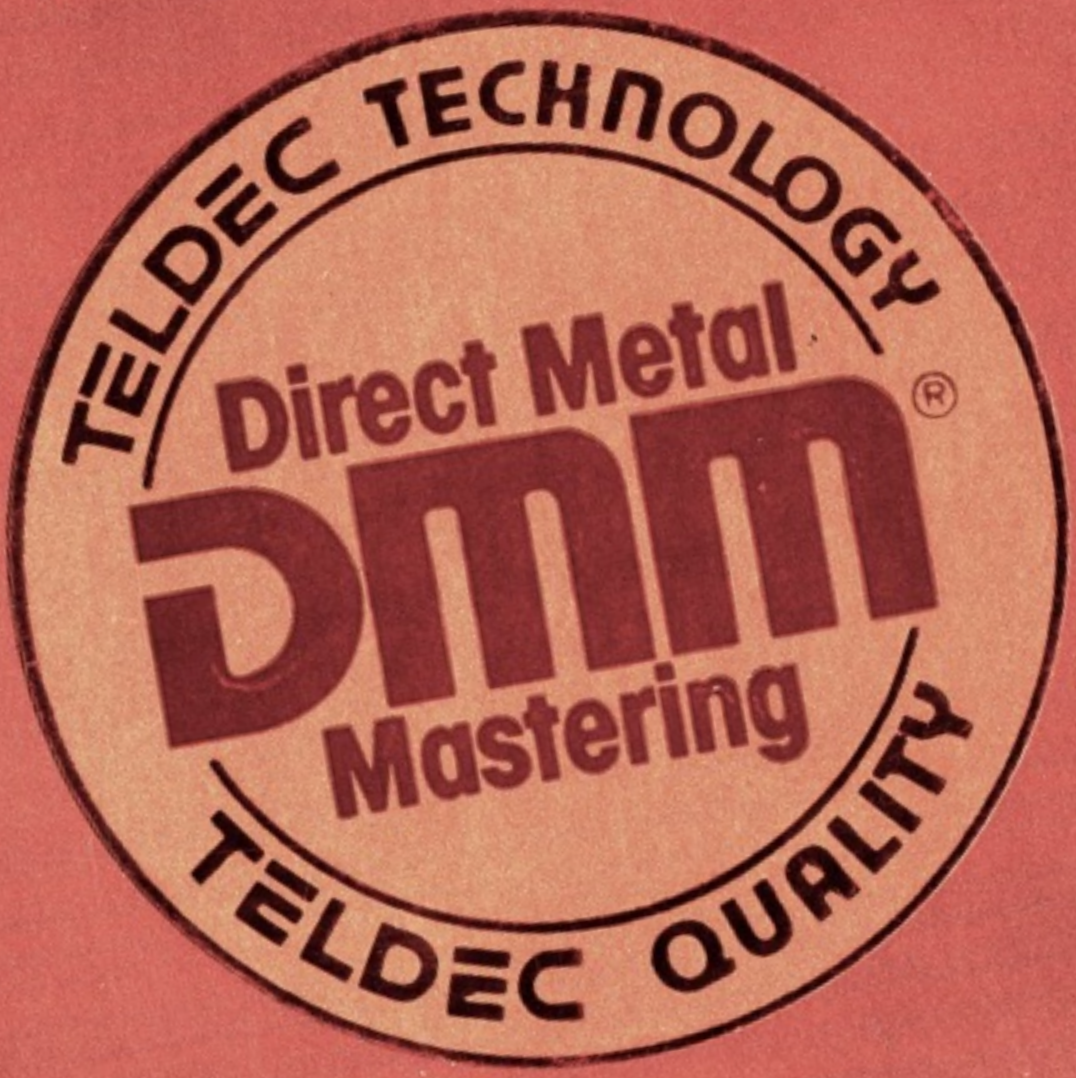
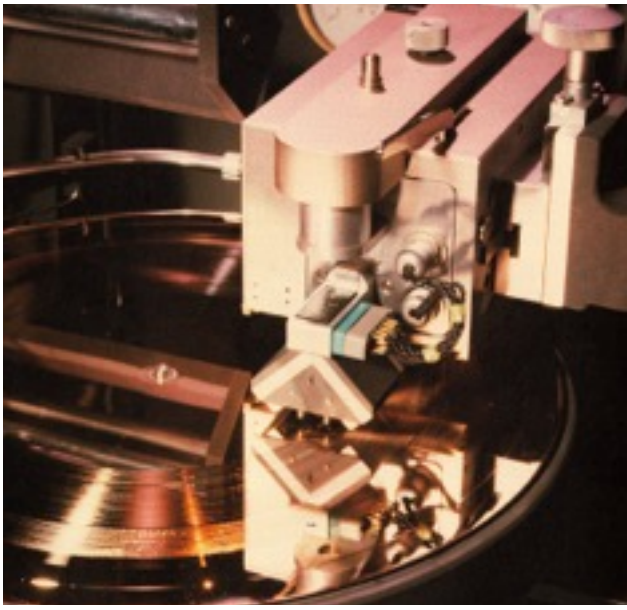

