

Laser Micromachining

**Ultrafast laser solutions
improve quality and
cycle times for medical
marker bands**



Introduction

Small metal bands attached to catheters used in minimally invasive medical procedures, marker bands are made of radiopaque materials that are highly visible under x-ray, allowing physicians to locate the catheter during procedures. And with a new ultrafast laser micromachining platform that integrates cutting, inspection and validation, these marker bands can be machined in a single high-speed micro-manufacturing process.

To manufacture a tiny metal ring that will slide smoothly along the outer diameter of a catheter and remain in place during the procedure, shops must meet stringent precision requirements. The outer diameter of a catheter can be as small as 100 μm ,

so the marker band must be just large enough to fit over the catheter with the surface and edge smoothness necessary for accurate placement without damaging the catheter.

Another challenge associated with marker bands is that the materials involved are expensive – typically gold, platinum or palladium. This makes precision machining even more important, as material loss can be very costly. Furthermore, in traditional marker band manufacturing, the bands are cut roughly and then finished through several post-processing steps. This includes cleaning, deburring, honing and chemical etching, all of which add further time and material loss to the manufacturing process.



Ultrafast laser solutions improve quality and cycle times for medical marker bands

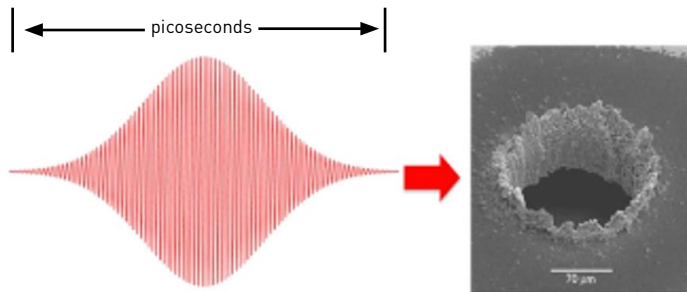
Femtosecond laser-machined bands machined better, faster with advanced tube cutting platform

The femtosecond solution

A major breakthrough in marker band manufacturing has taken place with the advent of commercial-grade ultrafast laser technology.

Ultrafast lasers pulse in the femtosecond range, several orders of magnitude faster than picosecond technology, allowing lasers to remove material faster than the surface can absorb heat. Because heat damage – melting, burring and recasting – is one of the primary sources of cost and failure in marker band manufacturing, femtosecond lasers minimize the heat-affected zones that must be reworked with extensive post-processing, often manually, which result in lower yields and longer cycle times.

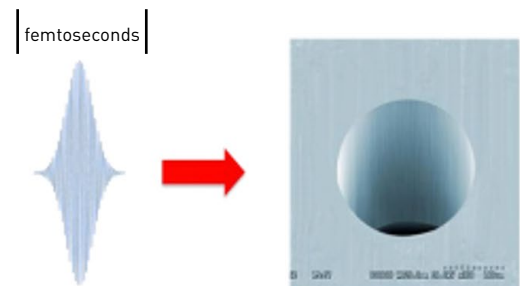
Long Pulse Laser Ablation



Pulses last longer than thermal diffusion time of material

Result: Thermal or Heat Affected Zone (HAZ) damage

Femtosecond Laser Ablation



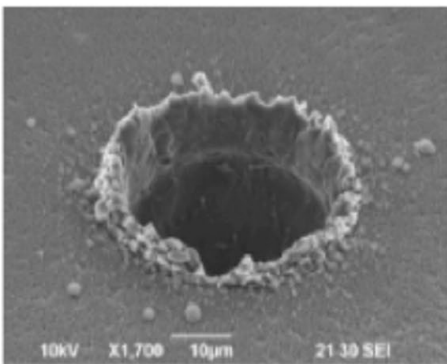
Plasma expansion carries away the energy before it can transfer to material.

