

# COHERENT LASER CUTTING SYSTEMS

## Laser cutting for MDM Industry

June 19th, 2024

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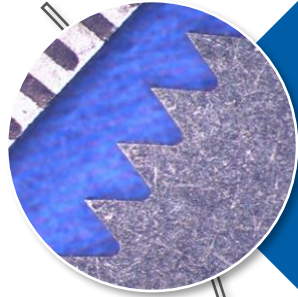
# AGENDA

- **Laser Basics**
  - Laser Cutting
  - Wet cutting for tubes
  - On center vs. Off center cutting
- **Trending Applications**
- **Virtual Application Lab Tour**
- **Automation**
- **Coherent Laser Cutting Solutions**
- **Catheter Processing System**

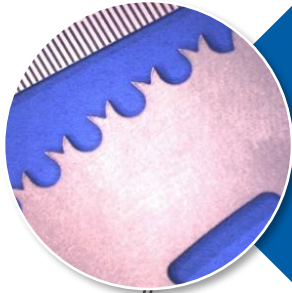
# LASER BASICS

# LASER CUTTING

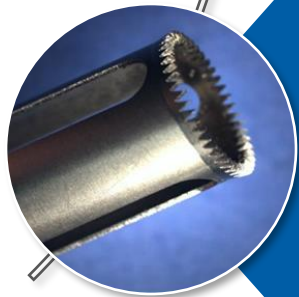
# LASER BASICS – ADVANTAGES OF LASER CUTTING



small spot size  
small HAZ  
high precision



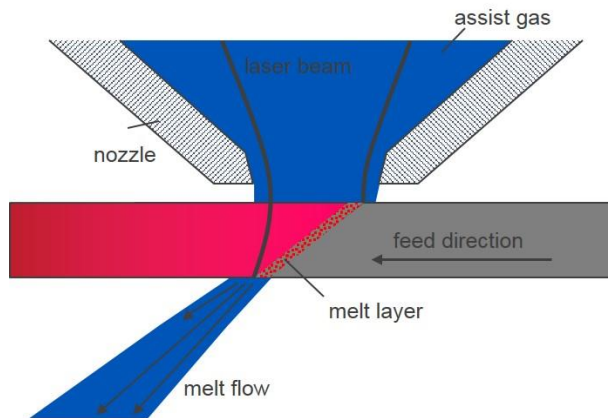
slight tool wear



huge flexibility in shape and material  
high efficiency  
minimal post-process

# LASER BASICS – PRINCIPLE OF LASER CUTTING

**Cutting by blowing melt off through pressure of an external assist gas  
the process gas and the laser beam emerge coaxially from the nozzle  
Cutting-nozzle very close to work piece**



## Fusion cutting

- use of inert gas, e.g. N<sub>2</sub> or Ar at 2-20 bar
- gas does not react with the material
- edges remain free of oxide and burrs

## Flame cutting

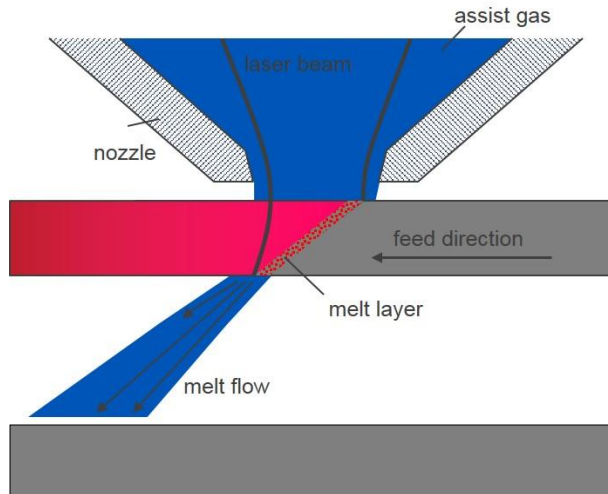
- use of reactive gas, e.g. O<sub>2</sub> up to 8 bar
- metal oxidizes
- exothermic reaction supports the cutting process

## Sublimation cutting

- use of inert gas, e.g. N<sub>2</sub> or Ar at 2-20 bar
- Use of femtosecond lasers
- Vaporization of material

# LASER BASICS – TUBE CUTTING AND CLEANING

**Cutting by blowing melt off through pressure of an external assist gas  
the process gas and the laser beam emerge coaxially from the nozzle  
Cutting-nozzle very close to work piece**



## Fusion cutting

- Mechanical deburring
- Sand blasting

## Flame cutting

- Chemical etching

## Sublimation cutting

- Ultrasonic cleaning

# CUTTING QUALITY AND ITS INFLUENCING FACTORS

## Laserbeam

- Wavelength
- Intensity distribution
- Beam quality
- Beam diameter
- Power

## Process gas

- Gas type
- Pressure
- Nozzle shape
- Nozzle distance

## Part

- Material
- Thickness
- Surface condition

## Handling system

- Speed
- Dynamics

## Optics

- Focal length
- Focus position

# PROCESS PARAMETERS

## Power [W]

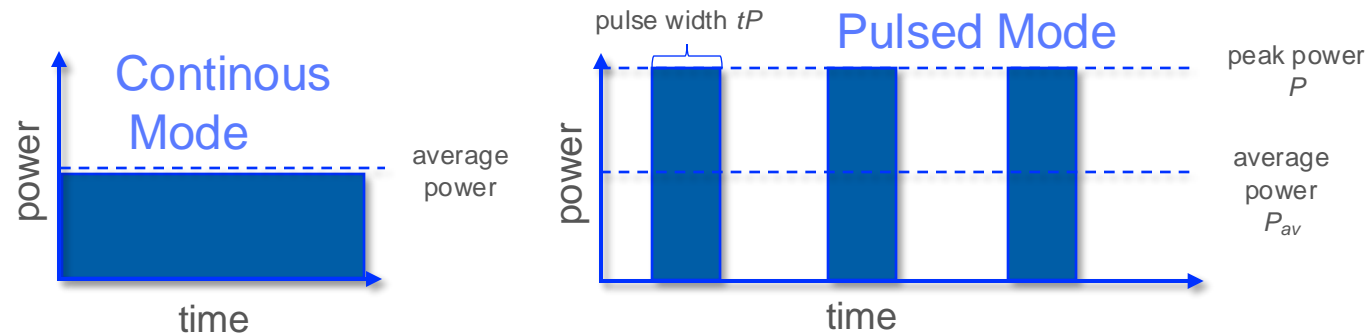
- cw (continuous wave) for flat sheet cutting
- pulsed cutting with high pulse peak power for flat and tube cutting

