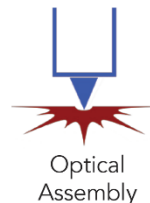


American Photonics – Made in USA

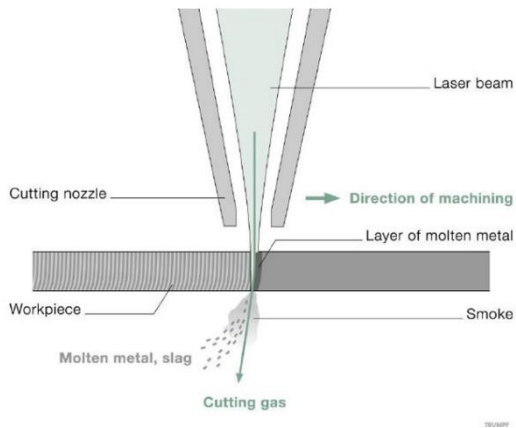
Infrared Optics Manufacture



**Welcome to
APC Sales
Training
My name is:
Ana Walters**



2016 Laser Sales Training



Agenda:

Review Laser Principles

Cutting Head Components

Optics

Laser Technology Products

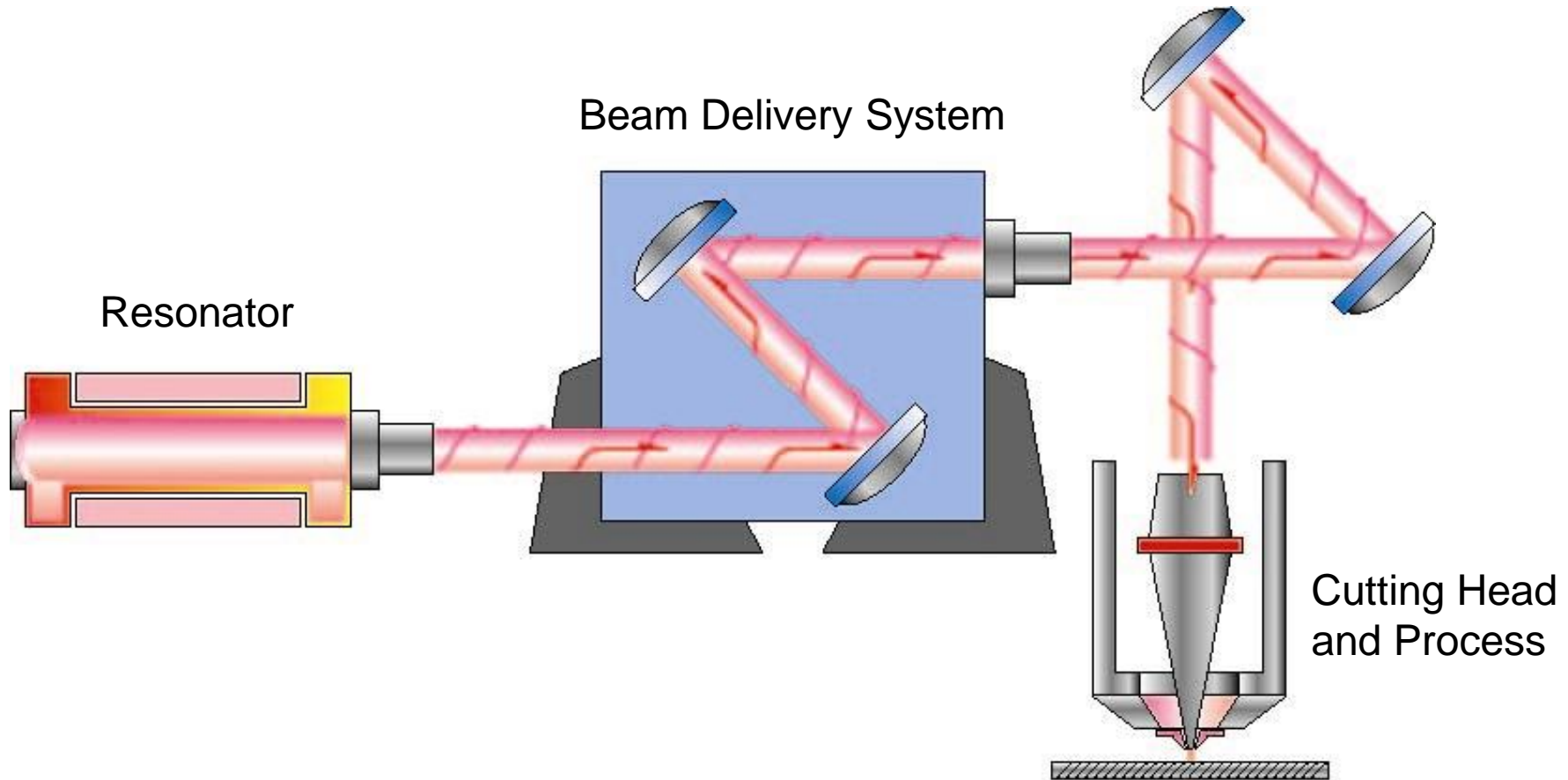
Consumable Ordering Information

Questions??

What is Laser?

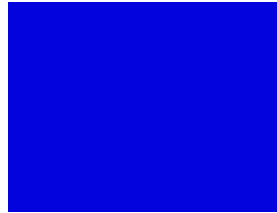
Light
Amplification (by)
Stimulated
Emission (of)
Radiation

Laser Cutting Process



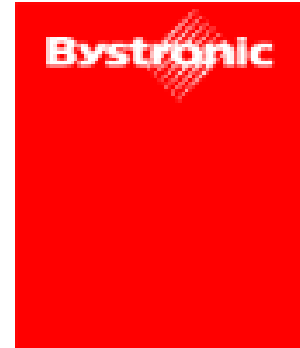
Who are the Major OEM' s

TRUMPF



Mazak

Bystronic



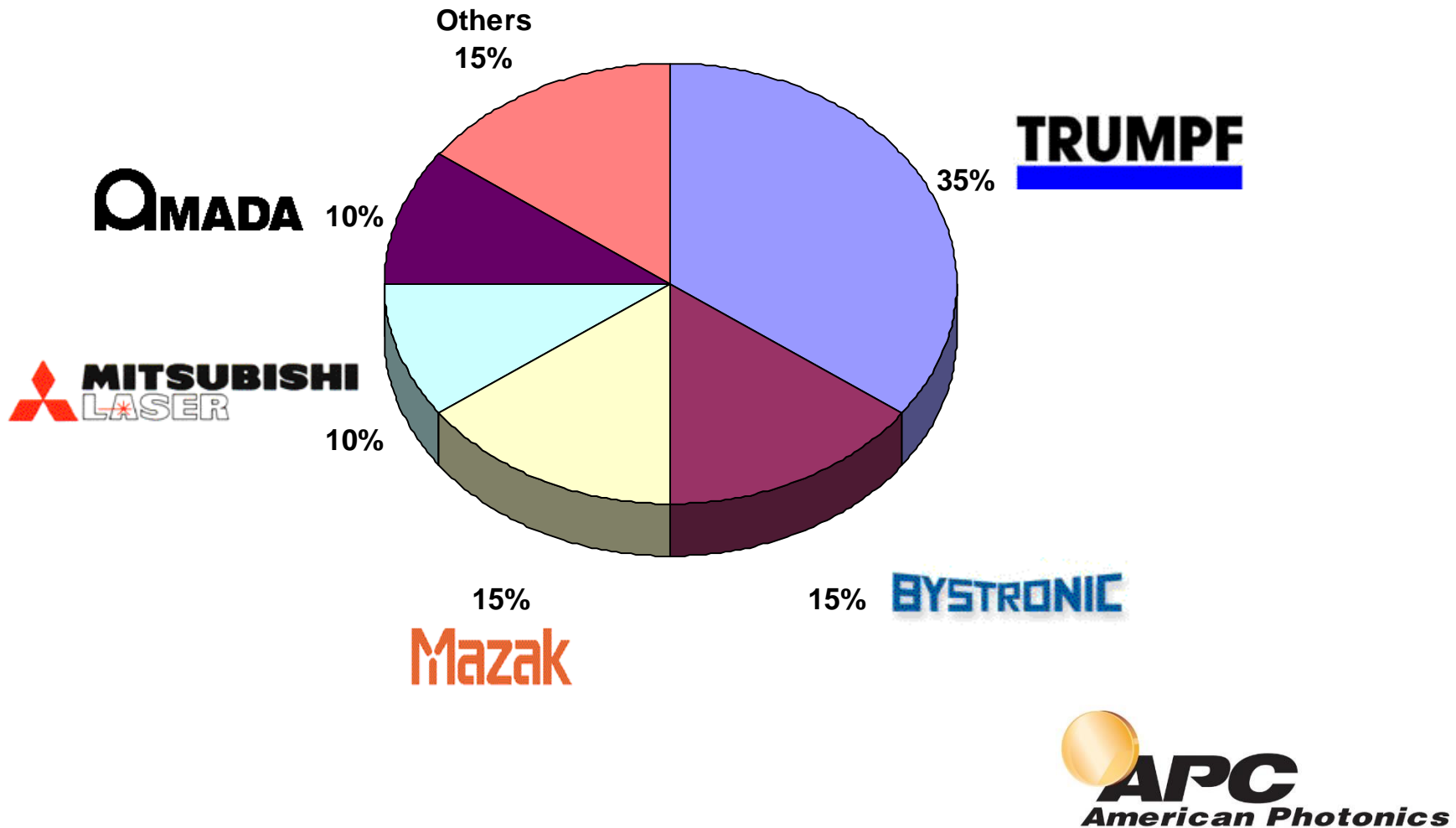
STRIPPIT[®]



CINCINNATI



OEM Market Share – North America



Types of Lasers - Industrial

- **Gas Laser: CO₂**
 - Carbon Dioxide w/ Helium and Nitrogen
 - Wave Length: 10.6um
 - Power: Up to 7,000 Watts
 - Beam Transmission w/ mirrors
- **Solid State Laser: YAG & Fiber Laser**
 - Neodymium in a Yttrium Aluminum Garnet Crystal
 - Wave Length: 1.06um
 - Power: Up to 4,000 Watts
 - Beam Transmission with Fiber Optic Cable

