

IU Media Digitization Studios
Lacquer disc preparation and digitization workflow

1. Preparation of lacquer discs prior to digitization

- 1.1 Always wear gloves while handling lacquer discs to prevent foreign matter (like oil or dirt) from touching the disc.
- 1.2 Retrieve disc from original sleeve.
- 1.3 Examine the surface and make note of anything that might be a problem, such as: delamination, exudation, cracking, or warping. If major problems exist, set disc aside and make note in the POD general comments section on the digital metadata page for that object. If necessary, confer with an expert about what the next step would be.
- 1.4 Examine disc under a microscope while making notes about the condition of the record, paying attention to groove wear or foreign matter inside or outside the grooves. Measure the grooves. Measure the top and bottom of the groove using the ruler that is in the right eyepiece of the scope. Once you have made notes about the condition and made the proper measurements with the microscope, retrieve the Audio Archive Stylus Calculator Excel file (downloadable) to determine the size of stylus to recommend to the engineer for transfer. Gather all information and place on the outside of record sleeve with a post-it note for engineer's reference. Mirror all the information in the Physical Object Database in the Digital Provenance section.
- 1.5 Once there is a proper number of discs examined, (at least 20 discs) place in groups grouped according to stylus size, minimum of 4, maximum of 10 sides in each grouping. Enter the groups into the Jira backlog for the engineers to choose at the Sprint meeting. Create separate groups for the cracked and/or delaminated discs for pre-cleaning transfers. Once pre-cleaning transfer discs have been transferred, discuss with engineers if cleaning and re-digitization is recommended.
- 1.6 Use a cart to transport discs between rooms.
- 1.7 Placing the disc on padded surface, apply LACQUER WASH onto the record in a spiral motion.
- 1.8 Use LACQUER WASH BRUSH in a circular motion to remove any, dirt, grime, palmitic and stearic acid or anything on the disc that will impede digitization. Go with the groove of the record when washing, paying attention to dirtier areas. Clean until the wash is off of the record.
- 1.9 After all of the LACQUER WASH has been removed by rinsing, place record onto Keith Monks disc cleaning machine and turn toggle switch to DRY. Place suction arm onto the area just outside the label and let go. The arm will suck the water and dirt from the inside of the record to the outside.
- 1.10 Examine the record to make sure you removed all the foreign matter. If not, wash again. Repeat until clean.
- 1.11 Once disc is completely clean and dry, remove barcode from original sleeve and place onto new envelope approximately 3 inches below flap. Write in pencil, above the barcode, the catalog number (ex. *ISOS 076*). Place clean disc into plastic sleeve, or paper envelope if none are available. Set aside. Make sure to note the cleaning date in the POD.
- 1.12 After the discs have been digitized, place in supplied disc boxes numerically by IU catalog number and by batch number.

2. Digitization of Lacquer Discs

- 2.1 Calibrate turntable using separate turntable calibration document (T:\Workgroups\IUMDPI\MDPI Documents\IUMDS_turntable_calibration_procedure).
- 2.2 Discs are delivered by the Audio Visual Specialist to lacquer digitization room and placed in the file cabinet. Choose a group to digitize.
- 2.3 Jot down the time before you start working with an object. You will need this at the end to calculate how many minutes it took to complete digitization of the disc.
- 2.4 Use purple nitrile gloves to remove disc from sleeve. Rotate the disc as you remove it to help reduce damage to disc. Place disc on turntable.

