Videotape and Optical Media Identification and Preservation

Webinar October 23, 2013

Linda Tadic
Audiovisual Archive Network
ltadic@archivenetwork.org

1

What Will be Covered

- Physical properties of media
- Preservation issues
- Formats and identification

2

What Will Not be Covered

- Digitization (that's the webinar on October 30)
- Cataloging and metadata

3

Additional Resources

- Bibliography of web-based readings
- Archival video preservation labs vendor list (USA)
- List of current video formats

4

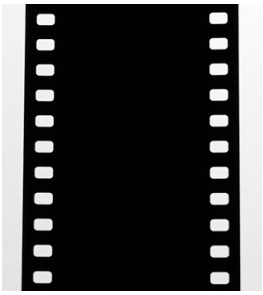
VIDEO

5

Videotape in Brief

If it has sprockets, it's **film** –

not video.



6

Videotape in Brief

Like audiotape, videotape is magnetic media.

Video can come in reel or cassette form – like audiotape.

It can carry both analog and digital signals – like audiotape.

7

Primary Concerns

- Multitude of formats (identification can be difficult)
- Format obsolescence
- Short Life Expectancy (LE)
- Environmental, organic, and human factors contributing to signal degradation

8

How Videotape Started

Thank Bing Crosby.

First funded development of audiotape. In 1950 gave $50,000 to a start-up called Ampex to develop magnetic videotape.

9

How Videotape Started

Original market/users: broadcasting

Like other time-based media, formats for the consumer market quickly followed.

NEVER intended as a preservation medium.

10

Over

60 formats

have been introduced since 1956!!!

11

... and unluckily for you, most are

12

..... obsolete

13

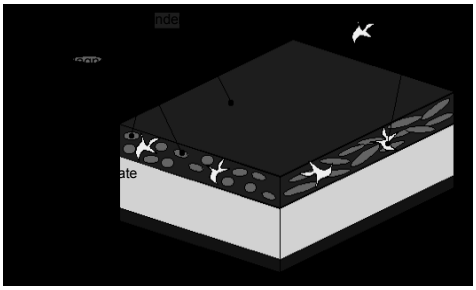
Before Delving Into Formats

Let's understand the general preservation concerns based on videotape's physical properties.

14

Videotape Properties

Van Bogart, *Magnetic Tape Storage and Handling: A Guide for Libraries and Archives*



15

Videotape Properties

- **Backcoat:** thin carbon-black ribbon (since late 1960s).
- Magnetic coating: holds binder, magnetic particles, lubricant

16

Problem Areas

Of the 6 components making up videotape, four can contribute to signal degradation:

- Binder
- Lubricant
- Metal Particles
- Substrate

17

Binder

Holds the magnetic particles. This is the weakest link.

Moisture in the air (high humidity) contributes to hydrolysis ("sticky shed syndrome"). The binder starts breaking apart, and magnetic particles can be "shed" when tape is played.

18

Binder

Shedding tapes can leave debris on video deck heads, damaging subsequent tapes.

Losing magnetic particles from shedding causes drop-outs in the signal.

Example: http://preservation.bavc.org/artifactatlas/index.php/Video_Dropout

19

Binder

Moisture can also create mold on tapes.

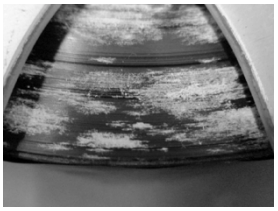


Photo from Quad Tape Transfer: http://www.quadtapexfer.com/Moldex5.php

20

Treating Hydrolysis

Once the binder starts breaking down, it can't be permanently stopped.

Baking tapes at 122°F (50°C) for 3 days will stabilize the binder long enough to transfer the content. Transfer within 1-2 weeks. ***SEEK EXPERT ADVICE***

21

Treating Mold

The mold must be carefully removed from the tapes and the tapes immediately transferred.

Have a professional working with proper equipment perform the cleaning.

Breathing mold can endanger your health.

22

Lubricant

Lubricant helps the tape move through the decks. It will dry out over time; hot and dry environments will accelerate this natural process.

Dry tapes become brittle, and can get stuck in playback decks, damaging the tape.

23

Treating Lubricant Loss

Tapes can be re-lubricated, but should be done by a professional.

Over-lubrication can cause signal loss.

24

Magnetic Particles

Magnetic particles store the information. They are held in the binder.

Any magnetic particle loss is irretrievable.

Magnetic particle degradation evidence: diminished hue/color, reduced sound.

25

Magnetic Particles

Iron oxide. 2″ Quad (earliest formats)

Cobalt-doped iron oxide. Started with 1″ Type C.

Chromium Oxide (CrO_2). Small format cassettes and some VHS.

cf. Wheeler, *Videotape Preservation Handbook*

26

Magnetic Particles and Oxidation

Moisture + oxide = rust

"Oxide"-based magnetic particles can degrade in high humidity environments.

27

Magnetic Particles

Barium ferrite (BaFe). Used in VHS tapes in mid-1990s and Betacam. BaFe has longer LE than MP, but not as efficient for recording.

Metal particulate (MP). Used from BetaSP to the present. Particles are coated for protection against moisture in the air, but not effective when water-damaged.

28

Magnetic Particles

Metal evaporated (ME). ME tapes do not have a binder. Magnetic particles are laid down directly to the tape substrate. Found in small-format cassettes (Hi8, Digital8, DVCAM, MiniDV). Thinner magnetic coating, so tapes more fragile. Repeated plays and leaving tapes in "pause" can damage the tape, resulting in particle loss. Archivists follow "5 play rule," then must transfer.

29

Avoiding Particle Loss

When it's gone, it's gone.

- Keep tapes cool and dry to slow down loss.
- Transfer content from ME tapes as soon as possible.
- Don't leave tapes in pause.
- Don't play ME tapes more than 5 times before transferring.
- Transfer content from tapes with evidence of metal particle loss.

30

Substrate (basefilm or carrier)

Made of polyester of varying thickness. Supports the magnetic coating.