Trumpf L3050



2D Flat Sheet CO₂ Cutting Laser

Strippit Axel 3015S



2D Flat Sheet CO₂ Cutting Laser

5 axis (3D laser System) TruLaser Cell 7040



Types of Light

Incandescent



Many Different Light
Frequencies

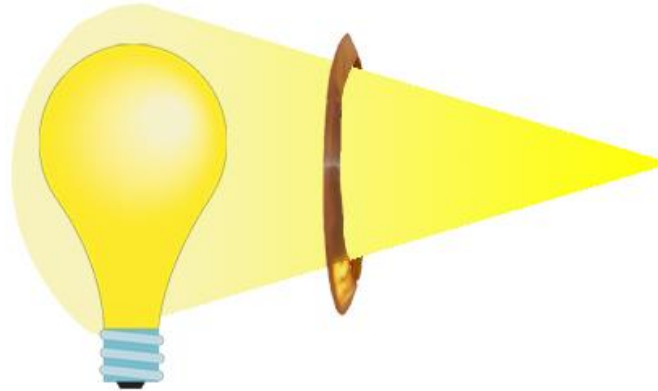
Laser Beam



Single Light Frequency
In Phase and Same
Direction

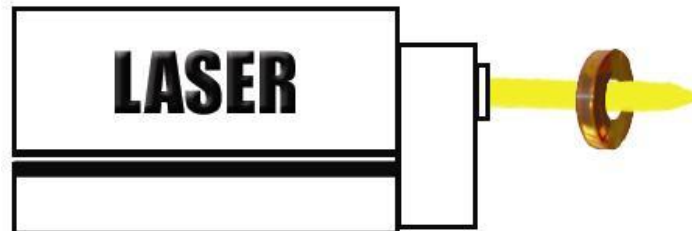
Incandescent vs. Laser Light

100 Watt Light Bulb



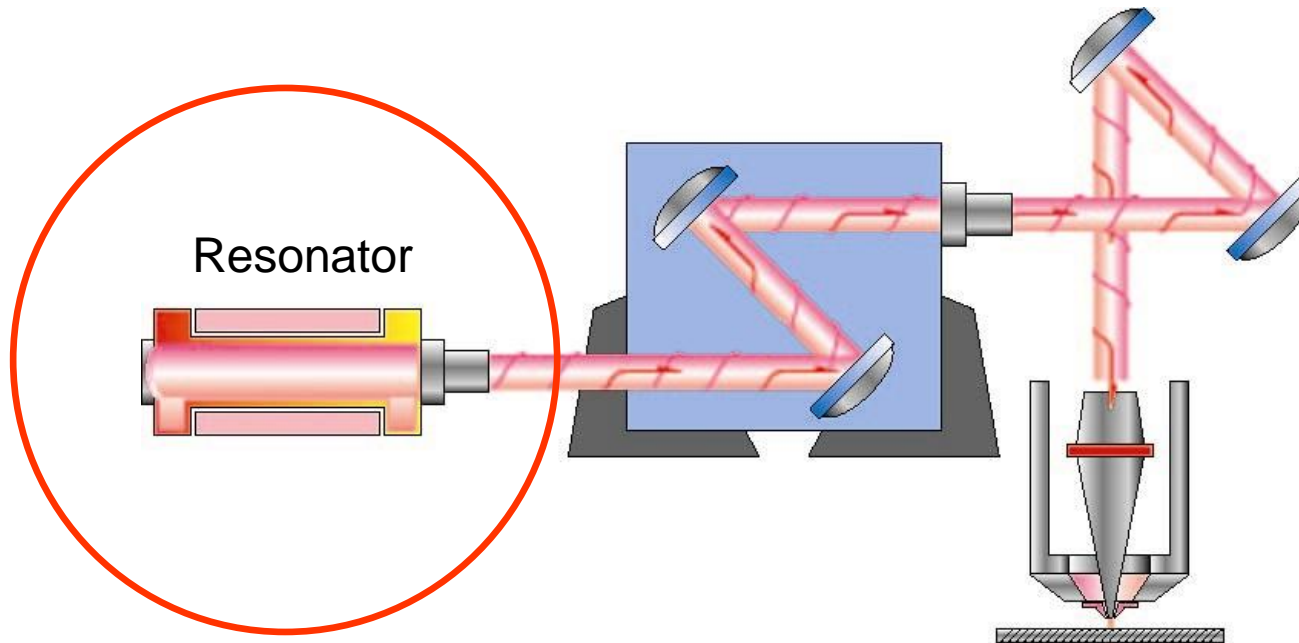
0.08 Watts/cm²

100 Watt Laser



550,000 Watts/cm²

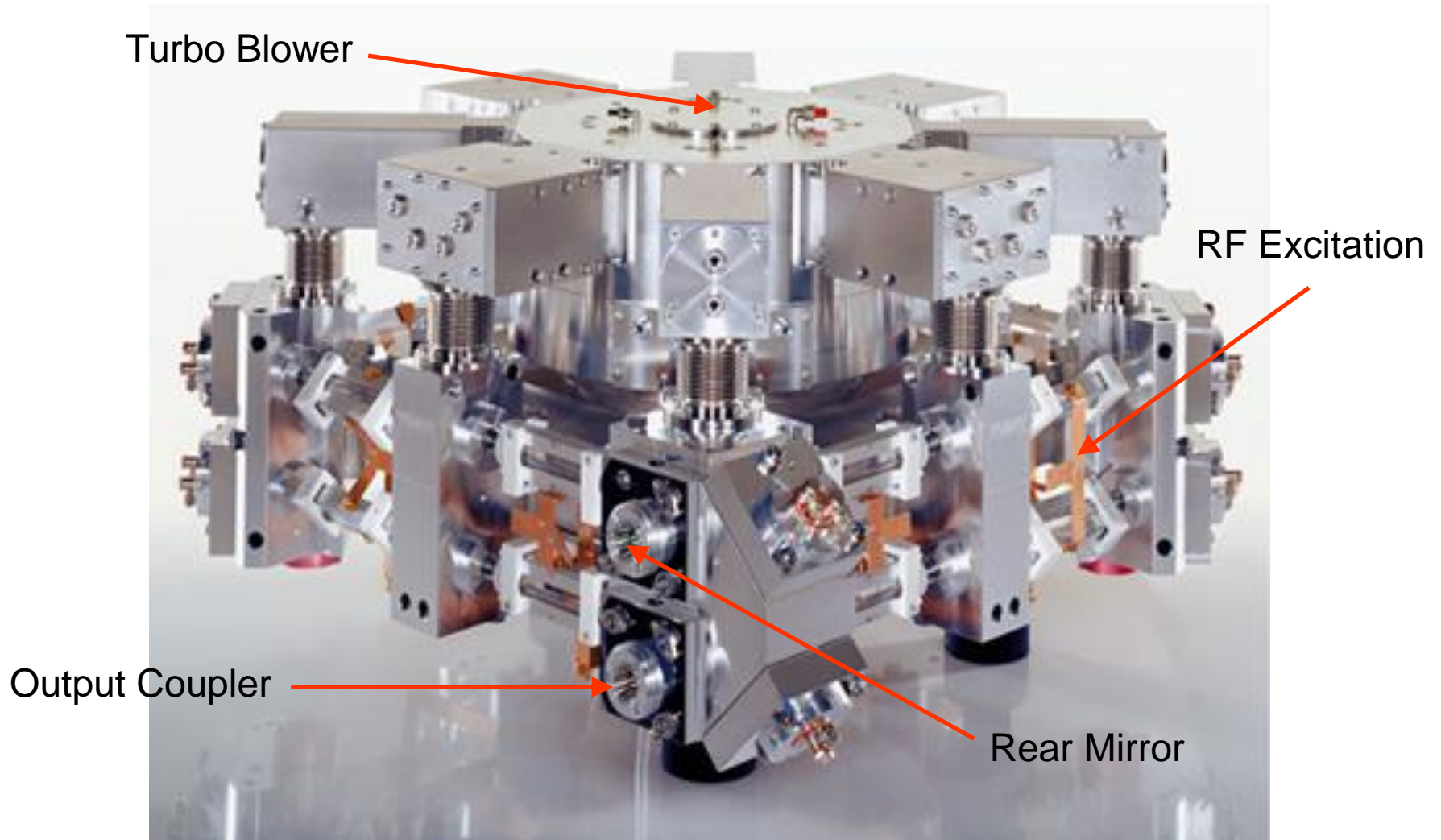
Resonator Gases



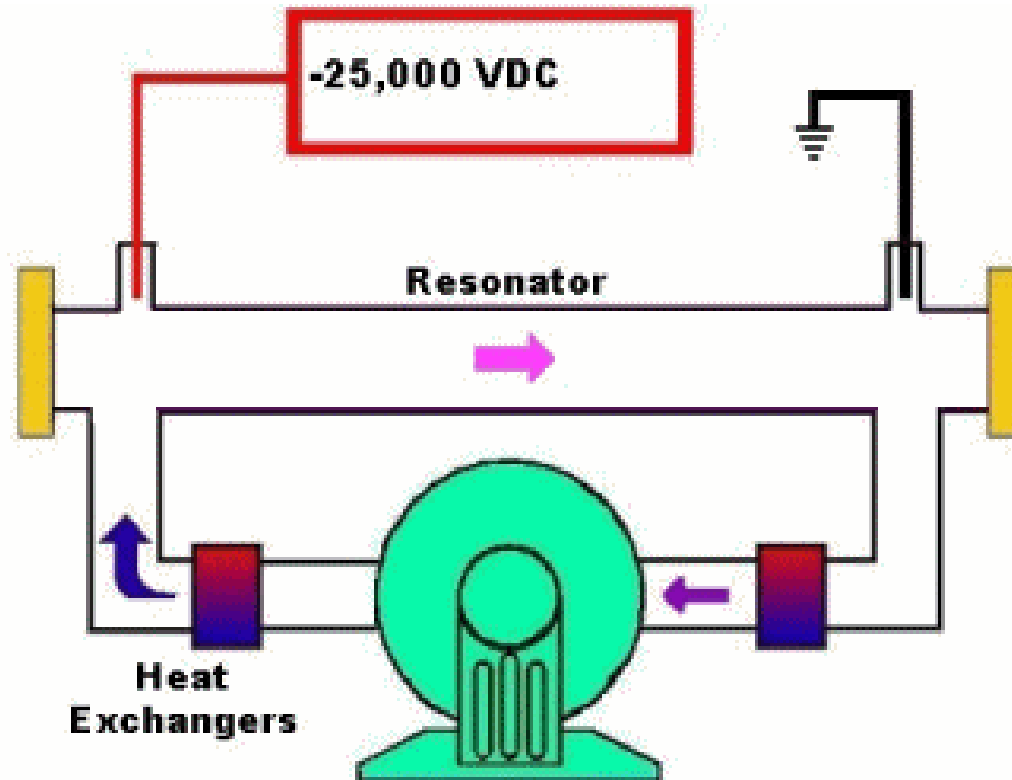
Resonator Gas Purity Levels

- **Helium (He)** – 99.996 Vol-%
 - Consumption: 20 l/h
 - Inlet Pressure: <100 psi
- **Carbon Dioxide (CO₂)** – 99.995 Vol-%
 - Consumption: 1.5 l/h
 - Inlet Pressure: <100 psi
- **Nitrogen (N₂)** – 99.999 Vol-%
 - Consumption: 8.5 l/h
 - Inlet Pressure: <100 psi

