MICRO-POINT MATCHED MASTERING

The disc recording stylus and the master record are two of the most critical, interrelated elements that determine the overall quality of a disc recording. Micro-Point is the only company that manufactures both components. This unique position and the ability to conduct sophisticated, precision tests of the disc recording process permits Micro-Point to match recording stylus geometry to master record composition for optimum results. This is "Matched Mastering", a process that permits recording studios to improve their mastering quality and efficiency.

The following defines and discusses the recording stylus, the master record, and their joint relationship to mastering quality. This is followed by complete specifications for Micro-Point recording styli and master records.

CUTTING THE GROOVE
A recording stylus performs two basic functions: it cuts the groove in the master record, and it smooths or burnishes the resulting groove walls. While cutting the groove the stylus is driven by the cutter head in a 45/45 stereo mode to form the complex mechanical waveforms in the master record which are a precise analog of the electrical waveforms fed to the recording amplifier.

The recording stylus and basic groove cutting action are illustrated in Figure 1. This drawing shows an oblique view and a cross section view of the stylus. The section view is from directly overhead as the stylus is cutting and burnishing a groove in the master disc.

![Figure 1. Recording Stylus View](image)

The cutting edge is the intersection of the stylus face and the burnishing facets, and as the master record moves past the stylus, a groove is cut. The cutting action leaves a certain amount of roughness on the groove walls. The burnishing facets, which trail the cutting edges, protrude slightly beyond the cut groove. As they pass by, the new walls are forced to rub against the facets, and in this way are smoothed or burnished. Heat generated by the cutting and burnishing friction, combined with heat supplied by the stylus heater raises the temperature of the lacquer sufficiently to allow a minute amount to flow and thus improve burnishing action. Any roughness remaining in the groove walls after cutting and burnishing is heard as noise during playback.

Low groove noise depends on three factors; recording stylus dimensions, stylus temperature, and lacquer composition. Recording stylus dimensions that influence recorded noise and program levels are; burnishing facet width and angle, cutting edge accuracy, tip radius, and back angle. Optimum dimensions of the stylus depend upon the specific lacquer composition.

BURNISHING FACET WIDTH AND ANGLE

Burnishing facets are specified by width and angle dimensions as shown in Figure 2. Changes of facet dimensions cause variations in a number of recording quality criteria in opposing directions. Some become better; some become poorer. Figure 3 illustrates this complex relationship between facet dimensions and the three recording qualities they influence; noise level, high frequency performance, and stylus life.

![Figure 2. Burnishing Facet Geometry](image)

![Figure 3. Relationship of Mastering Quality Factors to Burnish Facet Geometry](image)
Burnishing action increases as facet width and angle are increased and noise levels are reduced. Figure 4 shows that for given facet angle, changes in facet width can influence groove noise by more than 6 dB! However, large facet dimensions degrade high frequency performance.

![Figure 4. Influence of Burnish Facet Width on Groove Noise.](image)

CUTTING EDGE, TIP RADIUS, BACK ANGLE
The cutting edge is formed by the intersection of the front face and the burnishing facets. The finish of these surfaces determines the accuracy of the cutting edge itself. The finer the polish, the sharper the edge. Production holds these surfaces to a finish specification of better than 0.05 micron. In addition the edge must be flawless to produce a smooth groove without streaking.

The stylus tip radius provides a smooth, defined groove bottom at the intersection of the two groove walls. This permits clean metal-plastic parts separation during processing. To ensure bottom radius smoothness, the burnishing facets continue around the stylus tip from one side to the other. The stylus tip radius at 3.0 microns (0.00012 inch) maintains clearance between playback stylus and groove bottom.

![Figure 5. Modulated Groove and Recording Stylus Sections.](image)

The back angle imposes a limit on recording levels due to an interference called slope overload. When the slope of the modulated groove exceeds the slope of the trailing faces of recording stylus, overload occurs and distortion must result. Figure 6 illustrates this condition. The stylus shown by the dashed lines could not have cut the groove modulation as shown. The maximum slope that can be cut is that part of the groove that remains after the shaded section is removed. Older styli designs were made with a back angle of 45°. As compared to the specified angle of 40°, maximum slope has been increased 5°. This translates to an increase in recording level limits of over 1.5 dB.

![Figure 6. Influence of Burnish Facet Width on Frequency Response.](image)

MASTER RECORD QUALITY AND LACQUER COMPOSITION
Master record quality depends upon three major factors; aluminum base quality, lacquer coating uniformity, and lacquer composition. The aluminum base must be flat, free of surface flaws or contamination, and relieved of internal stresses in order to accept a uniform coating and prevent post-production warping. The coating process must provide uniform lacquer thickness and surface smoothness free of voids or imperfections. The third factor, lacquer composition, influences virtually all master record cutting characteristics. A list of factors influenced by lacquer surface smoothness and composition include:

- Noise Level
- Stylus Life
- Chip Integrity
- Groove Striations
- Pressing Quality
- Stamper Life
- Impulse Noise (Tics, Pops)
- Heater Current Level
- Master Processing
- Metal-Plastic Separation
- Advance Ball Noise
- Groove Echo
Abrasive properties of the lacquer composition is a large variable in master record quality. It varies not only with each manufacturer, but also from lot to lot from the same manufacturer. Since noise levels generally (but not always) increase with increased abrasiveness, groove noise tests also evaluate abrasiveness and hence stylus life.

