

Audio Reformatting Equipment and Workflow Steps

Important: Please note that these recommendations for equipment and processing are based on budgetary needs first, and then proximity to best practices given those budgetary constraints. For documentation on best practices with optimal tools, see *Sound Directions*.¹

Included in this document:

1. Audio CD to Editable File Migration
2. Analog to Digital Audio Cassette Tape Conversion
3. Analog to Digital ¼ Inch (Reel-to-Reel) Tape Conversion
4. Analog to Digital Phonograph Conversion
5. Field Recording Equipment
6. PCM Stereo file size calculations.

Please note: All equipment included in this are recommended as examples based on the experiences by partners in the Digital Library of the Caribbean using this equipment. This document should not be taken as an endorsement of any manufacturer's product. Those using this as a guide for their own purchases should be cautioned that equipment suited to each institution's specific needs, source materials, or fitness-for-purpose determinations may not be suited to another's. All prices are based on current estimates and are listed in USD.

¹ See Sound Directions, <http://www.dlib.indiana.edu/projects/sounddirections/> and Harvard College Library, Audio Preservation Studio's multiple project reports: <http://hcl.harvard.edu/libraries/loebmusic/aps/>

1. Audio CD to Editable File Migration

Standard Audio CDs are structured differently from normal computer media. In order to preserve files from an audio CD, the files must first be extracted or ripped from the audio format. After the files are extracted, they can be handled as computer files for the purposes of preservation processing.

To share the files or make copies after reformatting, copyright clearance or permissions are required. Where the audio files are under copy protection in addition to the standard copyright, ripping CDs that are under copyright protection for purposes of copyright violation is strictly forbidden by copyright rules in the US under the Digital Millennium Copyright Act (DMCA).

To make a preservation or backup copy of a CD or to migrate a CD that is not under copyright:

Equipment and Software for Windows:

Computer running Windows 7 or above, with a writable CD/DVD drive.

Windows Media Player 9 or above.

Workflow

1. Insert the CD into the CD drive
2. Open Windows Media Player
3. Select the CD drive from the menu, making sure that the CD file names are listed in the album column.
4. Select "Rip settings" > Format > Wav (lossless)
5. Select "Rip settings" > Audio Quality > Best Quality
6. Select "Rip settings" > More options > and choose the location to save the Wav files.
7. Select "Rip CD"
8. Files from the CD will be saved/ripped to the computer as Wav files into the folder you have chosen in the preferences settings
9. Open the WAV files in Audacity and, from the original master WAV files, you can make derivative (lossy) audio files (MP3, WMA, OGG Vorbis) that are smaller in size and compressed, but may act better as online service copies for download and distribution. Audacity can be downloaded free, and the separate Lame ff-mpeg encoder pack must be installed to export Mp3 and some other types of files.

<http://www.audacityteam.org/download/windows>

Equipment, software, and workflow for this process using a Macintosh running OSX and above and on a Linux machine are explained on the Audacity website:

<http://manual.audacityteam.org/man/faq.html>

2. Analog to Digital Audio Cassette Tape Conversion

Equipment:

Dual-tape cassette deck with noise reduction; microphone input (with recording control); and variable pitch speed control

~\$150 - \$250 (Recommended: TEAC W865R Double Auto-Reverse Cassette Deck).

Large, over-ear headphones (preferable to in-ear headphones) with or without noise-canceling function.

~\$20 - \$150 (Recommended: Grado SR80e Prestige Series Headphones).

PC Sound card with support for at least 96kHz/24-bit sampling (Current minimum library best practices)

~\$50 - \$300 (Recommended: Creative Labs Sound Blaster Series Sound Card)

Audio editing/recording software

~Free - \$500 (Recommended: Audacity (as above, a free program distributed under the GNU GPL)

Installation:

Connect cassette deck to PC sound card:

Connect RCA end of RCA-to-Mini cable to cassette deck's OUTPUT; connect mini end of RCA-to-Mini cable to PC sound card's line in/mic in port.

Sample Workflow (assuming use of Audacity)

Recording an audio cassette tape:

1. Turn on cassette deck.
2. Insert the tape into the cassette deck and play it, so as to assess its native quality (using headphones).



