

# Maxell Europe Limited



**Telford Factory**

**Introduction**

# Manufacturing Mini-Discs.

Presented by:  
Matthew Fletcher.

Optical Products  
Manager.

May 7th 2002.



# Introduction.

All parts except the metal hub are manufactured in the Telford factory. The shell, shutter, plastic case and small parts are all moulded in the General moulding shop.

The discs are manufactured in a class 10,000 clean room

Assembly and packaging is carried out in the conversion area.

# MiniDisc at a glance.

- Rewritable magneto optical disc.
- Recordable up to one million times.
- Fast random access (same as CD)
- 74 min or 80 min quality digital sound.
- Shock resistant memory during playback.
- Suitable for home recording and playback.

# Specifications.

|                              |                      |   |                            |
|------------------------------|----------------------|---|----------------------------|
| <b>Major specifications.</b> |                      | <b>Audio Charecteristics</b>  |                            |
| Recording/ playback time     | 74/80 minutes.       | Channels  | 2 channels(stereo/mono)    |
| Cartridge size (WHD)         | 72 X 68 X 5mm        | Frequency range   | 5-20,000 Hz)               |
| <b>Disc Specification.</b>   |                      | Error correction system   | 105dB                      |
| Diameter                     | 64 mm                | <b>Signal Format</b>  |                            |
| Thickness                    | 1.2 mm               | Compression system  | ATRAC*                     |
| Centre hole dia              | 11 mm                | Modulation system   | EFM**                      |
| Beginning of programme       | 32 mm                | Error correction system   | CIRC***                    |
| Track pitch                  | 1.6 microns          | <b>Optical parameters.</b>  |                            |
| Linear velocity              | 1.2 - 1.4 metres/sec | Laser wavelength  | Standard 780nm             |
|                              |                      | Laser diameter.   | Standard 0.45              |
|                              |                      | Recording power   | 5mW (max.)                 |
|                              |                      | Recording system.   | Magnetic Field Modulation. |
|                              |                      | * <u>A</u> <u>d</u> <u>a</u> <u>p</u> <u>t</u> <u>i</u> <u>v</u> <u>e</u> <u>T</u> <u>r</u> <u>a</u> <u>n</u> <u>s</u> <u>f</u> <u>o</u> <u>r</u> <u>m</u> <u>A</u> <u>c</u> <u>o</u> <u>s</u> <u>t</u> <u>i</u> <u>c</u> <u>C</u> <u>o</u> <u>d</u> <u>i</u> <u>n</u> <u>g</u> |                            |
|                              |                      | ** <u>E</u> <u>i</u> <u>g</u> <u>h</u> <u>t</u> <u>o</u> <u>F</u> <u>o</u> <u>u</u> <u>r</u> <u>t</u> <u>e</u> <u>e</u> <u>n</u> <u>M</u> <u>o</u> <u>d</u> <u>u</u> <u>l</u> <u>a</u> <u>t</u> <u>i</u> <u>o</u> <u>n</u>  |                            |
|                              |                      | *** <u>C</u> <u>r</u> <u>o</u> <u>s</u> <u>s</u> <u>o</u> <u>l</u> <u>o</u> <u>m</u> <u>o</u> <u>n</u> <u>C</u> <u>o</u> <u>d</u> <u>e</u> <u>.</u>   |                            |

# Shell / Shutter moulding.

- Shell is polycarbonate material . This has to be used due to the heat generated during recording. Cycle time = 10.9 sec (4 cav)
- Pad printing is carried out on line.
- Shutter material is polypropylene cycle time = 10 sec. (8 cav)
- P-Case material is polystyrene cycle time = 11.59 sec (4 cav)

# Clean Room Production

There are 5 stages of production in the clean room

- 1) Injection moulding
- 2) Sputtering
- 3) lacquer coating
- 4) lubrication coating
- 5) Inspection

# Manufacturing -(1)Moulding.

- Class 10,000 clean room
- 30 Tonne moulding machine (Sumitomo)
- Single cavity mould.
- Optical grade polycarbonate resin.
- Use of stamper for replication.
- Cycle time 5 to 5.5seconds.
- Shot weight disc = 4.6 g
- Shot weight sprue = 0.6g (reground)

# Injection Moulding Machine



# Manufacturing (2) Sputtering

Sputtering is carried out in a vacuum chamber, where a plasma is formed. Out of this plasma Argon ions are accelerated against a target (Cathode) consisting of the desired layer material. Through the ion bombardment, molecules are liberated and deposited on the disc which lies opposite the target. In this way a thin layer (Typically 310 angstroms) is formed. The layer thickness is determined by , the gas flow rate, the electrical power, and the deposition time.

