FIFTY QUESTIONS ON AUDIO RESTORATION AND TRANSFER TECHNOLOGY

by

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1. Q: What is the best method of cleaning discs?

   A: At the present time, the best method of cleaning is the Keith Monks Record Cleaning Machine and a dose of Liquid Archival Sound Treatment (L.A.S.T.). Other methods include Ivory soap and water, Freon-based cleaning, and various products sold by Disc Washer and others.

2. Q: What is the best way to clean cylinders?

   A: A specially formulated treatment of L.A.S.T. Another method is to get an old cylinder machine and outfit the Monks cleaning apparatus (i.e. distilled water) and vacuum suction. Also an air gun can be used. This is probably the safest.

3. Q: Does ultrasonic cleaning damage cylinders and discs?

   A: My experiments show that this method can lead to internal structural damage.

4. Q: What are the best methods of inspecting for groove damage?

   A: Audio-visual playback inspection, audio inspection or microscopic inspection with a monecular microscope of at least 150x.

5. Q: What does this inspection reveal?

   A: Proper inspection shows groove deformation, configuration, width, depth, lines per inch,and sidewall damage. A calibrated reticle is necessary to make some of these measurements.

6. Q: What is the general groove diameter of records from 78's to LP's?

   A:

Type	Diameter	Radius
Early Acoustic	8 mils	4 mils
78	6 mils	3 mils
Verticle Acoustic (early)	3 mils	3 mils
Lateral Acoustic (early)	6 mils	3 mils
Lateral Acoustic (late)	4-6 mils	2-3 mils
Early LP	3 mils	1.5 mils
LP	2 mils	.7-1 mils

7. Q: How many kinds of styli are there?

   A: The list is endless, but as a practical matter, bi-radials, truncated ellipticals, spherical, door-knob sapphires,and large diameter ball styli are most commonly used in restoration work.

8. Q: What are some recommended styli sizes and shapes?

   A: For lateral-cut discs:
   - Early Acoustics (to 1925): 4.7 mils, 4 mils, or 3.7 mils truncated ellipticals; 2.6, 3.8 truncated sphericals.
   - Early Electrics (1930's): 3.8 mils, 3.5 mils, 3.3 mils, 2.8 mils, or 2.6 mils diamond truncated ellipticals.
   - Middle Electrics (1930's-40's): 3.5 mils, 3.3 mils, 2.8 mils, 2.6 mils truncated ellipticals.
   - Late Electrics (1940's-50's): 3.3 mils, 2.8 mils, 2.6 mils truncated ellipticals.
   - Lateral Transcriptions: 2.6 mils
   - Aluminum Discs: These are a real problem because stylus choice depends on the machine that the disc was cut on and whether it is cut or embossed. Thorn and soft needles are recommended for acoustical reproduction so that the needle will wear to the groove configuration. These records were cut in a variety of ways and in many instances the record was meant to be played back only on the cutting machine. Adequate electrical reproduction is difficult, with groove width varying as much as 10 mils from system to system. I am currently trying to collect more information on this type of home recording.

9. Q: What are some other kinds of instantaneous records?

   A: In the late 30's and 40's all sorts of cutting machines flooded the market. Most of them disappeared almost as soon as they came out. A great deal of important material, however, found its way onto these discs. Acetate and early vinyl-based discs (about the size of a computer floppy disc) began to emerge as a medium for portable home and field recordings, under such names as Wagner-Nichols, Talk-O-Phone, and Speak-O-Phone.

10. Q: How are these not-so-common discs played back?

    A: These discs often have such shallow grooves and faint signals that it is difficult to tell whether the signal is lateral or vertical. This can be accomplished by altering and monitoring both modes. Microscopic examination will help you arrive at a ball-park figure of stylus size. Try a spherical stylus of 3-4 mils first, working your way down in size. Do the same with a truncated elliptical. If the sound becomes worse, try a larger size in both configurations. It can be

close to impossible to play these records back because of non-standard grooves and the fact that the machines they were cut on did not run at a fixed velocity.

11. Q: How can cylinders and vertically recorded discs be played back:

    A: The stylus configuration of cylinders is much more standardized, mostly because of Thomas Edison. His penchant for precision machining and standardization of manufacturing had its influence on the cylinder market. Some sizes are:

    2 min. brown wax - 7.4 mils. sapphire
    4 min. brown wax - 4.2 mils. sapphire
    Amberol - 3.7 mils. diamond
    Blue Amberol - 3.7 mils. diamond
    Diamond Disc - 3.7 mils. diamond
    Edison LP - 1.5 mils. diamond
    Pathé (small) - 8 mils. sapphire (ball)
    Pathé (large) - 1.8 mils. sapphire (ball)

    Most of the non-standard vertical "home" recordings were made with styli of about 3 mils.