## Frequency [kHz to MHz]

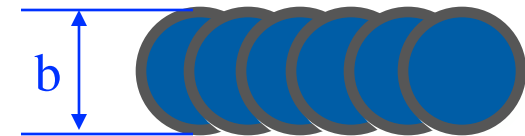
- the frequency describes the number of pulses per second
- Advantages: reduced heat transfer into the material
- high quality with a pulse overlap between 70-85 %

## Pulse width [ $\mu$ s or fs]

- the pulse width describes the width of a pulse



$$P_{av} = P * f * tP$$
$$O_p = 1 - \frac{v}{f_p * b}$$

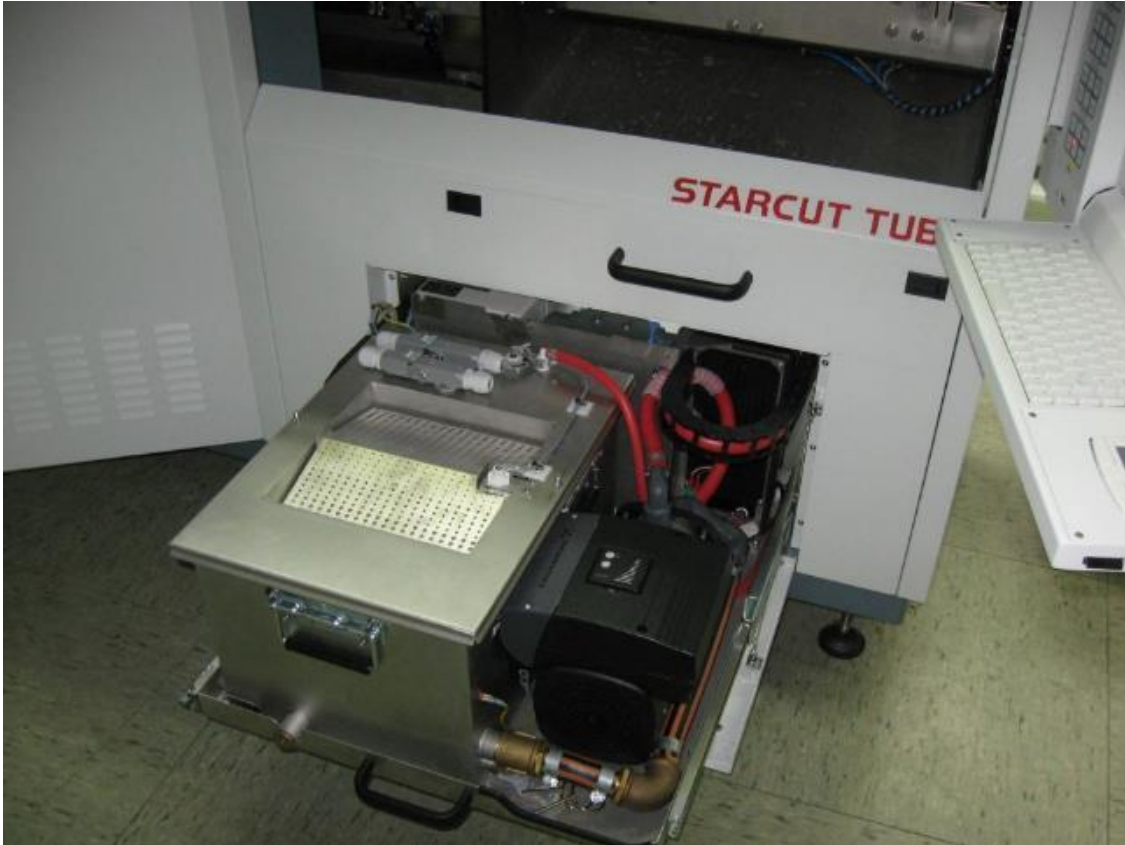




# LASER BASICS

# WET CUTTING FOR TUBES

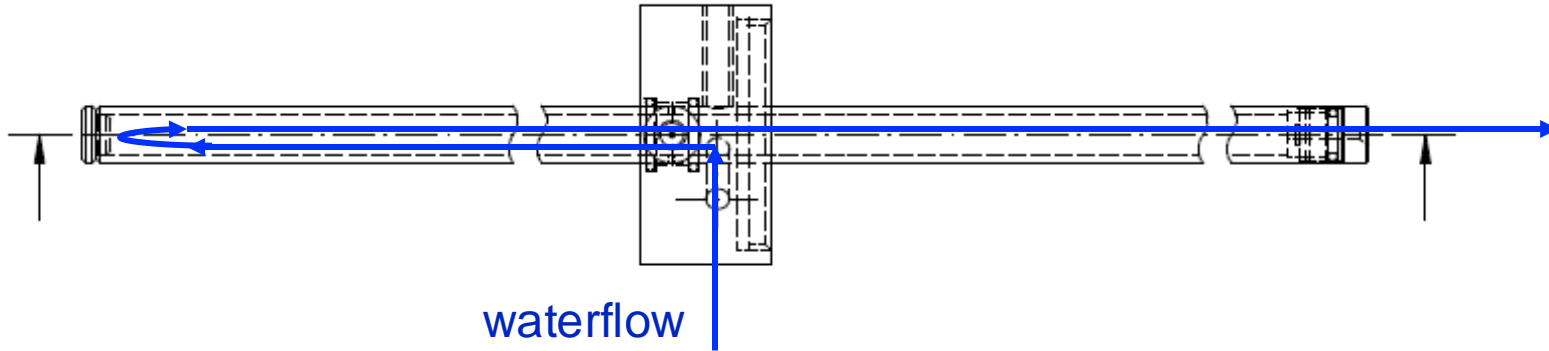
# INTEGRATED WATER CIRCULATION PUMP



## Water circulation pump

- Closed circuit
- Pressure control
- Fully integrated into StarCut Tube housing

# PRESSURE VESSEL



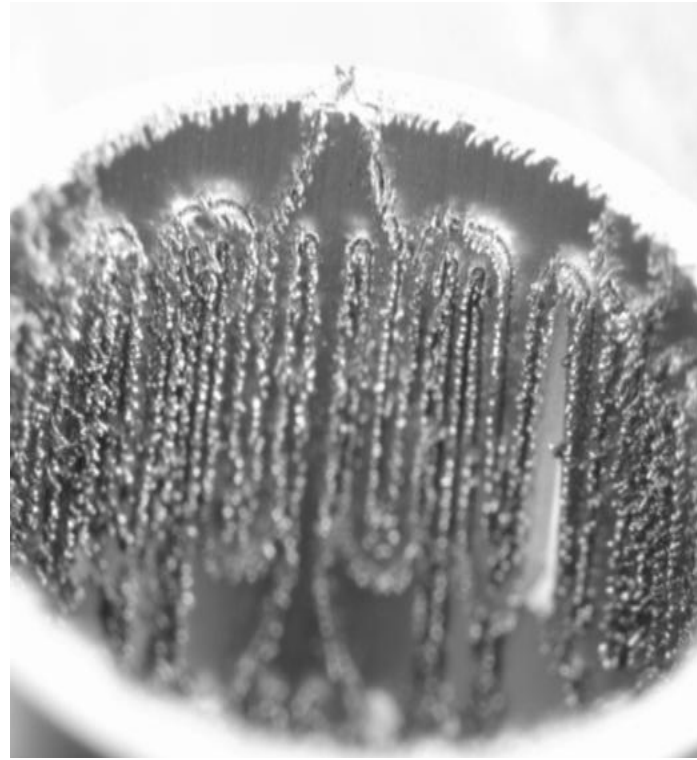
- **Mainly used for Nitinol cutting with fiber laser**
  - Cooling of the dross for easier cleaning
  - Protection of back wall splatter