Rotating magnets are used behind the target to ensure that they wear gradually and evenly. This allows us to get a much longer target life and thus a higher disc per target ratio.

# Manufacturing (2) Sputtering (Cont)

- 6 layers of sputtering carried out on Mini-Disc .
- 4 x Silicon nitride. 1 x Magneto optical. 1 x Aluminium Titanium.
- Material stored on a sputtering “target”

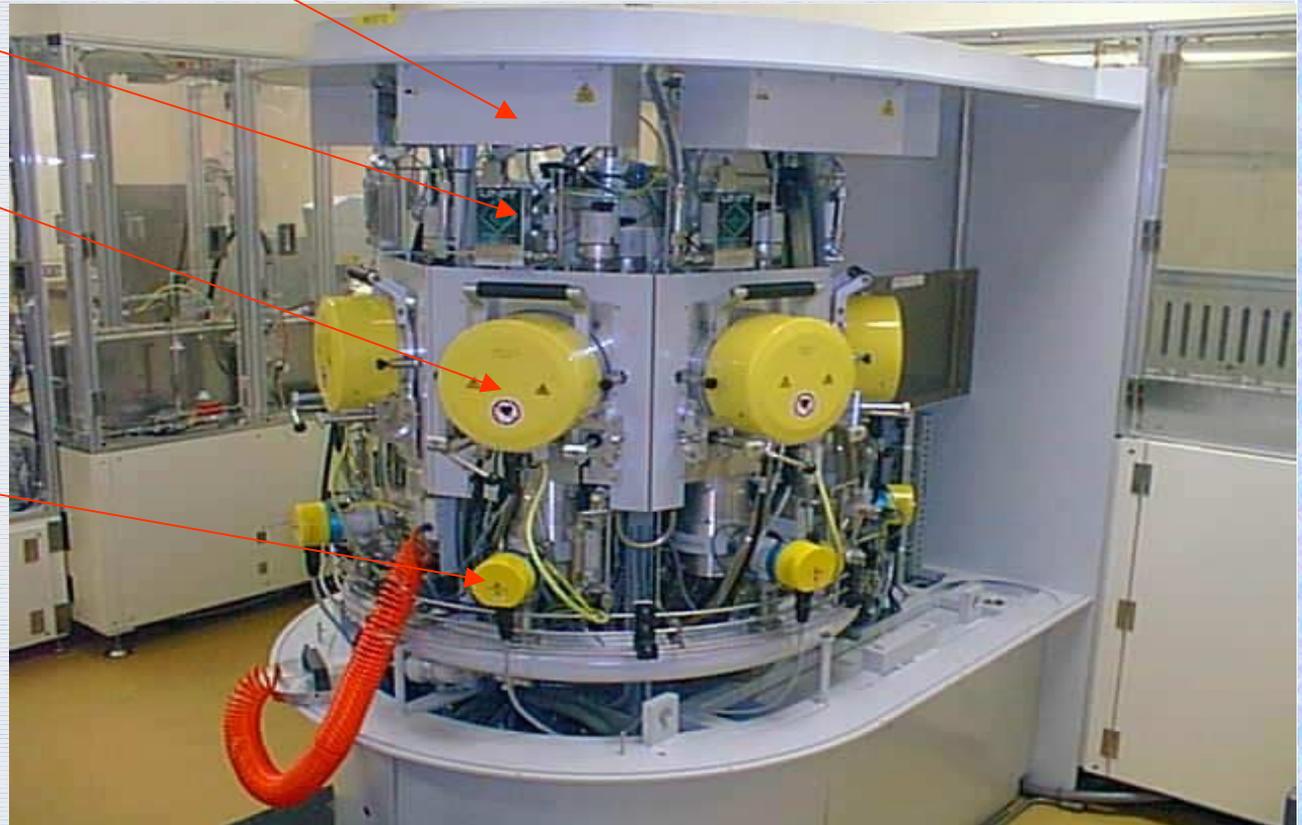
New target

Worn target

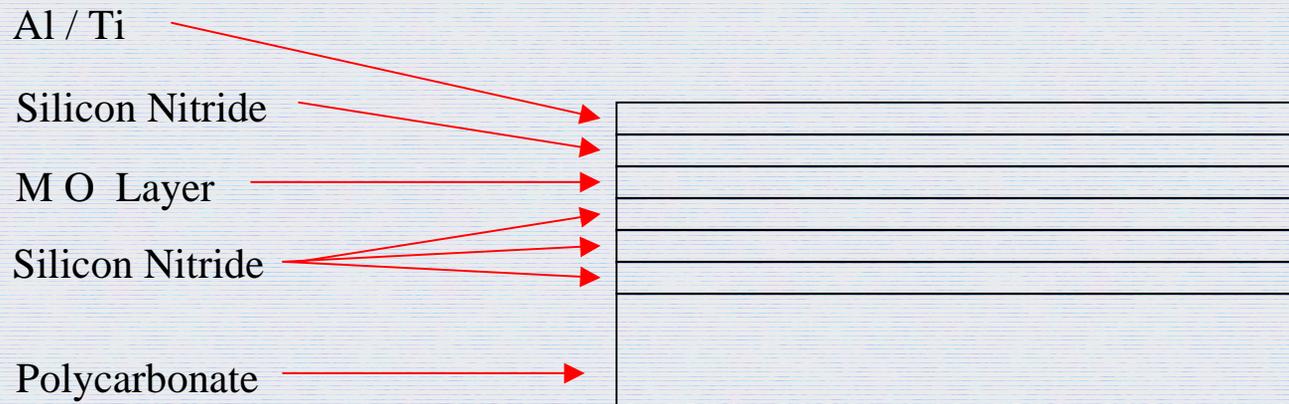


# M.D Sputtering machine

- D.C. voltage controllers
- Gas control valve
- Magnetrons
- Turbo vacuum pumps



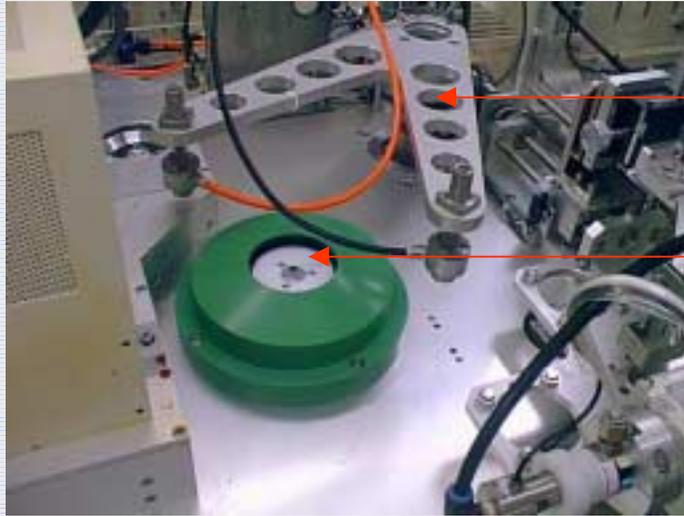