    Edison New Recorder - 4.1 mils French glass

12. Q: How do I monitor the different parts of a groove?

    A: With a canting device such as that found on the OWL 1 (see appendix).

13. Q: How will I know when the interface between the stylus and groove is right?

    A: Your ears will tell you. If that's not enough, a spectrum analyzer, oscilloscope, or other devices can be used to verify the mechanical interface.

14. Q: What is the correct turntable for restoring old records?

    A: A restoration turntable should theoretically be three-speed with centering capability that is micro-processor controlled with continuously variable speed from 12 rpm to 105 rpm, to accomodate records of up to 20' in diameter. It should also have a tone arm which is tangentially correct at up to 20' diameters, no appreciable wow or flutter, instant start, and remote-control capability.

15. Q: What does such a turntable cost?

    A: Ten thousand dollars.

16. Q: What are other more realistically-priced systems?

    A: 1. Lenco L-75 T: $150

2. Sony 3 speed, modified for vari-speed to 100 rpm T: $450

3. Technics SP 15 modified for 12-105 rpm digital readout
   SME 3012 111 Tonearm with spacial base T: $1595

17. Q: How can cylinders be played electrically?

    A: There are two ways: with the Cylinder Reproduction Kit manufactured by Owl Audio Inc., or with a tangential tracking arm such as the Rabco SL8E, combined with a balanced fly-reel mandral assembly and a belted Ampex hysterisis motor.

18. Q: What are the advantages of playing back cylinders electrically?

    A: It extends the audible frequency range, eliminates spurious resonances and rumble, and filters cracks, transient noises, and surface noise above and below the usable modulated frequencies.

19. Q: What sort of curve should be used to play cylinders?

    A: I recommend linear of flat. Since cylinders are cut acoustically, there is no electrical curve imposed. The Europeans prefer to impose a 6-db.-per-octave cut because of constant amplitude/constant velocity considerations.

20. Q: What is equalization?

    A: The addition of reactive electrical elements into the recording chain that are controlled by the operator.

21. Q: When did equalization come into use?

    A: In 1925 engineers began recording electrically with microphones and amplifiers in order to control the recording environment.

22. Q: Was this a positive discovery for the recording industry?

    A: Yes, insofar as the recording environment could be controlled, but as the engineers could now electronically introduce elements into the recording, thus creating possibility of abuse of equalization.

23. Q: What is pre- and post-equalization?

    A: Pre-equalization is equalization added into the recording circuits. Post-equalization is equalization added into the reproduction circuits.

24. Q: What is the purpose of pre- and post-equalization?

    A: To reduce surface noise, raise frequency response, extend the dynamic range, and introduce a control factor into the recording.

25. Q: What is the crossover frequency?

    A: The frequency at which a cutting head changes from a constant-velocity characteristic to a constant-amplitude characteristic. This is also called the turnover frequency.

26. Q: What is constant velocity?

    A: The stylus travels the same distance in a given amount of time, regardless of frequency.

27. Q: What is constant amplitude?

    A: Regardless of frequency, the amplitude swing of the stylus is constant.

28. Q: How are 78's recorded?

    A: Most 78's are recorded with constant amplitude to 500 hz, then constant velocity.

29. Q: What are the advantages to this type of recording?

    A: It permits a higher recording level at higher frequencies; because of the constant amplitude characteristic below the turnover frequency the signal-to-noise ratio of the constant velocity portion is increased.
    If the recording is reproduced with a magnetic pick-up, the frequency response above the turnover frequency is almost uniform. The use of an equalizer below the turnover frequency, having a rise of 6 db. per octave, restores lower frequencies to linearity.

30. Q: What is treble pre/de emphasis?

    A: Pre/de emphasis, commonly known as the "curve", is the equalization of a recording.

31. Q: What are some common curves?

A:

Recording	Crossover	Treble
78 (before 1940)	250/500	0
HMV	250	
FFRR	250	-5
RCA 78 (late)	500	-8.5
COL 78 (late)	250	-16
AES	500	-12
Orthocoustic	750	-14
Vertical Transcription	250	-16
Acoustic Recordings	0	0
Cylinders	0	0

32. Q: Are there any devices on the market for the proper playback of old recordings?

    A: The only device manufactured solely for audio restoration is the OWL 1. There are other limited-function devices available, modified by Mike Lane of Lane Audio and Richard Burns of Packburn for passive-curve equalization.