TELDEC TECHNOLOGY
Direct Metal
DMM
Mastering
TELDEC QUALITY

DIRECT METAL MASTERING
Technology



Anyone who is acquainted with the manufacture of phonograph records knows that some of the most difficult processes in the long chain of events through which this sound carrier must pass, are the cutting and plating process. Most of us are painfully familiar with the problems of lacquer blanks, cutting styli, silvering and the echo problems caused by the stress in the preplating nickel, and many others. The quality of the final product is seriously affected at this stage of the process, and the manufacturing yield is low if high demands are made on quality, especially for classical music recordings.

100 Years of Non—Metallic Recording Blanks

Ever since Alexander Graham Bell and Sumner Tainter engraved their sound waves into their phonograph-graphophone's wax in 1881, we have always used non—metallic materials for cutting; materials of which we expected favorable qualities for the cutting of the sound grooves and the information superimposed on those grooves. Wax with additives was used for a long time, and so were gellatinous substances, and finally nitro-cellulose lacquer, a material in use to this day. This means that these carriers of the sound recording have to undergo a process of depositing a conductive surface onto them, which, in turn, enables the plating process to the final pressing matrix. After the initial use of graphite for this conductive surface, there followed vacuum deposited gold, and finally silver, either as a wet process or through diffusion in a vacuum.

Conventional Record Cutting No Longer Suffices

Although it is true that the cutting of phonograph records into lacquer blanks has achieved a high level of quality, there nevertheless exist weak spots in the interaction between the lacquer blank and the cutting process which have led to some well known difficulties. The reasons may be found in the fact that the lacquer surface, which is ideal for the cutting process, is not a stable material, but rather changes with climatic conditions and time. Added to that are the effects of stylus heat and burnishing facets, which play a key role in the determination of the groove wall structure. Consider the problems of groove tearing or the formation of horns in this connection. Add to that the problem which results from the plastic deformation of the lacquer material: the spring-back of the engraved groove, which is time and temperature dependent.

But there are also severe demands placed on the next step, the nickel pre plating onto the silver conductive coating. It must be extremely thin, its metallurgy must be fine grained and it may not contain any pollutants. To assure this, the lacquer surface treatment must be executed with the greatest of care. The cleansing process may not attack the lacquer surface and the activation process (sensitizing) must assure a precisely even deposition of the silver atoms. It is here that the beginnings are to be found for those annoying impulse type noises (ticks), which are the bane of the record buying public.

Direct Metal Mastering

TELDEC has developed a new process which eliminates the above described problems by circumventing all those steps. Its principal feature is the cutting of the groove directly into a metal coating (TELDEC DMM technology) meaning that the cutting lathe directly produces the mother (metal positive) for the plating process. The cutting of grooves into metal was first proposed by J. Rosenthal and S. Frank in their German patent dated 13.November 1891. This idea

was reactivated some eighty years later by RCA for the cutting of their videodisks. However, this cutting process is quite a different one. The extreme storage density of such disks requires tiny grooves with dimensions of less than 1 micron depth and a bit over 2 micron width, using modulation excursions measured in several hundred Ångström!