- 2.5 Examine condition of the disc. Note any potential areas for tracking challenges. Use the flat velvet brush and/or carbon fiber anti-static brush to remove any stray debris on the disc. Sometimes there will be small, white clumps of palmitic acid that are left over from the wet cleaning process. Usually, these can be removed gently by picking it with your finger (with gloves on). When you are done handling the disc itself, you may remove the gloves.
- 2.6 Scan barcode from the sleeve into the POD. Note any existing comments in the physical object metadata, and any comments left by the AV Specialist in the digital provenance section. There will also be a post-it note on the paper sleeve notating groove measurements, stylus recommendation, and spindle-to-pivot point ideal length.
- 2.7 Based on the recommended stylus size, chose an array of styli to test. Start with the recommended size, plus one smaller and one larger. (For example, if the recommendation is 2.5 mils, choose a 2.5 ET stylus, plus a 2.2 ET stylus and a 2.7 ET stylus). You may expand your array later in the testing. You may also find it helpful to use the headphones for identifying the ideal stylus.
- 2.8 With the Timestep T-01EQ preamp: both flat and eq'ed outputs will be created from one preamp. You should have the input set to 1MM, load at 47k, and turnover and rolloff set according to the equalization needs of that disc. The Preset EQ knob MUST be set to variable in order for turnover and rolloff to function. None of the filters are to be used. Set the output to L+R mono, or left/right only if one groove sounds better than the other. You can use the L-R setting and blend knob to find the null which correlates to the maximum for an L+R summed output. Output gain should be set according to your source material. You should aim for peaks at -12 to -7 dBfs in the DAW. Check that the Direct L and Direct R are patched into 1 & 2, and that EQ L and EQ R are patched into 3 & 4.
- 2.9 Check your settings in WaveLab. Record to a named file to prevent losing any work. Record to a folder located at E:\AUDIO\Discs*today's date*. (For example, E:\AUDIO\Discs\20160114. Name your test file stylus (this can be overwritten for each test file since we do not save stylus tests. Audio File Format settings should be:
 - 2.9.1 Type: Wave (Microsoft)
 - 2.9.2 Audio format: PCM (uncompressed)
 - 2.9.3 Channels: Multi Stereo/Mono
 - 2.9.4 Sample Rate: 96 000 Hz
 - 2.9.5 Bit resolution: 24 bit
 - 2.9.6 Meta-data: inherit from source file
- 2.10 Click the set input field. You should have Channels 1, 2, and 3 selected. Channels 1 and 2 should record together as one stereo file (Timestep Direct out), and channel 3 will record as one mono file (Timestep EQ out).
- 2.11 Record a test comparing the styli so that you may go back and compare to make your decision. Start with the smallest size and work your way up. Record roughly 20 seconds right at the beginning and end of the main program on the disc. Do this for each stylus size. You want to make sure to record the same sections so that you can directly compare between the various styli.
- 2.12 You may find it helpful to drop markers during the recording designating where you switched styli. Click the yellow down arrow in the bottom left corner of the record window to create a marker while recording.
- 2.13 Listen to the recorded test, using the unequalized stereo file. Listen for differences in surface noise floor, signal to noise ratio, distortion of the recorded signal (especially in sibilance regions). You may find it helpful to use the level meter and spectrometer to analyze the differences. You are looking for the best representation of the signal with ideally the highest signal to noise ratio (SNR). However, if the highest SNR stylus produces pops, while a different stylus with lower SNR produces no pops in the transfer, we would select the lower SNR/no pops stylus. Similarly, if the highest SNR stylus produces distortion while a lower SNR stylus produces no distortion, we would select the lower SNR without distortion.
- 2.14 You may test various larger and smaller styli if the quality of reproduction still has room to improve.
- 2.15 Mount your selected stylus in the cartridge and clean it with the disc doctor needle cleaner and brush. ONLY MOVE THE BRUSH FROM THE BACK TO THE FRONT to avoid bending the cantilever in the stylus.
- 2.16 In the POD, go to the digital provenance page for object. Click "add digital file" to create the preservation master file. Filename (ex. MDPI_barcode_face_pres.wav), Date Digitized (01/13/2016) and Created

By (your user ID) will already be filled in for you. Add the Speed (ex. 33.3 rpm), Stylus Size (ex. 2.2 ET) and the proper signal chain from the drop down.

- 2.17 Click "Add PresInt file" to create the presInt file. The POD will copy entries for Date Digitized, Created By, Speed Used, Gain, Stylus Size, and Signal Chain. Enter the equalization settings for Turnover and Rolloff. Save by clicking "Update Digital Provenance."
- 2.18 Copy the pres file name from the POD to the file name in WaveLab's recording window.
- 2.19 Check the settings of your record backup systems, the Tascam DA-3000 which records to SD card, and the Denon DN-500R which records to USB drive. Tascam settings should be:
 - 2.19.1 Media Sel: SD
 - 2.19.2 Clock mstr: DIN
 - 2.19.3 Ref. Level: -14dB
 - 2.19.4 Cascade: off
 - 2.19.5 File: Wav-24
 - 2.19.6 Sample: 96 kHz
 - 2.19.7 Channel: stereo
 - 2.19.8 Name: date

Exit out of the menu. Press the record button to put the unit into record-ready mode. The pause and record buttons should light up.

