**Bentley Historical Library - University of Michigan**
1150 Beal Avenue
Ann Arbor, MI 48109-2113
(734) 764-3482 Fax (734) 936-1333

About Reel-to-Reel Tapes and the Bentley's digitization process

This document serves to inform researchers on how we digitize reel-to-reel tapes and explains how the digitized content made available to researchers was produced. Additionally, it provides a brief history and context on the construction and use of reel-to-reel tapes. Depending on the type of tape and the person who recorded it, each tape could result in a number of digitized audio files. During digitization, we asked our vendor to separate individual segments within a single reel if the speed, fidelity, or layout of the tape changed. In addition to digitizing the tape, we requested an assessment of each tape, a cleaning of the tape, images of the front and back of container, the reel itself, and any additional papers or programs inside the box. We did not request individual content to be divided up into separate files. Once digitized, the file was saved as an archival master .wav file with no manipulation, then a production master .wav file that was normalized to compensate for some variation in volume, and then finally an access mp3 file that would be made available to researchers. As a result, our specifications meant that a single reel-to-reel tape could produce a number of files as depicted in the below figure.
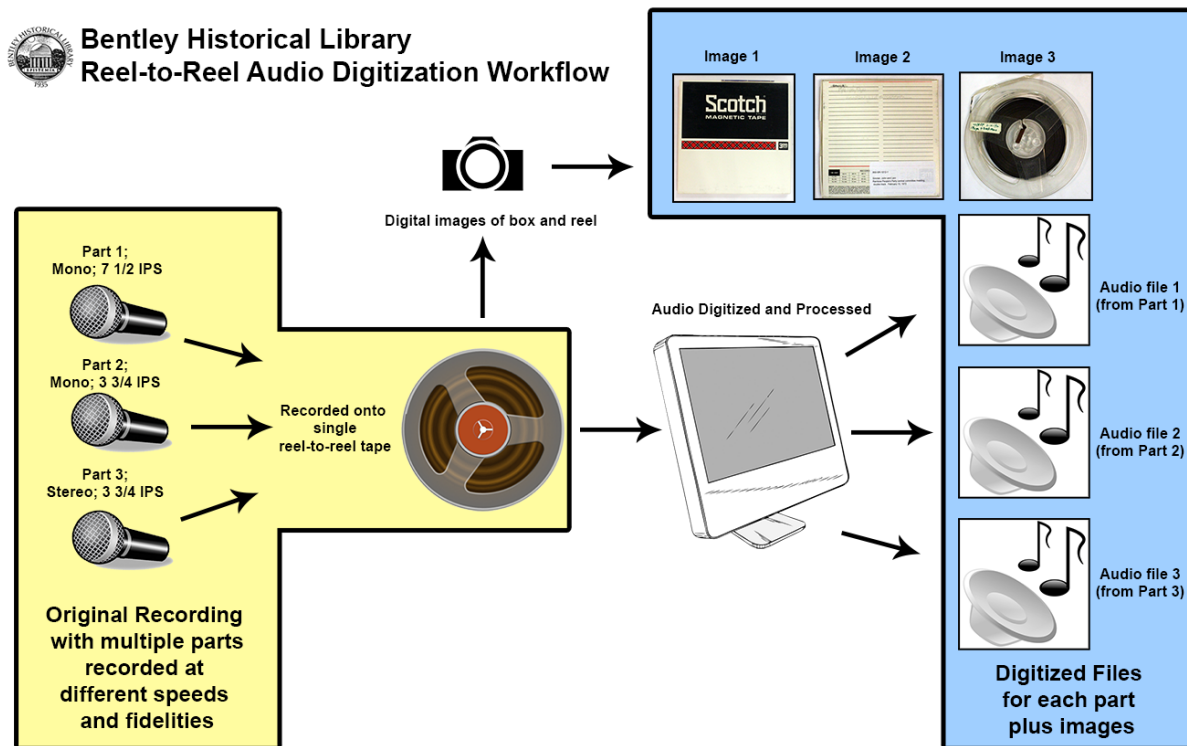

Our digitization workflow. Items in the yellow box represent original recordings; the blue box shows digitized files made available to the researcher.

History of Reel-to-Reel Tapes

Reel to reel magnetic tapes were developed in Germany in the 1920s and 30s and saw use by German forces during World War II. After the war, this equipment was captured and adapted in

the United States and continued used into the 1990s. General professional recording continued up until the 1990s while amateur recording tapered off in popularity by the 1980s with the increased prevalence of the compact cassette tape. Some recording engineers continue to use reels for specialist purposes or to achieve a "vintage" sounding recording, but the format is largely obsolete. Reel-to-reel's ability to be edited, spliced, reused, and manipulated made this an ideal format for professional music production, dictation, radio broadcast, field recordings, interviews, and meetings. On the flip side, this also means that a single reel can be full of varied, unknown, or unexpected content that requires special equipment and expertise to extract.
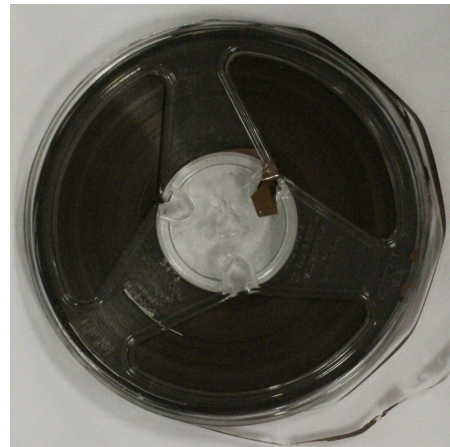