The DMM Mastering Blank

Suitable metals for such recording are Copper and also Cadmium under certain conditions. Cadmium was proposed by Wadsworth in his U.S. patent in 1922. Copper is more suitable, since Cadmium is not sufficiently resistant to the electrolytes used in the ensuing plating process. This is also the reason why videodisks are cut into an electrolytically produced Copper coating applied to a substrate. It is easy to see that such a process is not readily applicable to the cutting of phonograph records, since the cross section of the sound groove chip cut from such a coating is 100 times larger than that cut from videodisks.

The mechanical properties of such a chip are very similar to those of copper wire. Its ductility and elasticity must therefore be proper: the copper coating must have an amorphous rather than a crystalline structure. This is in sharp contrast to the structure of pure electrolyte copper. The required properties for the material are obtained from the electroplating process of the DMM technology. The equipment for producing the copper blank was developed in conjunction with EUROPAFILM of Sweden. The NEUMANN Model SX 80 CM Stereo Cutterhead is able to cut into the copper deposited onto the 0.8 mm thick stainless steel substrate, and the original which results may be immediately used as the mother in the plating process.

THE DMM CUTTING PROCEDURE

A metal cutting blank provides a significantly higher resistance to the cutting stylus than does the traditional lacquer blank. It was therefore necessary to dimension the cutting parameters in such a way as to minimize the cutting resistance. Three measures have been applied to make this possible:

1. New cutting stylus shape

The diamond cutting stylus has no burnishing facets. One of the positive side effects of this is that the innermost grooves on an LP show no amplitude losses even when cutting the highest frequencies.

2. Greater stylus face angle

The face angle of the diamond stylus is greater than 90°. The sum of the face and stylus angles are dimensioned in such a way, that for the maximum groove excursion there still remains sufficient space between the groove walls and the back of then stylus.

3. Superimposed ultrasonic frequency

The entire system comprising cutting stylus, stylus holder and the elasticity of the copper coating are so dimensioned, that during the cutting process the diamond is excited at an ultrasonic frequency, whose amplitude increases with increasing groove depth (greater cutting resistance). (Fig.1)

This results in an extremely smooth groove wall, and keeps the mechanical loading of the cutterhead structure and the resulting electrical power demand within reason. The NEUMANN SX 80 CM Stereo Cutterhead and its associated SAL 74 B amplifiers fulfill all of the demands even when the loading effect is considered.

Vertical Tracking Angle Correction

When cutting stereo grooves into a metal surface it has been found to be of advantage to select a cutterhead geometry which has a vertical tracking angle of virtually zero degrees. Using a construction with a larger VTA means that for a changing cutting resistance — such as might result from non—homogeneities in the metal surface — the varying horizontal loading component would be converted into a vertical motion of the stylus. Such a motion would result in the recording of unwanted modulation. An electronic compensation network was developed for the SX 80 CM Cutterhead to correct the VTA error.

