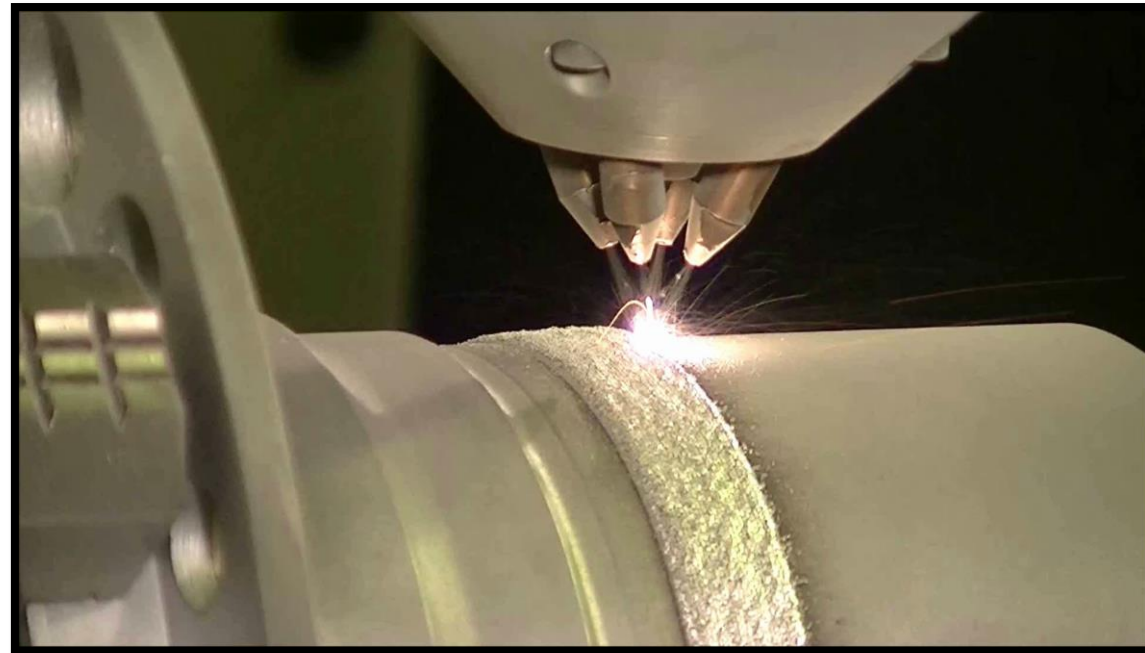
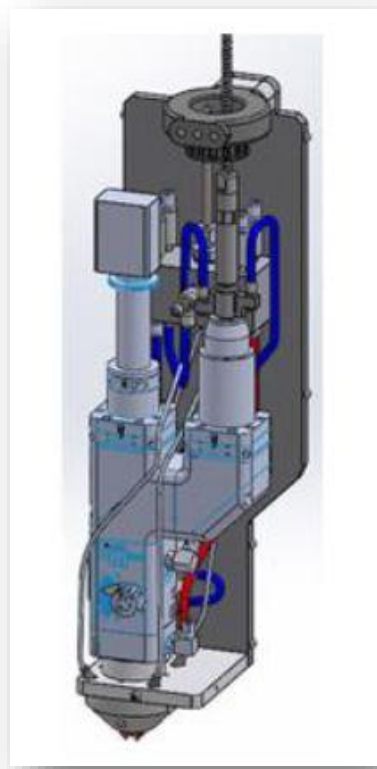


# LENS Deposition Head (LDH) Comparison of Models 2.0 and 3.X

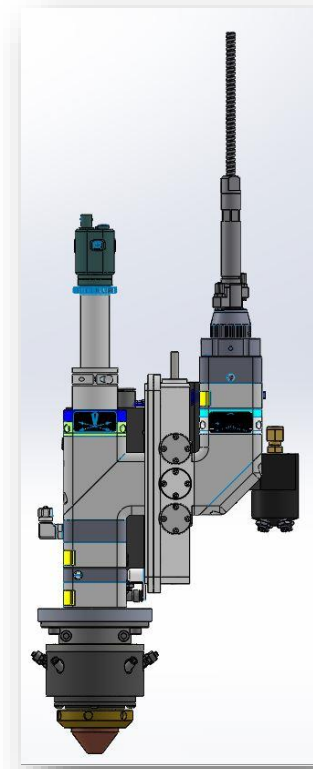


# LDH Models 2.0 and 3.X

**LDH 2.0**



**LDH 3.X**



# LDH Models- The Basics

LDH models will differ according to configuration and options, such as:

1. Overall dimensions and form.
2. Allowable laser power range.
3. Laser fiber cable diameter.
4. Focus lens length.
5. Spot size range.
6. Cooling (air or water).
7. Single nozzle or nozzle interchangeability (4-tip, coax, high overhang configurations).
8. Shaping optics.
9. Visual and monitoring tools, such as laser alignment, melt pool sensor, and thermal imaging.