Trumpf TLF4000 Turbo Resonator

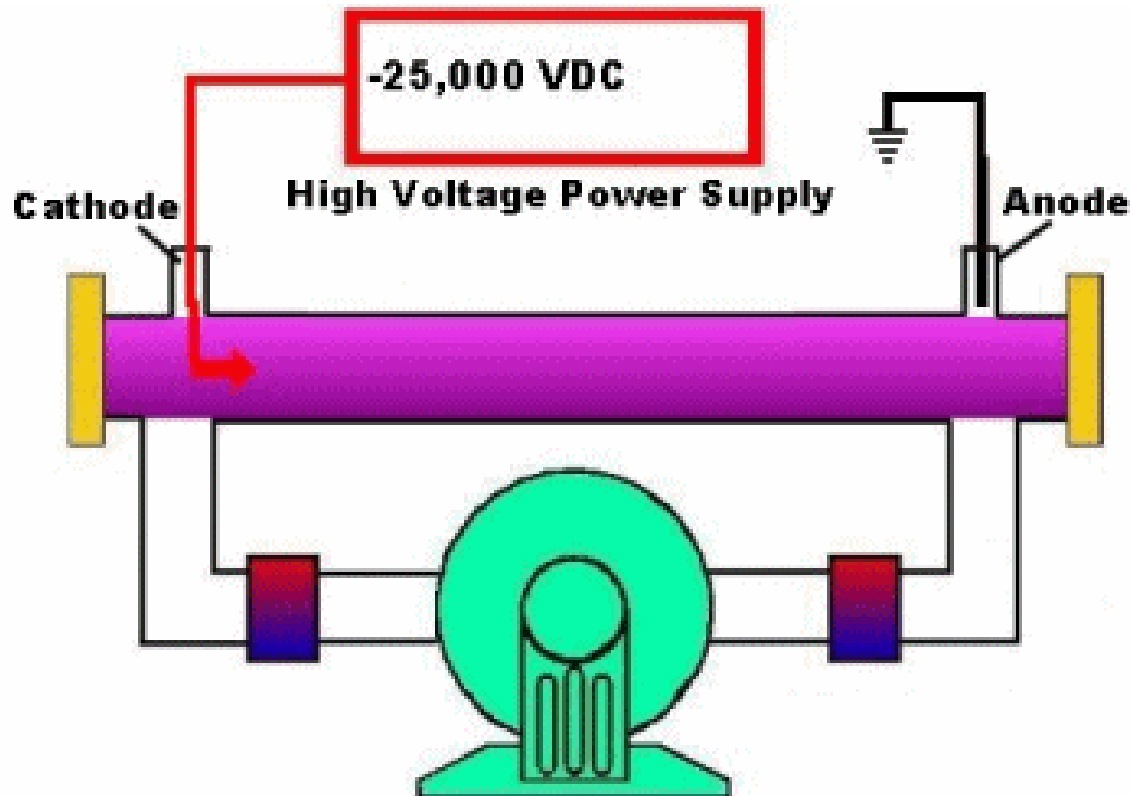


Beam Development – Step 1



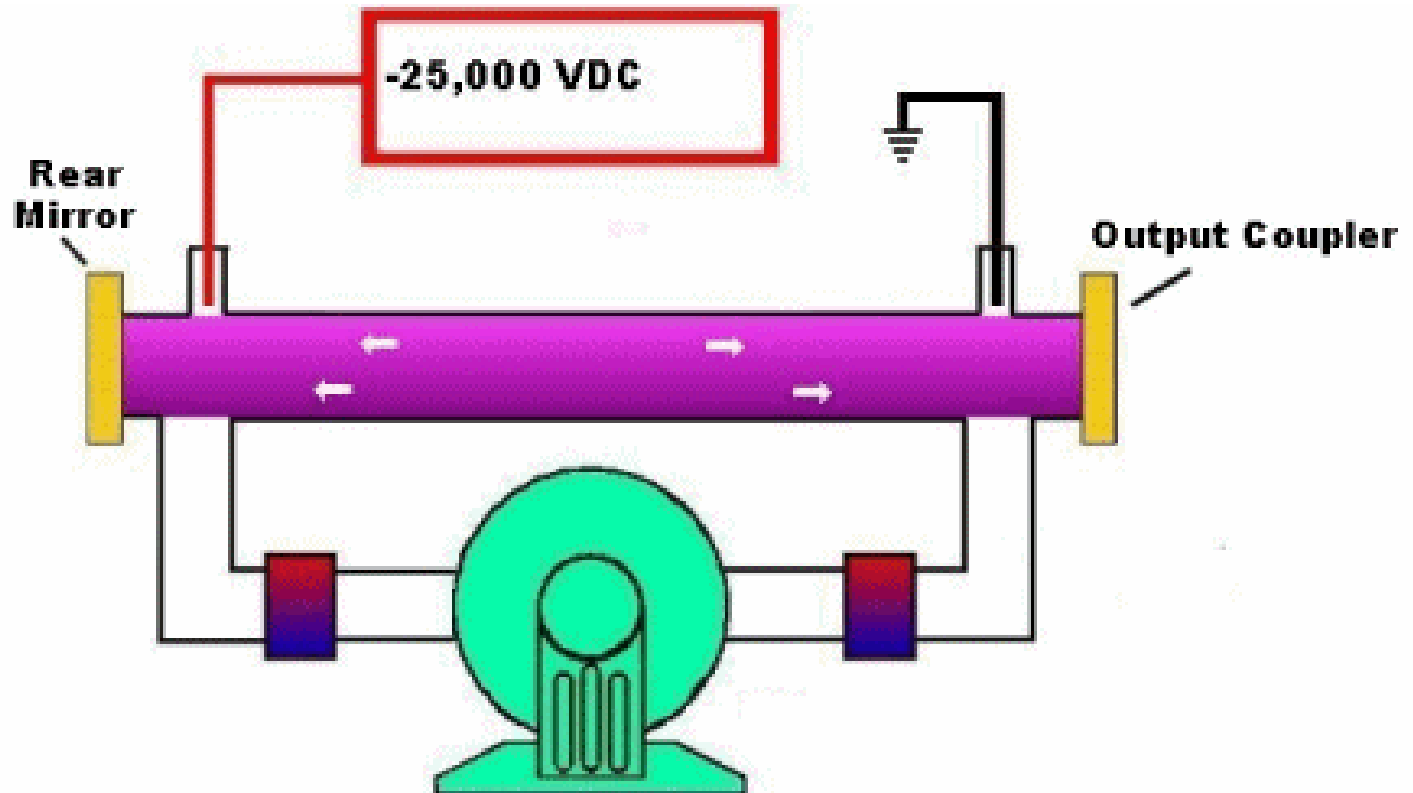
The turbine circulates the lasing gas through the laser resonator and heat exchangers. The heat exchangers cool the lasing gas to maintain power output and efficiency.

Step 2



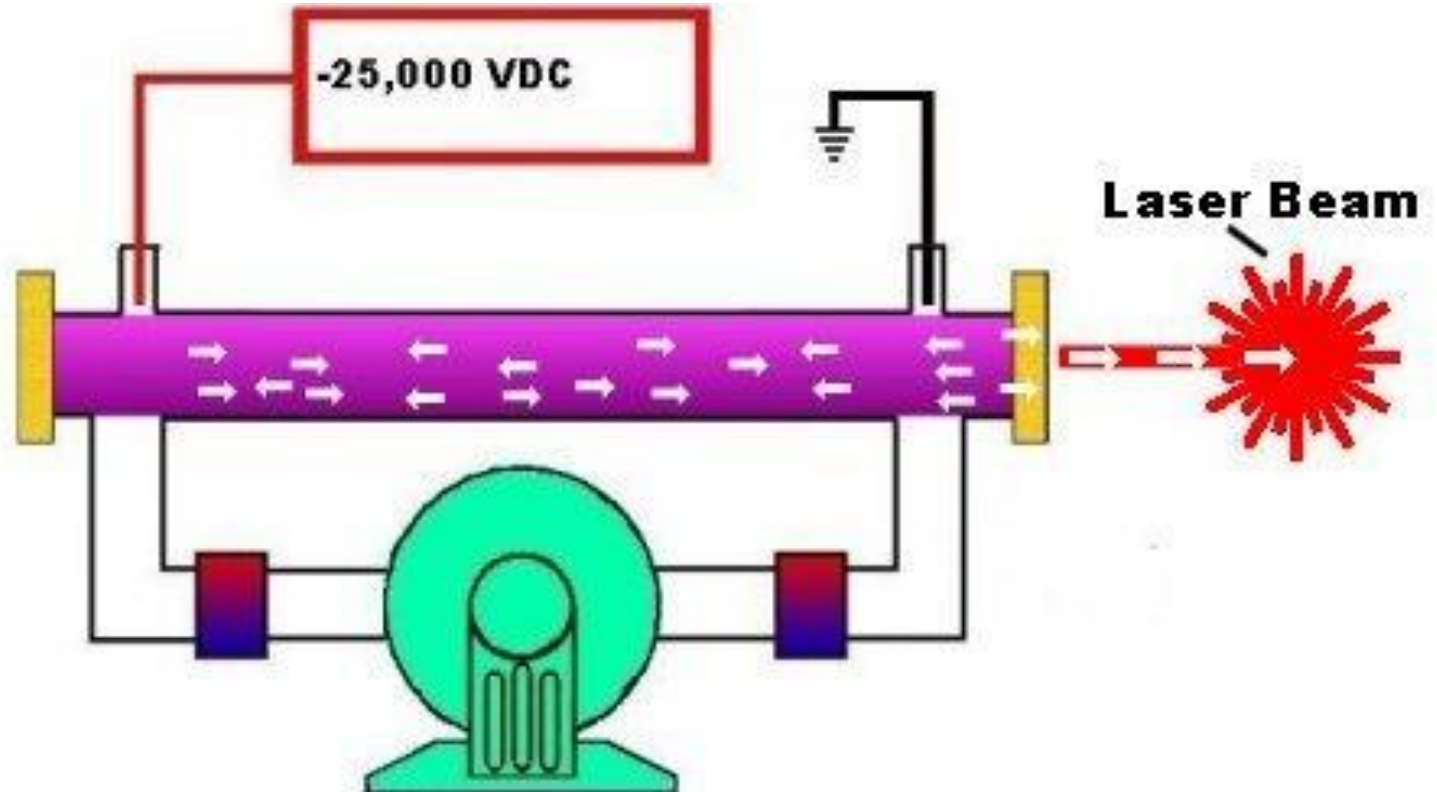
High Voltage DC is applied across the lasing gas, causing it to glow and create a plasma discharge.

Step 3



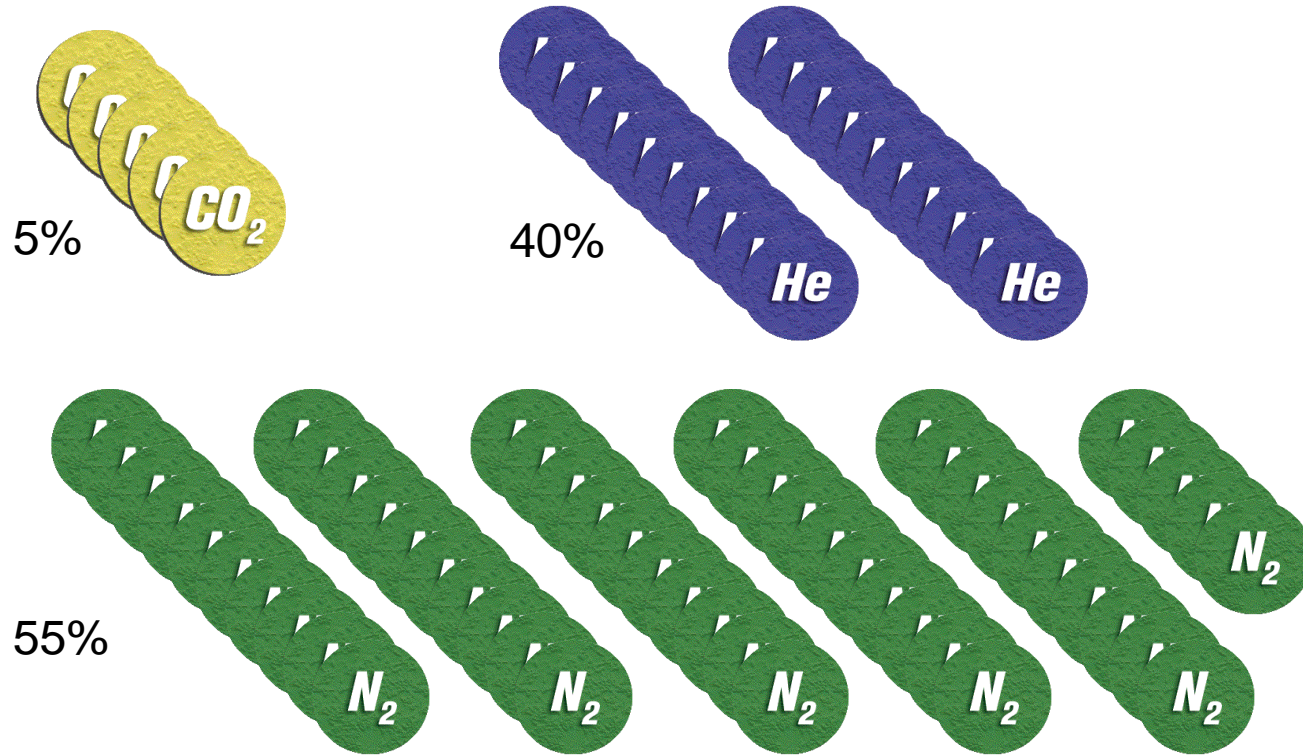
The DC current or RF energy excites the CO₂ molecules to a higher energy state, stimulating them to emit photons or units of light energy.

Step 4

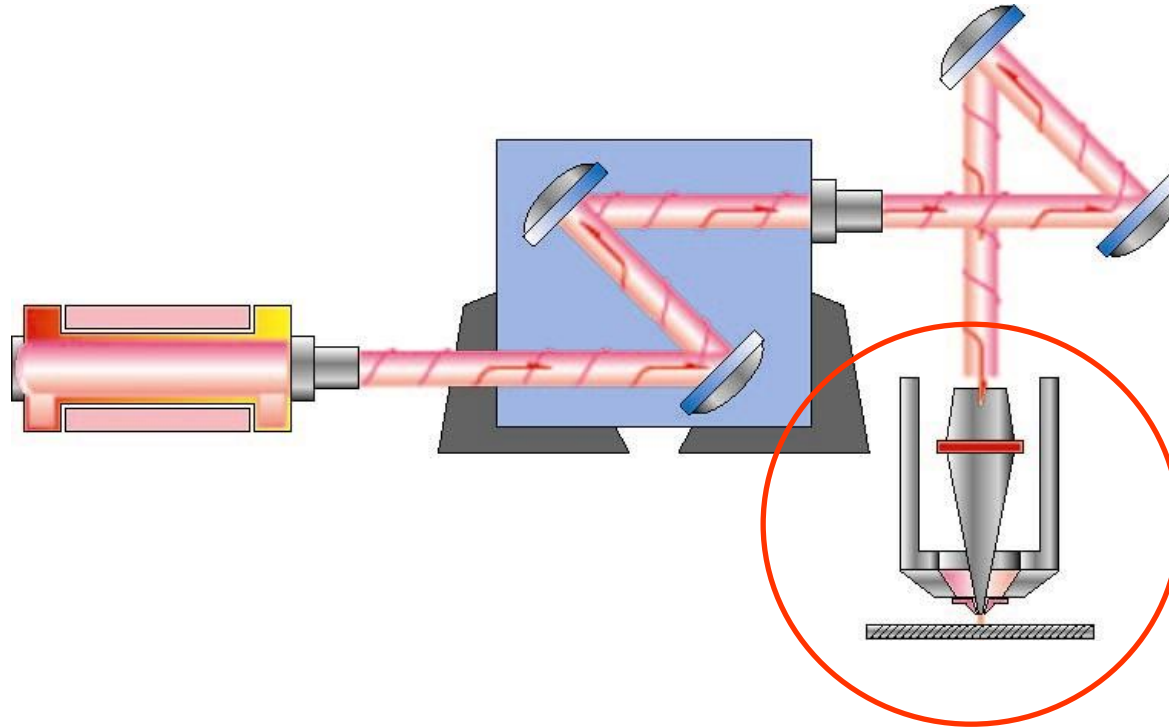


The photons pass back and forth as they reflect off the mirrors at the ends of the resonator, while stimulating more photons to be emitted. A percentage of the emitted photons are allowed to pass through a partially transmissive optic called an output coupler.