Left: A NAB Reel for professional recording; Right: Plastic reel used by both professional and amateurs

Reel sizes

Sizes of reels can vary. Typical sizes range from a radius of 3, 5, and 7 inches for amateur recordings to 10.5 and 16 inches, which tend to be specific to professional recording. Other sizes were in use in Europe and elsewhere, but the aforementioned sizes were the most common. Professional recordings tended to be housed in metal reels called NAB reels. NAB stands for National Association of Broadcasters, a trade organization that pioneered to use of reel-to-reel tape in broadcasting and recording and developed professional standards that were used in recording throughout the United States. Amateur and commercially available reels tended to be housed in transparent plastic or thinner metal reels and were more susceptible to damage through rusting or breaking.
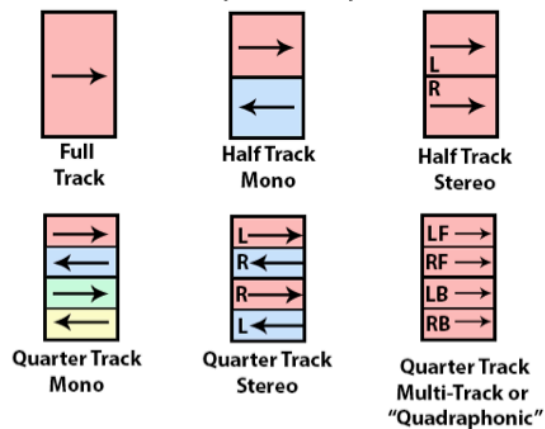
Based in part on the figure "Open Reel Quarter Inch Track Configurations" from Mike Casey's FACET Report.

Mono vs. stereo vs. quadraphonic:

Depending on the type of recording and playback device, engineers could capture and divide audio amongst different "channels" to create a sense of multiple voices or "surround sound." The most common types of channel divisions encountered with reel-to-reel tapes are mono, stereo, and multi-track, also known as "quadraphonic." A mono recording combines all the captured sound into a single recording, while a stereo recording combines the captured sound into two channels to make up a single recording. Less commonly, "Quadraphonic" sound was desired, where the captured sound is divided into four separate channels and then played back on four speakers in each corner of the room. This creates a "surrounding" effect for the listener. Reel-to-reel tapes can create any of these effects by recording on specific tracks of the tape. Most audio equipment and digital audio is suited for stereo or mono playback. Home audio equipment, mp3 players, televisions, and radios support both stereo and mono recordings but special equipment is necessary for the recording, playback, and digitization of multi-track recordings

Tracks

Unlike with CDs and modern music recordings where the term "track" refers to a means to divide content or songs, reel-to-reel tracks are the bands along the tape that are recorded upon. Three common types of track layout were manufactured and used by sound engineers to create a desired audio effect or to get the most use out of the tape. These types of tapes are called full track, half-track, and quarter-track. A full track is a single track along the entire tape producing a single mono recording. A half-track tape divides the tape into two separate tracks that can either produce two mono recordings running in opposing directions, or a single stereo track running in the same direction. A quarter track tape divides the tape into four tracks and could create four mono recordings running in two alternating directions, two stereo recordings running separate directions together, or a single quadraphonic multi-track recording with all tracks running in the same direction. We instructed our vendor to create a new digital file each time unique content was found on a different track and to maintain the mono/stereo/multi-track division as originally represented on the tape.

Speeds

Tapes could be recorded at a number of different speeds and sometimes at multiple speeds along different tracks of the tape. We instructed our vendor to create a new digital file each time the speed changed. Higher speed meant more tape used, but higher audio quality. Lower speed meant less tape used and lower audio quality. The common speeds used for reels are: 1 ⅞ ips (inches per second), 3 ¾ ips, 7 ½ ips, 15 ips, 30 ips. Speed also plays a factor in how many segments result. A higher recording speed was commonly used for professional music recordings or other conditions when quality was a priority. A slower speed sacrificed quality, but allowed for longer recordings and conserved tape. Speeches, stenographic transcriptions, or meetings were typically recorded at the slowest possible speed to conserve tape.

If the tape was recorded at a slow-enough speed, the recording could be several hours long, creating an archival .wav file several gigabytes in size. As a result, the digitized file was then broken up into two separate audio files due to restrictions on the .wav format used for digitization for certain computer operating systems that work in 32-bit environments. The two divided segments each became an individual access mp3 file made that we made available to the researcher.

Sources

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