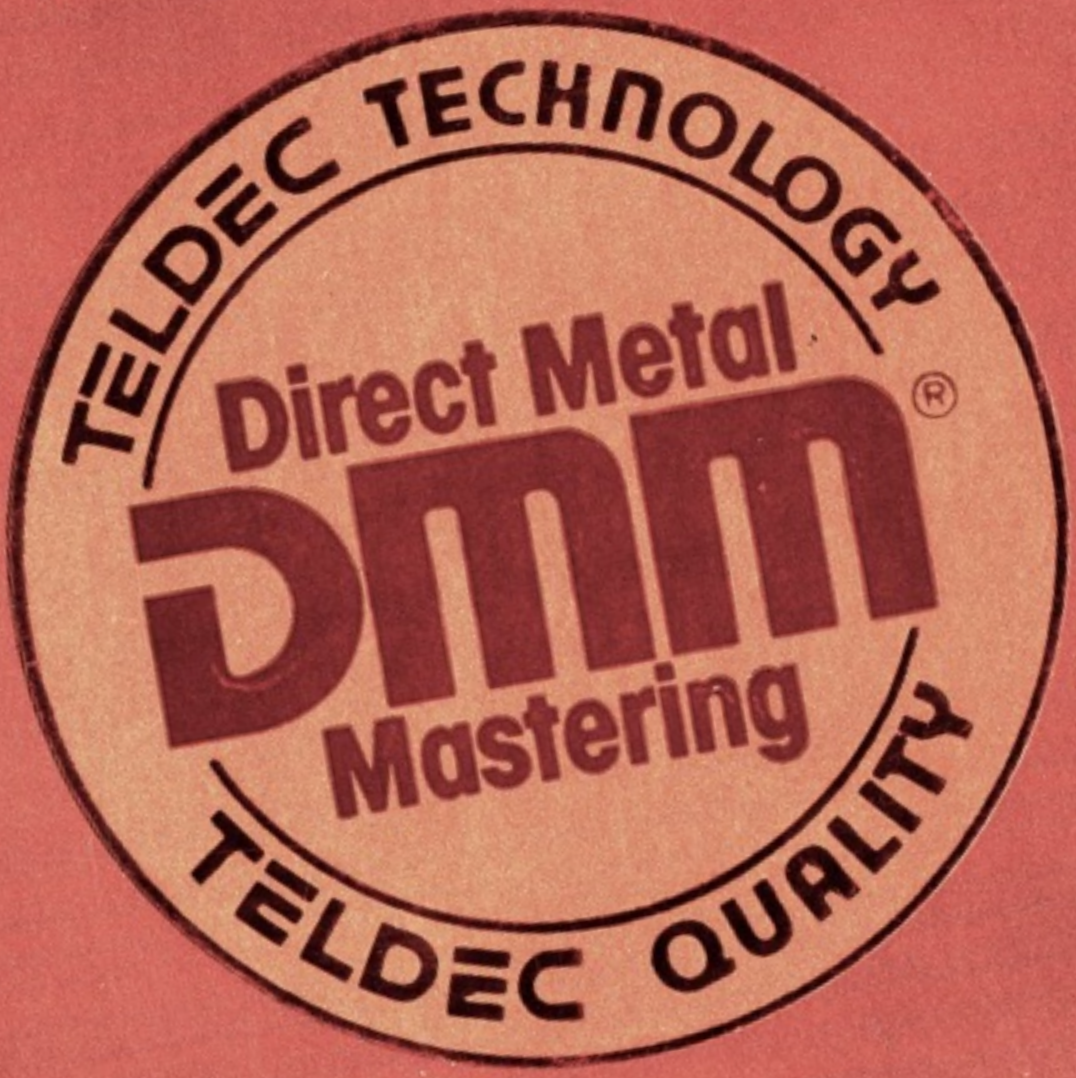
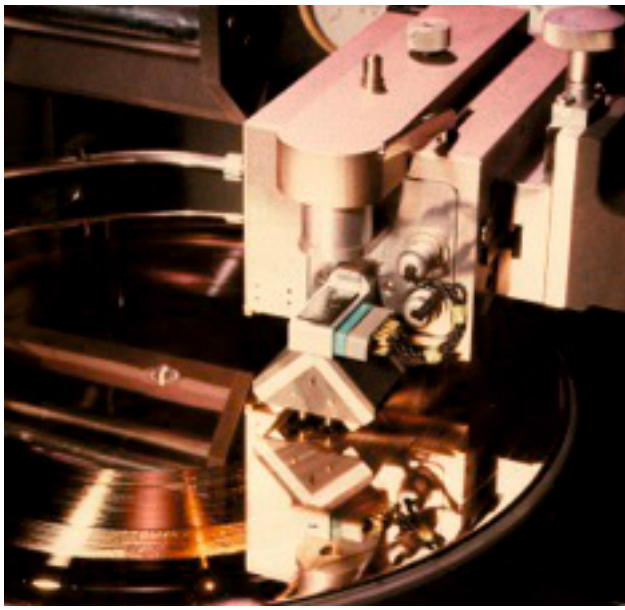

