVEHANDELS SIDSTE
 OFFER, DEN
 UNDRRESSING EXTRAORDINARY; OR,THE TROUBLES
 OF A TIRED TRAVELLER, 98; 7R
 UNIDENTIFIED MASSON NO. 8, 100; 7R
 UPSIDE DOWN; OR,THE HUMAN FLIES, 98; 7R
 USSARO DELLA MORTE, Lq= HÚSAR DE LA MUERTE,
 EL
 VALANGA. LA = LAVINEN
 VECCHIO MULINO, IL = OLD MILL,THE
 VED HAVET, 67; 14Z
 VENNERNE FRA OFFICERSSKOLEN, 58; 9R
 VERBUNDENE LIPPEN = LÈVRES COLLÉES
 VERDENS UNDERGANG, 62; 11Z
 VESTALI DELLqMORE, LE = GIRL WHO STAYED AT
 HOME,THE
 VICAR OF VEJLBY,THE = PRÆSTEN I VEJLBY
 VID HAFVET = VED HAVET
 VIOLINEN-KLAGENLIED, EIN = KUNSTNERS
 GENNEMBRUD, EN
 VISIT WITH GRANDMOTHER,A, 147; 9R, 12R
 MEGKORONÁZÁSA BUDAPESTEN 1916. ÉVI
 VITA DELLqOMO DEL VANGELO, LA =
 EVANGELIEMANDENS LIV
 VITA DI UN PESCATORE NORDICO = FISKERLIV I
 NORDEN
 %ITAGRAPH GIRL,THE+(canzone/song), 29
 VITAPHONE VARIETIES (serie/series), 50; 8Z
 VUURTOREN IN DEN STORM, DE = OUT YONDER
 WAR ON THE PLAINS, 78; 14Z
 WAR PICTURES = KRIGSBILLEDER
 WATER BABIES, 40; 11Z
 WAY DOWN EAST, 15, 93; 6 VERDI, 14Z
 WEARY WILLIES, 47; 10R, 12R, 13R
 WHITE SLAVE,THE = HVIDE SLAVEHANDEL, DEN
 WHITE SLAVE,THE = HVIDE SLAVINDE, DEN
 WHITE SLAVE TRADE,THE = HVIDE SLAVEHANDEL,
 DEN
 WILLIAM DESMOND TAYLOR & MARY MILES MINTER,
 153; 10R
 WILLIEqMAGIC WAND, 102; 7R
 WILLIE SOMMERFELD . DER STUMMFILMPIANIST, 154;
 13R
 WOMAN WITH THE HUNGRY EYES,THE, 155; 8R, 13R
 WOMANqDUEL,A = RIVALINDER
 YOU NEVER KNOW WOMEN, 104; 12Z
 YOUqRE DARN TOOTINq 156; 9R
 YOUNG RAJAH,THE, 126; 8R, 13R
 ZAUBERER, DER, 101; 7R
 ZAUBERSPIEGEL = GLACES MERVEILLEUSES, LES
 ZEITUNGSJUNGE UND BETTLER = BARNET SOM
 VELGØRER
 IV. KÁROLY KIRÁLY ÉS ZITA KIRÁLYNÉ OFELSÉGEIK
 MEGKORONÁZÁSA BUDAPESTEN 1916. ÉVI
 DECEMBER 30-ÁN., 145; 14R
 IV. KÁROLY MAGYAR KIRÁLLYÁ KORONÁZÁSA = IV.
 KÁROLY KIRÁLY ÉS ZITA KIRÁLYNÉ ÖFELSÉGEIK

APPENDIX 2

The film formats and colour systems in film archives

Film archives in Europe and the USA have extensive collections that cover a wide range of formats and film systems. It has been estimated that about 7. 10% of these archives can be from the silent era prior to 1930 (it has also been estimated that some 70. 85% of the titles from this period is missing entirely). Archives may have copies or versions of titles that are also found in many other archives, especially feature films that were widely distributed. No estimates exist of the scale of this overlap.

The film types, systems, elements and formats, independent of their content are important as determining the method and the specifications needed to ensure accurate, authentic and complete transfer of the content into digital files. There are a great many variables, and no universally accepted definition of these terms, and although many systems, especially colour systems, and formats were short lived, there are a very large number of variables even amongst commonly and widely used systems and formats. Each of these require a different approach to scanning, digitization and the optimum file for storage or display.

The two following tables, which are not intended to be a exhaustive, demonstrate something of this range.

Table 1 is a **selection** of the colour film systems used in cinemas, for television and for other cinematography, that can be found in European and US film archives. The first section lists both rare and common systems from the period before the Second World War (which changed many things in the film industry). These were many and various and variable in quality. After about 1950 when Eastman Color films stocks came onto the market there was a short period of competition between competing negative-positive systems, and somewhat longer between reversal systems for television news and current affairs. In the 1960s pressure in the US (and to some extent in some European markets e.g. in the UK) created a situation whereby the Eastman Colour processes, ECN and ECP became unofficial %open access standards+and were %shared+with other manufacturers (to avoid the legal issues of monopoly). This has resulted in a long period, almost 50 years, of relative stability in the cinema film technology and the market (and to a lesser extent in the television film market, with the reversal ME processes, now almost extinct).

This stability in one area of the technology has been responsible for a rising competition between formats, especially cinema formats.

Table 2 shows a **selection** of the cinema and cinematographic film formats found in European and US film archives. Formats in **bold** are found in all archives. Notice that in the early years of the cinema there were few standards and the technology drifted somewhat rather than had obvious and clear cut formats. After 1950 new formats became a marketing technique and were more frequent.

APPENDIX 2 Table 1

Colour System Name or Colour Film Stock Name	1st Date	Last Date	Country (orig)	Film/Process or part process	Principle	No of Camera films	Notes and/or Print Material	Guages	Sound track
Early processes to about 1950									
Metallic toning(ferrocyanides, sulphides etc)	1896?			B/W N/P	Ag replacement	1	normalB/W print stock/silver, iron, uranium, copper vanadium salts etc	35	none
Handcolouring	1896?			B/W N/P	Dyed Gelatin	1	normalB/W print stock/acid dye tinted	35	none
Dye Toning?mordant dye toning	1900?			B/W N/P	Ag replacement	1	normalB/W print stock/silver ferrocyanide mordant + basic dye	35	none
Tinting	1900?			B/W N/P	Dyed Gelatin	1	normalB/W print stock/acid dye tinted (hundreds of recipes)	35	none
Isenee?	1897		Germany	Pan B/W N/P	add 3 col	3?	contact on B/W?	NoData	none
Friese-Greene?	1898		UK	Pan B/W N/P	add 2 & 3 col	2 & 3	contact on B/W?	No Data	none
Jumeaux/Davidson	1904	1906	France	Pan B/W N/P	add 3 col	3?	contact on B/W?	NoData	none
Pathecolor / Pathechrome	1905	1928	France	any B/W film	stencil	1	contact on B/W	35	none
Three strip negative [generic term]	1905?			B/W N/P	BW Separations	3	additive analysis camera system only	35	none
Kinemacolor	1906	1912?	UK	Pan B/W N/P	add 2 col	1	contact on B/W	35?	none
Procede Colombier	1908		France	?	?	1?	?		none
Bassani	1910?	?	France	Pan B/W N/P	add 3 col	1	contact on B/W	35	none
Tinted Positive Film	1910?	1929	WW	B/W N/P	Col bases	1	normalB/W print stock/dyed in the mass nitrate base	35	none
Varnished/"lacquered" emulsion	1910?	1925?	France?	B/W N/P	painted emulsion	1	normalB/W print stock/brushed on varnish with acid dyes	35	none
Traube Process	1910?						incomplete data		
Urban-Joy Process	1910?		USA?	Pan B/W N/P	add 3 col	1	contact on B/W	NoData	
Colograph/Cinecolorgraph	1912		USA	B/W N/P	sub 2 col	2	onto double coated film	35	
Gaumont Chronochrome/Gaumont	1919		France	Pan B/W N/P	add 3 col	1	contact on B/W?	35	none
Panchromotion	1913		USA	B/W N/P	Add 4 col"	1	contact print B/W	35	
Brewster	1915	1929	USA	B/W N/P	sub 2 col	2	onto double coated stock, R on one side, G on other,	35	
Fox Natural Color = Kinemacolor in USA	1915		USA	Pan B/W N/P	add 2 col	1	contact on B/W	35?	
Fox Nature Color =Kodachrome 1916	1916	1934?	USA	B/W N/P+Diapositive	Sub 2 col	1	Processed to neg/unhardened gel dyed R/O one side, C on other	no data on neg	
Handschiegl/De Mille-Wyckoff/Wyckoff Process	1916		USA	B/W N/P	Dye transfer	1	normalB/W print stock	35	
Douglass Color	1918		USA	B/W N/P	Add 2 col	2	alternate printing onto one strip	35	

