

## Chapter 2 – Copying the Original: 78 RPM Records

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First, some general copying guidelines:

1. CRT monitors are terrible noise sources. LCD monitors are much quieter. If you are using a CRT monitor it's important to keep your turntable, reel-to-reel tape deck or audio cassette deck at least four feet from the monitor.
2. Operating your monitor (especially if it's the CRT type) on a line-isolation transformer may help to reduce the noise. Also reversing the monitor's mains cord plug and/or the turntable or tape deck plug may help. (I've seen a plug reversal make a 6 dB noise level difference so it pays to experiment.)
3. Power your computer and monitor on a different electrical circuit from the one powering your audio playback equipment. Have an electrician put in a new circuit if this is needed.
4. Copy the original source to a WAV file format: at least 16-bit stereo and 44,100 samples per second. This is the "Red Book" standard for CDs. You can copy at a higher resolution and a faster sample rate and then use your audio editing software to convert to the Red Book standard but it's doubtful that any of your source material will benefit from the extra time and hard drive space needed to do this.

### 78 RPM Records

You will need a good quality turntable with speed control from 70 to 80RPM [1], a preamplifier with selectable equalizations [2], a computer with a good quality sound card [3], a program to copy the sound card output to your hard drive [4], and (VERY IMPORTANT) good quality cables to connect the preamp output to the sound card's line-in connectors [5]. 78s are mono but I prefer to copy them in stereo because I have found it easier to do the "clean up" – that is, removing the clicks, crackle, pops and noise.

Most modern turntables include a stroboscope for setting the speed built into the outer edge of the turntable for setting 33-1/3, 45 or 78 RPM (depending on which speeds the turntable has). However, if you need one please see reference [6] -- they are very inexpensive. 78 RPM was not really a standard, just a sort of average, as some labels were intentionally recorded either slow or fast for one reason or another. (Maybe the recording engineer's breakfast didn't agree with him that morning.) The following may help but, in practice, I've found it doesn't make much difference. I have listened to the same "78" record at speeds from 75 to 82 RPM and frankly I can't tell what speed was used for recording. Of course, I don't have perfect pitch so some folks may be offended by a slightly off key performance.

Berliner, Zonophone, early Victor	71.29 RPM
Victor acoustic (through the mid '20s)	76.59

The supposed “standard”	78.26
Acoustic, Columbia, Edison, Pathe, Emerson, Brunswick and Okeh	80 RPM

As a starting point, set the equalization according to the record label (and year if you know when it was recorded and it’s in the table). With the sound card line-in volume control set to about 90% start your computer recording program (16-bit stereo, 44.1 kHz sample rate) and play the record through once without saving the recording file to set the volume level using the preamp’s volume control. The program will have a bar graph or other indicator to display the peak amplitude. Adjust the preamp volume control so the maximum peak is 2 or 3 dB below the maximum input. Then play the record through again and save the recording file to your hard drive. I like to use a simple, descriptive name when saving the file, such as, side1.wav for the front or “A” side and side2.wav for the back or “B” side. (Different sound card brands have different maximum input levels. If you can’t set the max peak as high as 2 or 3 dB below the max input, you will either have to live with what you can get or get a preamp with a higher max gain.)

The following chart provides the equalization curves for the (maybe) accurate reproduction of early LPs and all electrical 78s. Starting in 1955, all LPs use the standard RIAA curve, which is built into all new preamps. Acoustic 78s were made without any equalization.

“Turnover” is the frequency below which the record manufacturer diminished the bass when mastering the disc. So these frequencies need a corresponding boost during playback.

“Rolloff” is often defined as the amount of treble cut (diminishment) at 10 kHz needed during playback to compensate for the boost added during recording. However, it’s easier (in my opinion) to look at this as the corner frequency of a lowpass filter that produces the needed amount of cut at 10 kHz. Hence rolloff is also a frequency in this chart. A corner frequency of 1600 Hz provides about 16 dB of cut at 10 kHz, 2122 Hz provides 13.7 dB cut, 2700 Hz provides 12 dB cut, 5500 Hz provides 7 dB cut and 6360 Hz provides 5 dB of cut.

78 RPM equalizations were not standardized and were sometimes left to the preference (whim?) of the recording engineer so there may be considerable variation from one disc to another or one year to another even for the same brand name. You can make adjustments using another equalization curve: decrease the turnover frequency if the bass sounds too thin, or increase the rolloff frequency if the treble is too strong.