**MICRO-POINT MASTER RECORDS AND RECORDING STYLI MATCHED**

Specifications on the following pages fully describe the thorough, precision inspection and testing given every stylus and each master record lot produced. This not only provides superior quality assurance, but also indicates the window of quality beyond acceptable. This window permits adjustment of recording stylus facet dimensions to improve recording quality without exceeding acceptable noise levels or reducing stylus life.

For example, if a given lot of master records exceeds acceptable noise levels by several dB with an appropriate heater current range as tested using standard burnishing facet dimensions, it is possible to change those dimensions and thereby improve recorded levels and high frequency performance without exceeding acceptable noise levels or reducing stylus life. This is Micro-Point's "Matched Mastering".

On request Micro-Point will run the required tests to make recommendations matching styli and master records to achieve your particular recording goals. A number of studios maintain a stock of recording stylis with smaller facets as well as standard sizes. Based upon their own noise tests and processing experience they choose the stylus size best suited for each recording project. Three of these smaller alternate sizes that have become popular are listed under Recording Stylus Specifications.
NOTES: 1) Neumann stylus manufactured with Micro-Point shanks. Neumann shanks available on request.
2) Westrex 350AL has 35% less effective tip mass for increased high frequency range.
3) Facet width and tip radius options:

<table>
<thead>
<tr>
<th>Model Number Suffix</th>
<th>Facet Width “F”</th>
<th>Tip Radius “R”</th>
</tr>
</thead>
<tbody>
<tr>
<td>None (Standard)</td>
<td>4.2 Microns</td>
<td>3.0 Microns</td>
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<tr>
<td></td>
<td>0.00017 Inch</td>
<td>0.00012 Inch</td>
</tr>
<tr>
<td>-4.0</td>
<td>4.0 Microns</td>
<td>3.0 Microns</td>
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<tr>
<td></td>
<td>0.00016 Inch</td>
<td>0.00012 Inch</td>
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<tr>
<td>-K</td>
<td>3.8 Microns</td>
<td>2.0 Microns</td>
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<tr>
<td></td>
<td>0.00015 Inch</td>
<td>0.00008 Inch</td>
</tr>
<tr>
<td>-M</td>
<td>3.5 Microns</td>
<td>2.0 Microns</td>
</tr>
<tr>
<td></td>
<td>0.00014 Inch</td>
<td>0.00008 Inch</td>
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STYLUS HEATER SPECIFICATIONS:
WIRE: 39 Gauge Nichrome, 0.0035 ± 0.0001 Inch, Dia.
RESISTANCE COLD: Models 320, 329, 329SH, 350AL: 2.1 ± 0.1 Ohms.
Model 350: 4.2 ± 0.2 Ohms.
RESISTANCE HOT: Models 320, 329, 329SH, 350AL: 2.0 ± 0.1 Ohms.
Model 350: 4.0 ± 0.2 Ohms.

MASTER RECORD SPECIFICATIONS:
UNMODELATED GROOVE NOISE:
TEST EQUIPMENT:
Cutting Lathe: Scully Automatic Disc Recorder.
Cutting Head: Westrex 3D Stereodisk Recorder.
Cutting Stylus: Micro-Point 350.
Turntable: Scully Automatic Disc Recorder.
Cartridge/Stylus: Shure ML120HE/N120HE.
Stylus Force: 1 Gram.
Preamplifier: UREI 1122, Transcription.
Noise Meter: Computer Controlled, Sound Technology 1510A, 1/6 Octave Noise Spectrum Analyzer.

TEST CONDITIONS:
Signal Reference: 5.0 cm/sec Peak Velocity, 1000 Hz
Heater Current: That level below which noise would begin to rise.
Test Groove Diameter: 2 Inches less than disc diameter.
Test Groove Width: 2.5 Mils.
Advance Ball: Raised to clear surface, cutter balanced to control groove depth.
Playback Weighting: RIAA Equalization.
Playback Bandwidth: 400 to 20,000 Hz.
Spectral Analysis: 18, 1/3 octave bands.
Record Amplifiers: Off.
System Signal/Noise: Tone arm on rest, turntable running:
Each Spectral Band: Greater than 80 dB.
Ave All 18 Bands: Greater than 82 dB.

SIGNAL TO NOISE RATIO SPECIFICATIONS:
Left or Right Channel: Each Spectral Band: 70 dB Minimum.
Ave All 18 Bands: 75 dB Minimum.