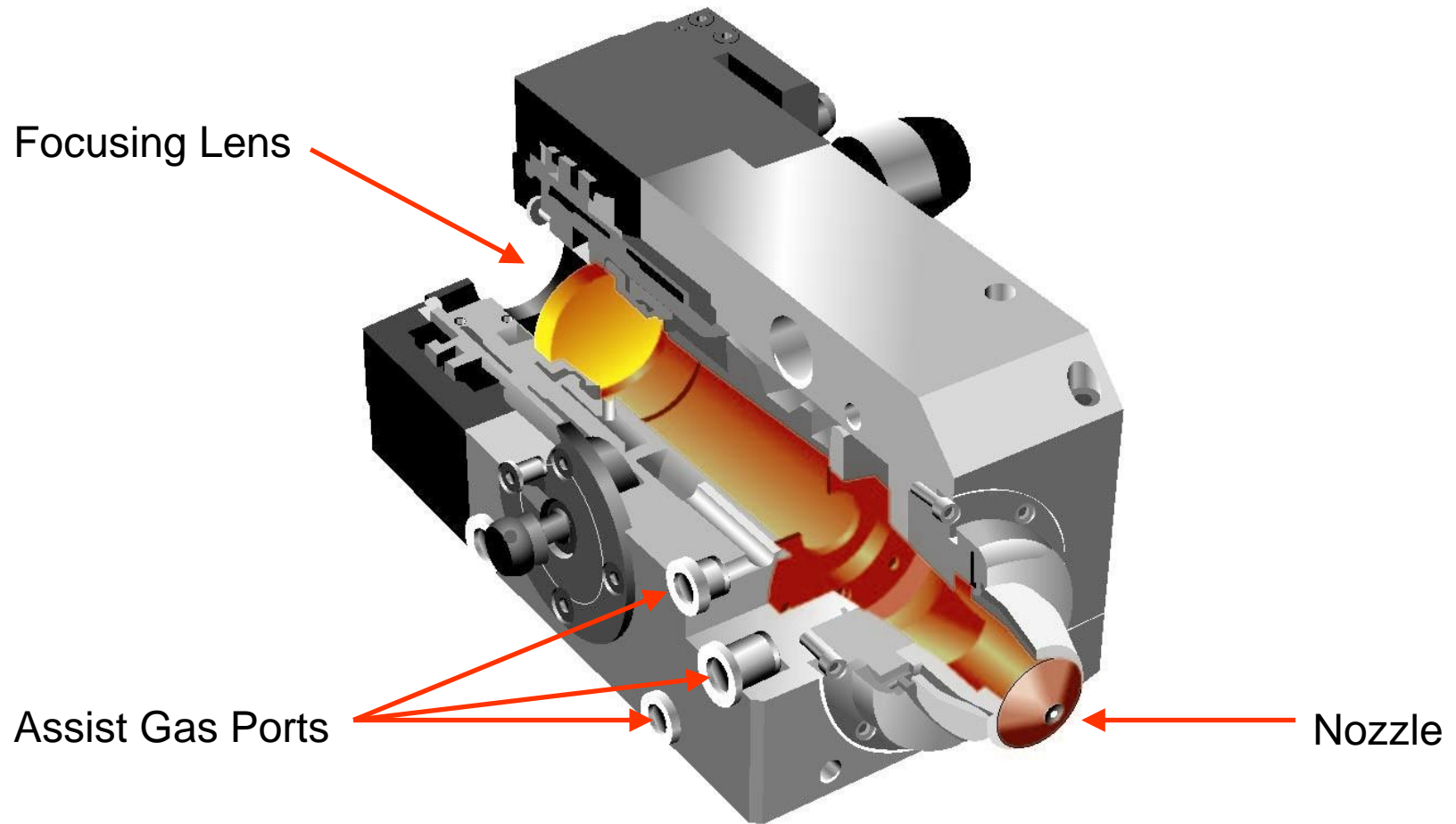
Resonator Gas Ratios



Cutting Assist Gasses



Laser Cutting Head



Cutting Assist Gasses

Work Piece	Assist Gas	Gas Pressure	Gas Flow SCFH	Purity ¹
Carbon Steel	Oxygen	< 100 psi	50-400	99.95%
Carbon Steel Stainless Steel Aluminum Non-metallic	Nitrogen	up to 500+ psi Increases with material thickness	300-3,500	99.995%
Titanium	Argon	Up to 400 psi Increases with material thickness	300-1500	99.995%

¹Typical Specifications, Consult Manufacturer



Oxygen Assist Gas

- **Burning Process**
 - Laser and Oxygen Combine to Create an Exothermic Reaction
 - Similar to Any Oxygen Assisted Cutting Process
- **Gas Requirements**
 - Purity >99.5% (Standard Industrial Grade)
 - Pressure Up to 150 psi
- Most Commonly Used for Carbon Steel

Oxygen Laser Cutting

- **Pros**

- Cost Effective Process
- Ability to cut thicker material with lower power level lasers

- **Cons**

- Oxygen cutting leaves an oxide layer on the cut edge that may need to be removed prior to painting, powder coating, or welding.
- Oxygen cutting is a speed limiting process because the oxygen requires time to burn the material. Adding more laser power does not necessarily provide faster cutting.

Nitrogen Assist Gas

- **Mechanical Process**

- Laser is the Only Heat Source
- Nitrogen Removes the Molten Material from the Cut Zone

- **Gas Requirements**

- Purity >99.97% (Standard Industrial Grade)
- Pressure up to 500+ psi and Flow Rates up to 3500 scfh

Note: Can be used for Carbon Steel Parts Which are to be Painted or Welded

Nitrogen Laser Cutting

- **Pros**

- Leaves an Oxide Free Cut Edge, Suitable for Most Food or Medical Applications
- Does not Suffer from the Same Speed Limitations that Oxygen Does

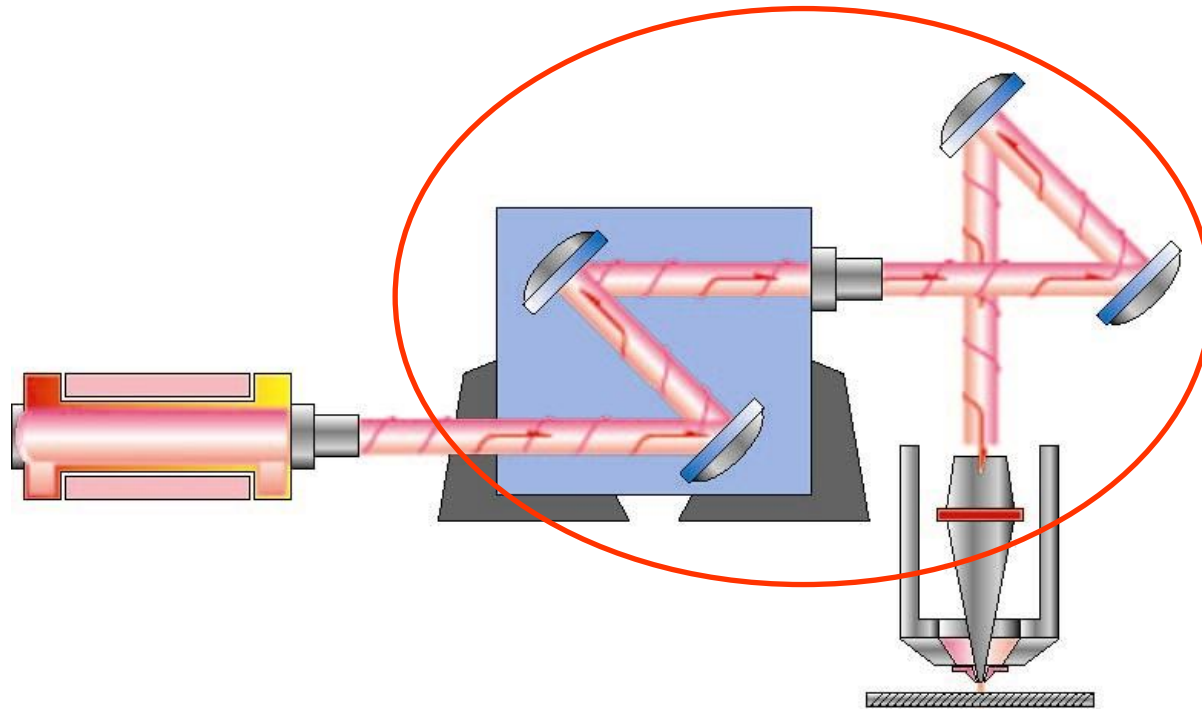
- **Cons**

- Lower Processing Speeds than O₂ at the Same Power Level
- Requires Higher Pressure / Higher Volume
- \$5-\$15/Hour More Costly (Due to N₂ volume)

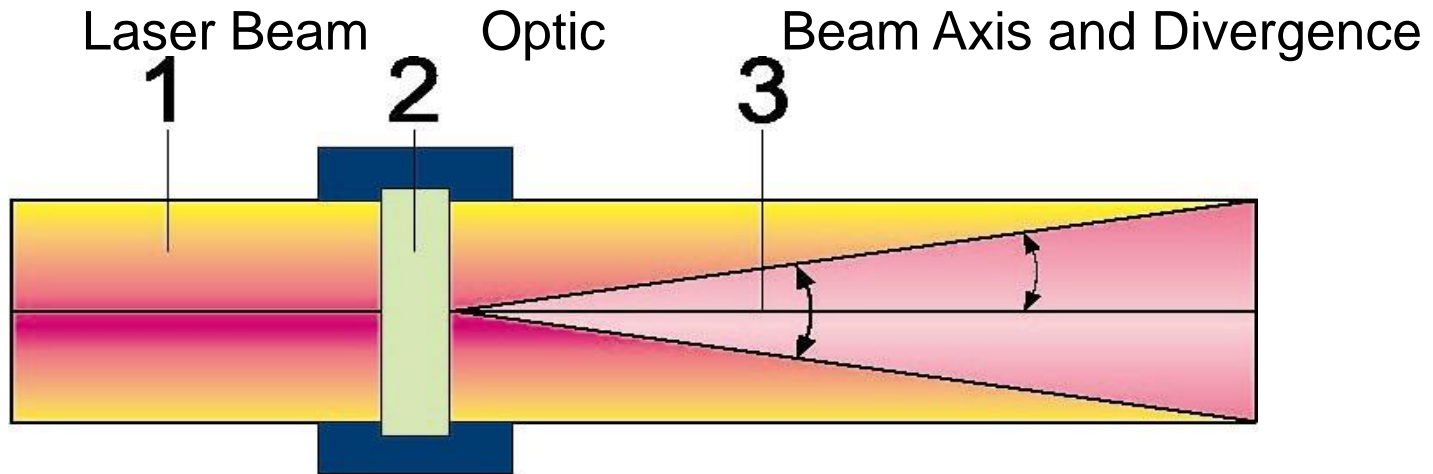
Air Assist Gas

- Composition Roughly 80% N₂ and 20% O₂
- Pros
 - Air Compressor Supply, Lower Cost
 - Does Not Suffer from the Same Speed Limitations as pure oxygen cutting
- Cons
 - Leaves an Oxide Layer and Minor Burr on Cut Edge
 - Requires More Power and Maintenance than Standard Delivery Systems
 - Thickness Limited to 0.060-0.080 on Most Materials