# Sputtering process



# Lacquer Coating

- Ultra violet curing lacquer (same as C.D.)
- Used to seal surface of reflective layer and prevent oxidation.
- D.I.C. SD 318 lacquer used.
- Recycled four times before changed.
- Curing cycle time = 1.5 seconds
- Can be coloured if required (for example gold disc)

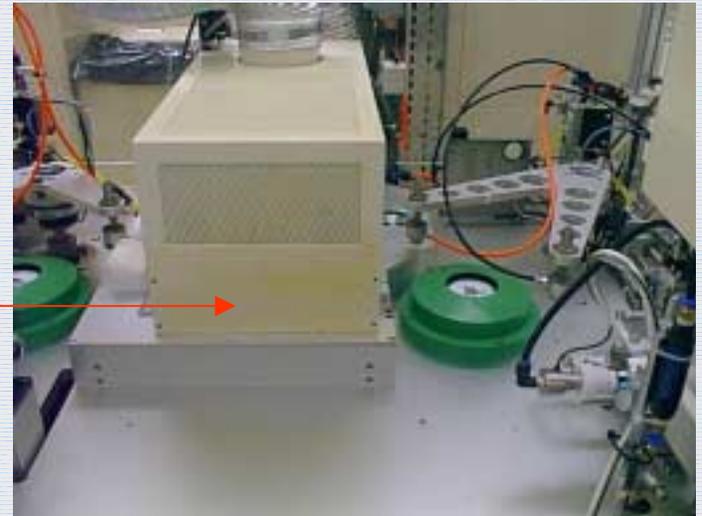
# Ultra Violet Lacquer station



Transfer station

Centrifugal spin station

U.V. Curing station



# Lubrication

- Lubrication is a butanol silicon oil mix.
- Butanol evaporates leaving oil layer on disc.
- Lubrication is important when recording as it prevents magnetic head from making contact with the disc.

