



Vinyl: still at the cutting edge

Against all earlier expectations, vinyl disc cutting is thriving. But with none of the original manufacturers active, how and why does the business work? **KEITH SPENCER-ALLEN** descends into the underworld of the cutter.

IT WAS 20 YEARS AGO that Compact Disc launched in Europe. Although the beginnings were slow, I doubt that, by the late 1980s, anyone would have given odds on the vinyl disc being part of any future business model. The major cutting rooms had transferred most of their efforts to meeting demand for CD mastering. Large disc pressing plants were being closed or wound down. And most manufacturers of equipment connected to vinyl disc cutting had either closed, been sold, or made it clear that production was to stop.

So it may come as a surprise to learn that in 2003 disc cutting is a thriving part of the recording business with an estimated 20-30% more cutting lathes in UK operation now than at the launch of the CD.

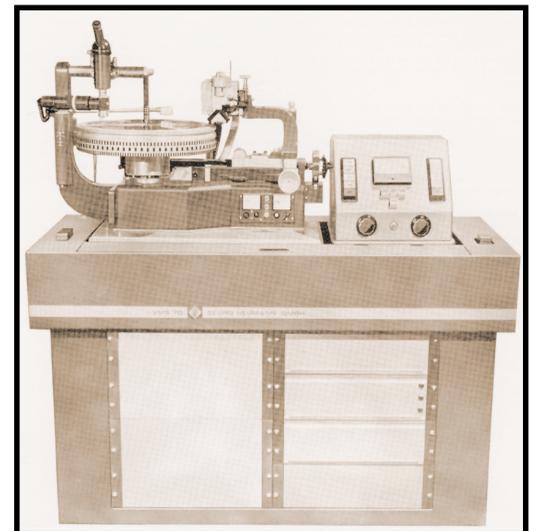
As has so often happened, musical styles have driven the industry against predictions. The rise of dance culture and its adoption of the 12-inch single, the multitude of small labels servicing that market, the way that DJs can use the vinyl disc, and a continuing demand for dub plates, has brought about the

resurgence of the disc cutting business.

Vinyl sales will never be large but it is thriving even in mainstream music stores. There is also an audiophile vinyl market that never faltered, serviced by small amounts of classical and rock releases, supported by the relative monster release, such as the recent Beatles *Let It Be* album and single with Europe-wide pressing runs of 50,000 each.

'I believe there are about 50 cutting lathes in the UK at present,' says disc cutting consultant, Sean Davies. 'It doesn't matter if you are going to press just 200 copies, you still need to cut a master. And with a large number of short run dance tracks, you don't need much in the way of sales to maintain the cutting business.'

Davies currently supports cutting facilities throughout the UK and Europe. With there being virtually no off-the-shelf equipment still being made much of his work relies on acquiring spares and parts from a variety of sources. It helps that the majority of



DMM, Neumann and Teldec

DMM, Direct Metal Mastering, is a cutting system that replaces the lacquer with a disc comprising high purity copper plating on a steel substrate. It was a spin-off from long running R&D by Teldec (Telefunken/Decca) into a video disc system who found that the post cutting 'relaxation' effect of lacquer caused the loss of short wavelength video information. Cutting into copper prevented this effect, and although the video system wasn't a great success, the benefits of copper cutting were later developed for audio discs. Teldec licensed the system in 1980 and Neumann produced practical systems in the form of a modified lathe and cutter head – the VMS82 and SX84 – the very last disc cutting products they manufactured.

Aside from having no relaxation effect, DMM virtually eliminates pre and post groove echo, and removes the need and costs for the silvering process at the start

of the pressing process, as well as its potential to add noise. The VMS82 lathe required a more powerful drive motor while the cutter head has to address several mechanical issues regarding cutting angle and the fact that the stylus is not heated.

Teldec had a strong engineering team and worked closely with Neumann from the 1960s. The original Neumann stereo cutting heads had been designed by Teldec, were tested at Decca in London, and were then manufactured and sold by Neumann. The VMS80, Neumann's first lathe that wasn't a direct descendent from the original AM31 design of 1931, resulted from Teldec's video disc development applied to Neumann lathe design. Teldec and Neumann also collaborated on a piezo-electric CD cutter that would allow CDs to be mechanically cut into copper, which worked, was demonstrated, but was never developed into a full product.



Neumann disc mastering system: VMS80 lathe; SX74 cutterhead; SP79 console; SAL74 cutter logic drive; and MT80 preview tape deck.

the cutting equipment comes from the same company.

'Nearly all of the machines in current use are Neumann. VMS80, 82, 70 and 66s but there are a few earlier including two AM32s and one AM31 – the original 1931 model! I also have a few Lyrec customers in the UK and Belgium.'