# LDH Models- The Basics

Each LDH model will have its own specific design or configuration. However, the components that make up the core of each LDH will generally include the following:

1. Fiber optic connector (QBH type, also called HLC-8)- where the laser is transmitted from the laser source to the LDH.
2. Collimating lens- aligns the beam path.
3. Turning mirrors- channel the beam.
4. Focusing lens- focuses the laser beam to an optimal spot size at the work piece location.
5. Powder delivery system- manifold, tubes, and housing for mixing and delivery of metal powders. The powders are blown with argon gas.
6. Gas delivery system- Argon gas is used to deliver the metal powder and provide positive pressure via a center purge from the deposition nozzle to the work piece.
7. Water cooling system (when operating with higher laser powers).
8. Deposition nozzle (also called the LPN)- houses the powder delivery nozzles, shield gas nozzle, and water cooling channels (when operating with higher laser powers).

## **Comparison of Capabilities- LDH 2.0 and 3.X**

# LDH 2.0 and 3.X Base Features Comparison

The LDH 2.0 and 3.X base features are shown below for comparison.

LDH Model Comparison- 2.0 vs. 3.X		
Features	LDH 2.0	LDH 3.X
Laser power range	up to 2kW	<b>up to 3kW</b>
Laser beam delivery- fiber cable diameter (um)	200	200
Collimator length (mm)	60	60
Focus lens length (mm)	200	200
Dimensions	The LDH 3.X is slightly larger in dimensions compared to the LDH 2.0. A new mounting plate is required when upgrading from LDH 2.0 to 3.X.	
Cooling system	water cooling (head chiller)	<b>New advanced water cooling head chiller, capable to cool head components for higher laser power operations.</b>
Deposition nozzle type(s)	4-tip nozzle only- cannot interchange	<b>4-tip and coax nozzles, each interchangeable on the head (note- the 4-tip nozzle from the LDH 2.0 will not fit on the LDH 3.X).</b>
Spot size- focused (mm)	0.50	<b>0.67 (no shaping optic)</b>
Spot size- shaping optic 1 (mm)	Not compatible for shaping optics	<b>2</b>
Spot size- shaping optic 2 (mm)		<b>3</b>
Powder delivery	Argon blown	Argon blown
Gas delivery	Argon center purge, argon blown powder	Argon center purge, argon blown powder
Functional grading	Up to 4 metal powders	Up to 4 metal powders

## LDH 3.X Advanced Capabilities

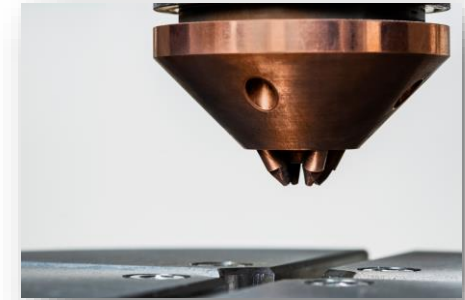
1. **Laser power-** The LDH 3.X has been designed to operate at up to 3 kW power. LDH 2.0 only up to 2 kW.
2. **Deposition nozzles-** the LDH 3.X has interchangeable deposition nozzles (4-tip and coax) for greater range of deposition flexibility. These nozzles are easily interchangeable on the 3.X. The LDH 2.0 has a fixed 4-tip nozzle only.
3. **Water cooling/head chilling-** the LDH 3.X has an advanced LDH chiller (water cooling system) that is capable of adequately cooling all head components for operations at powers up to 3 kW. This cooling system design is more robust than what is used on the LDH 2.0.
4. **Shaping optics-** The LDH 3.X comes equipped with a vertical tray that houses up to 2 shaping optics. The vertical tray slides into 3 different slots (slot 1=blank, slot 2= shaping optic 1, slot 3=shaping optic 2). This allows for quick changing of beam profile/spot size for greater processing capabilities. For comparison, the LDH 3.X is designed for focused spot sizes of 0.67, 2.0, and 3.0 millimeters. The LDH 2.0 has one fixed focused spot size of 0.50 millimeters.
5. The LDH 3.X is capable of operating with optional laser alignment software package, closed loop melt pool sensor, or thermal imaging.

*Note- for the alignment and MPS SW packages, a customer can purchase both, however, though they may have both capabilities, they cannot run both simultaneous. In addition, if a customer chooses the option of the thermal imager, they may also get the MPS SW package, but not the alignment camera.*

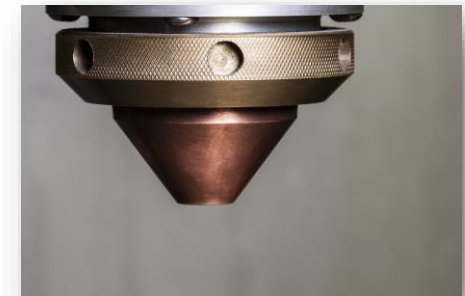
## ➤ LDH 3.X Interchangeable 4-tip and Coax Nozzle Comparisons

- A general rule of thumb when choosing between the two nozzles:
  1. The 4-tip nozzle is generally used for lower laser powers and smaller builds. When processing, the 4-tip is able to get finer build quality in complex contours or thinner wall structures.
  2. The coax nozzle is generally used for higher laser powers and material deposition rates. When processing, the coax is able to convey more powder flow evenly to larger spot sizes or melt pools typical of higher powers. It is the preferred nozzle for laying more metal such as in coating or cladding operations.