APPENDIX 2 Table 1 continued

Colour System Name or Colour Film Stock Name	1st Date	Last Date	Country (orig)	Film/Process or part process	Principle	No of Camera films	Notes and/or Print Material	Guages	Sound track
Kesdacolor	1918		USA	B/W N/P	Add 2col	1	onto double coated film/lines on inside picture on other	35	
Nature Color	1918?	1950?	USA	B/W N/P Bipack	Sub 2 col	2	Onto any double coated film/or other display method	35	
Polychromide	1918?	1925?	UK	B/W N/P	Sub 2 col	2	optical printer onto double sides film	35	silver
Douglass Color	1919		USA	B/W N/P	Add 2 col	2	onto normal B/W/print stock/one sep neg thru base/other thru top	35	
Prizma	1919		USA	B/W N/P	Sub 2 col	1	alternate frames on each side by "skipping" contact printer	35	
Kinekrom	1920?			Pan B/W N/P	add 3 col	1	contact on B/W	NoData	
Prizma	1920?		USA	B/W N/P	Sub 2 col	2	alternate frames on each side by "skipping" contact printer	35	Iron-tone blue
Kelleycolor	1923?	1930?	USA	B/W N/P	Sub 2 col	2	alternate frames on each side by "skipping" contact printer	35	Iron-tone blue
Warner-Powrie	1924		USA	Colour N/P	Add 3 col	1	onto 35mm[Opt] similr screen material to produce pos	C47/P35	
Biolour / Friese-Greene	1925		UK	Pan B/W N/P	add 2 col	1	contact on B/W	35	
Magnachrome	1925?		USA	B/W N/P	add 2 col	1	bipack frames printed on one strip alternately	35	
Polychromide	1925?	1933	UK	B/W N/P	Sub 2 col	2	optical printer onto double sides film	35	
Color Film	1927		USA	B/W N/P Bipack	Sub 2 col	2	Onto Eastman 5509 optical red to 2 track 16mm	35	Iron-tone blue
Harriscolor[early]	1928		USA	B/W N/P	Sub 2 col	2	Onto normal B/W Print film	35	Iron-tone blue
Kodacolor/Keller-Dorian Color	1928		USA	Pan B/W Reversal	add 3 col	1	none		
Multicolor	1928	1932	USA	B/W N/P Bipack	Sub 2 col	2	Onto Eastman 5509by contact tripack	35	Iron-tone blue
Raycol[early]	1928		UK	Pan B/W N/P	add 2 col	1	contact on B/W	35	
Splendicolor	1928		USA?	B/W N/P	Sub 3 col	?	possibly onto film recoated after initial exposure	35	
Colorcraft	1929		USA	2 separate films?	Sub 2 col	2?	no data	35	
Raycol	1929		UK	Pan B/W N/P	add 2 col	1	contact on B/W	35	

APPENDIX 2 Table 1 continued

Colour System Name or Colour Film Stock Name	1st Date	Last Date	Country (orig)	Film/Process or part process	Principle	No of Camera films	Notes and/or Print Material	Guages	Sound track
Sirius	1929		Holland	B/W N/P	Sub 2 col	2	step opt onto double sided film	35	
Sonochrome	1929		USA	B/W N/P	Col bases	1	Choice of 17 coloured bases	35	silver
Brewster	1930	1935?	USA	B/W N/P	Sub 3 col	3	onto double coated stock, R on one side, G on other,	35	
Busch Process	1930?		Germany	Pan B/W N/P	add 2 col	1	contact on B/W	35	
Chemicolor	1930?		UK	B/W N/P Bipack	Sub 2 col	2	Onto Agfa double coated film	35	
Coloratura	1930?	1931?	USA	B/W N/P Bipack	Sub 2 col	2	Onto Eastman 5509 optical red to 2 track 16mm	35	
Harricolor	1930		USA	B/W N/P	Sub 2 col	2	Onto normal B/W Print film	35	
Kislyn Color	1930?	1931	USA	Pan B/W Reversal	add 3 col	1	none		
Photocolor	1930		USA	B/W N/P	Sub 2 col	2	optical printer onto double sides film	35	
Sennett Color	1930	?	USA	B/W N/P Bipack	Sub 2 col	2	Onto Eastman 5509by contact tripack	35	
Uficolor	1930?		Germany	B/W N/P Bipack	Sub 2 col	2	Onto Agfa double coated film	35	
Vitacolor	1930	1949?	USA	B/W N/P	sub 2 col	2	onto single coat film/Rneg one side/Gpos on emul side	35	
Chimicolor	1931?	1947	France	Col N/P	Sub 3 col	3 or 1	onto double coated stock, R on one side, G on other,	35	cyan dye
Gilmore Color	1931?		USA	Pan B/W N/P	add 2 col	1	contact on B/W	35	
Magnacolor	1931	1950?	USA	B/W N/P Bipack	Sub 2 col	2	Onto Eastman 5509by contact tripack	35	
Rotocolor	1931		USA	B/W N/P	add 3 col?	no data	no data	35	
Dufaycolor (& Dufaycolor Print Film)	1932?	1950?	UK	Colour N/P	add 3 col	1	onto Dufaycolor Print Film with sim reseau	35	
Hillman Camera	1933	1934	UK	Pan B/W N/P	add 2 col	1	contact on B/W	35	
Morgana Process	1933		USA	Pan B/W N/P	add 2 col	1	contact on B/W	16	
Opticolor	1933		USA	B/W N/P	add 3 col	1	contact print - normal b/w film	35	
Spectracolor	1933?		UK?	B/W N/P Bipack	Sub 2 col	2	Onto Agfa double coated film	35	
Thompson Color	1933?		France	B/W N/P	Sub 3 col	1	Double coat film/B sep one side/R sep other/G sep on new layer.	35	
Agfacolor	1933		Germany	Pan B/W Reversal	add 3 col	1	incomplete data		
Animation Negative/Sequential Frame Animation	1934?	1975?	WW	B/W N/P	sub 3 col	1	Any available at the time eg Dye toning/Technicolor/Gaspar etc	35	
Cinamacolor	1934		USA	B/W N/P	add 2 color	1	contact print - normal b/w film	35	

APPENDIX 2 Table 1 continued

Colour System Name or Colour Film Stock Name	1st Date	Last Date	Country (orig)	Film/Process or part process	Principle	No of Camera films	Notes and/or Print Material	Guages	Sound track
Gasparcolor [or Gaspar Color]	1934	?	Belgium/UK	Col silver dye bleach	Sub 3 col		Print film two layers one side[topM,then Y],one the other[C]	35 & ?	silver
Rouxcolor	1934	1948	France	Pan B/W N/P	add 2 col	1	Opt on B/W?	35	
Rouxcolor	1934	1948	France	Pan B/W N/P	add 3 col	1	Opt on B/W?	35	
Sequential Sequence Negative =Sequential Frame	1934?	1975?	WW	B/W N/P	sub 3 col	1	Any available at the time eg Dye toning/Technicolor/Gaspar etc	35	
Cineoptichrome	1935?						no data		
Cosmocolour	1935		USA	B/W N/P	add 2 color	1	contact print - normal b/w film	35	
Dascolour	1935		Belgium	B/W N/P Bipack	Sub 2 col	2	Onto normalB/W Print film	35	
Francita-Realita/Francita/Opticolour/Realita	1935	1939	France	Pan B/W N/P	add 3 col	1	contact on B/W	35	
Harmonicolor	1935?		France	B/W N/P Bipack	Sub 2 col	2	Onto Agfa double coated film	35	
Herault Trichrome	1935?	?	France	Pan B/W N/P	add 3 col	1?	contact on B/W	35	
Dunning Color	1936	1937	USA	B/W N/P	Sub 2 col	2	onto Eastman 2-layer film,exposed fromeither side	35	
Telco color	1936		USA	B/W N/P	add 3 col	1	probably contact print	35	
Telco color	1936		USA	B/W N/P	add 2 col	1	probably contact print	35	
Dunning Color	1937	?	USA	B/W N/P	Sub 3 col	3	double coated film - no other data	35	
Telco color	1938	1941	USA	B/W N/P	sub 2 col	1	on double coated film /	35	
Dufaycolor	1938?	1950?	UK	colour Reversal	add 3 col	1	confused terminology - also used for N/P Dufay	16 & 35?	
Cosmocolour	1939		USA	B/W N/P	sub 2 col	1	opt print on 2standard format 35mm strips as sep negs or pos	35	
Agfacolor	1939		Germany	Col N/P	Sub 3 col	1	onto integral tripack/same layer order as camera stock	35	dye/silver later
Thomascolor	1940?	1945	USA	Pan B/W N/P	add 3 col	1	contact on B/W	35	
Gaspar Color	1941	1944?	Belgium/UK	Col silver dye bleach	Sub 2 col		Print film [topC/B],bottom [R/O]	35 & 16	silver
Fullcolor	1942	1948	USA	B/W N/P Bipack	Sub 2 col	2	Onto Eastman 5509by contact tripack	35 or 16	Iron-tone blue
Cosmocolour	1943		USA	B/W N/P	sub 3 color	1	no data	35	
Fullcolor	1943	1948	USA	B/W N/P Bipack	Sub 3 col	3	onto Eastman 5509 - 3 sep exposures!	35	
British Tricolour	1945?	1948	UK	Col N/P	Sub 3 col	3 or1	see Dufaychrome	35	
Bertrand	1946?		France	Colour Reversal	Sub 3 col		this material is a print stock only	35	no data
Americolor	1947		USA	B/W N/P	sub 2 col	2	Onto Eastman 5509by contact tripack	35	