The numbers in parentheses are the closest settable frequencies in the TDL® models 407 and 408 preamps.

### Equalization Chart for Pre-1955 LP Records

	Turnover	Rolloff
Angel	500 Hz	2700 Hz

Audio Fidelity	500 Hz	1600 Hz
Bach Guild (501 - 529)	500 Hz	1600 Hz
Bartok 301-304, 309, 906-920	629 Hz (500)	1600 Hz
Boston	500 Hz*	1600 Hz
Caedmon 1001-1022	629 Hz (500)	1600 Hz
Capitol	400 Hz	2700 Hz
Capitol-Cetra	400 Hz	2700 Hz
Cetra-Soria	500 Hz*	1600 Hz
or	400 Hz	2700 Hz
Colosseum	400 Hz	2700 Hz
or	500 Hz*	1600 Hz
Columbia	500 Hz*	1600 Hz
Concert Hall	400 Hz	2700 Hz
or	500 Hz*	1600 Hz
or (until 1954)	500 Hz**	5500 Hz (-8.5 dB)
Decca	400 Hz	2700 Hz
Decca (until 11/1955)	500 Hz*	1600 Hz
Decca FFRR (1951)	300 Hz (200 or 400)	2122 Hz (RIAA)
Decca FFRR (1953)	450 Hz (500)	2700 Hz
Ducretet-Thomson	450 Hz (500)	2700 Hz
EMS	375 Hz (400)	2700 Hz
Epic (until 1954)	500 Hz*	1600 Hz
Esoteric	400 Hz	2700 Hz
Folkways	500 Hz*	1600 Hz
Haydn Society	500 Hz*	1600 Hz
HMV	500 Hz*	1600 Hz
London (up to LL-846)	450 Hz (500)	2700 Hz

London International	450 Hz (500)	2700 Hz
Lyrichord	500 Hz*	1600 Hz
or	400 Hz	1600 Hz
Mercury (until 10/1954)	400 Hz	2700 Hz
MGM	500 Hz	2700 Hz
Oceanic	500 Hz*	1600 Hz
Oiseau-Lyre (until 1954)	500 Hz*	5500 Hz (-8.5 dB)
Overtone	500 Hz	1600 Hz
Polymusic	500 Hz	1600 Hz
RCA Victor (until 8/1952)	500 Hz	2700 Hz
Remington	500 Hz	1600 Hz
Urania (most)	500 Hz*	1600 Hz
Urania (some)	400 Hz	2700 Hz
Vanguard (411-22, 6000-18)	500 Hz*	1600 Hz
Vox (until 1954)	500 Hz*	1600 Hz
Westminster (before 1956)	500 Hz	1600 Hz
or	400 Hz	2700 Hz
<b>RIAA (standard after 1955)</b>	<b>500 Hz</b>	<b>2122 Hz</b>

### Equalization Chart for 78 rpm Records

	Turnover	Rolloff
Acoustics	Flat	Flat
Blumlein	250 Hz (200)	Flat
Brunswick	500 Hz	Flat
BSI 78	353 Hz (400)	3180 Hz (2700)
Capitol (1942)	400 Hz	2700 Hz

Columbia (1925)	200 Hz	5500 Hz
Columbia (1938)	300 Hz (400)	1600 Hz
Columbia (England)	250 Hz (200)	Flat
Decca (early 1930s)	150 Hz	5800 Hz (5500)
Decca (1934)	400 Hz	2700 Hz
Decca FFRR (1949)	250 Hz (200)	6360 Hz
Early 78s (mid 1930s)	500 Hz	Flat
EMI (1931)	250 Hz (200)	Flat
HMV (1931)	250 Hz (200)	Flat
London FFRR (1949)	250 Hz (200)	6360 Hz
Mercury	400 Hz	2700 Hz
MGM	500 Hz	2700 Hz
Musicraft #	200 Hz	Flat
Parlophone	500 Hz	Flat
US (mid 1930s)	400 Hz	Flat
Victor (1925)	200 to 500 Hz	5500 Hz
Victor (1938-47)	500 Hz	5500 Hz
Victor (1947-52)	500 Hz	2700 Hz

\* modified from NAB: less bass below 150 Hz, requiring about 3dB boost with bass tone control or multi-band equalization..