**4-tip nozzle**



**coax nozzle**





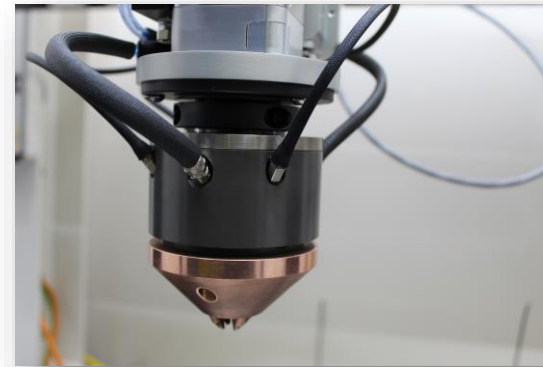
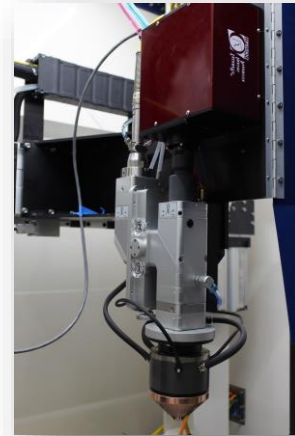
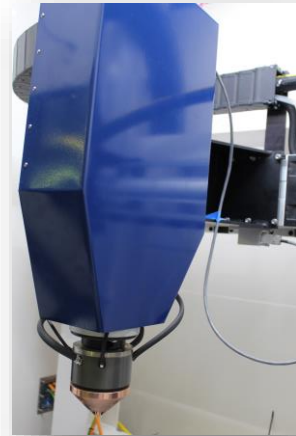
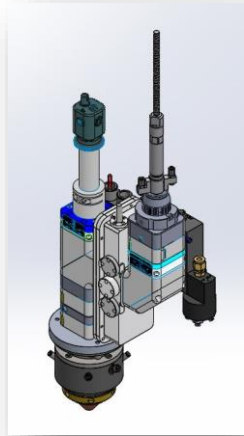
## LDH 3.X Applications

- The LDH 3.X is capable of carrying out all DED applications that the LDH 2.0 can perform, and in addition has more functional power and flexibility with higher laser power, deposition nozzle choice, and shaping optics.

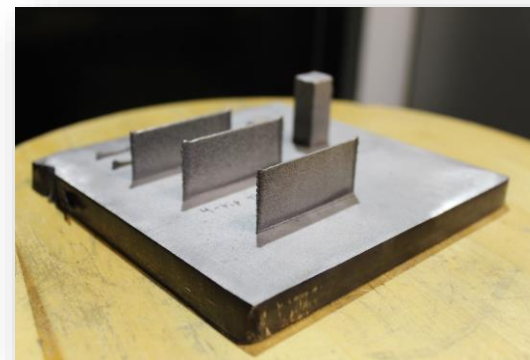
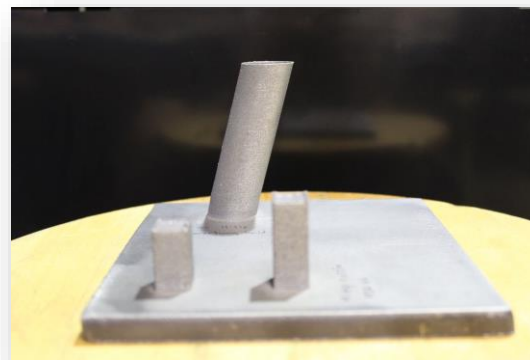
The LDH 3.X configurations are suitable for applications indicated below:

1. New builds
2. Add-ons
3. Repairs
4. Remanufacturing
5. Corrosion and wear coatings
6. Functional grading (up to 4 metal powder types)
7. Coatings requiring higher temperatures (i.e. coatings containing W carbides)
8. Cladding

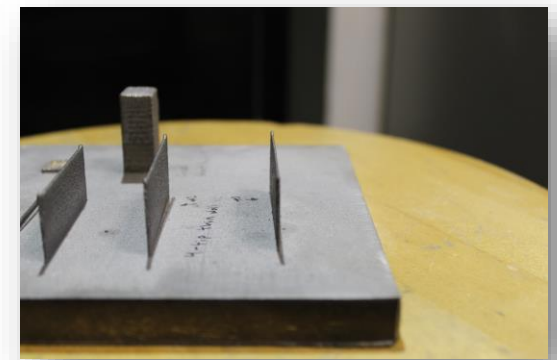
# LDH 3.X- Iso view dwg, photos of head, and recent test builds



15deg overhang build and cubes- 420 SS, 4-tip nozzle



Thin wall builds- 420 SS, 4-tip nozzle



Cube- 420 SS, coax nozzle

**Thank You.**