  - Less Heat Affected Zone (HAZ)



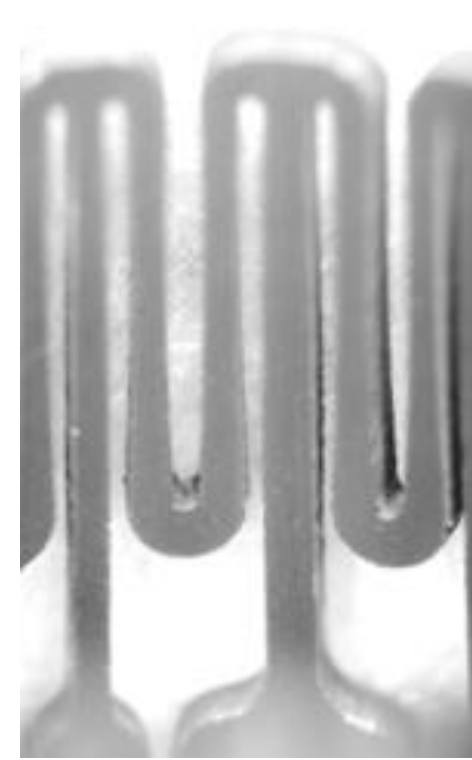
# COMPARISON DRY VS. WET CUTTING, HEART VALVE FRAME (NITINOL WT 0.6 MM)



**dry cutting,  
PowerLine FL 200  
Required cleaning:  
mechanical deburring**



**wet cutting,  
PowerLine FL 200  
Required cleaning:  
mechanical deburring**



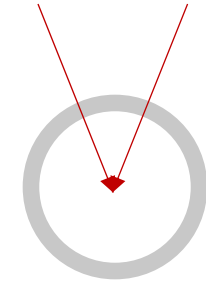
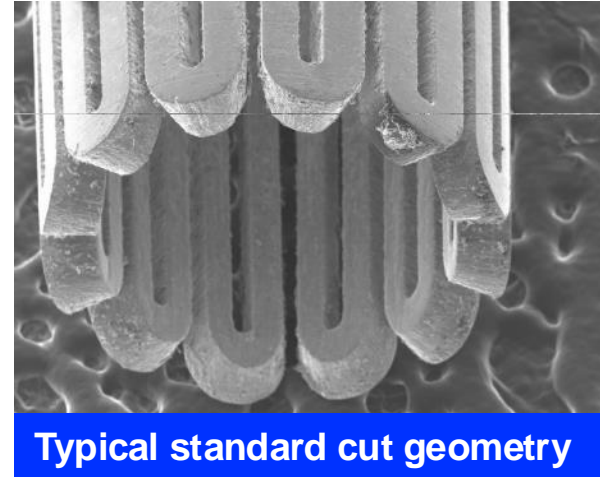
**dry cutting,  
Monaco  
Cleaned in  
ultrasonic bath**

# LASER BASICS ON CENTER VS. OFF CENTER CUTTING

# STARCUT TUBE 2 AXIS / 2+1 / 2+2 VERSIONS

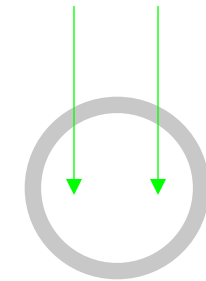
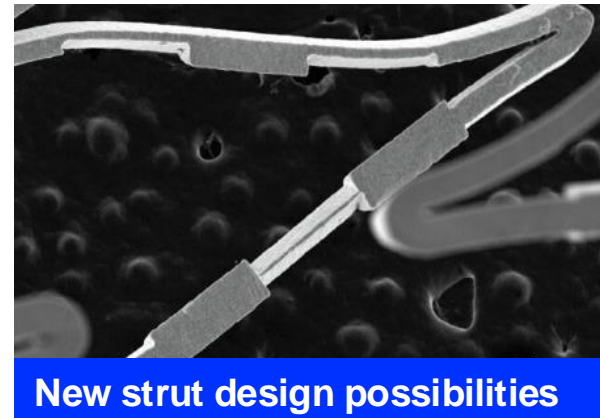
- **StarCut Tube (standard)**

- For standard (trapeze//tapered) strut designs



- **StarCut Tube 2+2**

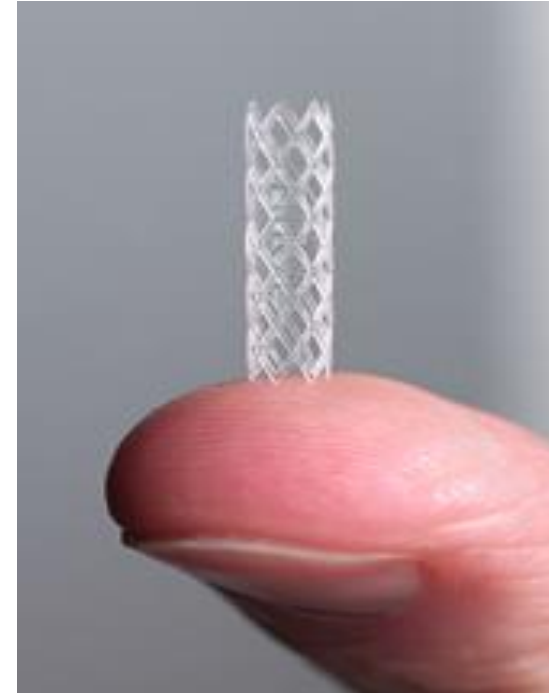
- Off-axis cutting allows new strut designs