TELDEC TECHNOLOGY
Direct Metal
DMM
Mastering
TELDEC QUALITY

DIRECT METAL MASTERING
Technology



Anyone familiar with the production of vinyl records knows that the cutting process in the long chain of manufacturing process is one of the most difficult besides the electroplating process.
The processing of Laquers in the cutting process, as well as in the silver processing of electroplating process, can cause many problems. The quality of the end product is strongly influenced at this production steps and the production reliability important for vinyl pressing plants becomes very low as a high quality product is needed.

100 years non-metallic record carrier.

Since Graham Bell and Sumner Tainter had cut the sound vibrations into wax for their Gramophon in 1881, a carrier made of non-metallic material has been used for the cutting process.
For a long time wax was used with additives, also gelatine or similar substances and finally nitrocellulose lacquers, which are still used today.In further processing of electroplating, these carriers had to be coated with an electrically conductive surface. Initially, graphite was used, later mainly reduction silver processing was used.

Conventional vinyl records cutting technology is no longer sufficient.

Even though vinyl cutting technology has reached a technologically high level, there are weak spots in the process of cutting lacquers which can lead to numerous difficulties.
The climate and age of the lacquer affect the quality, also the temperature of the cutterhead and the size of the counterfacette of the cutterhead play a crucial role in the quality of the surface.
Problems result from the elastic deformability of a lacquer.
High demands are also placed on the next production step, namely the application of a conductive layer for the galvanic process.
This electrically conductive layer must have a very small thickness also be without disturbing foreign inclusions.
To ensure this, pretreatment of the lacquer must be carried out with great care. The cleaning process must not attack the surface and the activation must allow the most uniform possible attachment of the silver atoms. This is where most of the mistakes haoppen that later lead to noise and cracks on the vinyl records

DMM Direct Metal Mastering

TELDEC has developed a procedure that eliminates these sources of error. It consists essentially of the fact that the groove are cut directly into a metal layer instead of nitro layer. (Direct Metal Mastering) Here, a metal master (DMM mastercut) is created during the record cutting process, which can be used directly as a masterplate for processing of stampers. Already in 1891 there was a german patent by J.Rosenthal and S.Frank about cutting into a metal plate.This basic idea was taken up 80 years later by RCA for the development of a video record.

RCA's research was unsuccessful as it required a groove depth of 1µm and a width of 2µm for data storage. Comparatively, a groove starts at 40 microns vinyl.

DMM record carrier

Suitable metals for vinyl cutting are, under certain conditions, copper and cadmium. Cadmium was proposed by Wadsworth in 1922 to create a master plate. However, cadmium was not sufficiently resistant to galvanic processing in contact with nickel sulfamate. Therefore, copper was used.

In order to use the copper plate for cutting process , a further development had to be made.
The deformability and elasticity had to be increased, and the texture of the extracted copper had to be amorphous and not crystalline.

With the implementation of these material properties in the galvanic manufacturing process, the required material properties were achieved in cooperation with the company Europafilm and Teldec.