# Inspection.

- All discs are checked by camera inspection system for surface flaws and warpage.
- Discs from spindles are checked for Mechanical / Jitter properties.
- Discs from each spindle are certified to check quality.
- Layer thickness is checked periodically
- Lubrication quality checked on friction test machine

# Inspection Equipment



Dr. Schenk inspection machine.

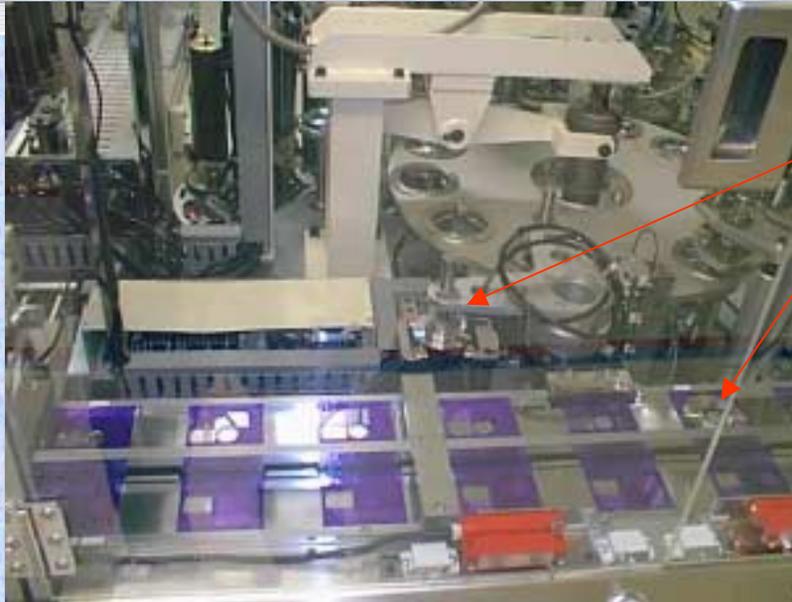
Certification machines



# MD. Assembly

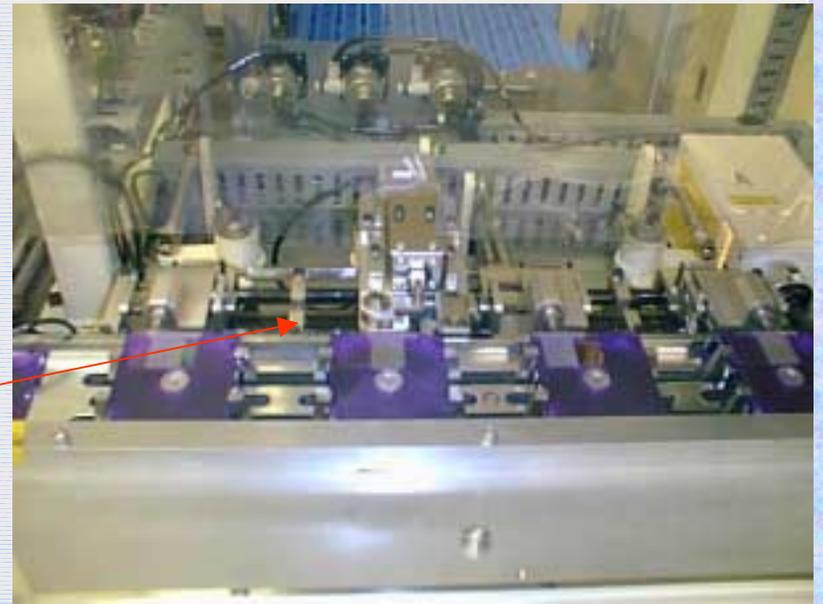
- Assembly machine cycle time = 1 second.
- Hub is inserted in to disc by ultra sonic welder.
- Shell is welded then checked for height.
- Shutter strength is automatically checked.
- P-Case is optional.
- Computerised fault finding

# M.D. Assembly machine



Disc loading station

Shutter check station



# MD Packaging.

- Cycle time = 0.5 second.
- Shells overwrapped then run through a shrink tunnel.
- Various finished goods, 5 pack, plastic box etc.
- Some goods in W.I.P. form to be used in special packaging.

# M.D Packaging samples.