# TRENDING APPLICATIONS

# APPLICATIONS TUBE CUTTING

- **Stents (coronary, bioresorbable, peripheral, venous)**
- **Challenge**
  - Heat sensitive materials – polymers (PLLA), Magnesium, Nitinol
  - Increasing wall thickness for venous stents (>0.5 mm)
- **Solution**
  - Femtosecond laser
  - Wet cutting for Nitinol stents





# APPLICATIONS TUBE CUTTING

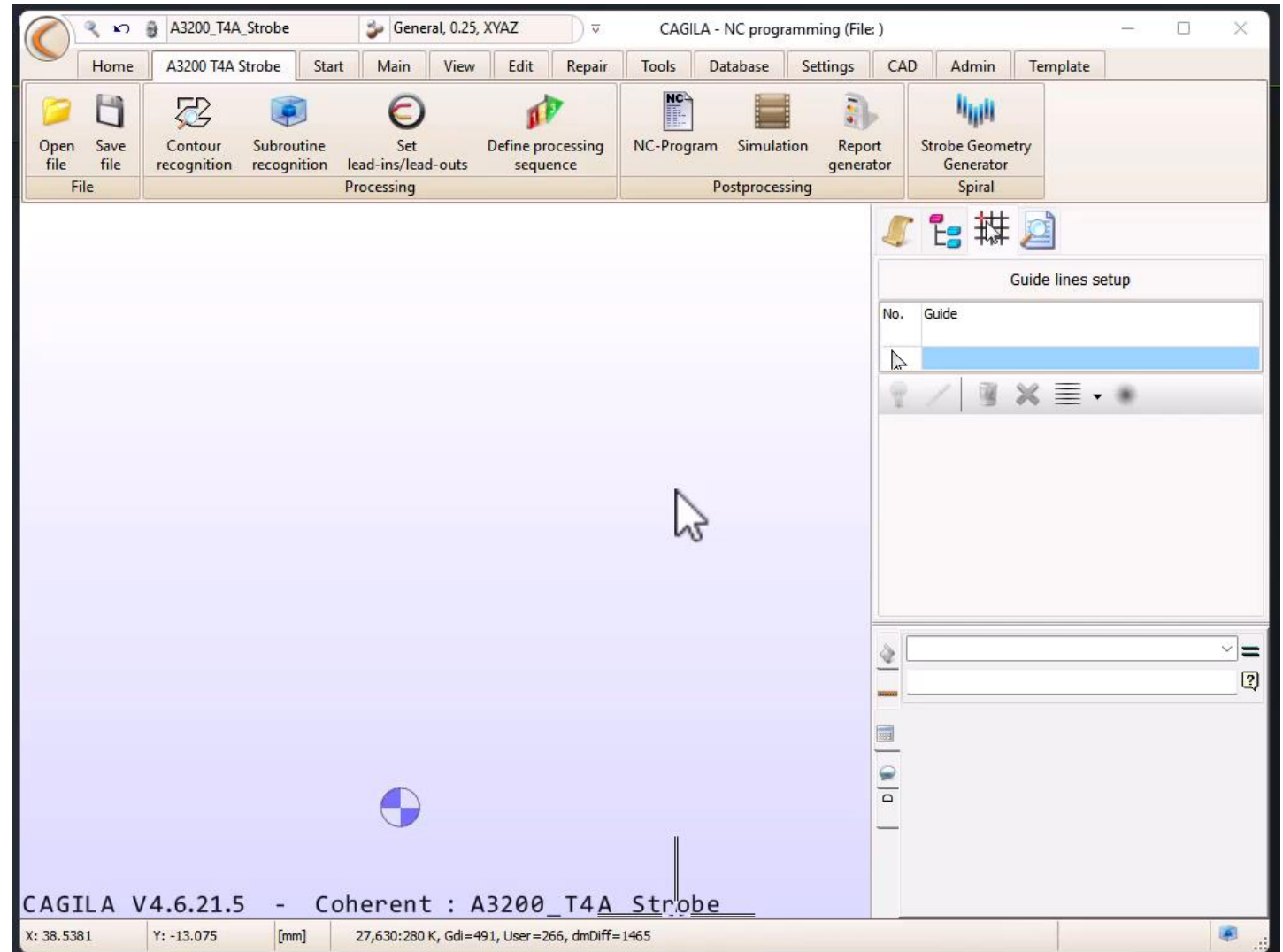
- **Hypotubes**

- **Challenge**

- Challenging designs – interrupted spiral, brickwork
- High material consumption
- Decreasing ODs (Outer Diameter)

- **Solution**

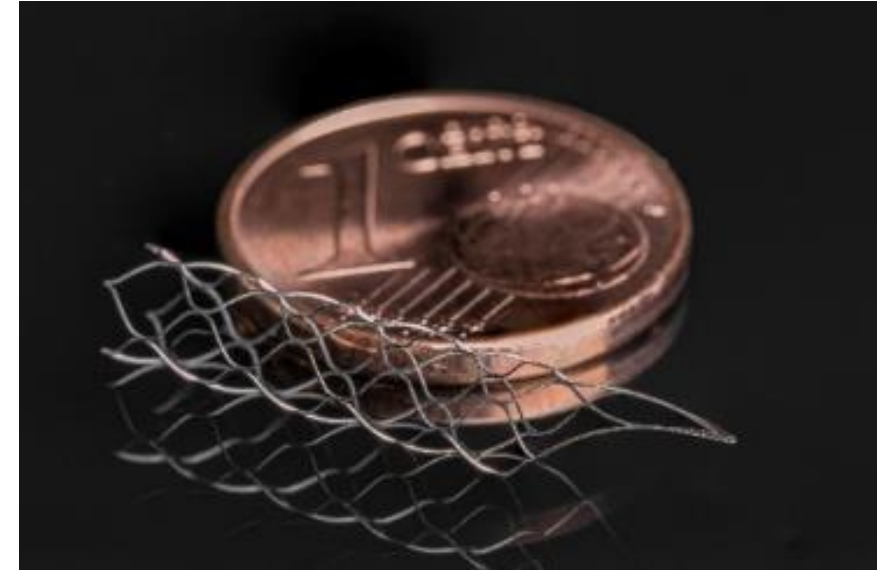
- Cutting on-the-fly
- Smart programming
- Automation