A 0,2mm thick copper surface is usuable by a Neumann cutterhead SX80.

The DMM Cutting Process

a metal recording medium sets the cutting stylus a much higher resistance than in previously used lacquers, therefore, the cutting resistance must be minimized in the cutting process. Three measures were used for this:

New shape of the diamond

used for cutting has no counter facets. This has the advantage that no amplitude losses occur when cut the highest transmission frequencies

Bigger cutting angle

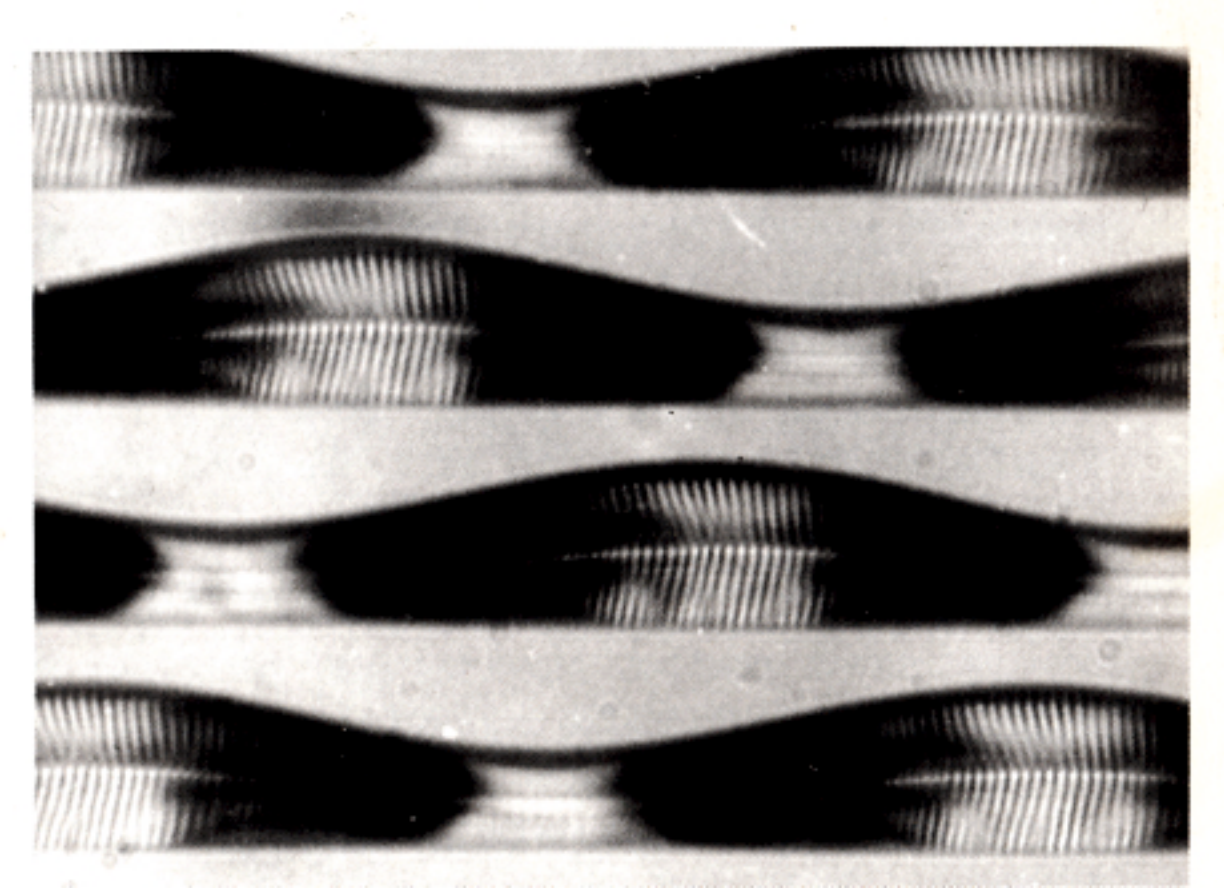
The cutting angle of the diamond is greater than 900. As a result, there is always enough space between the groove and the diamond, even with the greatest deflection. A clear advantage over lacquer cut.