Chemically stable, but can stretch. Stretching can be caused by: poor tape pack and high humidity/temperature.

If stretches, control track can be damaged and tape won't run through the deck.

31

Control Track

Not a physical property, but impacts the readability of an **analog** signal.

Pulse to drive the tape through the VTR according to the speed recorded on the control track. Recorded at the edge of the tape. (Similar to film's "sprockets")

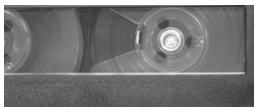
If damaged, there can be drop-outs, freezes, and "glitches" as the tape and VTR lose sync.

32

Avoid Substrate Deformation

- Store tapes in a cool and dry environment
- Make sure the tape has an even "pack" (no popped strands)

BAD!



33

Videotape Conservation

Videotape Life Expectancy (LE): between 5 to 50 years, depending on format, tape stock, and storage environment.

"LE" does not mean total signal loss, but the point where the signal is obviously deteriorating and the content should be transferred.

What can be done to extend LE?

34

Micro Steps

- Set tape cassette to SAVE (e.g., not RECORD). For U-matics, this means removing the red button in the back.

DVCAM

U-matic

35

Micro Steps

- Store standing up (like books). If stored flat, gravity will loosen tightness of tape pack.
- Tapes should have an even, flat wind with no popped strands.

36

Micro Steps

BAD!

- Wind to head or end; never leave the tape exposed.

37

Micro Steps

- Re-house tapes to inert plastic containers. Prioritize re-housing tapes in cardboard containers; cardboard/paper accelerates hydrolysis and mold.
- Remove any paper inserts from inside cases to diminish hydrolysis.

38

Macro Environment (Storage)

- Do not store tapes in non-archival or stock boxes.
- Use metal shelves – definitely not wood.
- Cool and dry environments will slow down deterioration.
- Magnetic media need not be stored in as cold an environment as film.

39

ANSI IT9.23-1996

USE	TEMP	RH
short-term storage (content used daily)	68° F	20-30%
medium-term storage (content used up to 10 years before moved or discarded)	59° F	20-40%
long-term storage	50° F	20-50%

40

Storage General Tips

- Videotape should **never be stored above 65% RH**. At that rate, fungal growth will occur.
- Videotape should **not be stored below 45°F**. Storage below this can result in binder break-down.

41

Storage General Tips

- A higher temperature must be balanced by lower humidity.
- Fluctuations of +/- 5% RH or 7°F within a 24-hour period can cause more damage than consistently high temperature or humidity.

42

Prioritization

The oldest tapes should not necessarily be preserved first.

Besides age, also consider:

- Condition
- Inherent format stability
- Storage environment over a tape's life
- Active use

43

How Would You Prioritize?

2" videoreel	¾" U-matic	MiniDV on ME stock
Recorded 1969 (44 y/o)	Recorded 1975 (38y/o)	Recorded 1998 (15 y/o)
Stored at 65 °F / 35% RH since 1969	Stored at 55° F / 50% RH past 10 years; at 80° F / 60% RH previous 28 years	Stored at 78° F / 45% RH for past 5 years; unknown before
Used a few times in first 5 years, then put in deep storage	Heavily used first 15 years	Heavily used first year; occasional use since
Obsolete format, but a few vendors available	Obsolete format, but old equipment and some vendors available	Active format, equipment available

44

Questions on conservation actions?

45

Format Obsolescence

What does "obsolete" mean?

- Stock is no longer manufactured
- Playback equipment is no longer manufactured and old decks are in limited supply

46

Endangered

A format can be "endangered" rather than obsolete if there is an adequate supply of operating playback decks.

47

Wake-up Call

Review the handout "Video stock and decks manufactured as of October 2013"

48

Digitization as Preservation

You MUST digitize videotapes for preservation.

Do NOT transfer video to video – the content will be moved from one obsolete format to a future obsolete format ("future" as in less than 10 years)

49

Before Transferring

- Know the format
- Identify the tape's maximum running time to help estimate transfer costs and digital storage.
- Identify the tape's broadcast standard: NTSC, PAL, SECAM

50

Format Identification

Learn to identify both the physical format and its required playback equipment.

51

Videotape comes in two "packages:"

Reel

52

Cassette

53

Videoreel Formats

- 2" Quad (1956-1985)
- ½" Portapak (1967-1978)
- 1" Type C (1976-1990s)

54

Ampex VRX-1000 **(2" Quad)** (1956)

Released 1956. Installed at ABC, CBS, NBC.

Recorded black and white (color added few years later)

1957: Ampex won Technical Emmy for VTR

1958: Improved model. Wider distribution.

55

Ampex VRX-1000 (2" Quad)

Cost: $ 45,000 ($363,587 today)

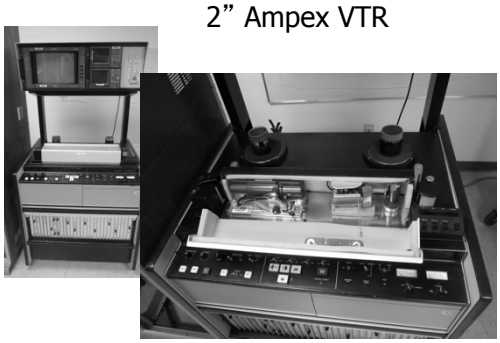
Tape: 1 hr @ $300 ($2,424 today)

# of plays before damage to tape: 30

Photo: Ampex Corporation

56

2" Ampex VTR



57

2" Ampex Tape Threading

58

... Across the head ...

In from the left...

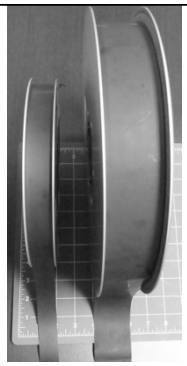
... Out to the right

59

2" reel case

60

1" tape width »



« " width

61

2" Videoreel Sizes and Running Time

- Reel sizes can be 5 inches to 14 inches in diameter.
- Tape maximum running time: 5 minutes to 90 minutes.