# AUTOMATION FOR HYPOTUBES

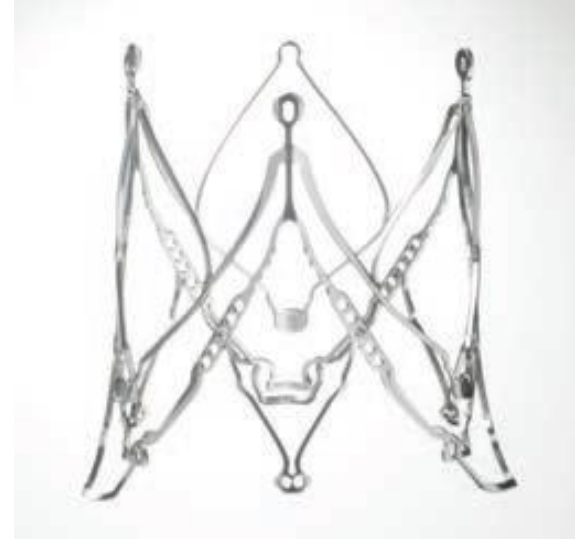
# APPLICATIONS TUBE CUTTING

- **Neurovascular devices**
- **Challenge**
  - relatively large OD of the tube in relation to the wall thickness
  - Nitinol material
- **Solution**
  - Femtosecond laser
  - Smart cutting strategy



# APPLICATIONS TUBE CUTTING

- **Heart Valve frames**
- **Challenge**
  - comparatively large OD
  - rigid tubes with wall thicknesses
- **Solution**
  - Fiber laser and wet cutting
  - (Femtosecond laser)
  - Smart cutting strategy



# APPLICATIONS TUBE CUTTING

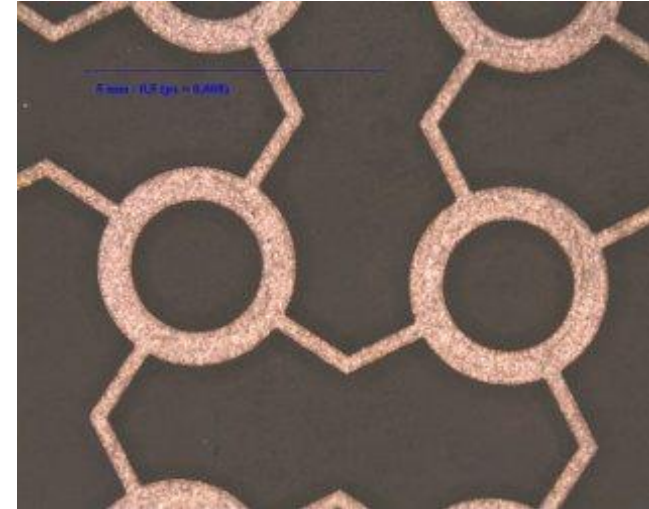
- **Endoscopes / Surgical instruments**
- **Challenge**
  - Non-cylindrical tubes
  - High material consumption
- **Solution**
  - Off-center cutting capability
  - Automation



# AUTOMATION FOR ENDOSCOPES / SURGICAL INSTRUMENTS

# APPLICATIONS FLAT CUTTING

- **Implants (picture)**  
Electrodes for implantable hearing aids,  
flat stents, intraocular lenses
- **Challenge**
  - Various materials –  
stainless steel, titanium, Platinum Iridium, polymers, Nitinol
- **Solution**
  - Cutting strategy
  - Mechanical setup



# ADDITIONAL RESOURCES



Manufacturing

## XL PRECISION: LASER MACHINES DELIVER FOR MDM

A leader in medical device and component manufacturing builds on...

[Read More >](#)

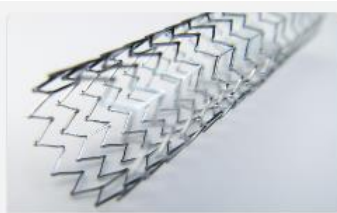


Manufacturing

## MOTION DYNAMICS: VERSATILE LASER CUTTING FOR NEUROLOGICAL SUB-ASSEMBLIES

Motion Dynamics is a leading manufacturer of neurological sub...

[Read More >](#)



Manufacturing

## NIT: STARCUT TUBE SPEEDS NITINOL STENT CUTTING

See how NIT uses a Coherent laser cutting machine for vertical...

[Read More >](#)

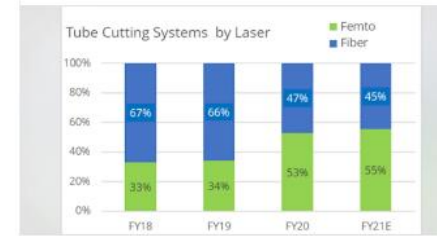


Manufacturing

## INTAI: PRECISION LASER CUTTING OF "DIFFICULT" MEDICAL DEVICES

INTAI manufactures a wide range of products for medical devices,...

[Read More >](#)



Femtosecond laser processing is a flourishing production tool  
laserfocusworld.com

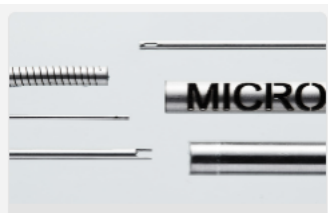
As advances in femtosecond laser cutting technology intensify, demand is surging.



## Laser Fabricated Heart Valves Poised to Revolutionize Heart Surgery

novuslight.com

Replacement heart valves with 'memory metal' nitinol frames created by laser cutting may replace traditional open heart surgeries with minimally invasive procedures.

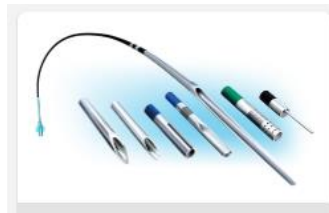


Life Sciences

## MICROMETRIC LTD: STARCUT TUBE DELIVERS SPEED AND PRECISION FOR MEDICAL AND AEROSPACE PRODUCTS

Learn how Micrometric Ltd uses the versatile Coherent StarCut Tube laser...

[Read More >](#)



Manufacturing

## CAMBUS MEDICAL: STARCUT TUBE AND SELECT WELDER IMPROVE HYPOTUBE PRODUCTION

Discover how Cambus Medical uses the Coherent StarCut Tube laser-powered...

[Read More >](#)



Medical

## NPX MEDICAL: STARCUT TUBE GIVES STENT MANUFACTURER A COMPETITIVE EDGE

Learn how the Coherent StarCut Tube and StarFiber laser-powered cutting...

[Read More >](#)



## Automated Processing of Hypotubes

coherent.com

Hypotubes are thin metal tubes used in many modern medical procedures. Laser processing in a fully automated workstation is the method of choice for manufacturing this type of delicate medical product with the requisite precision, yield, and...