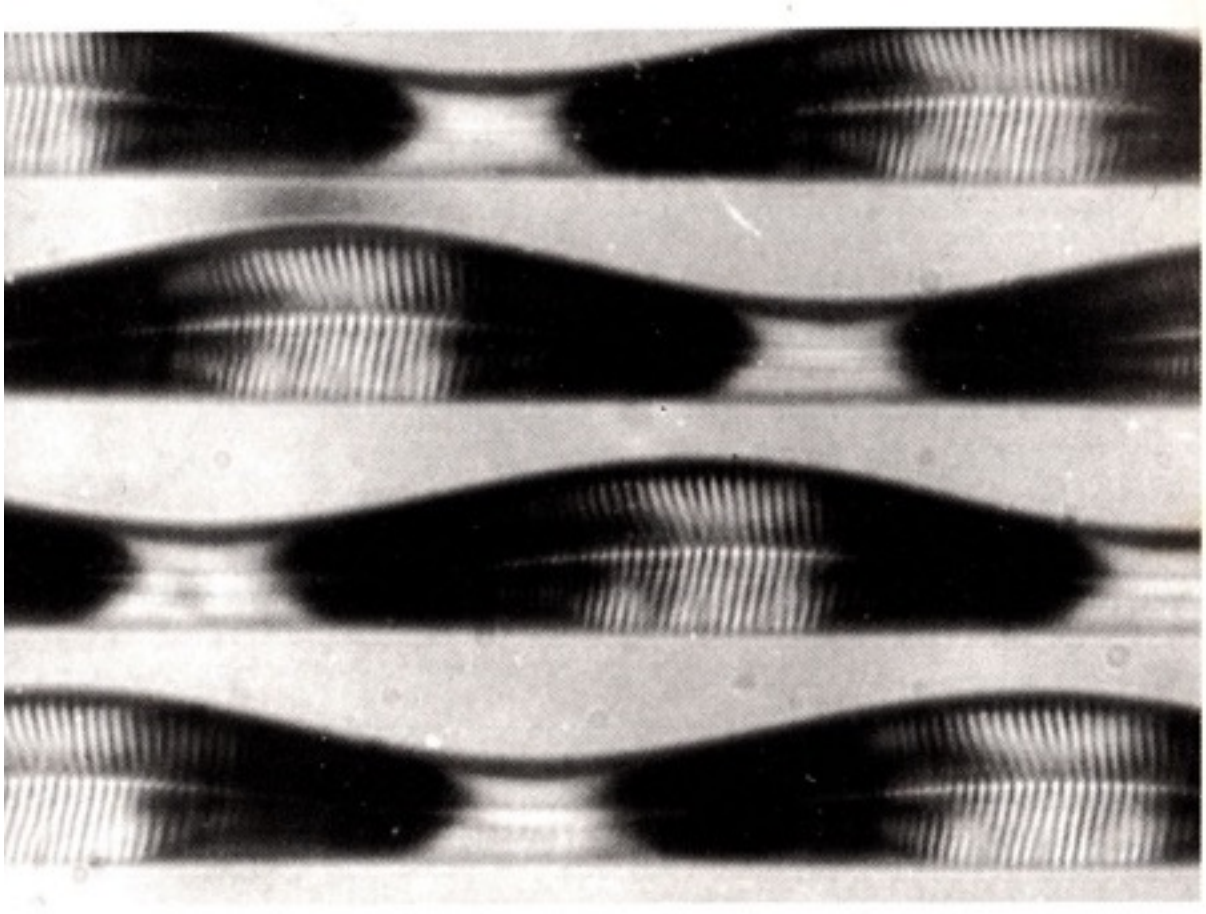


Fig. 1 - Ultra sonic oscillation to reduce the cutting significant groove depths.

DMM Conclusions:

Background Noise Reduction Clearly Audible

Experience up till now has shown that the stampers produced from DMM masters are entirely free of ticks and pops. For carefully pressed records, this clearly extends all the way to the final product. The background noise of the DMM disk contains fewer impulsefitype disturbances when compared to traditionally produced LP's, and especially the unwanted high frequency components are significantly reduced. The quiescent groove noise for records pressed on TELDEC vinyl is shown in Fig.§§; "A" for traditionally produced records and "B" for records pressed from DMM parts. A third—octave higher frequency spectrum analysis shows up to 6 dB improvement. The improvements in the low frequency region are clearly shown in the oscilloscope noise photos using a 1.8 second (one LP revolution) time base. Fig. Q shows the typical rumble obtained when playing back with a tonearm having a 12 Hz resonance.