Ultrasound overlay.

The cutting diamond, the position in the cutterhead, and the elasticity of the copper layer are matched to one another such that upon cutting, the diamond is placed in ultrasonic vibration whose amplitude increases in greater groove depth. This creates a perfect surface of the groove. The mechanical load of the cutterhead keep in limits. The Neumann SX 80 cutterhead with the associated SAL 74B cutting amplifier can easily withstand this load and supplies a perfect result.

vertical track angle correction.

When cutting stereo grooves into metal, the position near 0 degrees vertical has shown the best result. The use of a different cutterhead with changing cutting resistance has shown that the fluctuating horizontal force component is translated in the vertical movement of the diamond. But such a movement causes noise in the modulation. The Neumann SX80 cutterhead, the track angle has been changed by 20 degrees and serves to eliminate this distorted modulation.



Picture 1 - Ultrasonic vibration to reduce the cutting resistance at high groove depth

DMM Results:

Noise noticeably reduced.

It has been shown in extensive tests that the master produced by the DMM process are free from crackling and crackling noises. Under optimal conditions of vinyl pressing, this fact affects the end product.
The acoustically perceptible background noise of DMM records has less impulsive interference than conventional Lps made from lacquer process. This especially affects the higher frequencies.

Figure 3 shows the comparison of the typical noise pattern between lacquer and DMM technology in Teldec pressing plant. Picture A of lacquer cutting , picture B of DMM cutting.

In the higher frequency range, an improvement of up to 6 dB can be seen. The improvement in the low frequencies is particularly evident in the oscillograms of the noise voltage with a time base of 1.8 seconds equal to one disc turnaround.