## HIGH PRECISION FOR MEDICAL DEVICES

Success Story  
XL Precision  
Technologies

COHERENT

Video: High Precision For Medical Devices – Success Story XL Precision Technologies  
YouTube

XL Precision Technologies, a leader in medical device and component manufacturing, builds on strong growth by investing in more laser machines, including Coherent StarCut Tube cutting machines and Select manual welders. Learn which...



# APPS LAB TOUR



# AUTOMATION

# STARCUT TUBE – AUTOMATION OPTIONS STARFEED S AND L



## ■ StarFeed L

- For flexible instrument cutting mainly
- Single up to 48 tube loader
- Diameter: 2 mm to 15 mm
- for dry cutting process
- also working with the SL



## ■ StarFeed S

- Out of bundle tube feeder
- Diameter: 0.3 mm to 4 mm
- for dry cutting process
- also working with the ML

## ■ Unloader Unit

## ■ Sorter unit

# AUTOMATION AT A CONTRACT MANUFACTURER



# CUTTING SYSTEMS

# STARCUTTUBE

- **Best in class compact tube cutting system for medical device manufacturing**
- **Fiber laser or femtosecond laser**
- **Tube diameters from 0.3 mm to 30 mm**
- **Easy programming with CAGILA 2D or 3D**
- **Automated solutions**



Product Manager: Roland Woelzlein  
Business Unit: Systems Munich

# EXACTCUT 430



ExactCut 430

Product Manager: Thomas Schreiner  
Business Unit: Systems Munich

- Accuracy of +/- 2 microns
  - Laser system „all in one“ (small footprint)
  - Latest Fiber or Femto Laser technology
  - Exact can be used for a variety of today's manufacturing processes (modular design)
  - User friendly design (ergonomically designed)
  - Working chamber big enough for integration of work piece holder, clamping units, etc.
- Standard control unit (Beckhoff / CNC & PLC) for a high flexibility**

# CATHETER PROCESSING SYSTEM



# A JOURNEY TO FIND A SOLUTION

Problem

Feasibility/  
Application  
Testing

System  
Design

Commissioning  
Support

# CATHETER PROCESSING SYSTEM - AN EXAMPLE OF A JOURNEY

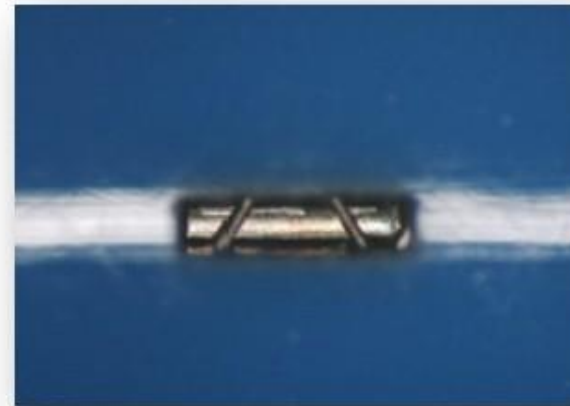
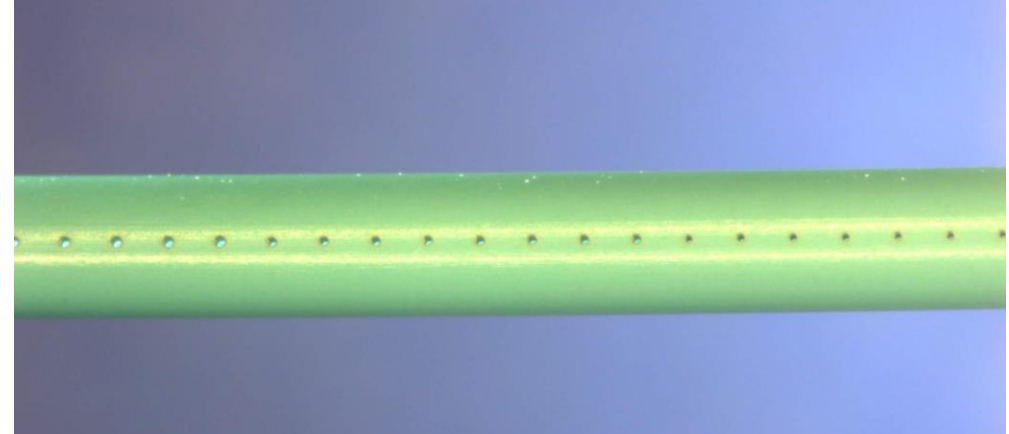
## ▪ Catheter Hole drilling

## ▪ Challenge

- Like processing “cooked spaghetti”
- Dual layers (ablate polymer, protect metal)

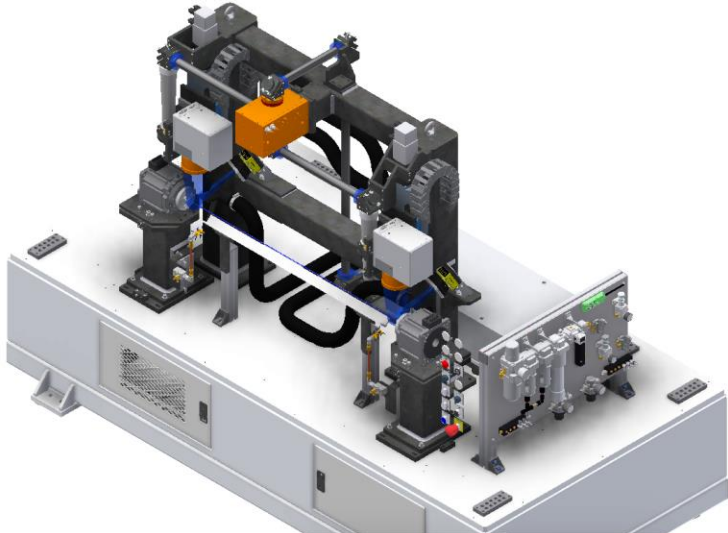
## ▪ Solution

- Green femtosecond laser
- 2 synchronized rotaries with one side loading
- Tug and fill catheter for rigid wall and to protect back-wall