See chart: http://www.quadtapexfer.com/ReelSize.php

62

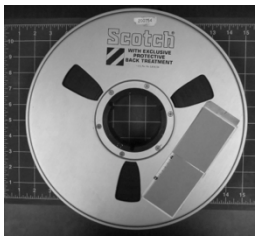
2" Videoreel: Format-Specific Problems

Foam flange deterioration and glue seepage.

Also: Some 2" containers have shedding foam that sticks to the tape.

(for photo examples, see: http://www.quadtapexfer.com/Examfoam.php)

63



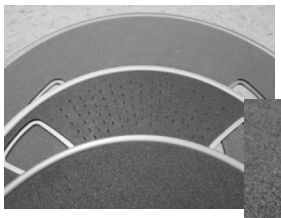
2" foam flange reel

foam not foam

Photo: Quad Tape Transfer

64

Types of foam



Foam deterioration

Shedding foam can stick to tape.

Photos: http://www.quadtapexfer.com/Morefoambreakdowns.php

65

2" Videoreel Summary

Container:	Reel-based
Active date range:	1956-1985
Status:	Obsolete
Stock manufactured?	No
Decks manufactured?	No
Used decks/parts available?	Extremely rare

66

½" Open Reel (1967)

Portapak introduced by Sony in 1967. "Prosumer" format: portable deck with attached camera.

Use: video artists, public access television, schools, military, and ENG (Electronic News Gathering).

Two versions: CV (1965) and AV (EIAJ) (1969). EIAJ-1 became standard.

67

Photo: Scene Savers

EIAJ color deck (1/2" open reel)

[no longer manufactured]

68

Memorex ½ tape case

Photo: Scene Savers

Sony ½ tape case

Photo: Linda Tadic

69

Photo: Linda Tadic

½" open video reel

½ video reel ¼ audio reel

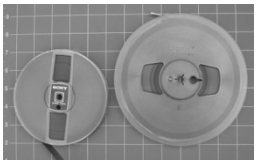


Photo: Linda Tadic

70

½ video tape width

¼ audio tape width

Photo: Linda Tadic

71

½" Open Reel Tape Running Time

- Tape recording time: 30 minutes
- Image can be black and white or color

72

½" Open Reel Summary

Container:	Reel-based
Active date range:	1967-1977
Status:	Obsolete
Stock manufactured?	No
Decks manufactured?	No
Used decks/parts available?	Extremely rare

73

1" Open Reel (Type C) (1976)

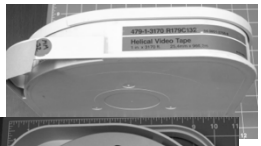
- Developed as more portable studio/ broadcasting format
- Use: in-studio and field (ENG) recordings; common preservation format at archives during late 1980s-1990s

74

1" tape decks

[no longer manufactured]

75



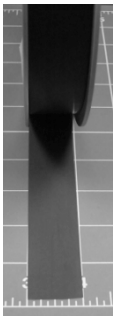
1" video case

76

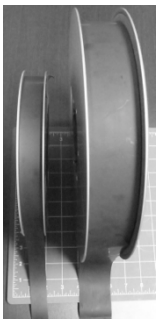
1" tape reel

1" reel 2" reel

77



1" tape width



1" 2"

78

1" Open Reel Summary

Container:	Reel-based
Active date range:	1976-1990s
Status:	Obsolete
Stock manufactured?	No
Decks manufactured?	No
Used decks/parts available?	Yes

79

Videocassette Formats: Common Older

- ¾" Umatic (1971-2008)
- Betamax (1975-1986)
- VHS (1976-current)

80

¾" U-Matic (1971) and U-Matic SP (1986)

- Replaced 16mm for ENG
- Small cassette (20 minutes) and large cassette (30 and 60 minutes)
- Unique problem: Some stock batches in the first 10 years (1971-1981) have noticeable dropouts and signal deterioration

81

¾" U-Matic (1971) and U-Matic SP (1986)

- Visual identification:
  - U-Matic cassette plastic color: gray, black, beige
  - U-Matic-SP cassette color: dark brown
  - Red "record" button (dot) on underside. [REMOVE THIS]

82

U-matic deck

[no longer manufactured]

Some decks are top-loading

U-matic-SP deck

Plays U-matic tapes as well.
[no longer manufactured]

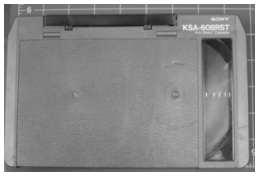
83

U-matic 20 minute small cassette

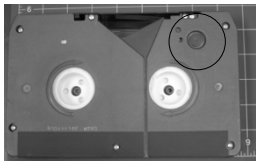
Tape maximum running time stamped on edge

Photos: Linda Tadic

84



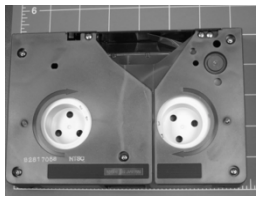
U-matic 60 minute cassette



Back showing red record button – REMOVE THIS

85

U-matic-SP (small cassette)



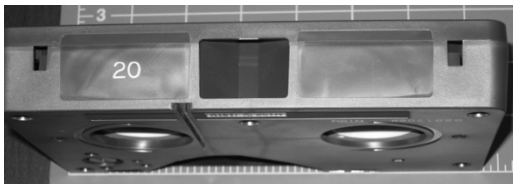
86

Regular U-matic tapes don't have a hole above the red button.

U-matic-SP tapes have a hole above the red REC button.

87

U-matic-SP maximum running time on spine



88

¾" U-matic Summary

Container:	cassette
Tape width:	¾"
Active date range:	1971-2008
Status:	Obsolete/Endangered
Stock manufactured?	No
Decks manufactured?	No (last: 2008)
Used decks/parts available?	Yes, but becoming difficult

89

Betamax (1975)

- First consumer cassette-based format. Developed by Sony
- Use: home movies, schools, local government, event documentation
- Lost the "format war" to VHS.
- However, "Betamax" became the foundation for Sony's "Betacam" suite of formats.