Davies' connections with Neumann grew closer last year when they realised that he was handling support for Neumann cutting systems following the death or retirement of those initially handling this work when the company ceased interest in the business a decade ago. A spell in Berlin gave him access to original

drawings and what disc cutting know-how was left in the company. They have no spares, those having being passed onto those carrying out initial support, and that supply was based upon a projected gradual demise of the business. However, this isn't an immediate threat as Davies confirms.

'Most parts on a disc cutting lathe rotate slowly and are massively engineered and there are mechanical adjustments because of wear and drift. The machine parts don't wear out that quickly. It isn't like a car engine where you have 5-6000rpm. I try to ensure that I have the major parts in stock that are going to wear out – the brushes and the turntable motors, the pitch motors, the tacho generator on the VMS70. Some of these are things that can be purchased as generic products but often Neumann bought in a part that was a stock item 20 or 30 years ago but may not be made any more. Sometimes they still remain available. The ball races on the VMS80 lead screw are a special type using a back-to-back pair matched to a high tolerance. This ensures that there is no end float in the lead screw, which would result in erratic groove spacing. These ball races are high precision and quite expensive. Both Neumann and Lyrec used bearings from GMN and those were all noise-tested which is important in a disc lathe. Unfortunately the company went out of business a few years ago and I bought as many as I could of suitable precision types, of the right grade, that ran quiet. There isn't a lot else to wear out – there is no reason why a lathe should be unrepairable.'

'The vast majority of problems occur in the electronic parts. Some of the early transistors,

The lacquer disc – keep it cool

First developed by Cecil Watts in the UK, Pyral in France, and others in the 1930s to replace the use of wax discs, the manufacture of lacquer discs is deceptively simple – a thin layer of cellulose nitrate lacquer is deposited onto a mirror-flat aluminium



substrate. However, very high levels of precision and quality control are required at all stages from the

mixing of the lacquer, the coating and drying. Variations in the lacquer mix of resins, pigments, plasticiser and solvents, or minute contamination of the surface can cause significant effects on performance.

There are just three manufacturers of lacquer discs – Transco and Apollo in the US, and MDC in Japan. Much like the professional magnetic tape market, if one manufacturer runs into production hiccups, as can happen occasionally, it can have an impact all across the mastering industry.

Equal care must be taken with the discs after mastering. The lacquer is a relatively soft material and it gradually 'relaxes' after cutting causing HF and other losses. It is therefore preferable to get the cut discs to the plating process at the pressing plant as soon as possible. However, in the real world that may not be possible so Sean Davies recommends the use of a fridge.

'I always say to my customers that as soon as you've cut a lacquer put it in the fridge. As an experiment, a few years ago, I cut a range of identical tones on two lacquer discs from the same box. One was placed in an ordinary domestic fridge on a Friday and the other left in the reception area. On the Monday I played the two back – the disc from reception was 2.5dB down at 15kHz in comparison to the one in the fridge, which is significant.'

'Copper doesn't relax – part of the success of DMM in maintaining brightness is not only its inherent properties but the fact that you can leave them in reception and they still sound good!'



Mixing for vinyl – basic rules

The recording engineer has largely been freed from the limitations of equipment dictating how creativity should be tailored to work within a given medium. Working with vinyl, however, requires a return to awareness of what the medium can and cannot do – there are undeniable laws of physics at work here.

The first aspect is playing time. Increased level on disc is created by increased lateral excursion in the groove and this eats up the disc surface reducing playing time. Your disc mastering engineer should be able to advise on levels versus playing time.

Take great care with the extremes of frequency. High frequencies such as cymbals, some brass instruments, or vocal sibilance can cause real problems. There is already HF pre-emphasis applied prior to cutting in the form of the RIAA curve and if the signal has high levels of HF there is a possibility of cutter head damage, or an unpleasant effect on disc. The mastering engineer will employ acceleration limiters to protect his gear but may also have to process your master to get around this.

Low frequencies have a different problem particularly if there are equal levels of opposing phase information present. This increases the vertical movement that cheaper cartridges will find difficult to track as the groove goes alternately shallow/narrow to deep/wide. Although this could be cut, it is likely that you would have an unplayable disc that nobody was happy with. To overcome this, a low frequency crossover system would be employed that allows the LF to be reordered and cut such that the LF is cut common in both channels. If this problem had been created by errors in mic technique then it would be advisable to use an oscilloscope to monitor out-of-phase material. However, some effects units can create extreme out-of-phase conditions that can be uncuttable.

The vinyl disc doesn't have the full usable dynamic range of modern digital media and this has to be borne in mind when mixing for it. If you make the right adjustments during mixing, the transfer to disc can be a relatively painless process. Otherwise you leave it to the skill of the cutting engineer to realise your mix on disc; he will have to apply what processing he needs to achieve that with no guarantee that it is true to what you had in mind when mixing.

microprocessors and logic circuits are hard to find. Increasingly we have to compete for some of these devices with an airline industry that is happy to pay high prices for obsolete ICs with the legally-required aviation documentation. This can raise prices by 50-60 times, and with a VMS 80 possibly needing 56 of those ICs, the costs of maintaining some lathes may rise but I think we are a long way from not being able to repair these products.'

