

SMPTE STANDARD

Archive Frame Rates
for D-Cinema



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Foreword

SMPTE (the Society of Motion Picture and Television Engineers) is an internationally-recognized standards developing organization. Headquartered and incorporated in the United States of America, SMPTE has members in over 80 countries on six continents. SMPTE's Engineering Documents, including Standards, Recommended Practices and Engineering Guidelines, are prepared by SMPTE's Technology Committees. Participation in these Committees is open to all with a bona fide interest in their work. SMPTE cooperates closely with other standards-developing organizations, including ISO, IEC and ITU.

SMPTE Engineering Documents are drafted in accordance with the rules given in Part XIII of its Administrative Practices.

SMPTE ST 428-21 was prepared by Technology Committee 21DC.

Intellectual Property

At the time of publication no notice had been received by SMPTE claiming patent rights essential to the implementation of this Standard. However, attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. SMPTE shall not be held responsible for identifying any or all such patent rights.

Introduction

This section is entirely informative and does not form an integral part of this Engineering Document.

The frame rates currently standardized by the D-Cinema Technology Committee are 24 and 48 frames per second (fps). The additional frame rates of 25, 30, 50 and 60 fps have also been standardized.

The history of film presentation is littered with frame rates ranging from less than 16 fps to 60 fps and there is a requirement to provide support for film archives for frame rates that preceded the standard of 24 fps. These archives were projected with governor-controlled projectors so the frame rates were not always precise. Furthermore, there was no common standard within the fledgling cinema industry until the agreement to harmonize on 24 fps presentation in the mid 1930's.

This standard defines how implementations that conform to the D-Cinema specifications can be extended to support archive frame rates.

1 Scope

This standard defines archive frame rates for D-Cinema that are in addition to the primary frame rates of 24 and 48 fps and the additional frame rates of 25, 30, 50 and 60 fps. These archive frame rates are defined to ensure that the artistic intent of the content producer can be maintained at the point of delivery. All other parameters defined by SMPTE ST 428-1 remain as specified.

This document is part of a suite of SMPTE engineering documents. This part defines the archive frame rates at 16/1, 200/11 (=approx 18.18181818), 20/1 and 240/11 (=approx 21.8181818) frames per second and defines the resulting audio samples per edit unit.

2 Conformance Notation

Normative text is text that describes elements of the design that are indispensable or contains the conformance language keywords: "shall", "should", or "may". Informative text is text that is potentially helpful to the user, but not indispensable, and can be removed, changed, or added editorially without affecting interoperability. Informative text does not contain any conformance keywords.

All text in this document is, by default, normative, except: the Introduction, any section explicitly labeled as "Informative", or individual paragraphs that start with "Note:".

The keywords "shall" and "shall not" indicate requirements strictly to be followed in order to conform to the document and from which no deviation is permitted.

The keywords, "should" and "should not" indicate that, among several possibilities, one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required; or that (in the negative form) a certain possibility or course of action is deprecated but not prohibited.

The keywords "may" and "need not" indicate courses of action permissible within the limits of the document.

The keyword "reserved" indicates a provision that is not defined at this time, shall not be used, and may be defined in the future. The keyword "forbidden" indicates "reserved" and in addition indicates that the provision will never be defined in the future.

A conformant implementation according to this document is one that includes all mandatory provisions ("shall") and, if implemented, all recommended provisions ("should") as described. A conformant implementation need not implement optional provisions ("may") and need not implement them as described.

Unless otherwise specified the order of precedence of the types of normative information in this document shall be as follows. Normative prose shall be the authoritative definition. Tables shall be next, followed by formal languages, then figures, and then any other language forms.

3 Normative References

Note: All references in this document to other SMPTE documents use the current numbering style (e.g. SMPTE ST 428-1:2006) although, during a transitional phase, the document as published (printed or PDF) may bear an older designation (such as SMPTE 428-1-2006). Documents with the same root number (e.g. 428-1) and publication year (e.g. 2006) are functionally identical.

The following standards contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this recommended practice are encouraged to investigate the possibility of applying the most recent edition of the standards indicated below.