3. Once satisfied, rewind tape and prepare Audacity software for recording.
4. Open Audacity program.
5. In main program window, select input device (your sound card)
6. Set sample quality (lower left of main screen) to desired rate (44.1kHz is default, and the highest sampling rate an audio CD can accommodate; for the purposes of making archival master audio files, 96kHz is recommended).
7. In order to properly sync the playback device (cassette deck) and Audacity, it may be necessary to begin recording with Audacity by clicking the red RECORD button prior to pressing play on the cassette deck. Doing so will give you a few seconds of lead-in time which will make post-processing and editing much easier).
 - a. Click on the red RECORD button in Audacity
 - b. After a few seconds, press play on your playback device.
8. When the tape comes to an end, you may do one of two things:
 - a. Press the yellow STOP button to cease recording, at which point the current track will end.
 - b. Press the blue PAUSE button to pause the recording, which is useful if you need to flip the cassette over to the alternate side, at which point you can begin recording that side on the same track.
 - i. If your cassette deck is equipped with auto-reverse, pausing the recording may not be necessary, as the tape's alternate side will begin playing back automatically.
9. When you are finished recording your track, you should save your project (File > Save Project) and either perform post-processing/editing, or save it for later.
10. When you are satisfied with your edits, export the track as a WAV or AIFF file (both lossless and uncompressed [settings for bitrate can be changed in Edit > Preferences]). This should serve as your archival master. From it you can make derivative (lossy) audio files (MP3, WMA, OGG Vorbis) that are smaller in size and compressed, but may act better as online service copies for download and distribution.

Further information from Audacity's wiki on conversion and editing:

<http://manual.audacityteam.org/man/faq.html>

3. Analog to Digital ¼ Inch (Reel-to-Reel) Tape Conversion

Equipment:

¼ inch tape two-track analog recorder/player (reel-to-reel), with pitch control, RCA output, headphone jack

~Prices vary. Only a handful of companies still manufacture ¼ inch reel-to-reel players/recorders (Otari, Inc., Nagra), and at very high prices. It might be easier to acquire an older player/recorder at less cost, most of which are fairly reliable.

(Recommended: TEAC TASCAM 32 - a popular pro-series model with a strong reputation of reliability)

Large, over-ear headphones (preferable to in-ear headphones) with or without noise-canceling function; 1/8 inch to 1/4 inch adapter

~\$20 - \$150 Recommended: Grado SR80e Prestige Series Headphones.

PC Sound card with support for 96kHz/24-bit sampling

~\$50 - \$300 (Recommended: Creative Labs Sound Blaster Series sound card).

Audio editing/recording software

~Free - \$500 Recommended: Audacity, a free program distributed under the GNU GPL)

Installation:

Connect reel-to-reel player to PC sound card:

Connect RCA end of RCA-to-Mini cable to player/recorder's OUTPUT; connect mini end of RCA-to-Mini cable to PC sound card's line in/mic in port.

Sample Workflow (assuming use of Audacity)

Recording a 1/4 inch tape:

1. Turn on player/recorder.
2. Load tape spool onto left side of player/recorder (loading directions may not consistent across all legacy player/recorders) play it, so as to assess its native quality (using headphones).
3. Once satisfied, rewind tape and prepare Audacity software for recording.
4. Open Audacity program
5. In main program window, select input device (your sound card)
6. Set sample quality (lower left of main screen) to desired rate (44.1kHz is default, and the highest sampling rate an audio CD can accommodate; for the purposes of making archival masters, 96kHz is recommended).
7. In order to properly sync the playback device (reel-to-reel) and Audacity, it may be necessary to begin recording with Audacity by clicking the red RECORD button prior to pressing play on the cassette deck. Doing so will give you a few seconds of lead-in time which will make post-processing and editing much easier).
 - a. Click on the red RECORD button in Audacity
 - b. After a few seconds, press play on your playback device.

8. When the tape comes to an end, you may do one of two things:
 - a. Press the yellow STOP button to cease recording, at which point the current track will end.
 - b. Press the blue PAUSE button to pause the recording, which is useful if you need to play the alternate side of your ¼ inch tape, at which point you can begin recording that side on the same track.
9. When you are finished recording your track, you should save your project (File > Save Project) and either perform post-processing/editing, or save it for later.
10. When you are satisfied with your edits, export the track as a WAV or AIFF file (both lossless and uncompressed [settings for bitrate can be changed in Edit > Preferences]). This should serve as your archival master audio file. From it you can make derivative (lossy) audio files (MP3, WMA, OGG Vorbis) that are smaller in size and compressed, but may act better as online service copies for download and distribution.

Further information from Audacity's wiki on conversion and editing:

http://wiki.audacityteam.org/wiki/Transferring_tapes_and_records_to_computer_or_CD

4. Analog to Digital Phonograph Conversion

Equipment:

Belt-driven turntable capable of playing at both 33-1/3 and 45 rpm; integrated pre-amp with line output; USB output

~\$130 - \$300 (Recommended: ION TTUSB05 LP Conversion System)

Large, over-ear headphones (preferable to in-ear headphones) with or without noise-canceling function; 1/8 inch to ¼ inch adapter

~\$20 - \$150 (Recommended: Grado SR80e Prestige Series Headphones).