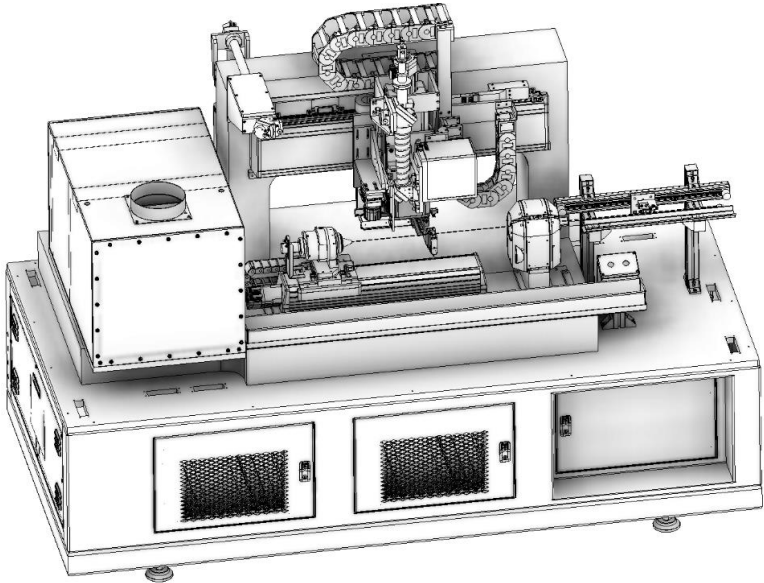
# SYSTEM CONFIGURATIONS – TWO EXAMPLES OF CUSTOMIZED SOLUTIONS

**Strategy #1**  
Dual end  
processing



**Dual Galvo:** distal &  
proximal end processing via  
beam switch

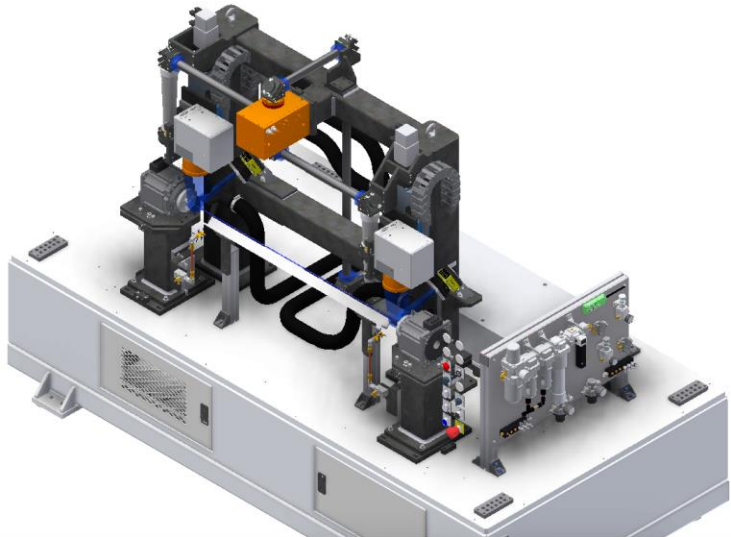
**Strategy #2**  
Single end  
processing



**Single Galvo:** single end  
processing with traversing  
galvo

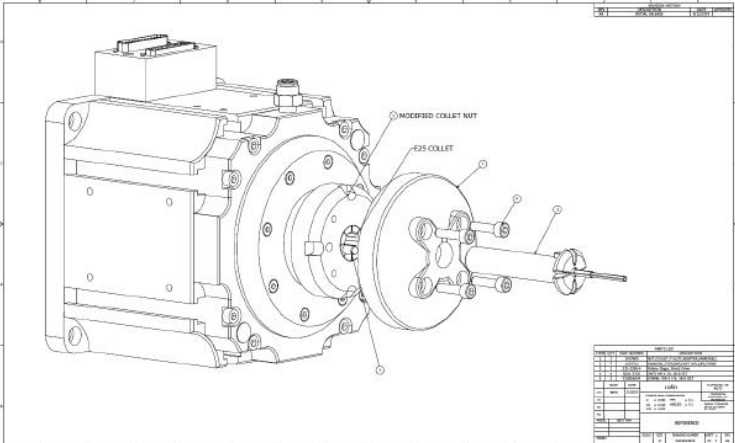
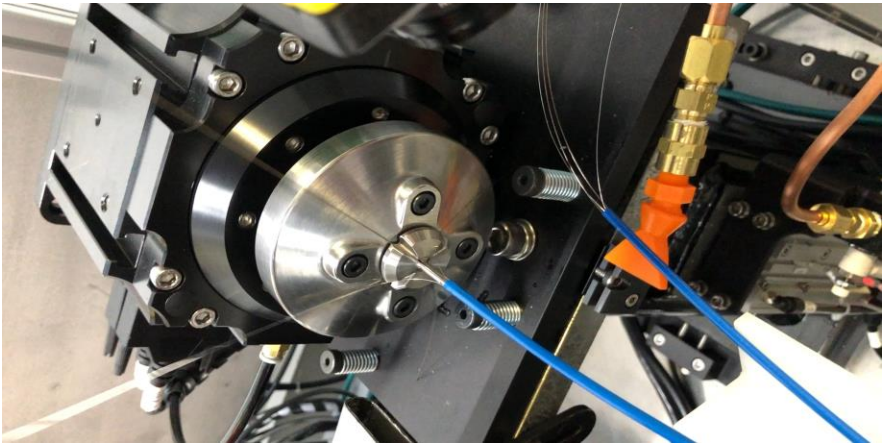
# SYSTEM CONFIGURATION, #1

**Strategy #1**  
Dual end  
processing



**Dual Galvo:** distil &  
proximal end processing via  
beam switch

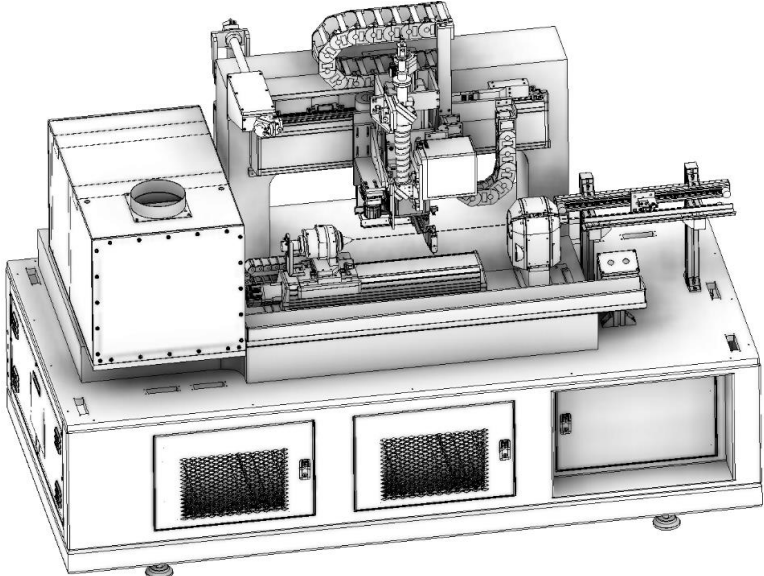
# CATHETER PROCESSING SYSTEM STRATEGY #1