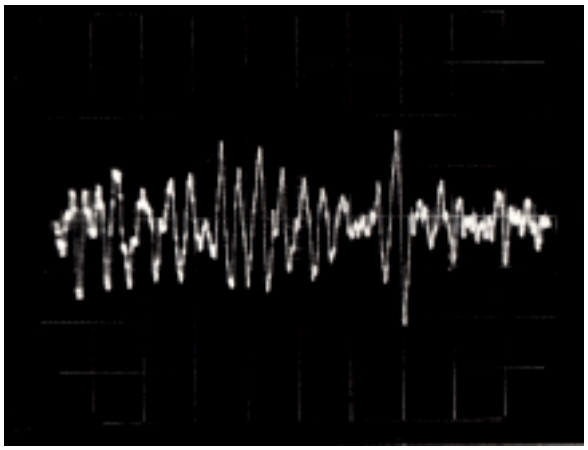


Bild 2 - Rumpelstörung: Normale LP

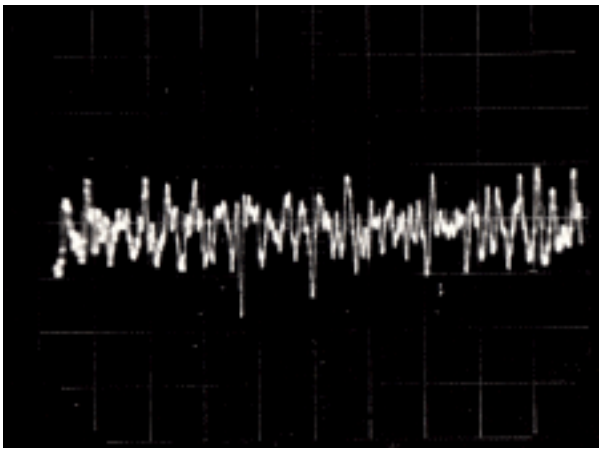
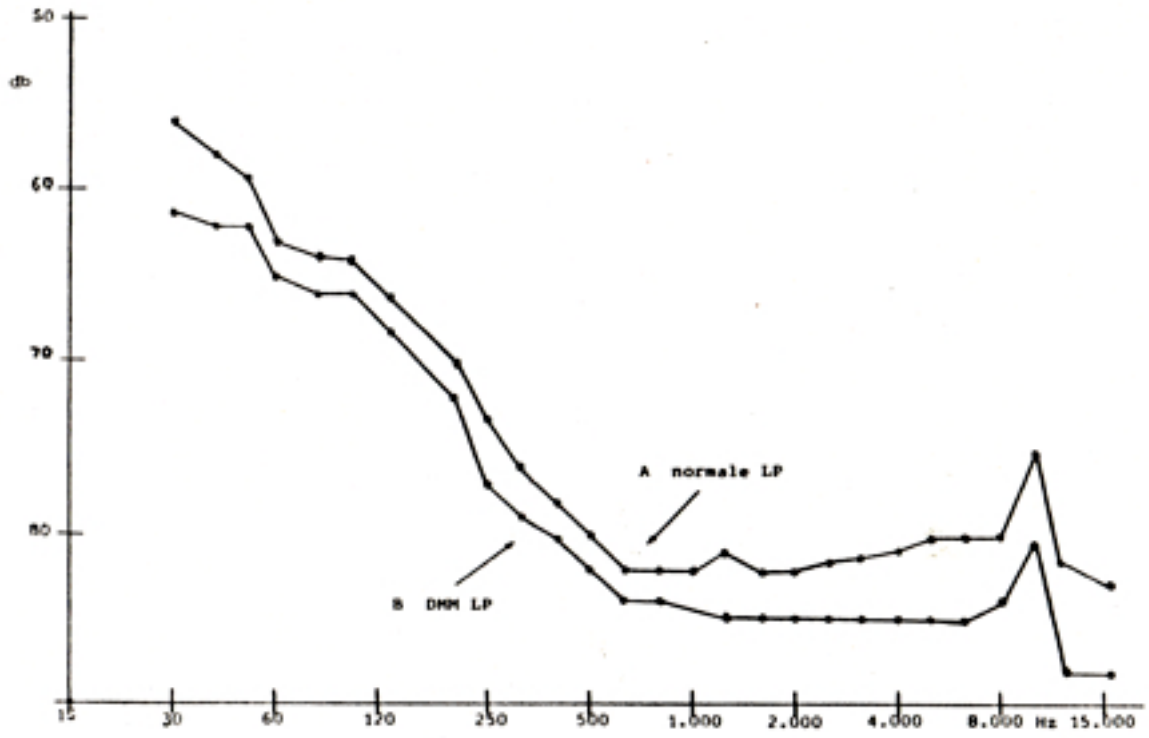


Bild 2 - Rumpelstörung: DMM LP



Picture 3 - Comparison of the basic noise Teldec Vinyl

Up to 15% more playing time without pre- and post-echoes.

Due to the absence of springback deformations in the recording process, the records are free of pre-echoes and post-echoes
It is therefore possible to minimize groove pitches and take full advantage of modern groove control techniques such as the Neumann VMS 80. The result is 10-15% more playing time on a record side on same loudness level.

Audible quality audibly better due to the absence of any groove deformation during or after the cutting process A and B comparisons of vinyl records made once in the lacquer process and once in DMM technology. A clearly better impulse behavior becomes visible

Harmonics intensive instrument sounds and voices in the consonant range are free from discoloration

Cost reduction and time savings in production

The manufacturing experience shows the assumption made at the beginning of the development that the manufacturing tolerance is much higher than with the lacquer process.
After conversion to the DMM technology, the number of new cuttings could be drastically reduced due to errors in the cutting and electroplating process. DMM provides a constant manufacturing security, failures and standstill time are may reduced. Lowest production risc.

In contrast to the lacquer cutting, a DMM master can make many galvanic processes, thus minimizing errors that can occur in the further plating process up to the press die. The short time required in the electroplating process is particularly evident in direct die development (Figure 4)

Especially with small runs of less than 3000 pieces, DMM achieves significant savings in electroplating costs. In summary, Teldec's DMM technology improves the quality level of the record and increases the profitability of the manufacturing process.