APPENDIX 2 Table 1 continued

Colour System Name or Colour Film Stock Name	1st Date	Last Date	Country (orig)	Film/Process or part process	Principle	No of Camera films	Notes and/or Print Material	Guages	Sound track
Cinefotocolor	1947	1954	Spain	B/W N/P	sub 2 col	2	onto single coat film/Rneg one side/Gpos on emul side	35	no data
Polacolor	1947	1949	USA	Rehalogenation	sub 3 col		B/W print stock, often? Eastman Fine Grain Release Film 5302	35	no data
Mondiacolor	1948		France	no data	add "4" col	1	no data		
Pinchart	1948		France	Pan B/W N/P	add 3 col	1	contact on B/W	35	
Dufaychrome	1948	?	UK	Col N/P	Sub 3 col	3 or 1	B sep printed onto pos film, recoated & G printed, recoated and R printed	35	silver
Chromart Simplex	1949		UK	B/W N/P	Sub 2 col	1	onto 3 layer /topRedsens-Ycoupler/midRedsensMcoupler/botGsensCcoupler	35	
Dugromacolor	1949		France	B/W N/P	Sub 3 col	1	no data - presumably to any 3 color printing system	35	
Alfacolour	1950?		UK	B/W N/P	Sub 2 col	2	onto two sides of Gevaert double coated film	35	Ag + dye?
Chromart Tricolor	1950		UK	B/W N/P	Sub 3 col	1	Tripack/topR sens-Mcoupler/midOrtho sens-C coupler/coll Ag/bot Bsens-Y coupler	35	
Tellko /Telcolor/Telchrome/	1950/60's		Switz	Col Reversal	Sub 3 col	1	onto integral tripack/same layer order as camera stock	Prob 8 & 16mm?	none?
Valca /no name data/doubtful if ever cine	1950/60's		Spain	Col Reversal	Sub 3 col	1	onto integral tripack/same layer order as camera stock	Prob 8 & 16mm?	none?
Colorvision	1952	1966	USA	B/W N/P	add 3 col	1	onto B/W for add proj/OR onto EastmanColor Int 5253to produce col neg	35	
Oriental	1953		Japan	Col Reversal	Sub 3 col	1	onto integral tripack/same layer order as camera stock	Prob 8 & 16mm?	none?
GAF (doubtful if ever cine)	1950/60's		USA	Col Reversal	Sub 3 col	1	onto integral tripack/same layer order as camera stock	Prob 8 & 16mm?	none?
Panacolor	1962	?	USA	color print/rehalogenation	sub 3 col		B/W print stock, poss? Eastman Fine Grain Release Film 5302	35	Ag

APPENDIX 2 Table 1 continued

Colour System Name or Colour Film Stock Name	1st Date	Last Date	Country (orig)	Film/Process or part process	Principle	No of Camera films	Notes and/or Print Material	Guages	Sound track
2 & 3-strip camera systems using									
Agfa bipack films (2)	1929?		Germany	BW Neg	Sub 2 col	2	camera films only		
Agfa double coated print film	1929?		Germany	Colour Print	Sub 2 col	1	printing system only, camera used bipack film		
Eastman Bi-Pack Negative	1929?	1949?	USA	BW Neg	Sub 2 col	2	2 negative stocks for camera use		
Eastman Duplitized Positive	1929?	1949?	USA	Colour Print	Sub 2 col	1	print stock for many 2colour film print systems including Trucolor and Cinecolor		
DuPont Dupliccoat Film	1930's		USA	Colour Print	Sub 2 col	1	print stock for many 2colour film print systems including Trucolor and Cinecolor		
Trucolor	1951	1952?	USA	BW Negs /Col Pos	Sub 2 col	2	successive printing onto 2 layer film/Du Pont type 275	35	silver
Trucolor	1952?	1958	USA	BW Negs /Col Pos	Sub 3 col	3	successive printing onto 3 layer film/Du Pont type 275	35	silver
Cinecolor[early]	1930	1834	UK	BW Negs /Col Print	add 2 col	2	contact on B/W	35	
Cinecolor	1932	1950	USA	BW Negs /Col Print	Sub 2 col	2	Onto Eastman 5509 by contact tripack	35	Iron-tone blue
Cinecolor[late]	1934	1949?	UK	BW Negs /Col Print	add 2 col	2	contact on B/W	35	
Cinecolor [16mm]	1939	1950	USA	BW Negs /Col Print	Sub 2 col	2	Onto Eastman 5509 optical red to 2 track 16mm	35Cam-16 Print	Iron-tone blue
Cinecolor Print	1939	1950	USA	BW Negs /Col Print	Sub 2 col	2	Onto Eastman 5509 optical red to 2 track 16mm	16	silver
Cinecolour [see Cinecolor -UK name	1946?	1950?	UK	BW Negs /Col Print	add 2 col	2			
Supercinecolor	1951	1951	USA	BW Negs /Col Print	Sub 3 col	1	via sep pos[Eastman 5203]to sep negs[Eastman 5365] to Eastman Dupl 5509, C toned,M & Y mordant toned, Y from sep B exp	35	

APPENDIX 2 Table 1 continued

Colour System Name or Colour Film Stock Name	1st Date	Last Date	Country (orig)	Film/Process or part process	Principle	No of Camera films	Notes and/or Print Material	Guages	Sound track
Technicolor & similar 2/3 colour matrix image systems									
Technicolor	1916	1919	USA	BW Negs /Col Print	add 2 col	2	onto separate B/W films		
Technicolor	1922	1928	USA	BW Negs /Col Print	Sub 2 col	2	2 dyed washoff films cemented together	35	
Technicolor	1928	1932	USA	BW Negs /Col Print	Sub 2 col	2	onto wash-off relief film to make 2printing matrices	35	silver
Technicolor, many variants	1932	1950	USA	BW Negs /Col Print	Sub 3 col	3	onto wash-off relief film to make 3 printing matrices	35	silver
Technicolor Monopack	1940?	no data	USA	Kodachrome camera	Sub 3 col	1	onto Technicolor imbition matrix film		
Technichrome	1946?	1949	USA	B/W N/P Bipack	Sub 2 col	2	onto Technicolor imbition matrix film	35	silver
Technicolor	1937	1970?	USA	Colour Neg /Col Print	sub 3 col	1	onto wash-off relief film to make 3 printing matrices	35	
Trucolor	1946	1951	USA	BW Negs /Col Print	Sub 2 col	2	onto Eastman 2-layer film,exposed fromeither side	35	AgS + C dye
Kodak stripping and relief image matrix & pan-matrix films	1948	?		BW Negs /Col Print	sub 3 col	1			
DuPont Stripping Negative/DuPont S T Tripac	1949		USA	BW Negs /Col Print	sub 3 col	1	sep negs printed onto dye transfer matrices	35	
Konicolor (using reversal original shooting)	1953	1956	Japan	BW Negs /Col Print	Sub 3 col	1	onto wash-off relief film to make 3 printing matrices(assumed)	35	
Konicolor (using three strip shooting)	1944	1959	Japan	BW Negs /Col Print	Sub 3 col	3	onto wash-off relief film to make 3 printing matrices(assumed)	35	
Sakura Cine Film 3 Color Separation films for matrix printing	1960	?	Japan	BW Negs /Col Print	Sub 3 col	3		35	

APPENDIX 2 Table 1 continued

Colour System Name or Colour Film Stock Name	1st Date	Last Date	Country (orig)	Film/Process or part process	Principle	No of Camera films	Notes and/or Print Material	Guages	Sound track
NON-SUBSTANTIVE REVERSAL									
tripack processes 1935-2000									
Kodachrome or Kodachrome Duplicating Film, 5262 (16mm)	1938	1940	USA	Col Reversal	Sub 3 col	1	colour development of C M Y dyes from colour couplers	35	D
Kodachrome Duplicating Film 5265	1940	1955	USA	Col Reversal	Sub 3 col	1	duplicating material specific to Kodachrome	35	
Kodachrome, Daylight Type (no??) (16mm)	1940	1950	USA	Col Reversal	Sub 3 col	1	colour development of C M Y dyes from colour couplers	35	
Kodachrome, Type A or Kodachrome Duplicating Film, 5265 (16mm)	1940	1950	USA	Col Reversal	Sub 3 col	1	colour development of C M Y dyes from colour couplers	16	
Sakura Color Film (non-substantive)	1941	1961	Japan	Col Reversal	Sub 3 col	1	colour development of C M Y dyes from colour couplers	35,16 & 8	no data
Kodachrome Commercial Safety Color Film 5268	1946	1958	USA	Col Reversal	sub 3 Col	1	residual Ag mask	16	
Kodachrome Duplicating Films - others from 1950 - no data	1950		USA	Col Reversal	Sub 3 col	1	colour development of C M Y dyes from colour couplers	16	
Kodachrome, camera stocks, A & D ? - little data	1950	1961	USA	Col Reversal	Sub 3 col	1	colour development of C M Y dyes from colour couplers	16, & 35 SO	
Dynachrome	1955	1970	USA	Col Reversal	Sub 3 col	1	colour development of C M Y dyes from colour couplers	8,16 ?	
Kodachrome II & later - camera films - no data	1961		USA	Col Reversal	Sub 3 col	1	colour development of C M Y dyes from colour couplers	16, & 35 SO	
CineChrome =Kodachrome relabel	1990's?	1990's?	USA	Col Reversal	Sub 3 col	1	colour development of C M Y dyes from colour couplers	S8	