SMPTE ST 428-1:2006, D-Cinema Distribution Master — Image Characteristics

SMPTE ST 428-2:2006, D-Cinema Distribution Master — Audio Characteristics

4 Glossary of Acronyms and Terms

The following acronyms are used in this document:

DCDM: Digital Cinema Distribution Master.

FPS (fps): Frames Per Second.

The following terms are used in this document:

Edit Unit: The smallest unit of D-Cinema content that can be successfully edited while maintaining the integrity of the content.

Edit Rate: A number of Editable Units to be reproduced during a temporal interval having a duration of exactly one (1.0) second. Because Edit Rate values are not always integer values and sometimes require many digits of precision, Edit Rate values are expressed as a rational number (the ratio of two integers).

5 Archive Frame Rate Values

This standard supplements the provisions of SMPTE ST 428-1 with archive frame rates and levels.

The archive frame rate values for D-Cinema use shall be 16/1, 200/11, 20/1 and 240/11 frames per second.

5.1 Definition of Archive Levels

The Archive Level shall have eight values defined as Archive Level 1 through Archive Level 8. The picture container size and frame rate for each Archive Level shall be as defined in Table 1:

Table 1 – Archive Level Definitions

Archive Level	Maximum Horizontal Pixels	Maximum Vertical Pixels	Frames per Second
Archive Level 1	4096	2160	16/1
Archive Level 2	2048	1080	16/1
Archive Level 3	4096	2160	200/11
Archive Level 4	2048	1080	200/11
Archive Level 5	4096	2160	20/1
Archive Level 6	2048	1080	20/1
Archive Level 7	4096	2160	240/11
Archive Level 8	2048	1080	240/11

These archive levels shall be in addition to the DCDM levels that are defined in SMPTE ST 428-1.

Implementations may support any one or more of the Archive levels defined in Table 1. Implementations using this standard shall identify the values of Archive levels that are supported.

Note: The archive level values use the prefix “archive” to avoid confusion with the level values defined in SMPTE ST 428-1 and the additional levels values defined in SMPTE ST 428-11.

5.2 D-Cinema Sound Sample Rates

The audio sampling parameters shall be as defined in SMPTE ST 428-2.

The four archive frame rates result in values for the number of audio samples per edit unit that shall be as defined in Table 2:

Table 2 – Audio Samples per Edit Unit for the Archive Frame Rates

<i>Audio Sample Rate → ↓ Edit Rate</i>	<i>48 kHz</i>	<i>96 kHz</i>
16/1	3000	6000
200/11	2640	5280
20/1	2400	4800
240/11	2200	4400

Note: Because edit rates must be the same for all content in a composition (e.g., picture and sound), and because sound is elsewhere constrained to be 48000 or 96000 samples per second, and because the ability to edit at each and every frame boundary is desired, the edit rates provided herein represent a reasonable approximation of the 'ideal' frame rate while still being compatible with the goal of presenting archive materials with recorded sound.

5.3 Other D-Cinema Engineering Documents (Informative)

Many D-Cinema engineering documents have no dependency on specific frame rate values. This standard anticipates that these engineering documents be supported in the same way as they are for the initial D-Cinema frame rates of 24 fps and 48 fps.

Annex A (Informative) Bibliography

Note: All references in this document to other SMPTE documents use the current numbering style (e.g. SMPTE ST 428-11:2009) although, during a transitional phase, the document as published (printed or PDF) may bear an older designation (such as SMPTE 428-11-2009). Documents with the same root number (e.g. 428-11) and publication year (e.g. 2009) are functionally identical.

SMPTE ST 428-11:2009, Additional Frame Rates for D-Cinema

SMPTE ST 429-2:2009, D-Cinema Packaging — DCP Operational Constraints

SMPTE ST 429-4:2006, D-Cinema Packaging — MXF JPEG 2000 Application

SMPTE ST 429-13:2009, D-Cinema Packaging — DCP Operational Constraints for Additional Frame Rates

SMPTE DC28 Study Group Report on Additional Frame Rates, July 2007