Beam Delivery Gasses

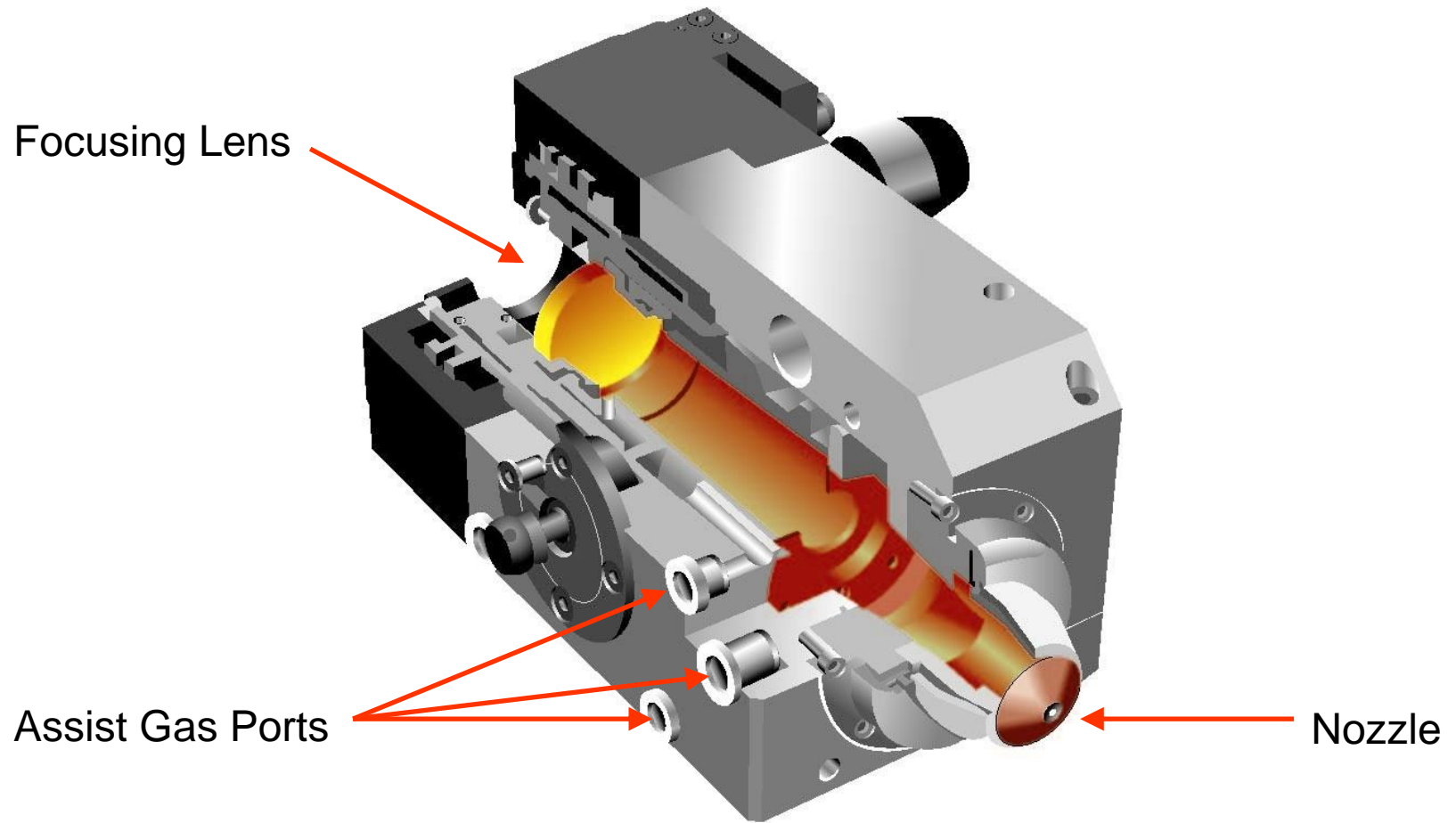


Beam Delivery Purge Gas

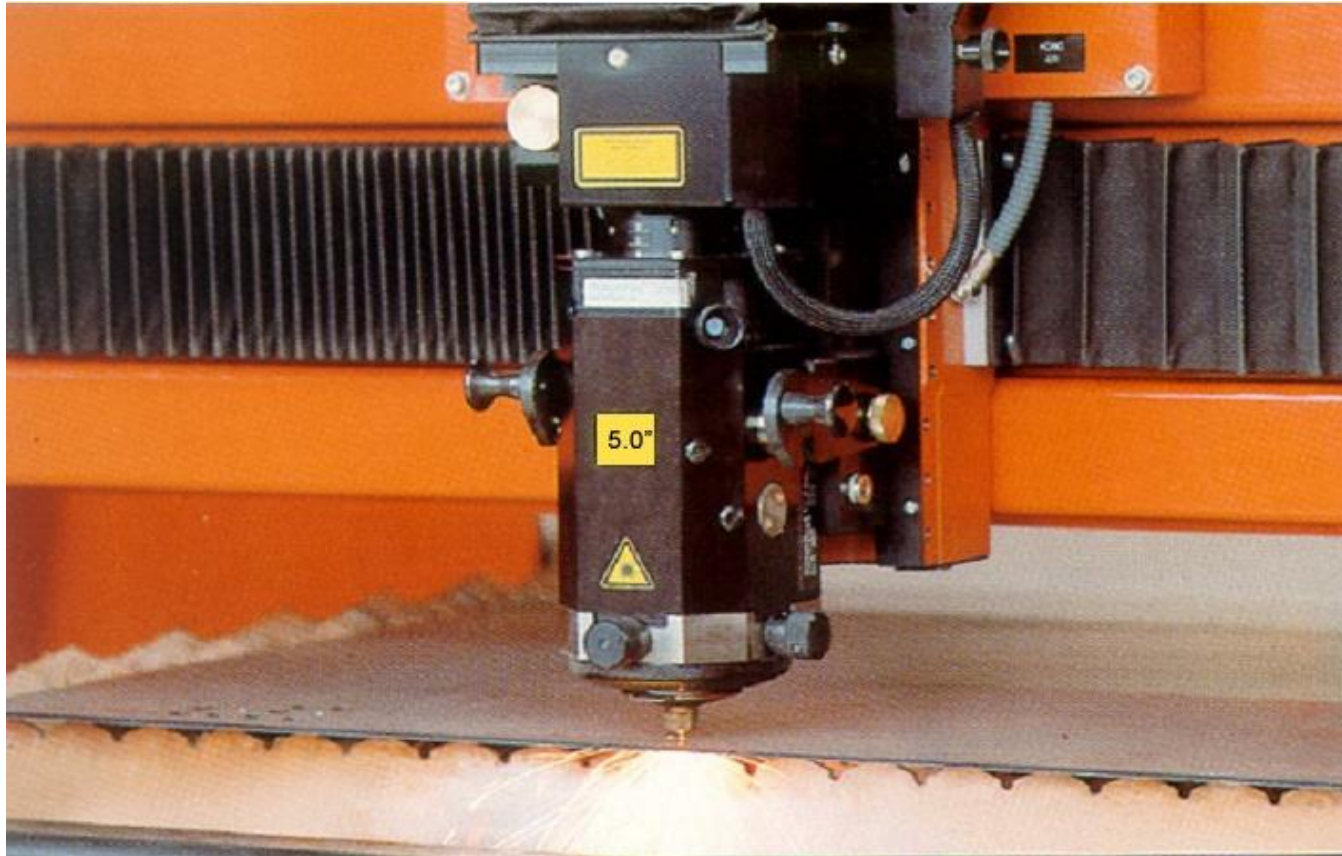


- Nitrogen or Air is Used to Pressurize Beam Guideway; >4kW Nitrogen is Recommended
- Keeps External Optics Clean from Resonator to Work Piece
- Same Purity as Assist Gas (>99.97%)
- Flow Rate 80-100 scfh

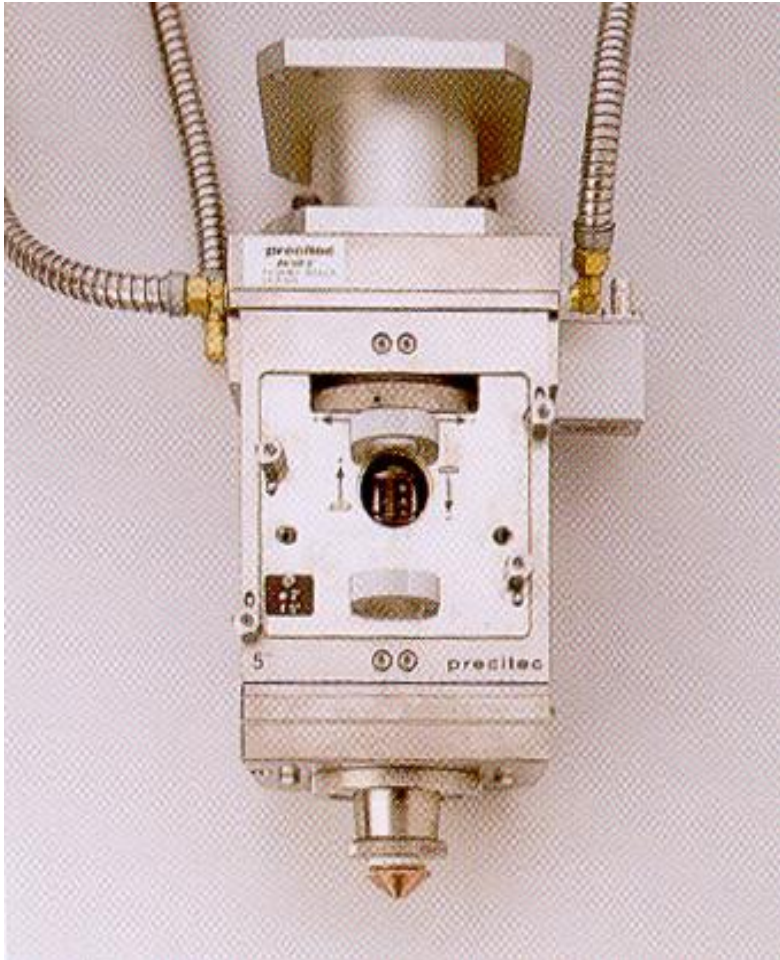
Laser Cutting Head



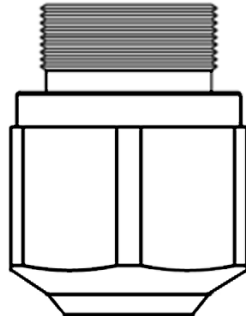
Bystronic Quick Change Head



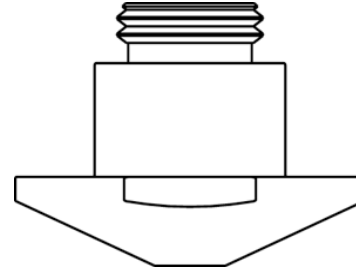
Mitsubishi High Speed Cutting Head



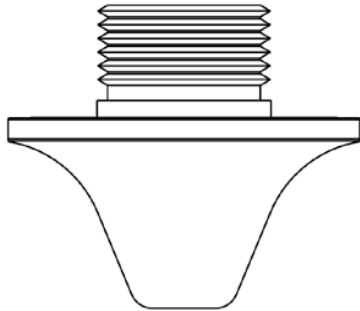
Laser Nozzles



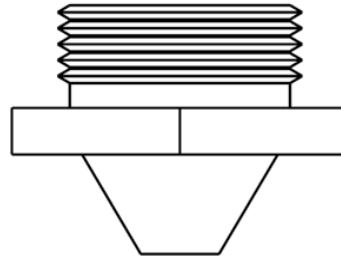
BYSTRONIC



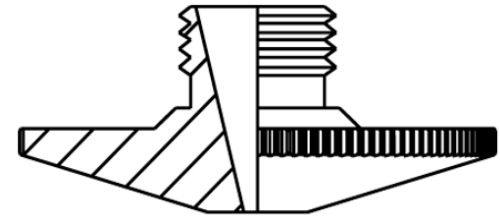
Mazak



AMADA

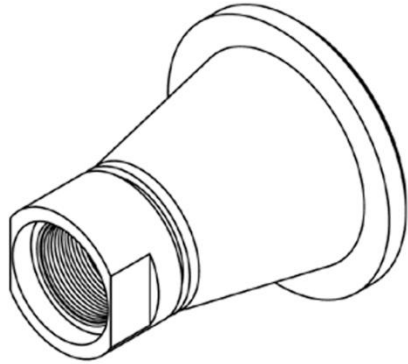


**MITSUBISHI
LASER**

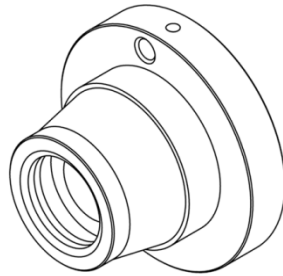


TRUMPF

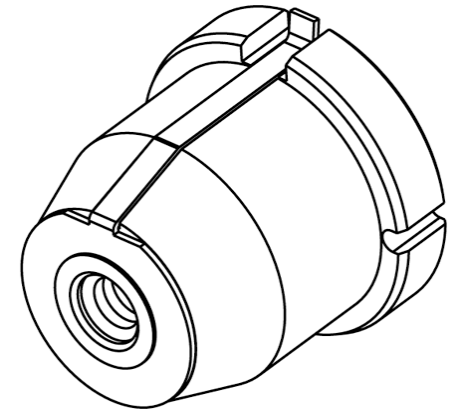
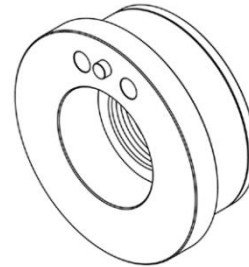
Cutting Head Consumables - Continued