There are a few Denon settings to confirm. They should be (click Menu button, then 02 Preset Setting):

- 2.19.9 06 Rec Leve Type: Separate L/R
- 2.19.10 09 Audio Input: AES/EBU
- 2.19.11 10 Rec Format: PCM-24
- 2.19.12 11 Rec Channel: Mono (L)
- 2.19.13 12 Sample Rate: Ext(AES)

Exit out of the menu. Press the record button to put the unit into record-ready mode. The pause button should light up while the record button flashes.

- 2.21 When you are ready to start recording, make sure there are no programs other than WaveLab open on the computer. Start the turntable spinning. Start WaveLab and the Tascam backup recording simultaneously. It is important to match start/stop times as close as possible for interstitial error checking purposes. Then, start the Denon recording.
- 2.22 Record the disc, including all inner and outer test grooves. You may have to manually move the stylus to the next band if there are locked grooves separating sections. Do this as carefully as possible to avoid erroneous noises in the transfer.
- 2.23 When recording is complete, remove the stylus from the disc. Stop WaveLab and the Tascam simultaneously, then stop the Denon. Close WaveLab. Remove the SD card from the Tascam and insert into the computer's SD card reader. Transfer the file to the desktop folder named "Int error file."
- 2.24 Open Interstitial Error checking software. Designate folder to which you recorded WaveLab file for "DAW Directory." Designate desktop folder "Int error file" for "Reference Directory." Designate "Interstitial Manifests" desktop folder for "Manifest Destination." Run the program. If it reports an error, check that sample number in the WaveLab file for problems. If there is a reported error, many times it will be near the start or end of a file and is attributed to the actual stopping or starting of the recording. Actual interstitial errors in the body of a recording are rare, but still possible. If you do find an Interstitial error, verify it by checking the WaveLab file and the Tascam file at the same point. There will be a "pop" or vertical line on the WaveLab file, but not the Tascam. Take a screenshot of the error and save it to a folder on the computer along with the corrupt WaveLab

file, and a copy of the manifest. Save the Tascam file as the new Preservation Master, and the Denon file as the Preservation Master Intermediate.

- 2.25 Assuming no errors are reported, reopen WaveLab and your two new files. If you had any overs (i.e. signal hit 0 dBfs) that occurred during the recording, check them now. There should be no more than 5 overs attributed to pops that were very difficult to avoid. If you have more than that, the disc will need to be re-digitized using a different stylus or as a last resort, reduced gain.
- 2.26 The stereo file will be the preservation master file. No editing should take place here, other than leaving two seconds of silence prior to the initial needle drop and two seconds after the final needle lift. The Preservation Master file will contain 2 seconds of silence before and after the first and last time the stylus is in contact with the disc. File will contain all needle drops, locked grooves, inner and outer grooves. Save-as using the proper file name.
- 2.27 The mono file will be the presInt file. Leave two seconds before the beginning of the initial content and two seconds after the end of the content. The noise before and after can be deleted. You are also permitted to make technical edits in this file. For example, you may edit out parts that were repeated in a locked groove. If a word is repeated six times while the engineer moves the stylus past a locked groove, four of those times may be edited out. The other two should remain to provide context indicating that there was a locked groove. Additionally, you may remove bands of unmodulated grooves from the body of a recording. For example, if you have a band of main program content, then an inner band of unmodulated grooves, then another inner band of recorded grooves, you may remove the section of unmodulated grooves. Save-as using the proper file name.
- 2.28 Notate any oddities about the recording in the comments section in the POD.
- 2.29 Record the time you ended work on the disc. Calculate the total number of minutes it took you from start to finish and record this number in the Digitization Time field in the POD.
- 2.30 Use gloves to put the disc back in the paper sleeve. Completed disc groups can be put back in the disc file cabinet and the AV Specialist will pick them up.