APPENDIX 2 Table 1 continued

Colour System Name or Colour Film Stock Name	1st Date	Last Date	Country (orig)	Film/Process or part process	Principle	No of Camera films	Notes and/or Print Material	Guages	Sound track
1940's onwards competing Integral subtractive NEGATIVE tripack systems									
Gevacolor Negative Type 6.51/T-48, 6.52 & 6.53	1947-8	1954	Belgium	Col Neg	sub 3 col	1	unmasked camera stock only	35	
Gevacolor Print Type 9.51	1947	1954	Belgium	Col Print	sub 3 col	1	Incorporated coupler integral tripack/top B/Coll Ag/G/R[Y M C]	35	
Gevacolor Negative Type 6.54, 6.55 & 6.80	1959?	?	Belgium	Col Neg	sub 3 col	1	masked camera stock only	35	
Gevacolor Print Type 9.52,	1954	1958	Belgium	Col Print	sub 3 col	1	Incorporated coupler integral tripack/top B/Coll Ag/G/R[Y M C]	35	
Gevacolor Print Type 9.53	1958	1967	Belgium	Col Print	sub 3 col	1	Incorporated coloured coupler integral tripack/top=G/R,B[m,c,y]	35	
DuPont Color Film Type 275	1949		USA	Col Print	sub 3 col	3	integral tripack/top Bsens,Mcoupler/Rsens,Ccoupler/Gsens,Ycoupler	35	
Agfacolor various negative films	1958?	1968	Germany	Col Neg	Sub 3 col	1	onto integral tripack/same layer order as camera stock	35	dye+silver
Agfacolor Print film, various	1950?	1968	Germany	Col Print	Sub 3 col	1	onto integral tripack/same layer order as camera stock	36	dye+silver
Eastman Color "system"	1950	pres day	USA	Col Neg/Col Print	sub 3 col	1	Incorporated coupler integral tripack/top G/R/B[M C Y]	35 & 16	Ag + dye ?
Eastman Color Negative Films	1950	pres	USA	Col Neg/Col Print	sub 3 col	1	camera stock only	35 & 16	Ag + dye ?
Eastman Color Print Films	1950	pres	USA	Col Neg/Col Print	sub 3 col	1	Incorporated coupler integral tripack/top G/R/B[M C Y]	35 & 16	Ag + dye ?
Eastman Color Internegative Film	1951		USA	Col Neg/Col Print	sub 3 col	1	Incorporated coupler integral tripack/top G/R/B[M C Y]	35 & 16	Ag + dye ?
Eastman Color Internegative Films/5243 &5245	1951	pres	USA	Col Neg/Col Print	Sub 3 col	1	onto itself [for a dup neg] /onto Eastman Color Print Film[for a print	35	none
Eastman Color Intermediate Film 5253,7252	1956	1988	USA	Col Neg/Col Print	Sub 3 col	1	onto itself [for a dup neg] /onto Eastman Color Print Film[for a print	35	none
Eastman Color Internegative Films, 5270,7270,5271,7271	1956	pres	USA	Col Neg/Col Print	Sub 3 col	1	onto Eastman Color Print Film	16 & 35	none
Eastman Color Reversal Intermediate Film, 5249,7249	1968	pres	USA	Col Reversal	Sub 3 col	1	onto Eastman Color Print Film	16 & 35	none

APPENDIX 2 Table 1 continued

Colour System Name or Colour Film Stock Name	1st Date	Last Date	Country (orig)	Film/Process or part process	Principle	No of Camera films	Notes and/or Print Material	Guages	Sound track
Ferrania-color Negative Film	1952	?1960+	Italy	Col Neg	sub 3 col	1	camera stock only	35	
Ferrania-color Print Film	1952	?1960+	Italy	Col Print	sub 3 col	1	Incorporated coupler integral tripack/top B/Coil Ag/G/R[Y M C]	35	
AnSCO Color Negative/Positive Process	1953		USA	Col Neg	sub 3 col	1	Incorporated coupler integral tripack/top B/Coil Ag/G/R[Y M C]	35	Ag + dye ?
AnSCO Color Duplicating Negative Film, Type 846	1953		USA	Col Neg	sub 3 col	1	onto AnSCO Color Positive	35	
Fujicolor Positive Films, 8811 to 8818	1955	1968?	Japan	Col Print	sub 3 col	1	Incorporated coloured coupler integral tripack/top=G/R,B[m,c,y]	35 & 16	Ag + dye ?
Fujicolor Negative Film 8511 to 8514	1955	1968?	Japan	Col Neg	sub 3 col	1	camera stock only	35	
Sakura Cine Film Positive 0650(8mm)	1960	?	Japan	Col Print	Sub 3 col	1	Incorporated coupler integral tripack/top G/R/B[M C Y]	8	
Sakura Cine Film Positive films 4125(35mm), 4325(16mm)	1959	1970	Japan	Col Print	Sub 3 col	1	Incorporated coupler integral tripack/top G/R/B[M C Y]	35 & 16	
Sakura Cine Film Positive 5626(35mm), 6626(16mm), 8626(8mm)	1970	1971	Japan	Col Print	Sub 3 col	1	Incorporated coupler integral tripack/top G/R/B[M C Y]	35,16 & 8	
Sakura Cine Film Positive 5625	1975	?	Japan	Col Print	Sub 3 col	1	Incorporated coupler integral tripack/top G/R/B[M C Y]	35	
ORWO Color camera negative films - various	1958	2002	E Germany	Col Neg	Sub 3 col	1	Integral subtractive 3 colour using non ECN chemistry	35	
ORWO Color intermediate films	1958	2002	E Germany	Col Neg	Sub 3 col	1	Integral subtractive 3 colour using non ECN chemistry	35	
ORWO Color print films - various	1958	2002	E Germany	Col Print	Sub 3 col	1	Integral subtractive 3 colour using non ECP chemistry	35	
Sovcolor camera negative films - various	1945	1990?	USSR	Col Neg	Sub 3 col	1	almost identical or always identical to ORWO, name fades by 1990	35	
Sovcolor intermediate films	1945	1990?	USSR	Col Neg	Sub 3 col	1	almost identical or always identical to ORWO, name fades by 1990	35	
Sovcolor print films - various	1945	1990?	USSR	Col Print	Sub 3 col	1	almost identical or always identical to ORWO, name fades by 1990	35	

APPENDIX 2 Table 1 continued

Colour System Name or Colour Film Stock Name	1st Date	Last Date	Country (orig)	Film/Process or part process	Principle	No of Camera films	Notes and/or Print Material	Guages	Sound track
Dynacolor	1949	1955	USA	Col Reversal	Sub 3 col	1		8,16 ?	
Perutz Color	1950's?		W Germany	Col Reversal	Sub 3 col	1	onto similar material	8,16 ?	
ICI/no name data/doubtful if ever cine	1950/60's		UK	Col Reversal	Sub 3 col	1	onto integral tripack/same layer order as camera stock	8 & 16mm?	
Gevaert "private"label films	1950's?		Belgium	Col Reversal	Sub 3 col	1	onto similar material	8,16 ?	
Gevachrome various balances and speeds,	1974	1974	Belgium	Col Reversal	sub 3 Col	1	camera stock printed on Gevachrome Print Film	16	
Gevachrome Print Films T9.00, 9.01, 9.02, 9.03	1974	1974	Belgium	Col Reversal	sub 3 Col		reversal print stock	16	
3M "private label" film	1970	?	USA	Col Reversal	Sub 3 col	1		8,16 ?	
Ferrania /no name data	1950/60's		Italy	Col Reversal	Sub 3 col	1	onto integral tripack/same layer order as camera stock	8 & 16mm?	
Sakura Cine Color Film Reversal 8	1961	1969?	Japan	Col Reversal	Sub 3 col	1	not known	16, 8 & S8	
Sakura Cine Color Film Reversal TV 6291,6292,2R6291	1967	1974	Japan	Col Reversal	Sub 3 col	1	not known	16	
Sakura Color Type A	1969	1976?	Japan	Col Reversal	Sub 3 col	1	not known	S8	
Sakurachrome Type A various speeds	1976	1985	Japan	Col Reversal	Sub 3 col	1	not known	S8	
Eastmancolor and compatable processes									
Eastman Color Negative Films	1951	pres	USA	Col Neg	sub 3 col	1	camera stock only	35 & 16	
Eastman Color Print Films	1951	pres	USA	Col Print	sub 3 col	1	Incorporated coupler integral tripack/top G/R/B[M C Y]	35 & 16	
Eastman Color Intermediate Film 5253,7252 etc	1956	1988	USA	Col Neg	Sub 3 col		onto itself [for a dup neg] /onto Eastman Color Print Film[for a print	35	
Eastman Color Interneegative Films, 5270,7270,5271,7271	1956	pres	USA	Col Neg	Sub 3 col		for printing from colour reversal to Eastman Color Print Film	16 & 35	
Eastman Color Reversal Intermediate Film, 5249,7249	1968	1993	USA	Col Reversal	Sub 3 col		onto Eastman Color Print Film	16 & 35	
Gevacolor Print Types 9.54, 9.85, 982, 986 &TV contrast versions	1980?	1970	Belgium	Col Print	sub 3 col		Incorporated coloured coupler integral tripack/top=G/,R,B[m,c,y]	35,16,S8	
Gevacolor Negative Film 682	1980?	?	Belgium	Col Neg	sub 3 col	1	camera stock only	35 & 16	
Gevaert films sold under Agfacolor names	1980	pres	Belgium	Col Neg/Col Print	Sub 3 col	1	onto integral tripack/same layer order as camera stock	35	