Machine Configuration #1, Monaco, Custom Rotary, ACS 150 Rotary, Collet/Mandrel, Vision

# SYSTEM CONFIGURATION, #2

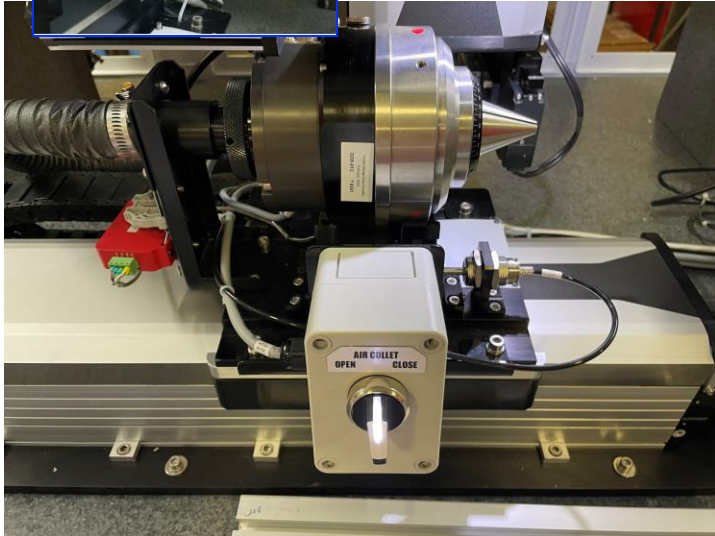
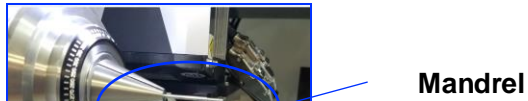
**Strategy #2**  
Single end  
processing



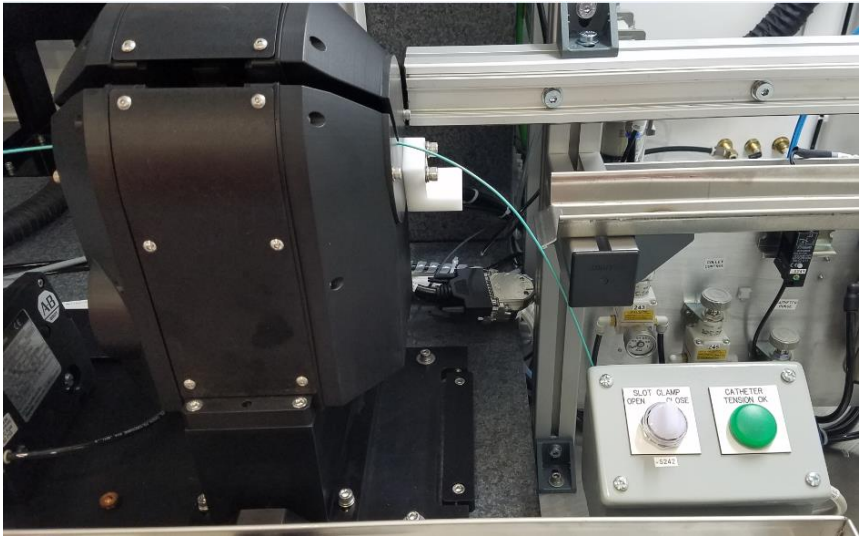
**Single Galvo:** single end  
processing with traversing  
galvo



# CATHETER PROCESSING SYSTEM STRATEGY #2



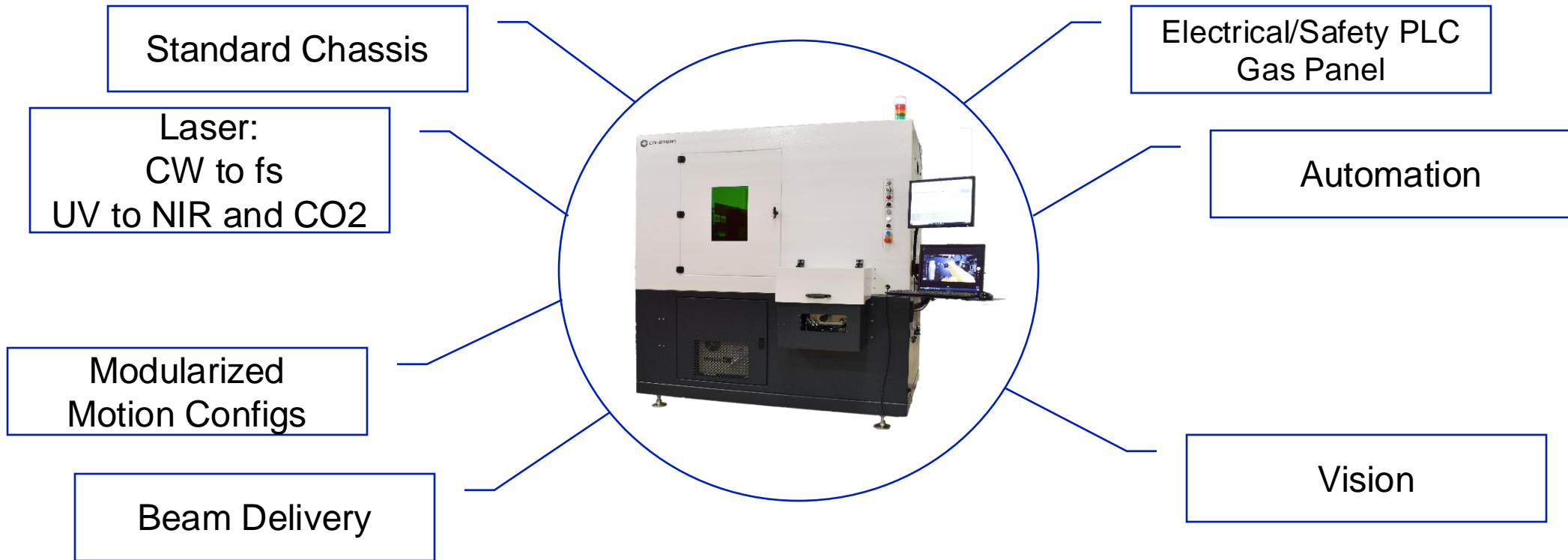
Rotary w/ER25 Collect Clamp Switch, w/Tube hard stop



Slot Rotary w/Collect Clamp Switch

# COMMON PLATFORM – MANY APPLICATIONS

- **Modular design – Pick and Build Architecture**



**APPLICATION CENTRIC & CUSTOMER DRIVEN**



**COHERENT**

**INNOVATIONS THAT RESONATE**