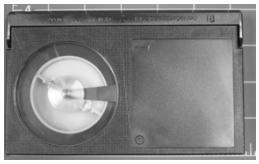
90

Betamax deck [no longer manufactured]

Note it is top-loading

91

Betamax tape



Note the tell-tale "B"

back

92

Betamax Summary

Container:	cassette
Tape width:	½"
Active date range:	1975-1986
Status:	Obsolete
Stock manufactured?	No
Decks manufactured?	No (last: 2002)
Used decks/parts available?	Medium rare

93

VHS (1976)

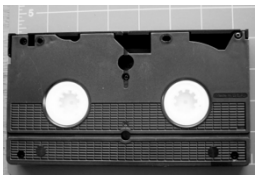
- Consumer cassette-based format. Developed by JVC
- Use: home movies, schools, local government, event documentation
- Tape stock still manufactured today (limited). VCRs only part of combo DVD-VHS units.
- Several other formats similar in size to VHS – beware!

94

Professional VHS deck [no longer manufactured]

95

VHS front



VHS tape maximum running time on spine

WRITE protect tab must be broken off

VHS back

96

VHS Summary

Container:	cassette
Tape width:	½"
Active date range:	1975-2008
Status:	Current
Stock manufactured?	Yes
Decks manufactured?	No (last dedicated deck: 2008); combo units available
Used decks/parts available?	Yes

97

Videocassette Formats: the Betacam Formats

Analog/SD (Standard Definition)

- Betacam (1982-1990)
- BetaSP (1986-2009)

98

Betacam (1982)

- Not to be confused with Betamax, even though uses Betamax shell and is also ½" width.
- First in a professional-grade "suite" of "Beta" formats (used in broadcasting)
- Metal particles: Barium ferrite (BaFe)

99

Betacam tape front

Betacam tape back

REC/SAVE tab

100

Betacam Maximum Running Time

On the spine

Back lower left

101

Betacam Summary

Container:	cassette
Tape width:	½"
Active date range:	1982-1990
Status:	Obsolete
Stock manufactured?	No
Decks manufactured?	No; although tapes can be played in Sony's J30 SDI combo unit
Used decks/parts available?	Medium rare

102

BetaSP (1986)

- SP = "Superior Performance"
- Metal particles: Metal Particulate (MP)
- Professional format (broadcasting)

103

BetaSP decks [no longer manufactured]

BVW-60 player

UVW-1800 recorder

BVW-70 editing VTR

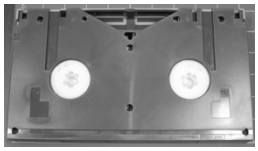
BCB-75 PAL

104

BetaSP tape

front

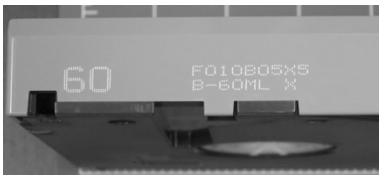
REC/SAVE tab



back

105

BetaSP Tape Maximum Running Time: on cassette lid



106

BetaSP Summary

Container:	cassette
Tape width:	½"
Active date range:	1986-2009
Status:	Endangered (limited use)
Stock manufactured?	Yes
Decks manufactured?	No; although tapes can be played in Sony's J30 SDI combo unit
Used decks/parts available?	Yes

107

Videocassette Formats: the Betacam Formats

Digital/SD (Standard Definition)

- Digital Betacam (DigiBeta) (1993-2012)
- Betacam SX (1996-2011)
- MPEG IMX (2001-2011)

108

Digital Betacam (1993)

- SD
- 3:1 DCT-compressed digital component signal
- 10-bit YUV 4:2:2 – bitrate: 90 Mbp/s
- Professional format; common physical preservation format at archives

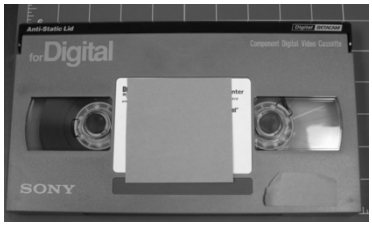
109

DigiBeta deck [no longer manufactured]
Some decks also play Betacam and BetaSP tapes.

DigiBeta tape case (blue)

110

DigiBeta tapes come in 2 sizes: Small (6, 12, 22, 32, 40 minutes) and Large (34, 64, 94, 124 minutes)



111

DigiBeta tape back

REC/SAVE tab

Tape maximum running time

112

Digital Betacam Summary

Container:	cassette
Tape width:	½"
Active date range:	1993-2012?
Status:	Current (but decreasing deck support)
Stock manufactured?	Yes
Decks manufactured?	Not clear; tapes can be played in Sony's J30 SDI and HDWD1800 combo units
Used decks/parts available?	Yes

113

BetacamSX (1996)

- SD
- 15:1 DCT-compressed digital component signal
- MPEG2 4:2:2 – bitrate: 18 Mbp/s
- Professional format; used in broadcast news

114

BetaSX deck [no longer manufactured]
Can also play BetaSP tapes.

Has analog and digital heads.

115

BetaSX cases and tapes are **yellow.**

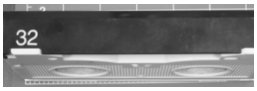
Tapes come in 2 sizes: Small (6, 12, 22, 32, 62 minutes) and Large (64, 94, 124, 184 minutes)

116

BetaSX tape back

REC/SAVE tab

Tape maximum running time



117

BetaSX Summary

Container:	cassette
Tape width:	½"
Active date range:	1996-2011
Status:	Current (but decreasing deck support)
Stock manufactured?	Yes
Decks manufactured?	No; tapes can be played in Sony's J30 SDI combo unit

Used decks/parts available? Yes

118

MPEG IMX (Betacam) (2001)

- SD
- H.262 MPEG2 – bitrate: 30/40/50 Mbp/s (compression: 6:1/4:1/3:1)
- Intraframe (I-frame); individual frames compressed rather than traditional MPEG2's group of pictures (GOP)
- "IMX" is a codec, not just a "tape" format. SMPTE calls it D-10.
- Professional format; used in broadcast news