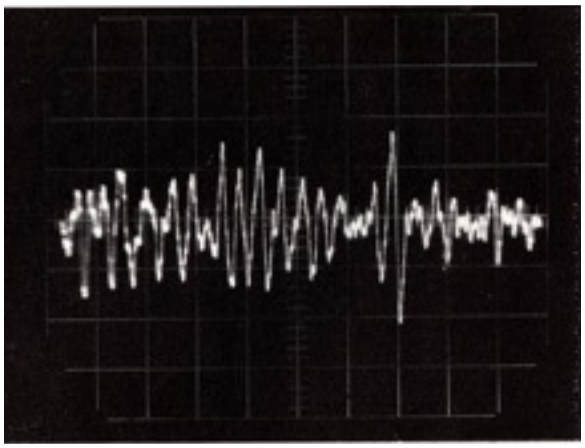


Fig. 2 - Rumble: normal LP

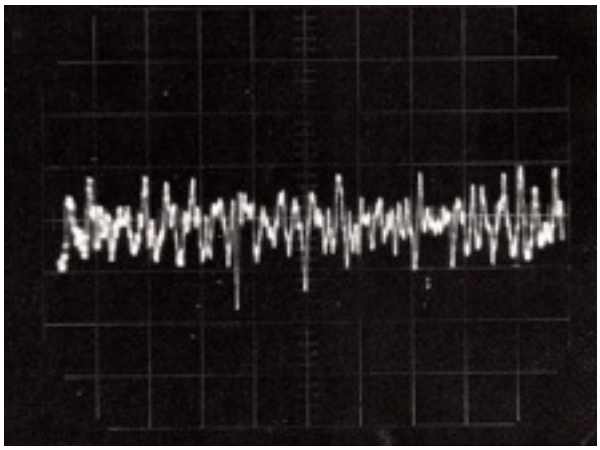


Fig. 2 - Rumble: DMM LP

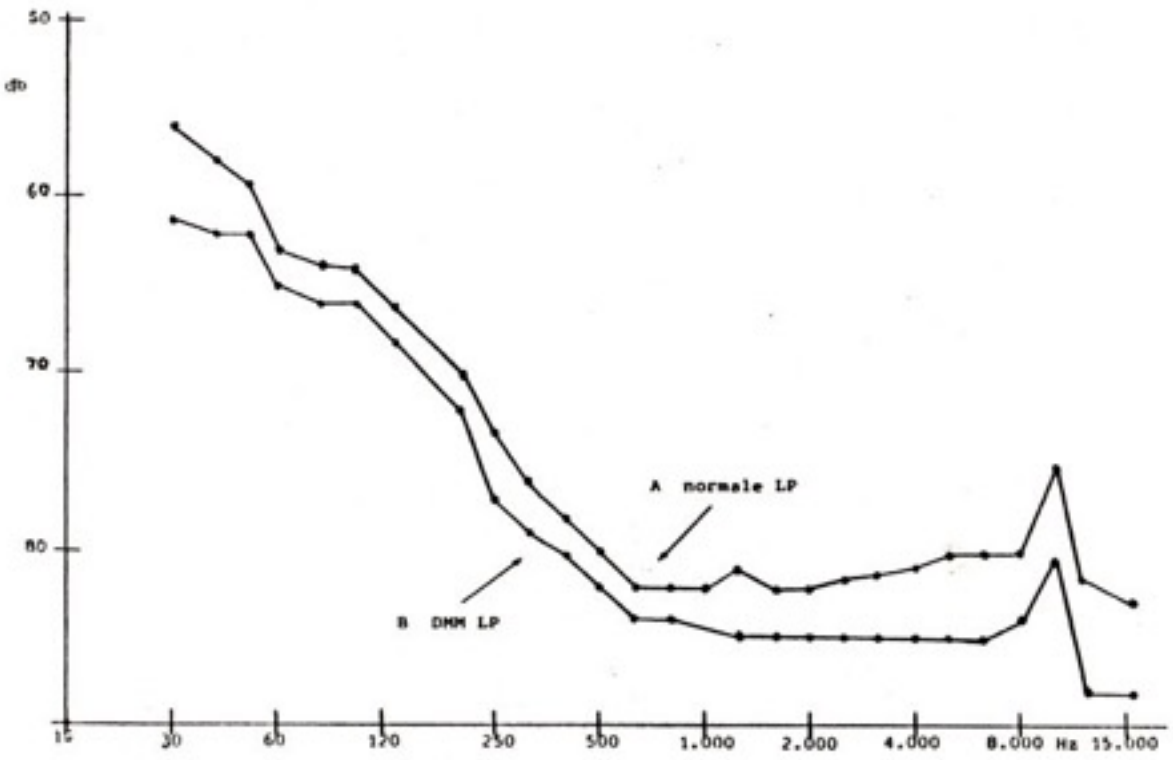


Fig. 3 - Comparison of the background noise TELDEC - pressing compound

Up to 15% More Playing Time Without Pre- or Post Echo

The elimination of lacquer springback also eliminates pre— and post groove echo. It is therefore possible to minimize the groove—to—groove spacing and to fully utilize modern pitch control methods as are used, for instance, in the NEUMANN VMS 80 Tape—to—Disk Transfer System. The result is 10 — 15% more playing time per record side.