APPENDIX 2 Table 1 continued

Colour System Name or Colour Film Stock Name	1st Date	Last Date	Country (orig)	Film/Process or part process	Principle	No of Camera films	Notes and/or Print Material	Guages	Sound track
Ferrania Type HS Color Release Positive	1968	1970	Italy	Col Print	sub 3 col		Incorporated coupler integral tripack/top B/Coll Ag/G/R[Y M C]	35	
Ferrania-color Print Film[same name in English as above]	?1964	1968	Italy	Col Print	sub 3 col		Incorporated coupler integral tripack/top B/Coll Ag/G/R[Y M C]	35	
Fujicolor Negative Films, many speeds and balance versions	1969	pres	Japan	Col Neg	sub 3 col	1	camera stock only	35	
Fujicolor Intermediate Films F-CI several versions	1968	pres	Japan	Col Neg	sub 3 col	1	camera stock only	35 & 16	
Fujicolor Positive Films, 8812 to 8818 many versions	1968	pres	Japan	Col Print	sub 3 col		Incorporated coloured coupler integral tripack/top=G/,R,B[m,c,y]	35 & 16	
3M Color Positive, Type 881, 650 & 651	1970	1974	Italy	Col Print	sub 3 col		Incorporated coloured coupler integral tripack/top=G/,R,B[m,c,y]	35 & ?	
Dontec 5247 & 5293	1990s	1990s	Japan	Col Neg	sub 3 col		camera negative films, no data	35	
Ektachrome and compatable processes									
Eastman Ektachrome MS Film,5/7256	1963	no data	USA	Col Reversal	sub 3 Col	1	camera stock only	16	
Eastman Ektachrome EF Film, 5/7241,5/7242 etc	1965	1978?	USA	Col Reversal	sub 3 Col	1	onto various duplicating/print films,Kodachrome or Ektachrome	16	
Eastman Ektachrome ER Film5/7257,5/7258 etc	1978	pres	USA	Col Reversal	sub 3 Col	1	onto various duplicating/print films,Kodachrome or Ektachrome	16	
Eastman Reversal Print Film 5/7386	196?	?	USA	Col Reversal	Sub 3 col		this is a print film only	8,16 & 35	Ag
Eastman Ektachrome Print & R-Print Films	1968	pres	USA	Col Reversal	sub 3 Col	1	this is a print film only	16	
Fujicolor Reversal TV Film RT-100 etc to 400	1978	1977 at least	Japan	Col Reversal	sub 3 Col	1	onto various duplicating/print films,Kodachrome or Ektachrome	16	
Gevachrome II Camera Film 732	1980?	1980?	Belgium?	Col Reversal	sub 3 Col	1	camera film	16	
Gevachrome II Print Film 782		?	Belgium	Col Reversal	sub 3 Col		print stock	16	
Note: many amateur film were compatible with the similar E-6 process									

APPENDIX 2 Table 2

LIST OF CINEMA and CINEMATOGRAPHY FILM FORMATS IN FILM ARCHIVES (representative and incomplete, omits rare "pre-cinema", experimental, 3D and some Soviet era widescreen formats, in first use date order.)													
Format	Creator	Year Created (approx)	First known work	Negative gauge	Negative aspect ratio (1:n)	Gate dimensions ins	Negative pulldown	Negative lenses	Projection gauge	Projection frame rate	Projection aspect ratio (1:n)	Projected film dimensions	Projection lenses
Edison's original silent film	William Dickson and Thomas Edison	1892	Blacksmithing Scene	35 mm	1.33	0.980" x 0.735"	4 perf, 2 sides	spherical	35 mm	12fps approx	1.33	0.931" x 0.698"	spherical
Cinematographe	Lumiere Brothers	1895	<i>La Sortie des Usines Lumiere</i>	35 mm	1.33	0.980" x 0.735"	1 perf, 2 sides (rounded)	spherical	35 mm	12fps approx	1.33		spherical
Silent film "standard"	William Dickson and Thomas Edison?	1896		36 mm	1.33	0.980" x 0.735" nominal, but many variations	4 perf, 2 sides	spherical	35 mm	16-24fps approx, 20-24fps common by 1920's	1.33	0.931" x 0.698" nominal, but many variations	spherical
Home Kinetoscope	Edison	1912	unknown (amateur format)	no standard	no standard	no standard	no standard	spherical	22 mm, 2 perf (on frameline between frame rows)	16fps approx	1.5	0.236" x 0.157" (three frames across width)	spherical
Pathe Kok	Pathe	1912	unknown (amateur format)	28 mm	1.36	0.748" x 0.551"	3 perf on one side, 1 perf on the other	spherical	28 mm	16fps approx			spherical
Duoscope	Alexander F. Victor	1912	unknown (amateur format)	17.5 mm			2 perfs, center	spherical	17.5 mm	16fps approx			spherical
Panoramico	Filoteo Alberini	1914	<i>Il sacco di Roma</i>	70 mm	2.52		5 perf, 2 sides	spherical	70 mm	16fps approx			spherical
Split Duplex	Duplex Corporation	1915		35 mm	1.33	0.980" x 0.735"	4 perf, 2 sides (shooting)	spherical	35 mm	16fps approx	1.87	0.735" x 0.394"	spherical (split image 90° rotated)
11 mm	(American)	1916	unknown (amateur format)	11 mm			1 perf, center	spherical	11 mm	16fps approx			spherical
Movette	Movette Camera Company	1917	unknown (amateur format)	17.5 mm			2 perfs, 2 sides (rounded)	spherical	17.5 mm	16fps approx			spherical
28 mm safety standard	Alexander Victor	1918	unknown (amateur format)	28 mm	1.36	0.748" x 0.551"	3 perf, 2 sides	spherical	28 mm	16fps nominal			spherical
Clou	(Austrian)	1920	unknown (amateur format)	17.5 mm			2 perf, 2 sides	spherical	17.5 mm	16fps nominal			spherical
26 mm	(French)	1920	unknown (amateur format)	26 mm			1 perf, 1 side	spherical	26 mm	16fps nominal			spherical

APPENDIX 2 Table 2 continued

Format	Creator	Year Created (approx)	First known work	Negative gauge	Negative aspect ratio (1:n)	Gate dimensions ins	Negative pulldown	Negative lenses	Projection gauge	Projection frame rate	Projection aspect ratio (1:n)	Projected film dimensions	Projection lenses
9.5 mm	Pathe	1922	unknown (amateur format)	9.5 mm	1.31	0.335" x 0.256"	1 perf, center	spherical	9.5 mm	16fps nominal	1.31	0.315" x 0.242"	spherical
Phonofilm	Lee De Forest	1922	Barking Dog and Flying Jenny Airplane	35 mm	1.33	0.980" x 0.735"	4 perf, 2 sides	spherical	35 mm	16fps nominal	1.17	0.826" x 0.708"	spherical
Widescope	John D. Elms and George W. Bingham	1922		35 mm x 2 (both in same camera)	0.980" x 0.735"	1.33 x 2 negatives	4 perf, 2 sides	spherical (one lens per strip)	35 mm x 2 projectors	16fps nominal	2.66	0.931" x 0.698"	spherical
Cinebloc	Ozaphan	1922	unknown (amateur format)	22 mm			2 perf, 2 sides	spherical	22 mm	16fps nominal			spherical
Tri-Ergon soundfilm	Tri-Ergon	1922		35 mm	1.33	0.980" x 0.735"	4 perf, 2 sides	spherical	42 mm	20fps approx?	1.33	0.931" x 0.698"	spherical
16 mm	Eastman Kodak	1923	unknown (initially amateur, later a professional format)	16 mm	1.37	0.404" x 0.295"	1 perf, 2 sides	spherical	16 mm	16fps	1.37, perf both sides	0.378" x 0.276"	spherical
Duplex	G.J. Bradley	1923	unknown (amateur format)	11 mm			2 perf, 2 sides (rounded)	spherical	11.5 mm	16fps nominal			spherical
Alberini-Hill	Corrado Cerqua	1924		35 mm	1.66	1.575" x 0.945" (curved)	10 perf, 2 sides, horizontal	spherical, on 65° revolving drum	35 mm	16fps nominal			spherical
Cinelux	Ozaphan	1924	unknown (amateur format)	24 mm				spherical	24 mm	16fps nominal			spherical
48 mm	J.H. Powrie	1924		48 mm	1.32	1.969" x 1.496"	horizontal	spherical	35 mm	16fps nominal	1.33	0.931" x 0.698"	spherical
Natural Vision	George K. Spoor and P. John Berggren	1925	Niagara Falls and Rollercoaster Ride	63.5 mm	1.84	2.060" x 1.120"	6 perf, 2 sides, 20 fps	spherical	63.5 mm	16fps nominal	2		spherical
13 mm	(French)	1925	unknown (amateur format)	13 mm			4 perf, center	spherical	13 mm	16fps nominal			spherical