119

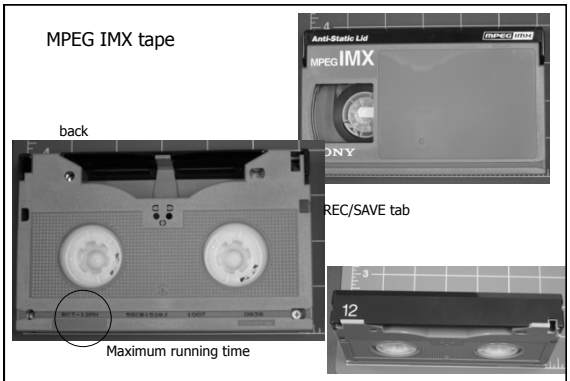
All IMX decks play BetaSX; some decks also play DigiBeta, BetaSP, and Betacam tapes. (Dedicated IMX decks are no longer manufactured)

IMX cases and tapes are **teal/ green.**

Tapes come in 2 sizes:
Small (12, 22, 32, 60 minutes) and Large (64, 94, 124, 184 minutes)

120

MPEG IMX tape



121

Betacam SX

MPEG IMX

122

MPEG IMX (Betacam) Summary

Container:	cassette
Tape width:	½"
Active date range:	2001-2011
Status:	Current (but decreasing deck support)
Stock manufactured?	Yes
Decks manufactured?	No; tapes can be played in Sony's J30 SDI and HDWD1800 combo units

Used decks/parts available? Yes

123

Videocassette Formats: the Betacam Formats

Digital/HD (High Definition)

- HDCAM (1997-current)
- HDCAM SR (2003-current)

124

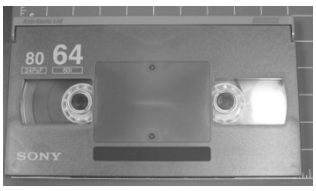
HDCAM (1997)

- HD
- 8-bit DCT compressed 3:1:1 - bitrate: 144 Mbp/s
- 1080i
- Professional format; used by studios, broadcasting, and some archives

125

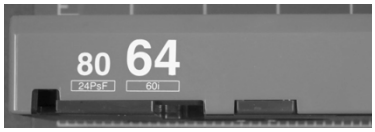
HDCAM tapes have an **orange** lid.

Tapes come in 2 sizes: Small (6, 12, 22, 32, 40 minutes) and Large (34, 64, 94, 124 minutes)



126

The tape has two maximum running times, reflecting two setting options in the camera (24PsF or 60i).



127

HDCAM

DigiBeta

BetaSP

128

HDCAM SR (2003)

- HD (SR = "Superior Resolution")
- 10-bit DCT compressed 4:2:2 (or 4:4:4 RGB) - bitrate: 440 Mbp/s
- 1920 x 1080 (2k resolution)
- Professional format; some TV shows and sports events recorded on it
- 2011 Japanese tsunami interrupted stock production

129

HDCAM SR tapes have a **cyan** lid

Tapes come in 2 sizes: Small (6, 33, 40 minutes) and Large (64, 94, 124 minutes)

Like HDCAM, tapes have two maximum running times.

Photo: tapeonline.com

130

HDCAM & SR Summary

Container:	cassette
Tape width:	½"
Active date range:	HDCAM: 1997- ; SR: 2003-
Status:	Current
Stock manufactured?	Yes
Decks manufactured?	Yes
Used decks/parts available?	Yes

131

Videocassette Formats: the Small Formats

8mm

- Developed for camcorder market.
- Cassettes size of audiocassette
- REC/SAVE tabs on spine side
- Superseded by MiniDV

132

8mm formats

	Video8 (analog)	Hi8 (analog)	Digital8 (digital)
Year introduced	1984	1989	1999
Metal particles	MP	MP and ME	MP and ME
Still manufactured?	No	Yes	Uses Hi8 stock

133

Hi8 deck [no longer manufactured]

134

Hi8 tape (MP)

Maximum running time (120 minutes) and MP

Digital8 cameras use Hi8 tape. Records DV signal at less running time.

A 120M Hi8 tape = 60M DV
Recorded at LP mode = 90M DV

135

Hi8 tape back

REC/SAVE tab

136

Hi8 Metal Particulate (MP)

Hi8 Metal Evaporated (ME)

Photo: Linda Tadic

137

8mm Video Summary

Container:	cassette
Tape width:	8mm (5/16")
Active date range:	1984-2000s
Status:	Endangered
Stock manufactured?	Only Hi8 (limited)
Decks manufactured?	No

Used decks/parts available? Yes but not plentiful

138

Videocassette Formats: DV Formats

- MiniDV (1995) and HDV (2003)
- DVCAM (1995)
- DVCPRO (1995)
- DVCPRO 50 (1997)
- DVCPRO HD (2000)

Tape width: ¼"
All are SD except HDV and DVCPRO HD.

139

MiniDV (1995) / HDV (2003)

- MiniDV captures a DV (e.g., DV25) stream
- MiniDV tapes can be used to record on DVCAM and HDV settings, but there are also HDV and DVCAM-specific media
- HDV captures MPEG 2 at 4:2:0, 720p or 1080i
- Used for ENG, oral histories, home movies
- All MiniDV tapes are ME.

140

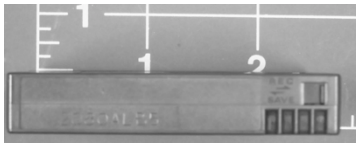
MiniDV tape

Two running times for regular and long play recording.

Note the ME.

141

MiniDV tape back



REC/SAVE window

142

MiniDV tape: used for both DV and HDV recording.

Note the ME!

143

MiniDV Summary

Container:	cassette
Tape width:	1/4"
Active date range:	1995-current
Status:	Current
Stock manufactured?	Yes
Decks manufactured?	Sony combo units: DSR series; HDV/DVCAM VTR

Used decks/parts available? Yes

144

DVCAM (1995)

- Sony developed
- DVCAM captures a DV (e.g., DV25) stream
- Similar to MiniDV, but captures at a higher speed.
- Used for ENG, oral histories
- All DVCAM tapes are ME.