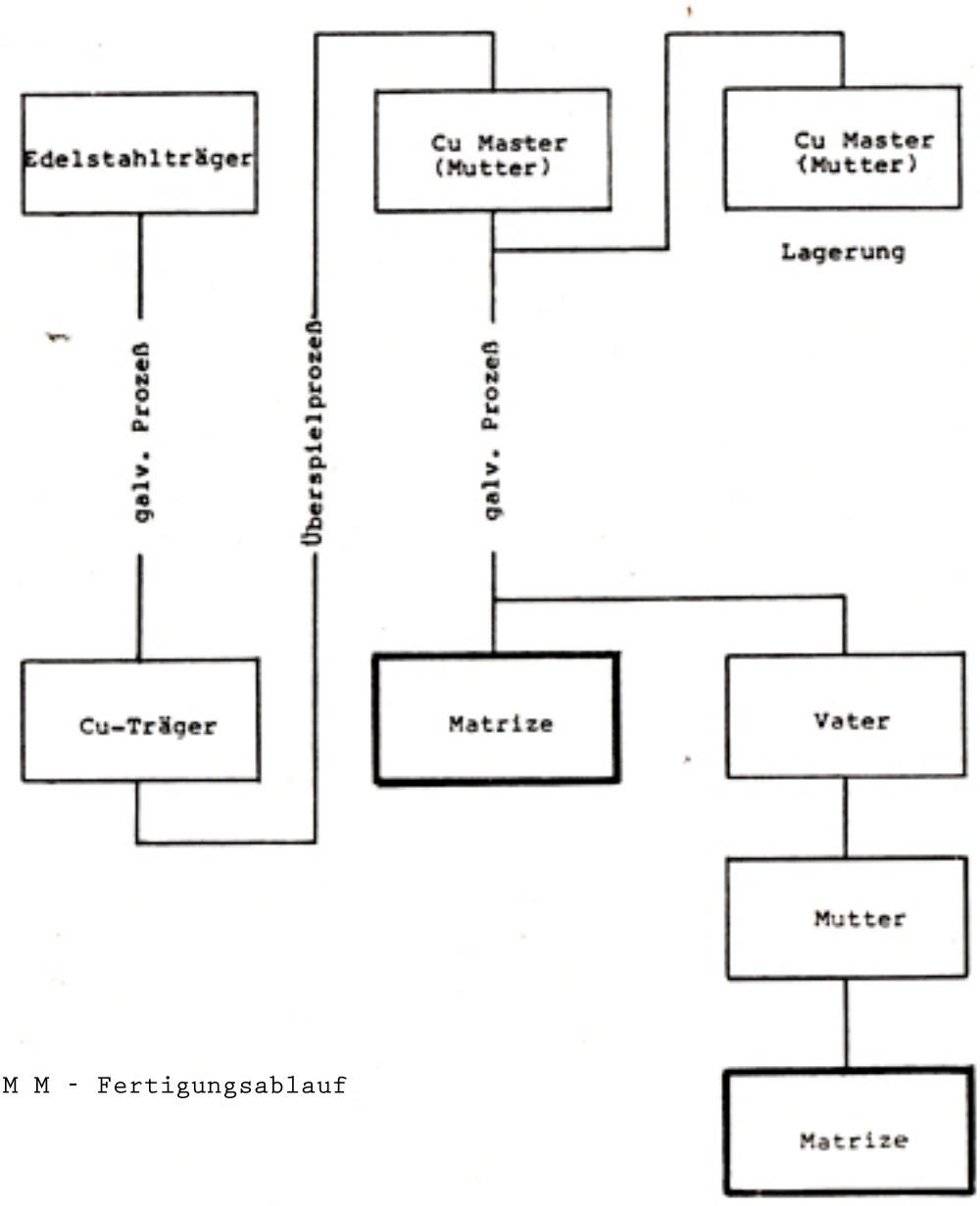


Bild 4 - D M M - Fertigungsablauf

additional DMM benefits:

no more sensitive silver processing

no time loss due to the direct plating of stampers

no heated cutterhead necessary, therefore no unclean flanks on the grooves.

no counter facet

no distortion of record due to springback, therefore no before and after echoes

longer playing time at a constant volume

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