SUBJECTIVE LISTENING—NOISE TEST GROOVE:
PURPOSE: To evaluate and rate all unmodulated groove sounds which are not always revealed by noise measurement.
TEST CONDITIONS:
Playback Equalization: Flat.
Playback Gain: 30 dB Above Normal Program Levels.
Playback Bandwidth: 20 – 20,000 Hz.
Test Groove: Recorded As Above Except for Advance Ball.
Advance Ball: Set to Contact Surface, Cutter Balanced for Advance Ball Control.
Evaluation Categories: 1) Tics and Pops, 2) Hiss, 3) Chip Tube and Advance Ball Noise.
MASTER RECORD SPECIFICATIONS: (continued)

SUBJECTIVE LISTENING SPECIFICATION:
Each category is rated on a scale of one to ten, poor to excellent, by an experienced listener with a knowledge of studio requirements. All categories must exceed a rating of five for lot acceptance.

MICROSCOPIC EXAMINATION, 220X TO 1220X:
EVALUATION CATEGORIES:
1) Groove Wall Polish, 2) Groove Bottom Polish, 3) Surface Flaws, 4) Surface Flatness, 5) Horns.

DIMENSIONS:

<table>
<thead>
<tr>
<th>MODEL</th>
<th>DIAMETER</th>
<th>DIAMETER</th>
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<td></td>
<td>INCHES</td>
<td>MM</td>
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<tr>
<td>MP-110</td>
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<tr>
<td>MP-112</td>
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<td>304.8</td>
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<tr>
<td>MP-114</td>
<td>14</td>
<td>355.8</td>
</tr>
</tbody>
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THICKNESS AND TOLERANCES; CUTTING AREA

| ALUMINUM BASE: | 0.039 ± 0.002 | 1 ± 0.05 |
| LACQUER COATING: | 0.0079 ± 0.0006 | 0.2 ± 0.015 |
| OVERALL: | 0.055 ± 0.003 | 1.4 ± 0.008 |
| CENTER HOLE DIA.: | 0.285 ± 0.001 | 7.239 ± 0.025 |

RECOMMENDED CUTTING SIDE:
Side without "0" mark. All records are double faced and although other side may be cuttable, it may have minor defects.

STORAGE CONDITIONS:
70 ± 10°F (21 ± 5.5°C) and 50% Relative Humidity.

SHIPPING OF UNCUT MASTERS:
Temperature must not exceed 110°F (43.3°C).

MATCHED MASTERING, A CONTINUING PROCESS

Experience and Engineering in the disc recording field combined with state-of-the-art, computer controlled, high tech, high speed equipment provides Micro-Point with the facilities necessary to continue the search for ever better ways to improve the recording art.

The concept of Matched Mastering is but one example of the possibilities. Micro-Point invites related comments and questions so that we may better serve the needs of the recording professionals.

RECORDING STYLI
Micro-Point is the World's Largest Manufacturer of Recording Styli. 3 out of 4 Records Mastered in the United States use Micro-Point Styli.

MASTER RECORDS
High Quality and Uniform Production Establishes Micro-Point as the Premium Master Record Brand.

MICRO-POINT INC.
45 KENSICO DRIVE, MT. KISCO, NEW YORK 10549
TELEPHONE (914)241-4439 TELEX 353664
RECORDING STYLI PRICES

<table>
<thead>
<tr>
<th>CUTTER HEAD</th>
<th>MODEL</th>
<th>UNIT PRICE</th>
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<tbody>
<tr>
<td>Neumann (Micro-Point shank)</td>
<td>320</td>
<td>43.00</td>
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<tr>
<td>Neumann (Neumann shank)</td>
<td>320NS</td>
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</tr>
<tr>
<td>Ortofon (Solid ruby)</td>
<td>329</td>
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<tr>
<td>Ortofon (Aluminum shank)</td>
<td>329SH</td>
<td>44.00</td>
</tr>
<tr>
<td>Westrex 3D (Solid ruby)</td>
<td>350</td>
<td>43.00</td>
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<td>Westrex 3D (Aluminum shank)</td>
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<td>Westrex 2B</td>
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<td>Grampian (Short shank)</td>
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<td>Fairchild/Presto (Long shank)</td>
<td>462</td>
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STYLI ACCESSORY PRICES

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<tr>
<td>Westrex Advance Ball</td>
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<tr>
<td>Pithwood</td>
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MASTER RECORD PRICES

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<thead>
<tr>
<th>DESCRIPTION</th>
<th>MODEL</th>
<th>UNIT PRICE</th>
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<tbody>
<tr>
<td>14 Inch master record</td>
<td>MP-114</td>
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<td>12 Inch master record</td>
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<td>10 Inch master record</td>
<td>MP-110</td>
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<tr>
<td>7 Inch master record</td>
<td>MP-107</td>
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TERMS AND CONDITIONS

**TERMS:** Net 30 days with approved credit. COD on all orders valued under $150.00

**SHIPPING CONDITIONS:** UPS ground for lacquers. UPS second day air for styli.

*Federal Express or UPS next day air on request.*