Result: No (HAZ) damage

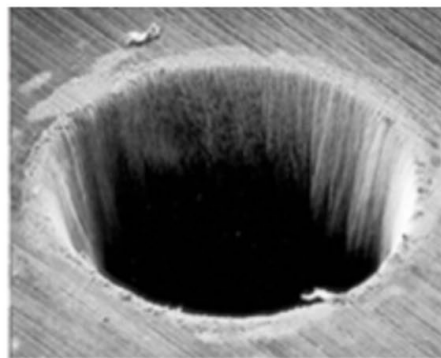
Still, even with the promise of ultrafast lasers, the raw material of the marker band – a metal tube – must be accurately held and moved throughout the machining processes. The pulse delivery must be synchronized with the motion of the material. There is little margin for error in marker band manufacturing; each part must meet specifications, which makes part-to-part consistency critical.

Achieve exceptional accuracy with the MLTC

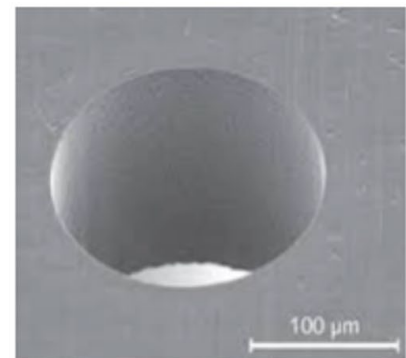
The Microlution MLTC uses ultrafast laser machining to achieve unprecedented accuracy in a single process, with surface and edge quality that ensure the highest level of part performance.



Nanosecond HAZ (Heat Affected Zone) Melt zone adds variability

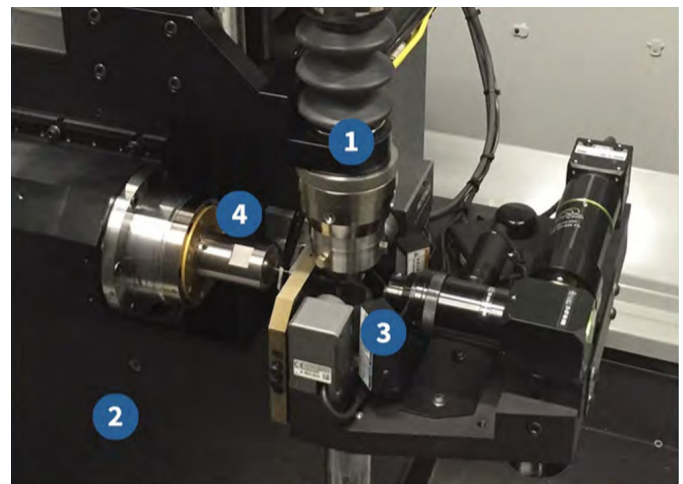


Picosecond Less HAZ Rough surface adds variability



Femtosecond No HAZ Low variability

The MLTC also features integrated metrology, with a laser micrometer that measures tube length and an optical camera that measures inner and outer tube diameters. Every part can be easily validated, with measurements stored for traceability, and parts that don't meet specifications can be separated out of the batch. This means the MLTC can deliver unmatched part-to-part accuracy and consistency in metal marker bands without the need for time-consuming I.D. honing, acid etching and bead blasting typical of other manufacturing processes.



1. Cutting Head 2. Granite Base 3. Measurement and Machining Area 4. Spindle

The Microlution MLTC features ultrafast laser tube cutting with integrated part characterization and validation

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Like all Microlution precision micromachining platforms, the MLTC is optimized for speed, accuracy and quality. It features a natural granite base mounted on a polymer concrete foundation for maximum stability. Axis stages are mounted directly onto the granite, and linear motors offer high peak acceleration. Integrated glass encoders deliver real-time position and feedback for in-line measurements and closed-loop measurements of the outer diameter, inner diameter, wall thickness and part length.



MLTC Ultrafast Laser Tube Cutter Key Features:

- + Precision-ground natural granite base
- + High-acceleration linear motors
- + HEIDENHAIN glass scale encoders
- + Granite-mounted ironless rails
- + Vibration-absorbing polymer-concrete stand
- + I.D., O.D. and length validation
- + Optical camera
- + In-line metrology
- + Positional accuracy: $\pm 1 \mu\text{m}$
- + Tube diameters down to $250\mu\text{m}$

Compact footprint (W x D x H):

- + 40 x 60 x 72 in
- + 1016 x 1524 x 1930 mm
- + Feed guide bushing
- + Actuator for changing tubes
- + Adjustable for different diameters
- + Cover for active tube
- + 3C collets

Your Contact

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