APPENDIX 2 Table 2 continued

Format	Creator	Year Created (approx)	First known work	Negative gauge	Negative aspect ratio (1:n)	Gate dimensions ins	Negative pulldown	Negative lenses	Projection gauge	Projection frame rate	Projection aspect ratio (1:n)	Projected film dimensions	Projection lenses
18 mm	(Russian)	1925	unknown (amateur format)	18 mm			1 perf, 2 sides	spherical	18 mm	16fps nominal			spherical
Pathe Rural	Pathe	1926	unknown (amateur format)	17.5 mm	1.35 (silent); 1.30 (sound)	0.516" x 0.382" (silent); 0.445" x 0.343" (sound)	1 perf, 2 sides	spherical	17.5 mm	16fps nominal	1.33 (silent); 1.26 (sound)	0.472" x 0.354" (silent); 0.445" x 0.343" (sound)	spherical
Widevision	John D. Elms and George W. Bingham	1926	Natural Vision Pictures	57 mm			5 perf, 2 sides	spherical	57 mm	16fps nominal			spherical
Magnascope	Lorenzo del Riccio	1926	<i>Old Ironsides</i>	35 mm	1.33	0.980" x 0.735"	4 perf, 2 sides	spherical	35 mm	16fps nominal	1.33	0.931" x 0.698"	spherical (selected scenes projected using a wider lens for larger picture)
Fox Movietone	Freeman Harrison Owens, Theodore Case, Tri-Ergon	1927	<i>Sunrise</i>	35 mm	1.33	0.980" x 0.735"	4 perf, 2 sides	spherical	35 mm	20fps+	1.17	0.826" x 0.708"	spherical
Polyvision	Abel Gance	1927	<i>Napoléon</i> , section only	35 mm x 3 cameras	1.33 x 3 negatives	0.980" x 0.735"	4 perf, 2 sides	spherical	35 mm x 3 projectors	16fps nominal	4	0.931" x 0.698"	spherical
Hypergonar	Henri Chretien	1927	<i>Pour construire un feu</i>	35 mm	2.66	0.980" x 0.735"	4 perf, 2 sides	2x anamorphic	35 mm	16fps nominal	2.66	0.931" x 0.698"	2x anamorphic
Magnafilm	Lorenzo del Riccio	1929	<i>You're in the Army Now</i>	56 mm	2.19	1.620" x 0.740"	4 perf, 2 sides	spherical	56 mm	16fps nominal	2		spherical
Fox Grandeur	Fox Film Corporation	1929	<i>Fox Grandeur News</i> and <i>Fox Movietone Follies of 1929</i>	70 mm	2.07	1.890" x 0.913"	4 perf, 2 sides, 20 fps (before 1930)	spherical	70 mm	20fps	2	1.768" x 0.885"	spherical
Fearless Super Pictures	Ralph G. Fear	1929		35 mm	2.27	1.813" x 0.800"	10 perfs, 2 sides, horizontal	spherical	35 mm, horizontal	20fps			spherical
Fearless Super-Film/Magnifilm/Fox Vitascope	Ralph G. Fear	1930	<i>Kismet</i>	65 mm	2	1.811" x 0.906"	5 perf, 2 sides	spherical	65 mm	20fps	2.05	1.772" x 0.866"	spherical
Realife	MGM	1930	<i>Billy the Kid</i>	70 mm	2.07	1.890" x 0.913"	4 perf, 2 sides	spherical	35 mm	24fps	1.75	0.904" x 0.517"	spherical
50 mm	Fox Film Corporation and SMPE	1930		50 mm	1.8	1.325" x 0.735"		spherical	50 mm	24fps	1.8	1.305" x 0.725"	spherical
17 mm sound	(French)	1930	unknown (amateur format)	17 mm			1 perf, 1 side	spherical	17 mm	16fps			spherical

APPENDIX 2 Table 2 continued

Format	Creator	Year Created (approx)	First known work	Negative gauge	Negative aspect ratio (1:n)	Gate dimensions ins	Negative pulldown	Negative lenses	Projection gauge	Projection frame rate	Projection aspect ratio (1:n)	Projected film dimensions	Projection lenses
Giant Expanding Pictures	George Palmer	1930		35 mm	1.33	0.980" x 0.735"	4 perf, 2 sides	spherical	35 mm	24fps	1.17	0.826" x 0.708"	spherical (with a special projection zoom lens zooming wider and opening masking for key sequences)
Kodel Kemco Homovie	Clarence Ogden	1931	unknown (amateur format)	16 mm		4 sequential images per frame	1 perf, 2 sides	spherical	16 mm	16fps			spherical
Academy format	AMPAS	1932	Format was a summary of existing common practice	35 mm	1.37	0.866" x 0.630"	4 perf, 2 sides	spherical	35 mm	24fps	1.37	0.825" x 0.602"	spherical
8 mm (also called Double 8)	Eastman Kodak	1932	unknown (amateur format)	16 mm	1.32	0.192" x 0.145"	1 perf, 1 side (using 16 mm film with twice as many perfs)	spherical	8 mm	16fps	1.331 (1perf, 1 side)	0.172" x 0.129"	spherical
Straight 8	Bell and Howell	1935	unknown (amateur format)	8 mm	1.32	0.192" x 0.145"	1 perf, 1 side	spherical	8 mm	16fps	1.33	0.172" x 0.129"	spherical
16 mm (sound)	Eastman Kodak	1935		16 mm	1.37	0.404" x 0.295"	1 perf, 2 sides	spherical	16 mm	24fps	1.37, Perf one side	0.378" x 0.276"	spherical
Vitarama	Fred Waller	1939		16 mm x 11 cameras	1.37 x 11 negatives	0.404" x 0.295"	1 perf, 2 sides	spherical	16 mm x 11 projectors	16fps	hemispherical view	0.378" x 0.276"	spherical
Cinerama	Fred Waller	1952	<i>This is Cinerama</i>	35 mm x 3 cameras	0.89 x 3 negatives	0.996" x 1.116"	6 perf, 2 sides at 26 fps	spherical	35 mm x 3 projectors, with 6 perf pulldown	26fps	2.59, with 146° curved screen	0.985" x 1.088"	spherical
Widescreen 1.66, aka "Matted 1.66"	Paramount, still used in Europe, 2000	1953	<i>Shane</i>	35 mm	1.37, only centre 1.66 area printed	0.866" x 0.630"	4 perf, 2 sides	spherical	35 mm	24fps	1.66	0.825" x 0.497"	spherical
Widescreen 1.85, aka "Matted 1.85"	Universal, the most common format in 2000	1953	<i>Thunder Bay</i>	35 mm	1.37, only centre 1.85 area printed	0.866" x 0.630"	4 perf, 2 sides	spherical	35 mm	24fps	1.85	0.825" x 0.446"	spherical
Widescreen 1.75, aka "Matted 1.75"	MGM, still used 2000 for some TV productions released in the cinema	1953	<i>Arena</i>	35 mm	1.37, only centre 1.75 area printed	0.866" x 0.630"	4 perf, 2 sides	spherical	35 mm	originally 24fps, some releases at 25fps	1.75	0.825" x 0.471"	spherical

APPENDIX 2 Table 2 continued

Format	Creator	Year Created (approx)	First known work	Negative gauge	Negative aspect ratio (1:n)	Gate dimensions ins	Negative pulldown	Negative lenses	Projection gauge	Projection frame rate	Projection aspect ratio (1:n)	Projected film dimensions	Projection lenses
Cinemascope	20th Century Fox	1953	<i>The Robe</i>	35 mm	2.55 (1953-1957); 2.37 (1957-1967)	0.937" x 0.735" (1953-1957); 0.866" x 0.732" (1957-1967)	4 perf, 2 sides	2x anamorphic	35 mm	24fps	2.55 (1953-1957); 2.35 (1957-1967)	0.912" x 0.715" (1953-1957); 0.839" x 0.715" (1957-1967)	2x anamorphic
Arnoldscope	John Arnold	1953		35 mm			10 perf, 2 sides, horizontal	spherical		24fps			
VistaVision	Paramount	1954	<i>White Christmas</i>	35 mm	1.51	1.495" x 0.991"	8 perf, 2 sides, horizontal	spherical	35 mm, 4 perf, vertical	24fps	1.85	0.825" x 0.446"	spherical
Superscope	Tushinsky Brothers	1954	<i>Vera Cruz</i>	35 mm	1.33	0.980" x 0.735"	4 perf, 2 sides	spherical	35 mm	24fps	2	0.715" x 0.715"	2x anamorphic
VistaVision Large Area	Paramount	1955	<i>Strategic Air Command</i>	35 mm	1.51	1.495" x 0.991"	8 perf, 2 sides, horizontal	spherical	35 mm, 8 perf, horizontal	24fps	1.96	1.418" x 0.723"	spherical
Circarama	Disney	1955	<i>A Tour of the West</i>	16 mm x 11 cameras	1.37 x 11 negatives	0.404" x 0.295"	1 perf, 2 sides	spherical	16 mm x 11 projectors	24fps	360°	0.378" x 0.276"	spherical
Todd A.O.[2]	Michael Todd	1955	<i>Oklahoma!</i>	65 mm	2.29	2.072" x 0.906"	5 perfs, 2 sides, at 30 fps	spherical	70 mm	30fps	2.21, with 120° curved screen	1.912" x 0.870"	spherical
Cinemascope 55	20th Century Fox	1955	<i>Carousel</i>	55 mm	2.55	1.824" x 1.430"	8 perfs, 2 sides	2x anamorphic	35 mm	24fps	2.55	0.912" x 0.715"	2x anamorphic
4.75 mm	Pathe	1955	unknown (amateur format)	9.5 mm			2 perf, 1 side (using 9.5 mm film with twice as many perfs)	spherical	4.75 mm	16fps			spherical, rotated 90°
Technirama	Technicolor	1956	<i>The Monte Carlo Story</i>	35 mm	2.26	1.496" x 0.992"	8 perf, 2 sides, horizontally	1.5x anamorphic	35 mm, 4 perf vertical	24fps	2.35	0.839" x 0.715"	2x anamorphic
Technirama Large Area	Technicolor	1956	<i>The Monte Carlo Story</i>	35 mm	2.26	1.496" x 0.992"	8 perf, 2 sides, horizontally	1.5x anamorphic	35 mm, 8 perf horizontal	24fps	1.421" x 0.881"	2.42	1.5x anamorphic
Dynamic Frame	Glenn Alvey	1956	<i>The Door in the Wall</i>	35 mm	1.3, 1.6, and 2.5	variable aperture plates	8 perf, 2 sides, horizontally	spherical	35 mm, 4 perf, vertical	24fps	1.3, 1.5, and 2.5		spherical
Superscope 235	Superscope Inc.	1956	<i>Run for the Sun</i>	35 mm	1.33	0.980" x 0.735"	4 perf, 2 sides	spherical	35 mm	24fps	2.35	0.839" x 0.715"	2x anamorphic
Thrillarama	Albert H. Reynolds	1956	<i>Thrillarama Adventure</i>	35 mm x 2 cameras	1.78 x 2 negatives		3 perf, 2 sides?	spherical	35 mm x 2 projectors	24fps	3.55, with a curved screen		spherical
Magirama	Abel Gance	1956	<i>Magirama</i>	35 mm x 3 cameras (mirrors)	1.33 x 3 negatives	0.980" x 0.735"	4 perf, 2 sides	spherical	35 mm x 3 projectors	24fps	4	0.931" x 0.698"	spherical