145

DVCAM deck [this model no longer manufactured]

Note it can play MiniDV tapes

146

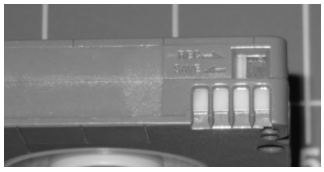
DVCAM tape

Maximum running time: 184 minutes.

Note the ME!

147

DVCAM Record ON



DVCAM Record OFF

148

DVCAM Summary

Container:	cassette
Tape width:	1/4"
Active date range:	1995-current
Status:	Current
Stock manufactured?	Yes
Decks manufactured?	Sony combo units: DSR series; HDV/DVCAM VTR. Panasonic combo unit: AJ series

Used decks/parts available? Yes

149

DVCPRO (1995), DVCPRO 50 (1997), DVCPRO HD (2000)

- Panasonic developed
- DVCPRO: DV @ 25 Mbp/s, 4:1:1
- DVCPRO50: DV @ 50 Mbp/s, 4:2:2
- DVCPRO HD (100): DV up to 100 Mbp/s, 4:2:2
- Used for broadcast news ENG, independent production, oral histories

150

DVCPRO (1995), DVCPRO 50 (1997), DVCPRO HD (2000)

- All DVCPRO media are interchangeable (e.g., can record DVCPRO50 on a DVCPRO tape).
- Tapes give running time for the format listed on the tape.
- All DVCPRO tapes are MP.

151

DVCPRO 50 deck. Also plays DVCPRO, DVCAM, MiniDV.

Need adapter for smaller MiniDV and DVCAM cassettes

DVCPRO HD deck. Also plays DVCPRO, DVCPRO50, DVCAM, MiniDV

152

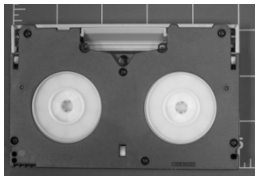
DVCPRO tape lids are **yellow**. DVCPRO50 is also recorded on this media.

Tapes come in 2 sizes: Medium and Large.

Maximum running time varies depending on format shot.
This 66L DVCPRO tape = 66M at DVCPRO, 33M at DVCPRO50, 33M at DVCPRO HD-LP, and 16M at DVCPRO HD

front

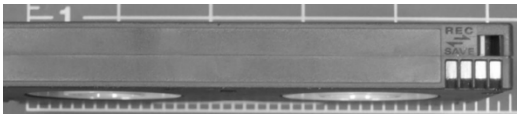
back



153

Maximum running time for regular DVCPRO on tape lid

REC/SAVE window on spine



154

DVCPRO HD tape lids are **red**.

DVCPRO HD is usually captured on DVCPRO HD media, but could also use DVCPRO.

Cassettes come in 3 sizes: Medium, Large, Extra Large.
Maximum running time varies depending on format shot.

This 126M XL tape =

252M at DVCPRO,
126M at DVCPRO50,
126M at DVCPRO HD-LP,
63M at DVCPRO HD

Photo: tapeandmedia.com

155

DVCPRO Summary

Container:	cassette
Tape width:	1/4"
Active date range:	1995-current
Status:	Current
Stock manufactured?	Yes
Decks manufactured?	Yes
Used decks/parts available?	Yes

156

DVCAM

DVCPRO

Hi8

MiniDV

157

Return to the Poll

158

How Would You Prioritize?

2" videoreel	¾" U-matic	MiniDV on ME stock
Recorded 1969 (44 y/o)	Recorded 1975 (38y/o)	Recorded 1998 (15 y/o)
Stored at 65 °F / 35% RH since 1969	Stored at 55° F / 50% RH past 10 years; at 80° F / 60% RH previous 28 years	Stored at 78° F / 45% RH for past 5 years; unknown before
Used a few times in first 5 years, then put in deep storage	Heavily used first 15 years	Heavily used first year; occasional use since
Obsolete format, but a few vendors available	Obsolete format, but old equipment and some vendors available	Active format, equipment available

159

Less Common Formats

- MII
- D1, D2, D3, D5, D9

160

MII (1986-1990s)

- Panasonic developed. Successor to M (1982)
- Competitor to BetaSP
- Analog, SD
- Same cassette shell size as VHS
- Used in broadcasting

161

MII deck [no longer manufactured]

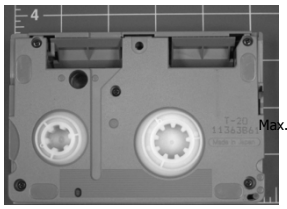
162

MII tape (20 minutes)

front

163

back



Max. running time

REC/SAVE tab

164

MII Summary

Container:	cassette
Tape width:	1/2"
Active date range:	1986-1990s
Status:	Obsolete
Stock manufactured?	No
Decks manufactured?	No
Used decks/parts available?	Rare

165

The "D" Formats

- D1 (1986)
- D2 (1988)
- D3 (1991)
- D5 (SD) (1995)
- D5 (HD) (2007)
- D9 (Digital S) (1999)

166

D-1 (1986)

- Developed by Sony
- Also called "422 Component Digital"
- First major digital format
- Uncompressed 4:2:2 8-bit **component**
- Initial VTR list price: $160,000

167

D-1 deck [no longer manufactured]

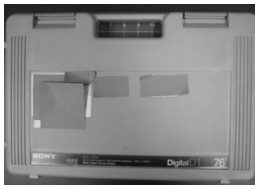
Note it s called "4:2:2 Component Digital"

Both NTSC and PAL settings/.