BYSTRONIC

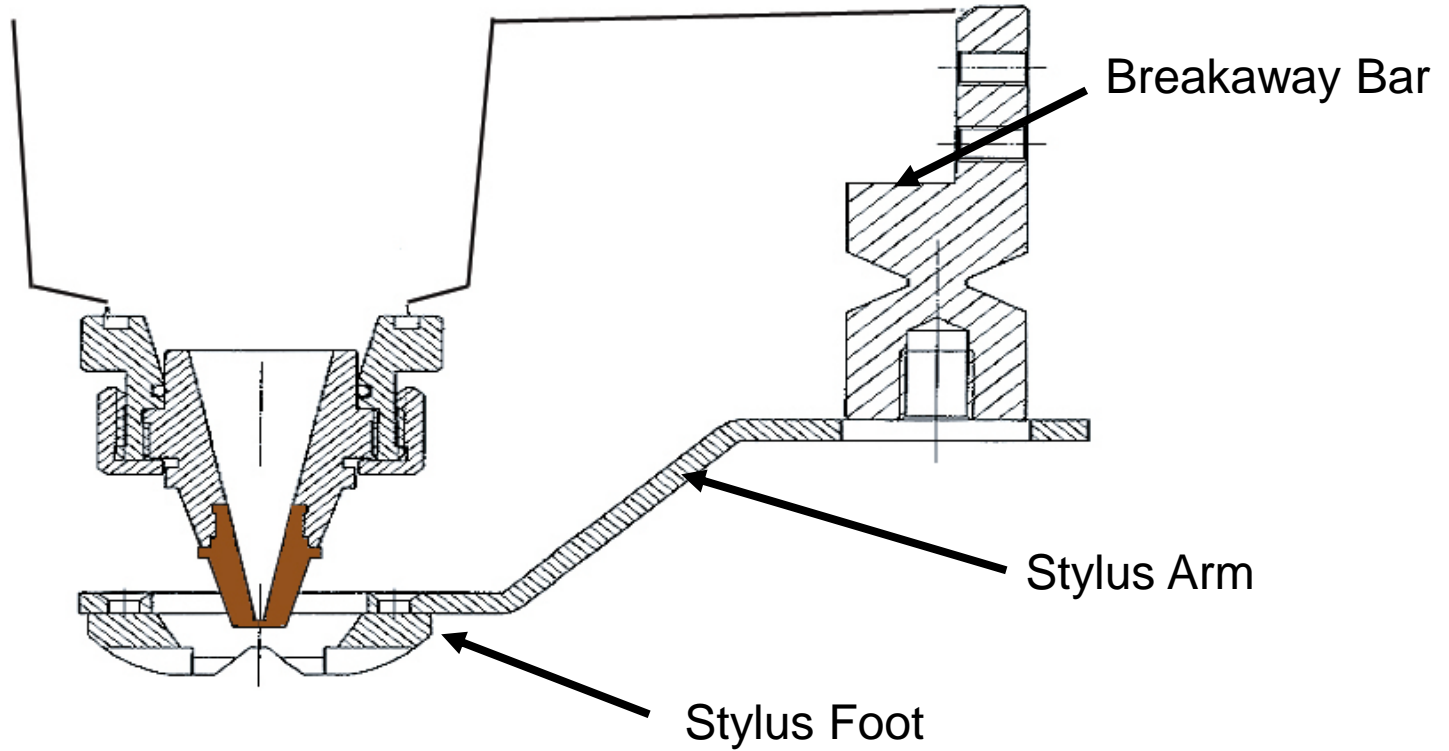


Mazak

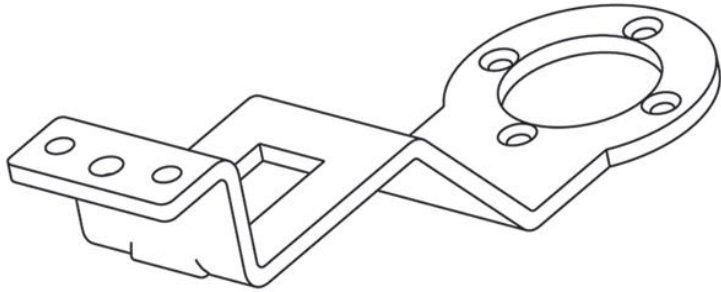


TRUMPF

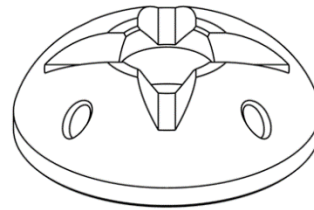
Mazak Stylus Foot Assembly



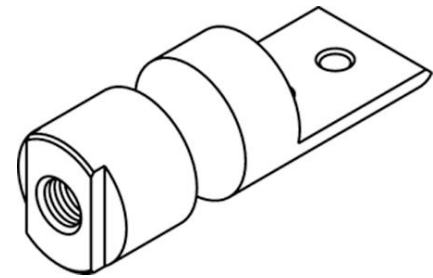
Cutting Head Consumables



Mazak
Stylus Arm



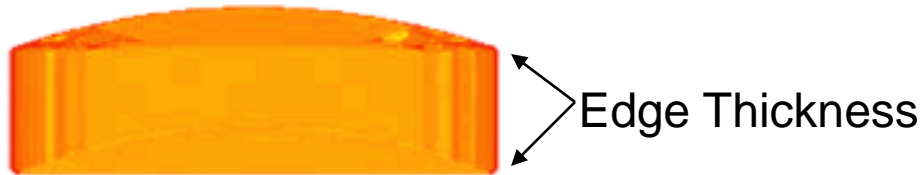
Mazak
Stylus Foot



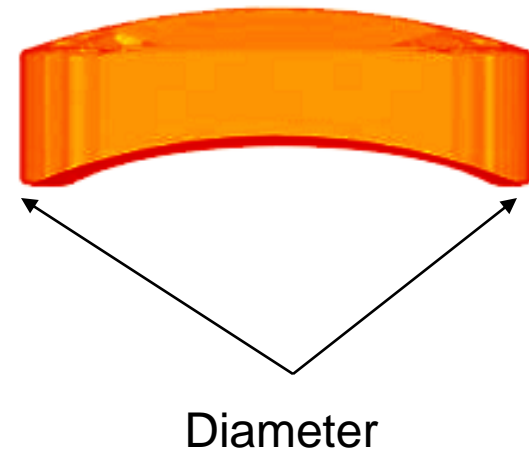
Mazak
Breakaway Bar

Lens Types and Dimensions

Plano Convex

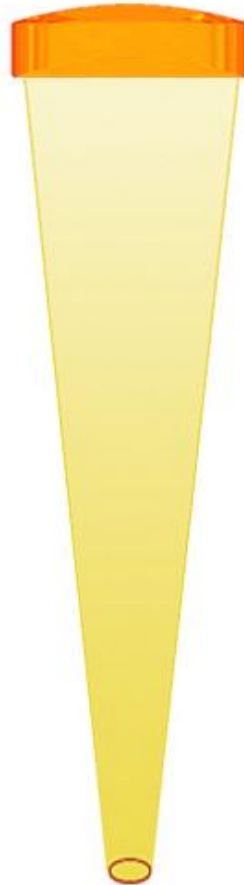


Meniscus



Lens Focal Length

7.5" Focal Length



5.0" Focal Length



Standard vs. Low Absorption Lenses

- **Standard**
 - Amber Color
 - Absorption $<0.22\%$
 - Life = 600 Hours
- **Low Absorption(MP-5)**
 - Amber Color
 - Absorption $<0.10\%$
 - Potentially 2 to 2.5 x Life
 - ~1/3 Cost Premium Vs. Standard



Optics Competitive Advantage

Standard Lens

	American Photonics - APC	Competitor I	Competitor II
<i>Diameter Tolerance</i>	+ 0.000" / - 0.004"	+ 0.000" / - 0.005"	+ 0.000" / - 0.004"
<i>Thickness Tolerance</i>	± 0.002"	± 0.010"	± 0.004"
<i>Power</i>	2FR	Not Listed	Not Listed
<i>Edge Thickness Variation</i>	< 0.0002"	≤ 0.002"	≤ 0.001"
<i>Surface Figure</i>	0.4F @ 633 nm	Varies Depending on Radius	0.5 F @ 633 nm
<i>Clear Aperture % of Lens</i>	DIA 90%	90%	90%
<i>Surface Quality</i>	≤ 20 - 10	20 - 10	Not Listed
<i>Total Transmission</i>	≥ 99.6%	Not Listed	>99.3%
<i>Absorption</i>	<0.17%	<0.20%	<0.20%

Low Absorption Lens

	American Photonics - APC	Competitor I	Competitor II
<i>Absorption</i>	<0.13%	<0.15%	<0.15%

Precision Infrared Optics & Coatings



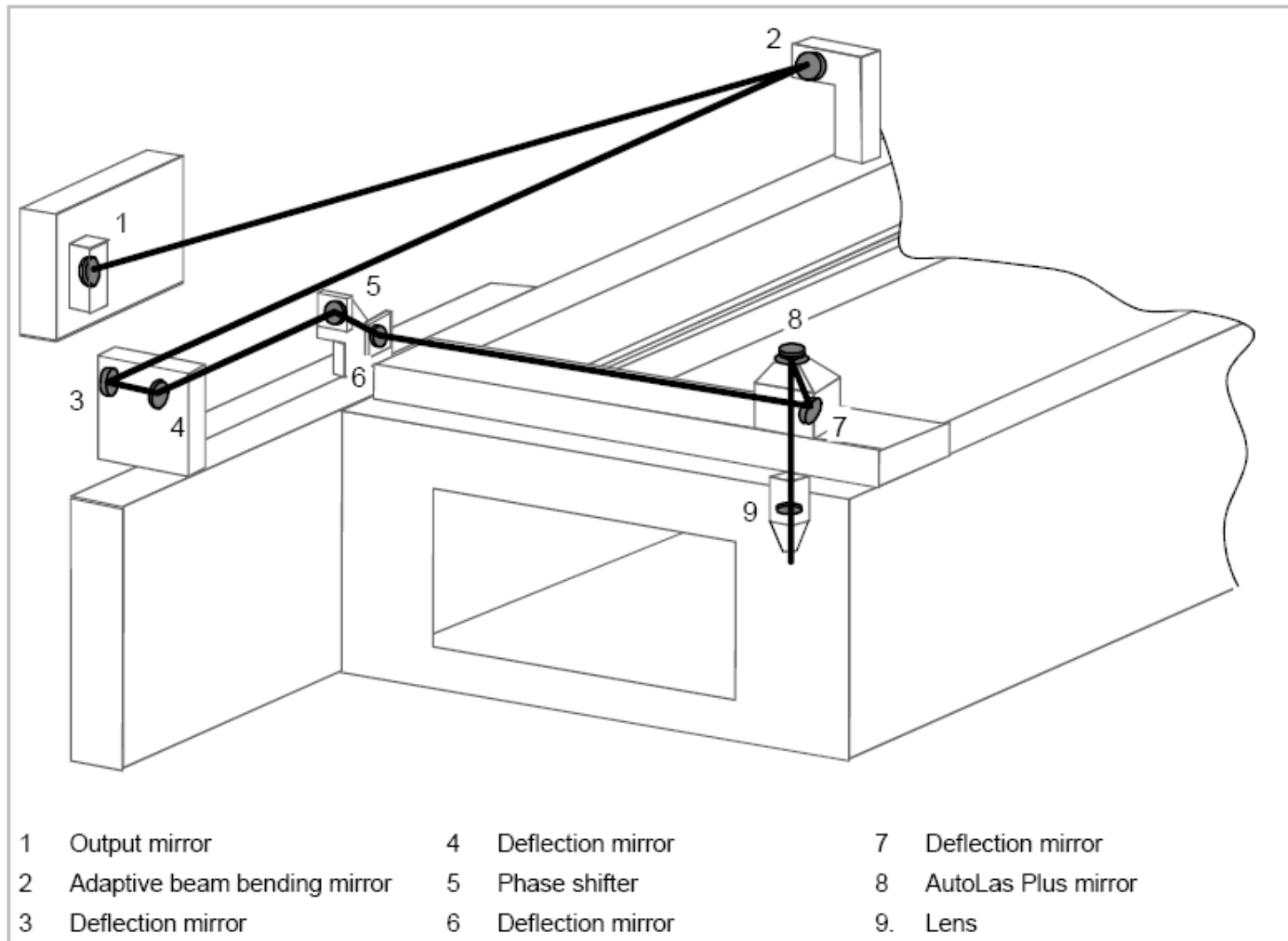
6621 19th Street East, Sarasota, Florida 34243
 Sales: (866) 464-7370
 Manufacturing: (941) 752-5811
 Fax: (941) 752-5861
 Email: Sales@AmericanPhotonics.com