Playback Quality Audibly Better

The elimination of all groove deformation during or after the cutting process has provided A/B comparisons between disks cut in lacquer and DMM cut w masters which clearly show improved transient behavior. Instruments rich in upper harmonics and sibilant voices are particularly free of coloration.

Cost And Time Economies

Initial manufacturing experience has shown that the original assumption, namely that manufacturing reliability will be much higher than through the use of traditional technology has been proven correct.

After conversion to DMM technology, it was possible to reduce drastically the number of recuts which were necessitated either in the cutting or plating process.

By contrast to lacquer masters, it is possible to produce numerous matrices from a DMM master. This permits easy correction of those defects which may appear in the ensuing plating steps all the way to the stamper, neglecting the fact that it is far simpler to plate copper masters altogether. The significant time economy in the plating process, especially when making a stamper directly (Fig. 4), is of great advantage. Especially in short press runs as is often the case in classical recordings or special programs, the DMM process results in significant plating economies. To sum up it is clear that the DMM technology will improve the quality of phonograph records, while at the same time effecting significant economies in the manufacturing process!

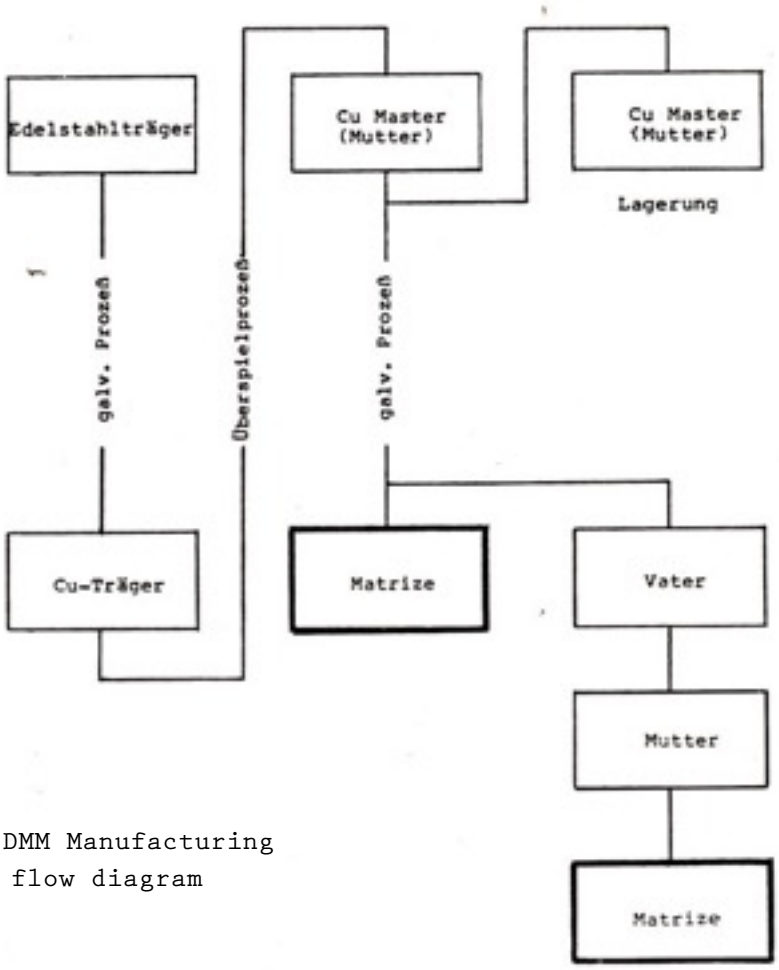


Fig. 4 - DMM Manufacturing flow diagram

Additional DMM Advantages

- NO complex silvering needed.
- NO waiting! Direct stamper production. Pressings in 2 hours!
- NO stylus heat requirement, therefore no burnt lacquer adhering to the cutting stylus and no tears in the groove walls.
- NO burnishing facet and therefore no formation of "horns" at the groove edge
- NO lacquer spring back distortion and therefore no pre/post groove echo thereby providing longer playing time.

Herausgegeben von der
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