3. Cracked and delaminating discs:

The process for cracked and delaminating discs is slightly different, due to their advanced state of degradation. Wet cleaning discs like this can cause further cracking and delamination. The AV Specialist will identify such discs and put them aside in special groups to be transferred prior to cleaning. If you are working with a group of discs in this category the process is as follows:

- 3.1 If applicable, place a large kimwipe on the turntable platter to keep it clean of palmitic acid deposits. Poke a hole for the spindle.
- 3.2 Place disc on top of kimwipe. Use small kimwipes to remove surface layer of palmitic acid deposits, if applicable.
- 3.3 Use the recommended stylus size without testing an array of styli.
- 3.4 Transfer the disc using the method outlined above. It will likely have much more surface noise than normal transfers.
- 3.5 Discs that have been transferred prior to cleaning will then go back to the AV Specialist for cleaning. If the disc has no further damage, it will then return to the studios to be transferred a second time.
- 3.6 For the clean transfer, test for the ideal stylus, and follow the procedure for normal disc transfers.
- 3.7 As long as nothing goes awry with the transfer, the post-cleaning transfer files will be the masters.
- 3.8 The pre-clean transfer file will be moved out its current folder and placed into the "Pre-cleaning files" folder. Filenames should be appended with "_TEST" to identify them as non-master files.

- 3.9 It should be notated in the POD file comment field for the preservation master that there was a pre-cleaning transfer done on xx/xx/xx date with xx stylus.
- 3.10 Date digitized and stylus size in the digital provenance section of the POD should reflect the post-cleaning file metadata.

4. Sides containing only unmodulated grooves:

Some discs contain grooves on one side that are unmodulated (i.e. no content). We will listen to the entire side to confirm that there is no content but will not retain audio files. No digital provenance files should be created for unmodulated sides. The engineer will make a note in the general object comments field that the side contains unmodulated grooves/no content, so no file was created.

Turntable Calibration Procedures

Step 1: Balance the turntable. Remove the slipmat so the level will not be influenced by ridges on the mat. Use the bubble level on the turntable platter in various places. If bubble is not centered, adjust the table's feet or shim the turntable feet.

Step 2: Balance the tonearm. Remove the anti-skate weight and place the tracking force at 0g. The idea is to have the tonearm naturally in balance prior to adding any tracking force or antiskate. The tonearm should freely float, without drifting down or up. Use the counterbalance at the back of the tonearm to achieve balance.

Step 3: Set tracking force. The scale is measured in .25g increments on the tracking force arm, starting with 0g in the back, and going up to 5g towards the front. You should start with 3.75 g for the Stanton 500 cartridge. Measure with the digital tracking force gauge to confirm that it is set properly. The further the tonearm is from balanced, the further this reading will be from the desired value.

Step 4: Set anti-skate force. You should start with this value equal to the tracking force value. The anti-skate force on the SME 3012R tonearm is set using the small weight hanging off the fishing line. Like tracking force, the scale is measured in .25g increments, with 0g in the front and 5g towards the back.

Step 5: Set spindle to pivot point length. Measure the distance, in mm, from the spindle to the innermost groove, and spindle to the outermost groove. Using the Baerwald-Lofgren HTA spreadsheet (at T:\Workgroups\IUMDPI\MDPI Tools) enter the values you just measured to find the spindle to pivot point length. Use the tonearm calibration protractor tool to set the length at the recommended spindle to pivot point length. This will optimize stylus tracking through the duration of the disc. The design of the SME 3012r tonearm is such that the headshell is kept fixed, while the tonearm may be moved forwards and backwards, changing the spindle to pivot point length. You will find most 16" discs will fall near 287mm (when a 16" disc is mostly filled with grooves), so it will usually be okay to keep this length the same. However if you have a different size disc, or grooves that are all near the center or outer edge, this number will vary.

Step 6: Vertical tracking angle: Check vertical tracking angle with ruler. The tonearm should be parallel to the plinth for a proper tracking angle. The stylus is meant to imitate the angle of the original cutting lathe, so proper VTA will optimize frequency response.

Step 7: Confirm azimuth: Check cartridge azimuth with mirror. If the cartridge and headshell are mounted properly, it should look perfectly centered. If it is leaning one way or the other, you can adjust the stylus or check the headshell mount to make sure it is properly attached.

Step 8: **Confirm playback speed:** Use the strobe disc at 33 rpm, 45 rpm, and 78 rpm. The corresponding bands on the strobe disc (60Hz) should appear still if the speed is calibrated properly.

Step 9: **Calibration disc:** Use the Hi-Fi News setup disc and follow directions on the disc for further fine-tuning, including channel correlation, phase, and anti-skate setting. Ensure that you are using a microgroove stylus, and your preamp is set to an RIAA curve for proper disc reproduction.