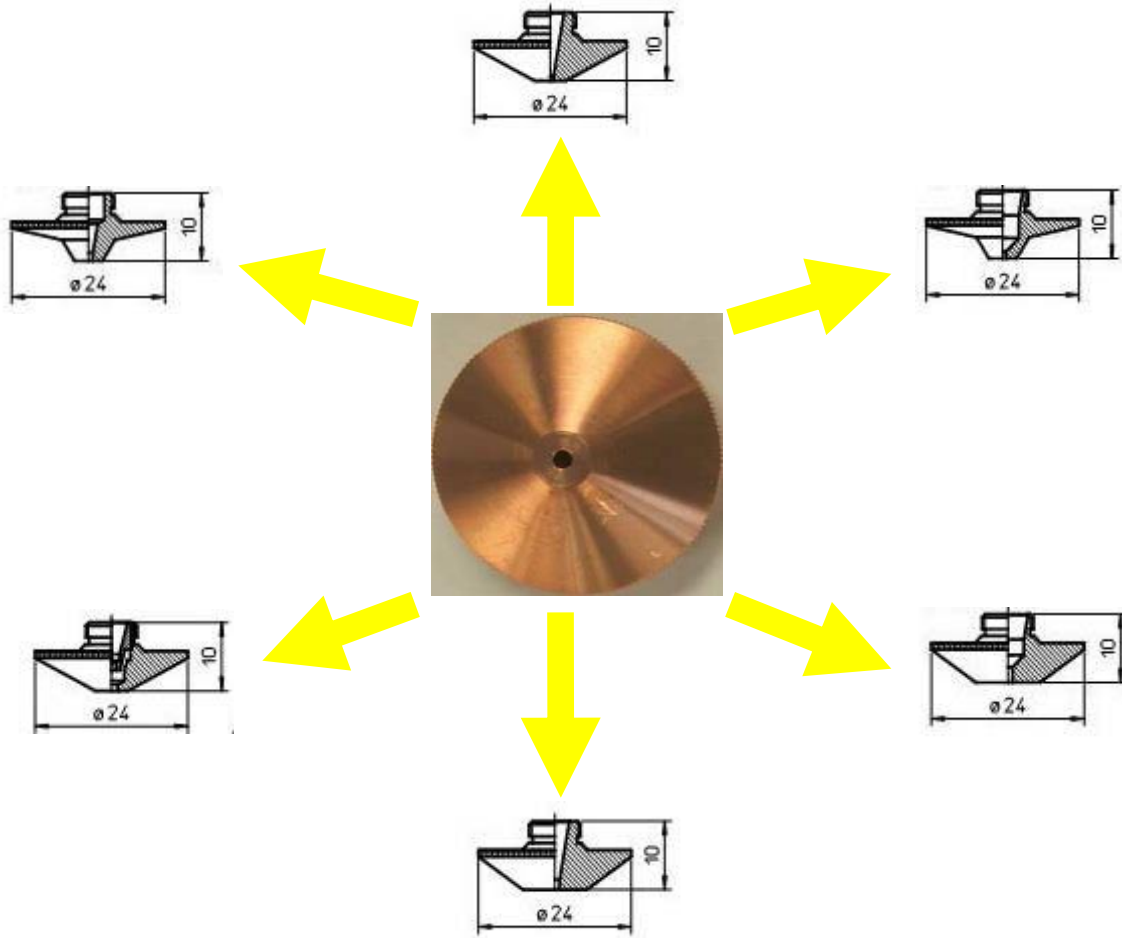
When to Replace a Lens

- **Surface Imperfections**
 - Scratches
 - Pits or Digs
 - Pinholes or Inclusions in the Coating
- **Surface Contamination**
 - Metal Spatter
 - Dust
 - Oil
 - Fingerprints

Beam Delivery Block Diagram



Special Application Nozzles



Shower Nozzles

- Used to cut thick mild steel ($>1/4''$) with oxygen assist gas by forcing the gas into the cut.
- This design ensures more effective assist gas volume without significantly increasing real volume.



Double Nozzles

- Double nozzles are better for cutting thick material ($>1/4''$). Better refers to edge quality not an increase in speed.
- Double nozzles have a high aspect ratio at the exit which helps to protect the focus lens from back spatter.



Nozzle and Hardware Ordering Info.

- Obtain the Following Information From the Customer, or from Existing Packaging

- Part Number

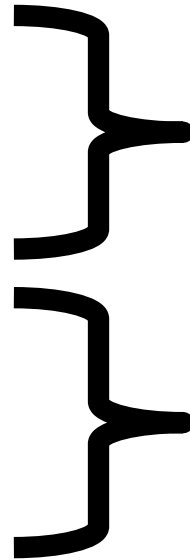
- Manufacturer

- Description

- Cost

- Monthly Volume

- Current Supplier



MUST PROVIDE

WOULD LIKE

Sample Packaging



Nozzles and Hardware Info.

- How often are these consumables / parts replaced? (depending on level of usage - time and thickness)
- Nozzles – every 1-2 shifts
- Lenses – every 1-3 months
- Mirrors – recommended every year, but most replace every 2 years
- Sensor Cables 1-2 months
- Sensor Cones 3-6 months
- How much do these consumables cost?
- Nozzles - \$1 - \$30
- Lenses - \$200 - \$600
- Mirrors - \$3,000 – \$6,000
- Sensor Cables – \$100 - \$275
- Sensor Cone (repair) - \$700

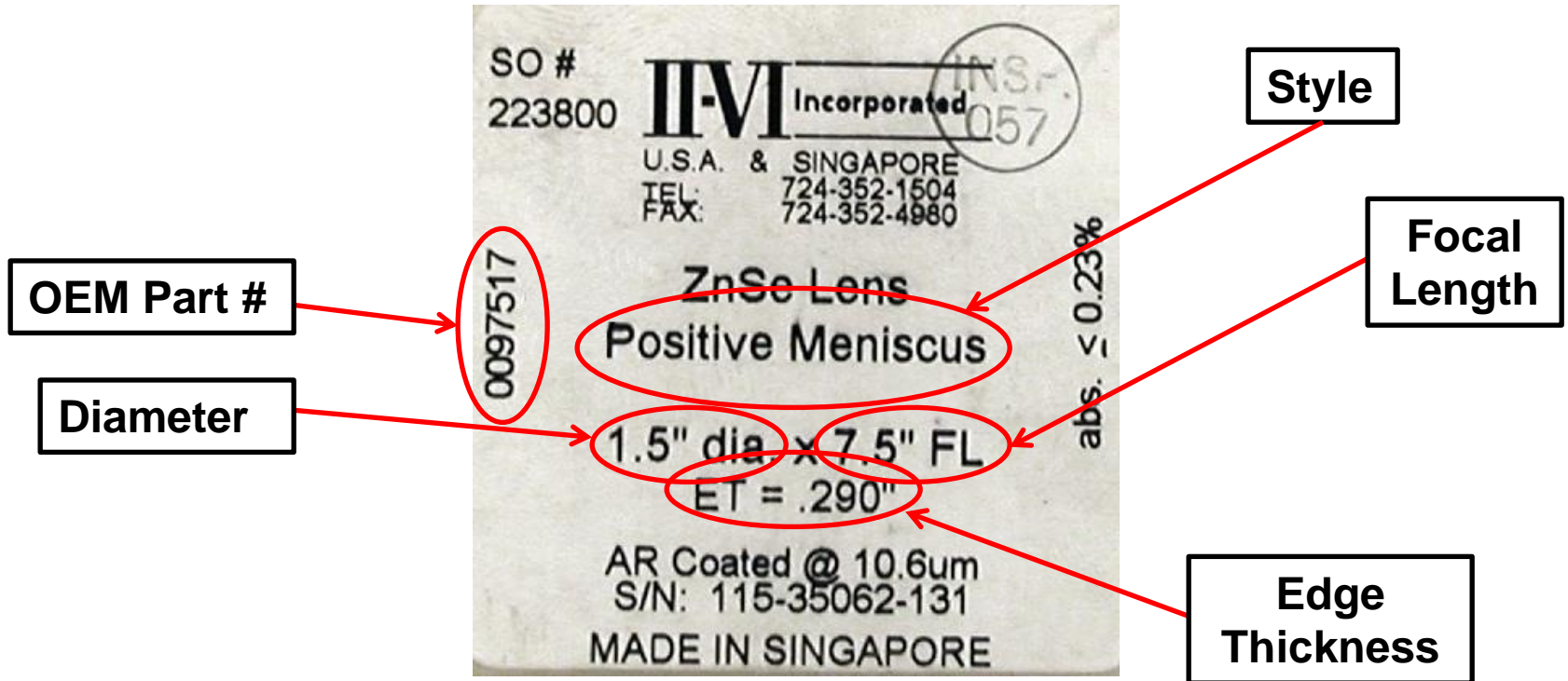
Nozzles and Hardware Info.

- Do end-users typically change them themselves?
- Nozzles - yes
- Lenses – yes
- Mirrors - changing mirrors requires specialized OEM training
 - Approximately 50% of laser end users change their own delivery optics - less than 5% will change their own resonator mirrors
 - If the customer / end-user can't replace, the OEM technician will install – many end-users have a stock room with these parts and will call a technician to replace those the end-user can't (OEM tech will not decline to install)
- Sensor Cones - yes
- Sensor Cables - yes

Lens Ordering Information

- Obtain the Following Information From the Customer, or from Existing Packaging
 - OEM Part Number
 - Style (Plano-Convex or Meniscus)
 - Diameter (1.1", 1.5", 2.0")
 - Focal Length (3.75", 5.0", 7.5", 9.0")
 - Edge Thickness (0.236, 0.310, etc.)
 - Standard or Low Absorption
 - **IF possible TARGET PRICE**
 - **YEAR UNITS VOLUME**

Sample Packaging - Lenses



PART NUMBERING – How to Read and understand ATTC Part Numbers.

Lenses

ZM15500291 Z | M | 15 | 500 | 291

Z = ZnSe (Material or Substrate)

M = Meniscus (Geometry or Shape of Lens)

15 = Outer Diameter of lens (1.5")

500 = Focal Length of lens (5.00")

291 = Edge thickness of lens (0.291")

ZC15500300-HS Z | C | 15 | 500 | 300 | -HS

Z = ZnSe

C = Plano Convex

15 = Outer Diameter of Lens (1.5")

500 = Outer Focal Length of Lens (5.00")

300 = Edge Thickness of Lens (0.300")

-HS = High Speed Design – APC Design

LM-20-50.8-ET2.0-DBAR LM | -20 | -50.8 | -ET2.0 | -DBAR

LM = Lens Meniscus

-20 = Outer Diameter (20mm)

-50.8 = Focal Length (50.8mm / 2.0")

-ET2.0 = Edge Thickness (2.0mm)

-DBAR = Coating (Dual Band AR)

Windows

WZ1.0-AR-0.120 W | Z | 1.0 | -AR | -0.120

W = WINDOW

Z = ZnSe (Material or Substrate)

1.0 = Outer Diameter (1.0")

-AR = Coating

-0.120 = Edge Thickness

American Photonics– Value Add

- 100% made in America – Optical Manufacturing
- Expand and Strengthen relationships with Existing Customers
- Growth Opportunity for Today and the Future
- **Large inventory for immediately delivery most of the Lens and nozzles we have inventory – same day shipping**
- **Price match against II VI and Ophir, any customer that send to us a invoice from this 2 competitors we match the price and give 10% discount on top.**
- Bundles
- Any suggestions from Sales team?