168

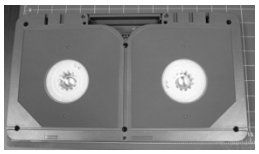
D-1 media is the largest videocassette format you'll likely see.

front



case

Maximum running time: 94 minutes.



back

169

D-1 Summary

Container:	cassette
Tape width:	3/4"
Active date range:	1986-1990s
Status:	Obsolete
Stock manufactured?	No
Decks manufactured?	No
Used decks/parts available?	Rare

170

D-2 (1988)

- Developed by Ampex
- Uncompressed 4:2:2 8-bit **composite**
- Cost was halved from D-1

171

D-2 deck (no longer manufactured)

172

D-2 tape

front

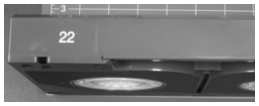
REC/LOCK button

173

D-2 tape

back

Maximum tape running time on lid



174

D-2 Summary

Container:	cassette
Tape width:	3/4"
Active date range:	1988-2003
Status:	Obsolete
Stock manufactured?	No
Decks manufactured?	No
Used decks/parts available?	Rare

175

D-3 (1991)

- Developed by NHK/Panasonic
- Competitor to D-2
- Uncompressed 4:2:2 8-bit **composite**

176

D-3 tape

177

D-3 Summary

Container:	cassette
Tape width:	1/2"
Active date range:	1991-2003
Status:	Obsolete
Stock manufactured?	No
Decks manufactured?	No
Used decks/parts available?	Rare

178

D-5 (1994)

- Developed by NHK/Panasonic
- Uncompressed 4:2:2 **10**-bit **composite**
- D-5 media is used for both SD and HD
- HD: 1080
- 2007: Add-on box to D-5 VTR; records 2k 4:4:4 JPEG2000 [D-5 VTR no longer manufactured]

179

D-5 HD deck [no longer manufactured]

180

D-5 media

Two sizes: Medium and Large

181

D-5 Medium

D-5 Large

Maximum running time depends on whether SD or HD is recorded.

182

D-5 tape back.

Maximum media running time on back left corner.

183

VHS

D-5 Medium

184

D-5 Summary

Container:	cassette
Tape width:	1/2"
Active date range:	1994-2010
Status:	Endangered
Stock manufactured?	Yes
Decks manufactured?	No (last deck: 2010)
Used decks/parts available?	Yes

185

D-9 (Digital-S) (1995)

- Developed by JVC. Called Digital-S; SMPTE changed name to D-9 (1999)
- Competitor to DigiBeta
- Same shell as VHS
- Records DV @ 50 Mbp/s; 4:2:2
- Also HD version (DV @ 100 Mbp/s)

186

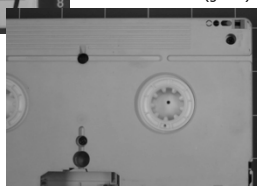
D-9 (Digital-S) deck [no longer manufactured]

187

D-9 (Digital-S) tape

front

REC/SAVE tab (green)

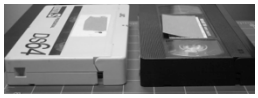


back

188

VHS

D-9 Digital-S VHS



189

D-9 (Digital-S) Summary

Container:	cassette
Tape width:	1/2"
Active date range:	1995-2010
Status:	Endangered
Stock manufactured?	Yes
Decks manufactured?	No
Used decks/parts available?	Yes

190

End of Video

(... literally)

Any quick questions on video format identification?

191

OPTICAL MEDIA

192

Optical Media Formats

- Laserdisc (1971-2001)
- CD (CD-ROM: 1981-; CD-R: 1990-current)
- DVD (1995-; DVD-R: 1997-current)
- Blu-Ray (2002-current)

193

CD-R

- CD-ROM is the commercial distributed format (purchased CDs): read only
- CD-R: recordable media
- CD-RW: "ReWritable:" recordable and erasable

We' ll focus on the recordable media

194

CD-R

- Released 1990; became affordable late 1990s
- Used for storing images, audio, and smaller files
- Storage capacity: 650 – 700 MB

195

CD-R

- CD-R: recordable (write)
- CD-RW: write/erase. Not compatible with all CD devices
- Audio CD-R: early 1990s: distinction between Audio CD-R and data CD-R. Impacts playing devices, although physically these are the same as CD-R

196

DVD-R and DVD+R

- DVD-R: Released 1997
- DVD+R: Released 2002. Recordable (write). Has improved error management; most drives today can play both formats, although DVD video players favor DVD-R
- RW available in both DVD-R and DVD+R

197

DVD-R and DVD+R

- Used for storing images, audio, video, and smaller files
- Storage capacity: 4.7 GB
- Similar construction to CD-R, but two discs glued together

198

DVD-R DVD+R (RW)

199

How It Works

- A laser writes data onto "pits" on the data layer.
- With CD-R and DVD-/+R, the data layer is an organic dye. The dye changes when data is written on it.
- With RW, a phase-changing film is used for the data layer rather than dye.
- Data is written from the inner hub to the outer edge following grooves (like LPs).
- When reading data, the metal reflective layer points the light back to the laser photosensor.

200

CD-R Layers

Top (label) side

Label	
Lacquer	
Metal reflective layer	Gold, silver, silver alloy
Data layer (Organic dye)	Cyanine, phthalocyanine, azo
Polycarbonate substrate	Under (shiny) side (laser writes and reads from this side)

201

DVD-/+R Layers (single side)

Top (label) side

Label	
Polycarbonate substrate	For stability
glue	
Metal reflective layer	Gold, silver, silver alloy
Data layer (Organic dye)	Cyanine, phthalocyanine, azo
Polycarbonate substrate	Under (shiny) side (laser writes and reads from this side)

202

RW Disc Differences

- Data layer is a phase-changing metal alloy film rather than dye
- Metal reflective layer is aluminum
- NOT considered appropriate for long-term storage. Less physically stable; aluminum oxidizes.

203

Problems: Substrate

The reader reads from the under (shiny) side.

- Smudges and dirt can block the laser from reading the data.
- The laser can compensate for minor scratches.
- Moisture is absorbed into the disc through the substrate (can lead to metal layer oxidation)

Polycarbonate substrate

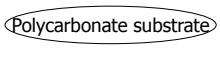
Under side

204

Problems: Substrate

Related issue in DVD-Rs:

The glue holding the two polycarbonate parts together can fail. The DVD can fall apart, or more likely, moisture creeps in.