33. Q: What is the best way to eliminate transient noise?

    A: Right now, the best and only worthwhile device on the market is the Packburn Transient Noise Suppressor. I am currently at work on a digital device for transient noise suppression that will, I hope, be marketed in late 1985.

34. Q: What is the signal-to-noise ratio?

    A: The difference, in decibels, of a 100% modulated groove, and the noise content of adjacent unmodulated grooves at the same input voltage and frequency.

35. Q: What is surface noise?

    A: The amount of ambient noise in an unmodulated groove.

36. Q: What causes surface noise?

    A: Mistakes in cutting, mastering and plating, as well as the most important factor: the material used for the pressing. Abrasive materials such as shellac are very noisy. Modern polymers such as vinyl are much quieter.

37. Q: Can surface noise be filtered out?

    A: Yes, by proper equalization and dynamic and static filtering.

38. Q: Are there any chemical treatments to reduce surface noise?

    A: Yes: Liquid Archival Sound Treatment (L.A.S.T.).

39. Q: What are some static filtering devices?

    A: The OWL 1, Orban and U.R.E.I. parametric equalizers, Pultec equalizer, U.R.E.I. "Little Dipper" passive filters, as well as others.

40. Q: What are some dynamic noise filters?

    A: SAE, Burwin, SEA, DBX, Dolby, MicMix, Packburn, and many others.

41. Q: What kind of filtering causes that "pumping" so often heard on transfers?

    A: Dynamic filtering.

42. Q: At what frequency does the "rumble" of old records occur?

    A: For both cylinders and discs, usually from 20 hz to, at most, 80 hz.

43. Q: At what frequency does "shellac" noise occur on 78's?

    A: The noise is broadband (over the entire spectrum), but it is most disagreeable in the 7,000 to 10,000 hz range.

44. Q: To make a proper archival (objective) recording what kind of filtering is used?

    A: Only static filtering is used.

45. Q: What kind of equalization should be used for archival recording?

    A: Experiment and use your ears, test gear (spectrum analyzer, etc.) and consult the record companies setting.

46. Q: What is a real-time spectrum analyzer?

    A: A device used to measure audio signals in 1/3, 1/6 or full octave increments. One can see on the display such things as rumble, ticks, pops, and surface noise, as well as hear them. It gives you the ability to pinpoint the trouble and the exact frequency at which it occurs. The ability to measure instantaneously and view spectrally the incoming signal is of tremendous value in doing restorations. Needless to say, this cuts the time needed for restoration, usually by half.

47. Q: How can sides of a continuous performance be edited?

    A: Simple editing can be done with a blade or using a multi-track recorder and overlaying the sides. The most efficient way of editing is done on a digital editing set-up, such as

the Soundstream or Sony PCM 1600. However, it is very expensive.

48. Q: Why are the curves of the early 1950's so varied?

    A: Mainly because this was a time of experimentation for the recording industry. The LP was something new, and each company wanted to impose its own sound on the process.

49. Q: How can the date of a recording be found?

    A: If the material is commercially issued, its date can usually be ascertained with some help from company records, Schwann, or other books. If the material has no documentation, its physical description can tell a lot. For example, a 12-inch acetate with a 2-mils diameter would under normal circumstances date from 1948 or later.

50: Q: Where can I write for further information on audio restoration?

    A: See the appendix for names and addresses of manufacturers and individuals who may be helpful.

APPENDIX

COMMERCIAL Audio Restoration and Transfer Technology Products and Services

Owl Audio Products Inc.
P.O. Box 616 Ansonia Station
N.Y., N.Y. 10023 — Tom Owen, Barton Wimble

Packburn Electronics
P.O. Box 353
Dewitt, N.Y. 13214 — Richard Burns

Lane Audio and Records
P.O. Box 29171
Los Angeles, CA 90029 — Michael Lane

Conductart
P.O. Box 616 Ansonia Station
N.Y., N.Y. 10023 — Barton Wimble, Don Hladik

Art Shifrin
243-56 72nd Avenue
Douglaston, N.Y. 11362

Steve Smolian
8807 Postoak Road
Potomac, MD 20854

Jack Towers
1417 Jefferson Street
Hyattsville, MD 20782

Expert Pickups
P.O. Box #3
Ashtead, Surrey
KT21 2QD, England