CROSS REFERENCE HIGH POWER CO2



Rank	OEM	OEM	ATTC	Centricut	II VI	Ophir	ThermaCut	RICHARDSON	NEW APC# "A" LEVEL	item_desc_1 /// item_desc_2	Diameter	Focal Length	Edge Thickness
1.5"	Name	Ref Number	Ref Number	Ref Number	Ref Number	Ref Number	Ref Number	Ref Number	Ref Number	Standard - 1.5"			
1	Trumpf	97517	ZM15750291	TR300-7517	702232	60697	HG10.168/H	RLT101/75S	LM-38.1-Z-190.5-7.39-AR	Lens Meniscus ZnSe 1.5" 7.5"fl .291"et	1.5"	7.5"	0.291"
1						61983				Lens ZnSe Menisc D=38.1mm FL=7.5" ET=7.4mm	38.1mm		7.4mm
2	Trumpf	88114	ZM15500291	TR300-8114	406294	60696	HG10.167/H	RLT100/50S	LM-38.1-Z-127.0-7.39-AR	Lens Meniscus ZnSe 1.5" 5.0"fl .291"et	1.5"	5.0"	0.291"
2						61982				Lens ZnSe Menisc D=38.1mm FL=5" ET=7.4mm	38.1mm		7.4mm
3	Bystronic	4-05094	ZM15500350	BY314-5094	767963	60615	HG10.733/H	RLB400/50S	LM-38.1-Z-127.0-8.89-AR	Lens Meniscus ZnSe 1.5" 5.0"fl .354"et	1.5"	5.0"	.354"
3						631079-117				Lens ZnSe Menisc D=38.1mm FL=5" ET=9.0mm	38.1mm		9.0mm
4	Bystronic	4-05095 or 698637	ZM15750350	BY314-5095	698637	60616	HG10.734/H	RLB401/75S	LM-38.1-Z-190.5-8.89-AR	Lens Meniscus ZnSe 1.5" 7.5"fl .354"et	1.5"	7.5"	.354"
4						60616				Lens ZnSe Menisc D=38.1mm FL=7.5" ET=9.0mm	38.1mm		9.0mm
5	Bystronic	4-00186	ZM15500236	BY314-0186	227092	60260	HG10.731/H	RLB404/50S	LM-38.1-Z-127.0-5.99-AR	Lens Meniscus ZnSe 1.5" 5.0"fl .236"et	1.5"	5.0"	.236"
5										Lens ZnSe Menisc D=38.1mm FL=5" ET=6.0mm	38.1mm		6.0mm
6	Bystronic	4-00185	ZM15375236	BY314-0185	698637	60603	HG10.730/H			Lens Meniscus ZnSe D=38.1mm ET=6.0mm fl 3.75"	1.5"	3.75"	.236"
6										Lens ZnSe Menisc D=38.1mm FL=3.75" ET=6.0mm	38.1mm		6.0mm
7	Bystronic	4-00187	ZM15750236	BY314-0187	372665	60602	HG10.732/H	RLB403/75S	LM-38.1-Z-190.5-5.99-AR	Lens Meniscus ZnSe 1.5" 7.5"fl .236"et	1.5"	7.5"	.236"
7										Lens ZnSe Menisc D=38.1mm FL=7.5" ET=6.0mm	38.1mm		6.0mm
11	Trumpf	346104	ZM15375291	TR300-6104		61962	HG10.166/H	RLB102/375S	LM-38.1-Z-095.3-7.39-AR	Lens Meniscus ZnSe 1.5" 3.75"fl .291"et	1.5"	3.75"	.291"
11						61962				Lens ZnSe Menisc D=38.1 FL=3.75" ET=7.4mm	38.1mm		7.4mm
12		141972	ZM15900291			61961	HG10.169/H	RLT103/90S	LM-38.1-Z-228.6-7.39-AR	Lens Meniscus ZnSe 1.5" 9.0"fl .291"et	1.5"	9.0"	.291"
12						61961				Lens ZnSe Menisc D=38.1mm FL=9" ET=7.4mm	38.1mm		7.4mm
13			ZM15100291	TR300-0163		61960	HG10.179/H	RLT104/100S	LM-38.1-Z-254.0-7.39-AR	Lens Meniscus ZnSe 1.5" 10.0"fl .291"et	1.5"	10.0"	.291"
13						61960				Lens ZnSe Menisc D=38.1mm FL=10" ET=7.4mm	38.1mm		7.4mm
18		81140306 or 71501072	ZC15500300-HS	AM313-0306NM		62670	HG15.015/H		LM-38.1-Z-127.0-7.62-AR	Lens Plano Convex ZnSe 1.5" 5.0"fl .300" et	1.5"	5.0"	.300"
18						62670				Lens ZnSe PlanoConvex D=38.1mm FL=5" ET=7.6mm	38.1mm		7.6mm
19	amada	71501070 or 81140400	ZC15750300-HS	AM313-0400		62649	HG15.016/H		LM-38.1-Z-190.5-7.62-AR	Lens Plano Convex ZnSe 1.5" 7.5"fl .300" et	1.5"	7.5"	.300"
19										Lens ZnSe PlanoConvex D=38.1mm FL=7.5" ET=7.6mm	38.1mm		7.6mm
20	Bystronic	4-10736	ZM15375350				HG10.729/H		LM-38.1-Z-096.3-8.89-AR	Lens Meniscus ZnSe 1.5" 3.75"fl .350"et	1.5"	3.75"	.350"
20										Lens ZnSe Menisc D=38.1mm FL=7.5" ET=9.0mm	38.1mm		9.0mm

Rank	OEM	OEM	ATTC	Centricut	II VI	Ophir	ThermaCut	RICHARDSON	NEW APC# "A" LEVEL	item_desc_1 /// item_desc - 2	Diameter	Focal Length	Edge Thickness
2.0"	Name	Ref Number	Ref Number	Ref Number	Ref Number	Ref Number	Ref Number	Ref Number	Ref Number	Standard - 2.0"			
8	Mitsubis hi	W505 / 304725	ZC20500310-HS	MB312-505		62728	HG15.029/H		LM-50.8-Z-127.0-7.87-AR	Lens Meniscus ZnSe 2.0" 5.0" fl .310"et Lens ZnSe PlanoConvex D=50.8mm FL=5" ET=7.87mm	2.0" 50.8mm	5.0"	.310" 7.87mm
8	MAZAK	Z50ZZ005610											
9	Trumpf	81140307	ZM20500380	AM313-0186NM	741363	60991	HG10.620/H		LM-50.8-Z-127.0-9.65-AR	Lens Meniscus ZnSe 2.0" 5.0"fl .380"et Lens ZnSe Menisc D=50.8mm FL=5" ET=9.7mm	2.0" 50.8mm	5.0"	.380" 9.7mm
10	Trumpf	81140186	ZM20750380-HS	AM313-0307NM	695399	60698	HG10.621/H		LM-50.8-Z-190.5-9.65-AR	Lens Meniscus ZnSe 2.0" 7.5"fl .380"et Lens ZnSe Menisc D=50.8mm FL=7.5" ET=9.7mm	2.0" 50.8mm	7.5"	.380" 9.7mm
14			ZM20100380				HG10.622/H		LM-50.8-Z-254.0-9.65-AR	Lens Meniscus ZnSe 2.0" 10.0" fl .380"et Lens ZnSe Menisc D=50.8mm FL=10" ET=9.7mm	2.0" 50.8mm	10.0"	.380" 9.7mm
14						6210							
15		81140307	ZC20500380-HS	AM313-0186NM		61019	HG15.002/H		LM-50.8-Z-127.0-9.65-AR	Lens Plano Convex ZnSe 2.0" 5.0"fl .380" et Lens ZnSe PlanoConvex D=50.8mm FL=5" ET=9.7mm	2.0" 50.8mm	5.0"	.380" 9.7mm
16	MAZAK	Z50ZZ005200	ZC20750380-HS	AM313-0307NM		60911	HG15.003/H		LM-50.8-Z-190.5-9.65-AR	Lens Plano Convex ZnSe 2.0" 7.5" fl .380" et Lens ZnSe PlanoConvex D=50.8mm FL=7.5" ET=9.7mm	2.0" 50.8mm	7.5"	.380" 9.7mm
16		81140186											
17	Mitsubis hi	W510	ZC20750310-HS	MB312-510		62729	HG15.028/H		LM-50.8-Z-190.5-7.87-AR	Lens Plano Convex ZnSe 2.0" 7.5"fl . 310" et Lens ZnSe PlanoConvex D=50.8mm FL=7.5" ET=7.87mm	2.0" 50.8mm	7.5"	.310" 7.87mm

High Power - Low Absorption - Ultra Low Absorption

Rank	OEM	OEM	ATTC	Centricut	II VI	Ophir	Thermacut	RICHARDSON	NEW APC# "A" LEVEL	item_desc 1 /// item_desc - 2	Diameter	Focal Length	Edge Thickness
1.5"	Name	Ref Number	Ref Number	Ref Number	Ref Number	Ref Number	Ref Number	Ref Number	Ref Number	Low Absortion - 1.5"			
21	Trumpf		ZM15500291-HP	TR300-8114 LA		60696ULA 61982ULA	HG10.167/HU	RLT200/50LA	LM-38.1-Z-127.0-7.39-ARHP	Lens Meniscus ZnSe 1.5" 5.0"fl .291" et HP Low Absortion Lens ZnSe Menisc D=38.1mm FL=5" ET=7.4mm Ultra Low	1.5" 38.1mm	5.0" 127mm	.291" 7.4mm
22	Trumpf	141972	ZM15750291-HP	TR300-7517-LA	474644	60697ULA 61983ULA	HG10.168/HU	RLT201/75LA	LM-38.1-Z-190.5-7.39-ARHP	Lens Meniscus ZnSe 1.5" 7.5"fl .291" et HP Low Absortion Lens ZnSe Menisc D=38.1mm FL=7.5" ET=7.4mm Ultra Low	1.5" 38.1mm	7.5" 190.5mm	.291" 7.4mm
23			ZM15900291-HP			61961ULA 61961ULA	HG10.169/HU		LM-38.1-Z-228.6-7.39-ARHP	Lens Meniscus ZnSe 1.5" 9.0" fl .291"et HP Low Absortion Lens ZnSe Menisc D=38.1mm FL=9" ET=7.4mm Ultra Low	1.5" 38.1mm	9.0" 228.6mm	.291" 7.4mm
24	Bystronic	4-05095	ZM15750350-HP		602033	60616ULA 62709ULA	HG10.734/HU	RLB5023/75LA	LM-38.1-Z-127.0-8.89-ARHP	Lens Meniscus ZnSe 1.5" 5.0"fl .350" et HP Low Absortion Lens ZnSe Menisc D=38.1mm FL=5" ET=9.0mm Ultra Low	1.5" 38.1mm	5.0" 127mm	.350" 9.0mm
25	Bystronic	4-07475	ZM15500350-HP	BY314-5094LA		60615ULA	HG10.733/HU	RLB502/50LA	LM-38.1-Z-127.0-8.89-ARHP	Lens Meniscus ZnSe 1.5" 5.0"fl .350" et HP Low Absortion Lens ZnSe Menisc D=38.1mm FL=5" ET=9.0mm Ultra Low	1.5" 38.1mm	5.0" 127mm	.350" 9.0mm
26		350163	ZM15100291-HP			61960ULA	HG10.179/HU		LM-38.1-Z-254.0-7.39-ARHP	Lens Meniscus ZnSe 1.5" 10"fl .291" HP Low Absortion Lens ZnSe Menisc D=38.1mm FL=5" ET=7.4mm Ultra Low	1.5" 38.1mm	10.0" 254mm	.291" 7.4mm
29	amada	71501070 or 81140400	ZC15750300-HSP	AM313-0400LA			HG15.016/HU		LM-38.1-Z-190.5-7.62-AR	Lens Plano Convex ZnSe 1.5" 5.0"fl .300" et HP Low Absortion Lens ZnSe Menisc D=38.1mm FL=7.5"ET=9.0mm Ultra Low	1.5" 38.1mm	7.53" 191.3mm	.300" 9.0mm
30	Trumpf	346104	ZM15375291-HP	TR300-6104 LA			HG10.166/HU		LM-38.1-Z-095.3-7.39-AR	Lens Meniscus ZnSe 1.5" 3.75"fl .291"et HP Low Absortion Lens ZnSe Menisc D=38.1mm FL=3.75" ET=7.4mm Ultra Low	1.5" 38.1mm	3.75" 95.3mm	.291" 7.4mm

Rank	OEM	OEM	ATTC	Centricut	II VI	Ophir	Thermacut	RICHARDSON	NEW APC# "A" LEVEL	item_desc 1 /// item_desc - 2	Diameter	Focal Length	Edge Thickness
2.0"	Name	Ref Number	Ref Number	Ref Number	Ref Number	Ref Number	Ref Number	Ref Number	Ref Number	Low Absortion - 2"			
27	Trumpf	81140307	ZC20500380-HSP	AM313-0307NMLA		60991ULA	HG10.620/HU		LM-50.8-Z-127.0-9.65-ARHP	Lens Meniscus ZnSe 2.0" 5.0"fl .380" et HP Low Absortion Lens ZnSe Menisc D=50.8mm FL=5" ET=9.7mm Ultra Low	2.0" 50.8mm	5.0" 127mm	.380" 9.7mm
28	Trumpf	81140186	ZM20750380-HSP	AM313-0186 NMLA		60698ULA	HG10.621/HU		LM-50.8-Z-190.5-9.65-ARHP	Lens Meniscus ZnSe 2.0" 7.5"fl .380" et HP Low Absortion Lens ZnSe Menisc D=50.8mm FL=7.5" ET=9.7mm Ultra Low	2.0" 50.8mm	7.5" 190.5mm	.380" 9.7mm
31	Mitsubis hi	Z50ZZ005610	ZC20500310-HSP	MB312-505 LA		62728ULA	HG15.029/H ULA			Lens Meniscus ZnSe 2.0" 5.14" fl .310"et HP Low Absortion Lens ZnSe PlanoConvex D=50.8mm FL=5.14" ET=7.87mm Ultra Low	2.0" 50.8mm	5.14" 130.6mm	.310" 7.87mm
32	Mitsubis hi		ZC20500310-HSP	MB312-505 LA		6272	HG15.029/H ULA			Lens Meniscus ZnSe 2.0" 7.55" fl .310"et HP Low Absortion Lens ZnSe PlanoConvex D=50.8mm FL=7.55" ET=7.87mm Ultra Low	2.0" 50.8mm	7.55" 191.8mm	.310" 7.87mm