APPENDIX 2 Table 2 continued

Format	Creator	Year Created (approx)	First known work	Negative gauge	Negative aspect ratio (1:n)	Gate dimensions ins	Negative pulldown	Negative lenses	Projection gauge	Projection frame rate	Projection aspect ratio (1:n)	Projected film dimensions	Projection lenses
Ultra Panavision	Panavision	1957	<i>Raintree County</i>	65 mm	2.86	2.072" x 0.906"	5 perf, 2 sides	1.25x anamorphic	70 mm	24fps	2.76	1.912" x 0.870"	1.25x anamorphic
Modern anamorphic	Panavision	1957	<i>Silk Stockings</i>	35 mm	2.37	0.866" x 0.732"	4 perf, 2 sides	2x anamorphic	35 mm	24fps	2.35 (1957-1970); 2.39 (1970-present)	0.839" x 0.715" (1957-1970); 0.838" x 0.7" (1970-1993); 0.825" x 0.690" (1993-present)	2x anamorphic
Cinestage	Mike Todd	1957	<i>Around the World in 80 Days</i>	65 mm	2.29	2.072" x 0.906"	5 perfs, 2 sides	spherical	35 mm (1 mm shaved off for UK prints)	24fps	2.12	0.912" x 0.675"	1.567x anamorphic
Rank VistaVision	J. Arthur Rank Organization	1957		35 mm	1.51	1.495" x 0.991"	8 perf, 2 sides, horizontally	spherical	35 mm, 4 perf, vertical	24fps	1.82	0.825" x 0.602"	1.33x anamorphic
Kinopanorama	NIKFI	1958	<i>Great Is My Country</i>	35 mm x 3 cameras	0.91 x 3 negatives	1.014" x 1.116"	6 perf, 2 sides, at 25 fps	spherical	35 mm x 3 projectors	25fps	2.72	0.985" x 1.088"	spherical
70 mm[2]	American Optical Company	1958	<i>South Pacific</i>	65 mm	2.28	2.066" x 0.906"	5 perfs, 2 sides	spherical	70 mm	24fps	2.21	1.912" x 0.87"	spherical
Cinmiracle	National Theatres	1958	<i>Windjammer</i>	35 mm x 3 cameras (sides bounced off of mirrors)	0.89 x 3 negatives	0.996" x 1.116"	6 perf, 2 sides at 26 fps	spherical	35 mm x 3 projectors (sides bounced off of mirrors), with 6 perf pulldown	26fps	2.59, with 120° curved screen	0.985" x 1.088"	spherical
Super Technirama	Technicolor	1959	<i>Sleeping Beauty</i>	35 mm	2.26	1.496" x 0.992"	8 perf, 2 sides, horizontally	1.5x anamorphic	70 mm	24fps	2.21	1.912" x 0.816"	spherical
Smith-Carney System	Rowe E. Carney Jr. and Tom F. Smith	1959	<i>Missouri travelogue</i>	35 mm	4.69	0.839" x 0.370" (bottom half) and 0.449" x 0.370" (top quarters)	4 perf, 2 sides	spherical x 3	35 mm	24fps	4.69	three sub-frames projected to one 180° image	spherical x 3
Circular Kinopanorama/Circlorama	E. Goldovsky	1959	<i>The Path of Spring</i>	35 mm x 11 cameras	1.37 x 11 negatives	0.866" x 0.630"	4 perf, 2 sides	spherical	35 mm x 11 projectors	24fps	360°	0.825" x 0.602"	spherical
Varioscope	Jan Jacobsen	1959		65 mm	2.28	2.066" x 0.906"	5 perfs, 2 sides	spherical	70 mm	24fps	variable framing run through control signal	1.912" x 0.87"	spherical

APPENDIX 2 Table 2 continued

Format	Creator	Year Created (approx)	First known work	Negative gauge	Negative aspect ratio (1:n)	Gate dimensions ins	Negative pulldown	Negative lenses	Projection gauge	Projection frame rate	Projection aspect ratio (1:n)	Projected film dimensions	Projection lenses
Techniscope	Technicolor	1960	<i>The Pharaoh's Woman</i>	35 mm	2.33	0.868" x 0.373"	2 perf, 2 sides	spherical	35 mm	24fps	2.39	0.838" x 0.7"	2x anamorphic
Wonderama (Arc 120)	Leon W. Wells	1960	<i>Honeymoon</i>	no standard	no standard	no standard	no standard	no standard	35 mm	24fps	2.50 with a 120° curved screen	0.931" x 0.698", with two half-images turned 90° and placed side-by-side	spherical x 2
Cine System 3	Eric Berndt	1960	USAF and NASA usage	3 mm			1 perf, centered	spherical		24fps			
Grandeur 70	20th Century Fox	1961	<i>The King and I</i> (re-release)	55 mm	2.55	1.824" x 1.430"	8 perfs, 2 sides	2x anamorphic	70 mm	24fps	2.21	1.912" x 0.87"	spherical
Cinerama 360	Cinerama Corporation	1962	<i>Journey to the Stars</i>	65 mm	1.00 (circle)	2.25" diameter circular image	10 perf, 2 sides	spherical	70 mm	24fps	1.00 (circle)	2.25" diameter circular image	spherical
Super 8	Eastman Kodak	1965	unknown (amateur format)	8 mm	1.48	0.245" x 0.166"	1 perf, 1 side	spherical	8 mm	18fps	1.36	0.215" x 0.158"	spherical
Single-8	Fujifilm	1965	unknown (amateur format)	8 mm	1.36	0.224" x 0.164"	1 perf, 1 side	spherical	8 mm	18fps	1.35	0.213" x 0.157"	spherical
Real Sound	Kenner	1965		no standard	no standard	no standard	1 perf, 1 side	spherical	11.5 mm	24fps	1.33	0.172" x 0.129"	spherical
Double Super 8	Eastman Kodak	1965	unknown (amateur format)	16 mm	1.48	0.245" x 0.166"	1 perf, 1 side (using 16 mm film with twice as many perfs)	spherical	8 mm	24fps	1.36	0.215" x 0.158"	spherical
Dimension 150	American Optical Company	1966	<i>The Bible: In the Beginning</i>	65 mm	2.28	2.066" x 0.906"	5 perfs, 2 sides	spherical	70 mm	24fps	2.21, with 150° curved screen	1.912" x 0.87", optically curved to compensate for the screen	spherical
Circle Vision 360	Disney	1967	<i>America the Beautiful</i>	35 mm x 9 cameras	1.37 x 9 negatives	0.866" x 0.630"	4 perf, 2 sides	spherical	35 mm x 9 projectors	24fps	360°	0.825" x 0.602"	spherical
Astrovision	Goto Optical	1969		65 mm			10 perf, 2 sides	spherical or fish-eye	70 mm	24fps			fish-eye (dome projection)
IMAX	IMAX Corporation	1970	<i>Tiger Child</i>	70 mm	1.34	2.772" x 2.072"	15 perf, 2 sides, horizontally	spherical	70 mm, horizontal	24fps	1.31	2.692" x 2.056"	spherical