\*\* "Very close" to 500 Hz

# Based on listening tests, that is, trying various equalizations and choosing the one with the best sound.

This table is based on information from the following web sites which cite still more references:

<http://sound.westhost.com/project91.htm>

<http://www.rfwilmur.clara.net/repro78/repro.html>

<http://www.swazoo.com>

Also, please take a look at the extensive equalization table in the Model 4010 (The Restoration

Preamp™) User Guide. Click [here](#) to download a copy of the User4010.zip file.

I just found this web site (November 2008). The page is titled "How to EQ Old Records" and it contains much interesting and useful info:

<http://www.geocities.com/midimagic@sbcglobal.net/mixphono.htm>

1. We like the direct drive *Stanton* model STR8-80 (<http://www.stantondj.com>). We have several interchangeable head shells with pickup cartridges using wide groove styli with diameters between 2.5 and 3 mils. These include a *Stanton* 520SK cartridge with a 2.7 mil stylus and a *Shure* M78S with a 2.5 mil stylus: (<http://www.shure.com>). For more information on selecting a turntable, please see our **Audio Help** page: Where can I buy audio equipment in different price ranges?

I've been criticized by a couple of readers for recommending a turntable with a straight pickup arm for 78 RPM restoration. I'll explain my reason and give you an alternative -- then you can take your choice. A "bent" or offset pickup arm does have a lower tracking error than a straight arm, but at a price. The offset arm tends to pull towards the center of the disc. 78's are often worn or warped so the inward pull tends to make the pickup arm jump out of the groove, especially when using a low tracking force. So we have two opposing needs: track with minimum distortion and keep the pickup stylus in the groove. I suggested the straight arm because it maximizes your chance of playing worn and warped records. If your 78's are all in good to excellent condition, then go with a turntable with an offset arm. You can find additional information on this subject in our **Audio Help** section: "How do I listen to 78 RPM records?" and "How do I copy a 78 RPM record to CD?"

There are 35 useful articles on tracking and several other topics that have been reprinted in a 160-page paperback book titled: "The LP is Back." It is available from the Audio Amateur Press, Peterborough, NH, (<http://www.audioXpress.com>). I have a copy and I recommend it to those who are serious about playing and restoring music from 78's and LP's.

2. We especially developed our models 407 and 408 stereo preamps to restore 78's. To download a data sheets or User Guide click [here](#) to go to our Preamp Products page.

3. Some restoration advisors suggest using a preamp with a flat frequency response and then correcting the file with a software equalizer. THIS IS A BAD IDEA. The phase response is totally wrong because of the phase shift at each band edge in the equalizer. An equalizer is dangerous to use because the phase distortion (time delay distortion) can sound terrible -- I can demonstrate this. I plan to write an article on this subject, when I get around to it!

4. Sound cards are not created equal. For a fairly comprehensive comparison go to (<http://www.pcavtech.com/soundcards/compare/index.htm>). The site operator, Mr. Arnold Krueger, tests the cards and posts his findings. We like the *Turtle Beach Santa Cruz* card (it has a score of 7 with 5 being the best) and the *Waveterminal 192X* (it's not rated but it does up to 24-bit sampling at up to 192 kHz). Also check out the cards at (<http://www.tracertek.com>).

5. There are many programs which you can use to copy the sound card output to your hard drive. Among other, we use the following: *CoolEdit Pro* (in May 2003 *Adobe* bought the *Syntrillim* software and *Cool Edit Pro* became *Adobe Audition*), *Dart XP Pro* (DARTech, Inc., 7400 Metro Blvd #350, Edina, MN 55439. 800-799-1692. (<http://www.dartpro.com>) and Sony Sound Forge 8,

<http://www.sony.com/mediasoftware>).

6. Buy the best quality cables you can afford! Cheap cables have insufficient shielding to keep noise and power line hum out of your audio. If you have gotten this far, you have already spent quite a few dollars getting set up for restoration so get good cables. Primarily, we use *Dayton Audio Cables* from *Parts Express* (<http://www.partsexpress.com>). *Radio Shack Goldline Cables* are pretty good too. (<http://www.radioshack.com>)

7. A stroboscope for 78 and 80 RPM is available from *Hawthorns Antique Audio*, (<http://www.thoseoldrecords.com>) for \$4.00 postpaid (as of Oct '05). A 12-speed model covering 16, 33, 45 and 68.5 to 90 RPM costs \$9.60 postpaid (as of Oct '05) from *Esoteric Sound Products*, (<http://www.esotericsound.com>).

Click [here](#) to download this chapter in *Adobe Acrobat* (pdf) format.

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