Cutterheads have proved to be a little more difficult to support being high precision products on a par with watchmaking. Picture what happens inside – a cutting amplifier may push as much as 600W per channel into 10mm coils made from 1mm wire. The coil is designed to operate at up to 200 degrees Celsius but requires Helium to cool it and aid heat dissipation through the magnet system. The stylus cuts a groove in the lacquer while a fine coil of nickel chromium wire, powered by 1/2amp current, heats it to partially melt the lacquer as it cuts. The heat also reduces the surface noise as do the polishing bevels on the corners of the cutter.

'The demands made on cutting heads today are fairly extreme,' continues Davies. 'When they were designed in the 1960s/70s the type of work was varied. Now it may be 12-inch singles at maximum possible playing level all day – the head is working at its limit all the time. It is the volume on the record that determines how much of a pasting that the head gets. Things like metal fatigue in the suspension springs can set in. In the cutter drive coil, the copper in the windings expands and contracts around the aluminium former and that heating/cooling can loosen the adhesive that holds the drive coil together. If one turn of that gets loose, because it is in a feedback loop in the amplifier, it will take off, the head starts to oscillate and it trips the circuit breaker immediately and won't work anymore.'

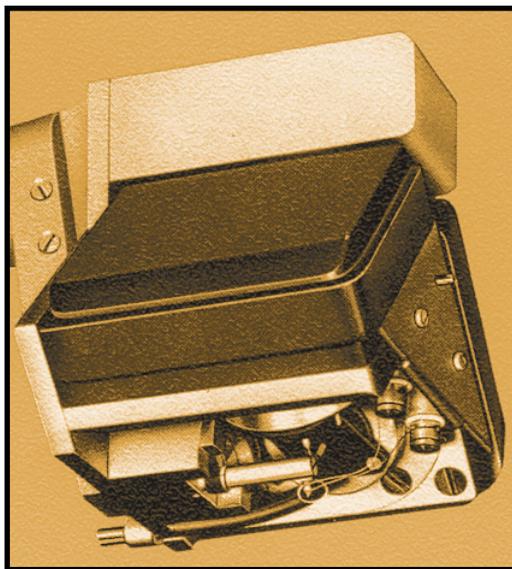
Davies, together with two European partners, is in the middle of developing replacement parts for cutterheads enabling a quick turnaround in head repairs. But the challenge is considerable, such as when the German precision engineering company was supplied with the wrong hardness of aluminium for coil assemblies. This led to a phase shift in the response

loop and the completed head not performing correctly. Davies now has access to Neumann's original check-out tolerances and matching repairs against that will ensure a product of the same standard that Neumann would have made.

While the maintenance of the key components may be looking good for the long-term, there are other problems, such as where the next generation of cutting engineers will come from.

'No one expected vinyl to last and the traditional training programmes were stopped or scaled down,' says Davies. 'Training was originally within the studio on a watch and learn basis with the trainee gradually taking more responsibility under supervision. It is not something you can pick-up overnight. Anyone can buy a CD recorder and provided you learn the buttons and pay some attention to the meters, it is possible to produce a reasonable CD-R. But it isn't like that with vinyl.

'You have to understand the medium, what it is good at and what it isn't good at. You have to learn how to get the best out of it.' ■



Sean Davies

Sean Davies is a well known audio consultant specialising in studio design and transducers but has increasingly found himself at the heart of UK and European disc cutting. This he explains by saying that he's always kept an involvement with disc cutting and is 'one of the few left who still know all the machines'.

He started cutting discs at home, aged 13, by connecting home electrical equipment and progressed to a portable lathe that needed constant rebuilding. A hobby of repairing and reselling broken radios financed a connection to a source of reject lacquer discs and he was away. Joining IBC Studios in the maintenance department soon led to working within its disc cutting operation. Building a reputation as an expert, he was later to be found behind the technical side of Strawberry Mastering.

His company, SW Davies Ltd, is involved in most aspects of professional audio and currently supports cutting facilities throughout the UK and Europe.

His factual input to his article has been considerable, for which I'm very grateful.



Metropolis Mastering's Miles Showell is an advocate of half-speed cutting.

'In a nutshell the half-speed cutting process is the most accurate and transparent way to transcribe music to vinyl – bar none. We gave acetates to Rick Smith from Underworld as an example of what's possible. He was so impressed that he organised having the entire back catalogue re-cut half-speed for vinyl reissue. When we heard Born Slippy played back from the half-speed cut for the first time, it was simply mind blowing.'