APPENDIX 2 Table 2 continued

Format	Creator	Year Created (approx)	First known work	Negative gauge	Negative aspect ratio (1:n)	Gate dimensions	Negative pulldown	Negative lenses	Projection gauge	Projection frame rate	Projection aspect ratio (1:n)	Projected film dimensions	Projection lenses
Super 16 mm film	Rune Ericson	1970	<i>Blushing Charlie</i>	16 mm	1.66, but subsequently 1.85 more common.	0.493" x 0.292"	1 perf, 1 side	spherical	no standard, but often blown up to 35 mm	24fps and 25fps	no standard	35mm only, 0.463" x 0.279" (full frame); 0.463" x 0.251" (framed for 1.85)	spherical
8.75 mm	Chinese	1970	unknown (amateur format)	8.75 mm			1 perf?	spherical	8.75 mm	16fps ?			spherical
Pik-a-Movie	Leon W. Wells	1972		no standard	no standard	no standard	no standard	no standard	70 mm, horizontal, 1 perf, 2 sides	24fps	1.48	0.245" x 0.166", 12 rows high, underneath 12 rows of optical sound	spherical
OMNIMAX	IMAX Corporation	1973	<i>Garden Isle</i>	70 mm	1.34	2.772" x 2.072"	15 perf, 2 sides, horizontally	special fish-eye lenses optically centered 0.37" above film horizontal center line	70 mm, horizontal	24fps	1.31	2.692" x 2.056"	spherical, projected elliptically on a dome screen, 20 degrees below and 110 degrees above perfectly centered viewers
8/70 (Dynavision, Iwerks 870)	Dynavision	1973		65 mm	1.37	2.031" x 1.484"	8 perf, 2 sides, 24 or 30 fps	spherical	70 mm	24fps	1.34	1.913" x 1.431"	spherical
Showscan	Douglas Trumbull	1978	<i>Night of Dreams</i>	65 mm	2.28	2.066" x 0.906"	5 perfs, 2 sides, at 60 fps	spherical	70 mm, at 60 fps	60fps	2.21	1.912" x 0.87"	spherical
Polavision	Polaroid Corporation	1978	unknown (amateur format)	8 mm	1.48	0.245" x 0.166"	1 perf, 1 side	spherical	8 mm	24fps	1.36	0.215" x 0.158"	spherical
Omnivision Cinema 180	Omni Films	1979	<i>Crazy Wheels</i>	65 mm	2.28	2.066" x 0.906"	5 perfs, 2 sides, 30 fps	fish-eye	70 mm	24fps	180°, on a dome	1.912" x 0.87"	fish-eye
"35mm TV" 25fps		1980		35 mm	1.33	0.980" x 0.735"	4 perf, 2 sides	spherical	35 mm	25fps	no standard	no standard	no standard
Super 35	Joe Dunton	1982	<i>Dance Craze</i>	35 mm	1.33	0.980" x 0.735"	4 perf, 2 sides	spherical	35 mm	24fps	no standard 1.85 to 2.35	no standard	no standard
Circle Vision 200	Disney	1982	<i>Impressions de France</i>	35 mm x 5 cameras	1.37 x 5 negatives	0.866" x 0.630"	4 perf, 2 sides	spherical	35 mm x 5 projectors	24fps	6.85, on a 200" screen	0.825" x 0.602"	spherical
Swissorama 360/Imagine 360	Ernst A. Heiniger	1984	<i>Impressions of Switzerland</i>	65 mm	360°	1.91" (outer edge), 1.20" (inner edge)	10 perf, 2 sides	360° x 35° extreme fisheye	70 mm	24fps	360°		360° x 35° extreme fisheye

APPENDIX 2 Table 2 continued

Format	Creator	Year Created (approx)	First known work	Negative gauge	Negative aspect ratio (1:n)	Gate dimensions	Negative pulldown	Negative lenses	Projection gauge	Projection frame rate	Projection aspect ratio (1:n)	Projected film dimensions	Projection lenses
3-perf	Rune Ericson	1987	Pirates of the Lake	35 mm	1.79	0.980" x 0.546"	3 perf, 2 sides	spherical	35 mm	24fps	no standard	no standard	no standard
Super VistaVision	Paramount	1989	<i>The Ten Commandments</i> (re-release)	35 mm	1.51	1.495" x 0.991"	8 perf, 2 sides, horizontal	spherical	70 mm	24fps	2.21	1.912" x 0.87"	spherical
Kinoton HDFS	Kinoton	1990		no standard	no standard	no standard	no standard	no standard	35 mm	24fps	2	0.931" x 0.698"	1.5x anamorphic
IMAX Magic Carpet	IMAX Corporation	1990	<i>Flowers in the Sky</i>	70 mm x 2 cameras	1.34	2.772" x 2.072"	15 perf, 2 sides, horizontally	spherical	70 mm, horizontal x 2 projectors	24fps	1.31 x 2 screens (one in front, one below)	2.692" x 2.056"	spherical
Iwerksphere	Iwerks	1991		65 mm	1.37	2.031" x 1.484"	8 perf, 2 sides, 24 or 30 fps	fish-eye	70 mm	24fps	1.34	1.913" x 1.431"	fish-eye
IMAX HD	IMAX Corporation	1992	<i>Asteroid Adventure</i>	70 mm	1.34	2.772" x 2.072"	15 perf, 2 sides, horizontally, 48 fps	spherical	70 mm, horizontal	24fps	1.31	2.692" x 2.056"	spherical
Ultra Toruscope	Mac McCamey	1992		35 mm x 3 cameras	1.37 x 3 negatives	0.866" x 0.630"	4 perf, 2 sides, at 30 fps	spherical	70 mm x 3 projectors, at 30 fps	30fps	360°	1.912" x 0.87"	spherical
Analogue and Digital Video cameras		1992	-	35mm	various within an Academy area	-	-	-	36 mm	24 and 25fps	no standard, 1.66, 1.85 & 2.35	no standard	no standard
Imagination FX 7012	Geo-Odyssey	1992		35 mm	2.08	2.040" x 0.980"	12 perf, 2 sides, horizontal	spherical	70 mm	24fps	2.21	1.912" x 0.87"	spherical
Super 35 25fps		1995		35 mm	1.33	0.980" x 0.735"	4 perf, 2 sides	spherical	35 mm	25fps	no standard, 1.77 to 2.35	no standard	no standard
Univisium	Vittorio Storaro	1998	<i>Tango</i>	35 mm	2	0.945" x 0.472"	3 perf, 2 sides at 25 fps	spherical	35 mm	25fps	2		spherical
Digital Intermediate		1998	via video - unknown, via data-Zingo	Super 16, Academy, Super 35 or 3-perf, or a mixture.	various	various	4 perf, 2 sides	spherical or x2 anamorphic	35 mm	24fps or 25fps	no standard, 1.66, 1.77, 1.85, 2.35 etc	no standard	no standard
Maxivision	Dean Goodhill	1999		35 mm	1.79	0.980" x 0.546"	3 perf, 2 sides	spherical	35 mm, 3 perf	24fps	1.85		spherical
Maxivision 48	Dean Goodhill	1999		35 mm	1.79	0.980" x 0.546"	3 perf, 2 sides, 48 fps	spherical	35 mm, 3 perf, 48 fps	48fps	1.85		spherical

APPENDIX 2 Table 2 continued

Format	Creator	Year Created (approx)	First known work	Negative gauge	Negative aspect ratio (1:n)	Gate dimensions ins	Negative pulldown	Negative lenses	Projection gauge	Projection frame rate	Projection aspect ratio (1:n)	Projected film dimensions	Projection lenses
Super Duper 8/Max 8/Super 8B	Mitch Perkins	2002	<i>Sleep Always</i>	8 mm	1.51	0.250" x 0.166"	1 perf, 1 side	spherical	8 mm	24fps	no standard	no standard	spherical
Super Dimension 70	Robert Weisgerber	2002		65 mm	2.28	2.066" x 0.906"	5 perfs, 2 sides, at 48 fps	spherical	70 mm, at 48 fps	48fps	2.21	1.912" x 0.87"	spherical
Futurevision 360				65 mm	1.52	2.066" x 0.906"	5 perfs, 2 sides, 30 fps	1.5x vertical anamorphic	70 mm	30fps	1.47	1.912" x 0.87"	1.5x vertical anamorphic
Mini-Max	Vistascope			35 mm	2.66		2 perf, 2 sides, 30 fps	spherical	35 mm	30fps	2.66		spherical
MotionMaster	Omni Films			65 mm	2.28	2.066" x 0.906"	5 perfs, 2 sides, 30 fps	spherical	70 mm	30fps	2.21, on a curved screen	1.912" x 0.87"	spherical
Quadravision				? mm x 4 cameras	? x 4 negatives			spherical	? mm x 4 projectors	24fps	? (4 images in 2x2 configuration)		spherical
Row-film	R. Thun			35 mm		20 rows of images wide		spherical		24fps			spherical
Septorama				? mm x 7 cameras	1.33 x 7 negatives			spherical	? mm x 7 projectors	24fps ?	hemispherical view		spherical
Single Cinerama	Fred Waller			35 mm		curved gate	16 perf, 2 sides, horizontal	spherical	35 mm, horizontal	24fps	curved screen		spherical
Soviet 10				65 mm			10 perf, 2 sides	2x anamorphic	70 mm	24fps	2.09	1.890" x 1.811"	2x anamorphic

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