PC Sound card with support for 96kHz/24-bit sampling

~\$50 - \$300 (Recommended: Creative Labs Sound Blaster Series sound card).

Audio editing/recording software

~Free - \$500 (Recommended: Audacity, a free program distributed under the GNU GPL)

Installation:

A. Connect turntable to PC sound card:

Connect RCA end of RCA-to-Mini cable to turntable's OUTPUT; connect mini end of RCA-to-Mini cable to PC sound card's line in port.

B. Connect turntable to PC via USB cable (plug-and-play)

Connect one end of USB cable to turntable's USB output; connect other end to an available USB port on PC.

Sample Workflow (assuming use of audacity and RCA output)

Recording a vinyl record:

1. Turn on turntable.
2. Set record on platter and set rpm, lift tone arm and place it at edge of record and play it, so as to assess its native quality (using headphones).
3. Once satisfied, stop record.
4. Open Audacity program
5. In main program window, select input device (Sound card)
6. Set sample quality (lower left of main screen) to desired rate (44.1kHz is default, and the highest sampling rate an audio CD can accommodate; for the purposes of making archival masters, 96kHz is recommended).
7. In order to properly sync the playback device (reel-to-reel) and Audacity, it may be necessary to begin recording with Audacity by clicking the red RECORD button prior to pressing play on the cassette deck. Doing so will give you a few seconds of lead-in time which will make post-processing and editing much easier).
 - a. Click on the red RECORD button in Audacity
 - b. After a few seconds, lower the tone arm of turntable onto desired track.
8. When the track comes to an end, you may do one of two things:
 - a. Press the yellow STOP button to cease recording, at which point the current track will end.
 - b. Press the blue PAUSE button to pause the recording, which is useful if you want to cue the turntable's tonearm to create dead air between tracks.
9. When you are finished recording your track, you should save your project (File > Save Project) and either perform post-processing/editing, or save it for later.

*Alternately, you may record a record using the player/recorder's USB connection either via Audacity (by selecting USB as your input) or the turntable's included software.

When you are satisfied with your edits, export the track as a WAV or AIFF file (both lossless and uncompressed [settings for bitrate can be changed in Edit > Preferences]). This should serve as your archival master audio file. From it you can make derivative (lossy) audio files (MP3, WMA, OGG Vorbis) that are smaller in size and compressed, but may act better as online service copies for download and distribution.

Further information from Audacity's wiki on conversion and editing:

http://wiki.audacityteam.org/wiki/Transferring_tapes_and_records_to_computer_or_CD

5. Field Recording Equipment

2 - 6 channel field recorder; able to capture uncompressed PCM audio at least 24-bit/96kHz; w/4+ hours of recording time on a single battery array and a high-capacity storage option.

Recommended 2 channel: Marantz Professional PMD-661 MKIII Handheld Solid-State Recorder with File Encryption and Built-In Stereo Condenser Microphones. Model PMD661MKIII. (~\$500)

Recommended 6 channel: Marantz PMD-706 Professional 6-Channel DSLR Recorder Recording up to 96kHz/24-Bit (~\$400)

*Note: XLR cables and ports are single-channel (mono), thus, two channels are required to achieve stereo sound from a single microphone; ¼" stereo cables and ports are dual-channel and require one port to achieve stereo sound.

Rugged, multi-purpose, directional dynamic microphone (with stand)

Recommended: Sennheiser e825 S (~\$120)

Over-ear headphones (preferable to in-ear headphones) with or without noise-canceling function.

~\$20 - \$150 Recommended: Grado SR80e Prestige Series Headphones.

Post-processing software (can be used in lieu of tabletop mixer, power and flexibility varies by package)

Recommended: Audacity (light mixing) (Free); Acoustica (~\$24)

6. PCM Stereo file size calculations

Formula: Bits per sample x samples per second = bits per second x 2 channels = bits per second of stereo / 8 = Bytes per second of stereo x 60 seconds = Bytes per minute of stereo x 60 minutes = Bytes per hour of stereo.

24 bit, 96KHz, Stereo: [576 KB per second; 34.56 MB per minute; 2.07 GB per hour]

24 bits per sample x 96,000 samples per second = 2,304,000 bits per second x 2 channels = 4,608,000 bits per second of stereo.

4,608,000 bits per second / 8 = 576,000 Bytes per second x 60 seconds = 34,560,000 Bytes or 34.56 MB per minute of stereo.

34.56 MB per minute of stereo x 60 minutes = 2.07 GB per hour of stereo.