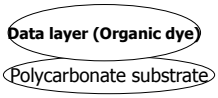
Under side

205

Problems: Data Layer

The data layer is made of organic dye, which is susceptible to fading from UV rays (light) and heat.

If the dye fades, the data can't be read.



Under side

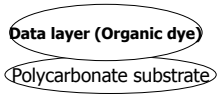
206

Problems: Data Layer

Three types of dye.

1. **Cyanine:** earliest dye.
   Color: on gold metal: green; on silver metal: blue

Tests: Most sensitive to fading of the three.



Under side

207

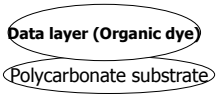
Problems: Data Layer

Three types of dye.

2. **Phthalocyanine.**

Color: on gold metal: gold; on silver metal: silver

Tests: More durable than cyanine.



Under side

208

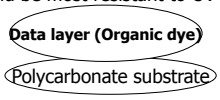
Problems: Data Layer

Three types of dye.

3. **Azo.** Most DVD-R discs use azo dye.

Color: on gold metal: dark green; on silver metal: dark blue.

Tests: Could be most resistant to UV rays.

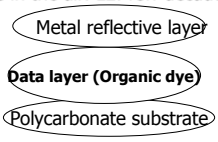


Under side

209

Problems: Metal Reflective Layer

- Gold: non-corrosive; LE 100+ years
- Silver and silver alloy: corrosive; sulfur dioxide pollutants can impact the reflective surface and make the data difficult to read. Sulfur dioxide can attach itself to moisture in the air. LE: few decades



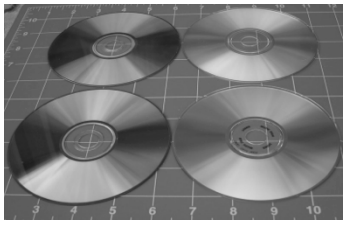
"Disc rot" and mold occur on media with an aluminum metal layer (ROM, RW)

210

"Under" (Write) Side

DVD-R (Azo dye on silver alloy)

DVD+R(RW) (Azo dye on aluminum)



CD-R (Phthalocyanine dye on silver alloy)

CD-R (Phthalocyanine dye on gold)

211

Problems: Label Side

Top (label) side

Scratches on the label side can harm the metal reflective layer (CDs & double-sided DVDs)

Label

Lacquer

Metal reflective layer

Labels adhered to media can accelerate deterioration

Data layer (Organic dye)

Polycarbonate substrate

Under side (laser writes and reads from this side)

212

Blu-Ray (BD-R)

- BD-RE: Released 2002; BD-R: Released 2005
- RW is called "RE" for Recordable Erasable (BD-RE)
- Used for storing images, audio, HD video, and larger files
- Storage capacity: 25 GB for single layer
- Dual layer (DL) capacity: 50/100/128 GB

213

Blu-Ray Differences from DVD and CD

- The laser is blue-violet (higher frequency) rather than the red used in DVDs -- hence the name "Blu-Ray." (The CD laser is infrared)
- The dye is **in**organic, and is not affected by UV light. EXCEPT:
- **BD-RE LTH** uses **organic** dye (less expensive to produce)

214

BD-RE

BD-R **LTH**

BD-RE DL (50 GB)

215

BD-RE and XDCAM

- XDCAM is a Blu-Ray-based format used in broadcasting.
- Used to shoot ENG and deliver content.
- Higher read/write speeds than consumer BD-RE

216

Problem Areas Impacting Data Readability

- Organic dye (fades in light and heat)
- Metal reflective layer (can corrode from high humidity and pollutants)
- Media obsolescence
- Poor handling (fingerprints, scratches)
- Writing on the media (ink and scratches)
- Erasing files on RW/RE discs

217

Optical Media Conservation

Life Expectancy (LE): between 2 to 100 years, depending on metal layer, dye, quality of writing/recording, and storage environment.

What can be done to extend LE?

218

Micro Steps

- Re-house media in inert polypropylene jewel cases.
- Remove any paper inserts from inside the case.
- Store upright like books.

219

Micro Steps

- Do not write directly on the media recording area (top or bottom sides).
- Do not affix labels to the top label side.
- Only write identifying characters on the inner plastic hub, using a water-soluble pen.

220

Micro Steps

- Don't touch the under (recording) side.
- Remove fingerprint smudges with a chamois cloth and isopropyl alcohol.
- Clean in a straight motion, going from the hub out. Don't clean following the grooves; you could inadvertently create groove-like scratches that the laser will follow.

221

Micro Steps

- If recording to media, don't fill up the disc. Leave "blank" space at the edges in case of edge damage (media writes from the hub to the edge)
- Do not use RW media
- For longer life expectancy, use gold media with **phthalocyanine dye.**

222

Macro Environment (Storage)

Keep out of the light!!! UV rays will cause the dye (data layer) to fade.

Store in archival boxes. Do not store discs in non-archival or stock boxes.

Use metal shelves – definitely not wood.

223

Macro Environment (Storage)

Temperature/RH recommendations vary.

Temperature: 41-68° F
RH: 30-50% RH

224

Obsolescence

Optical media formats will likely become obsolete long before the media dies.

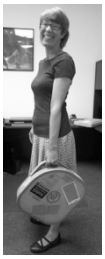
225

Get the Content Off!

As with any AV media, focus on preserving the **content**, not the physical object.

Copy files from optical media to HDDs or servers.

226



Thank You

Photo credits:

Unless otherwise credited, video tape formats and decks were photographed at Alteran Technologies and BroadcastStore.com. Thanks Lou, Norm, and Lance!
Photographer: Mark Steinberger

Other photos:

Scene Savers (1/2" open reel Memorex tape and Sony deck)
Quad Tape Transfer (2" reel problems)
Linda Tadic (optical media, ½" Sony tape, Hi8 media)

227