Why Connections Matter in Additive Manufacturing

Four Key Connector Considerations

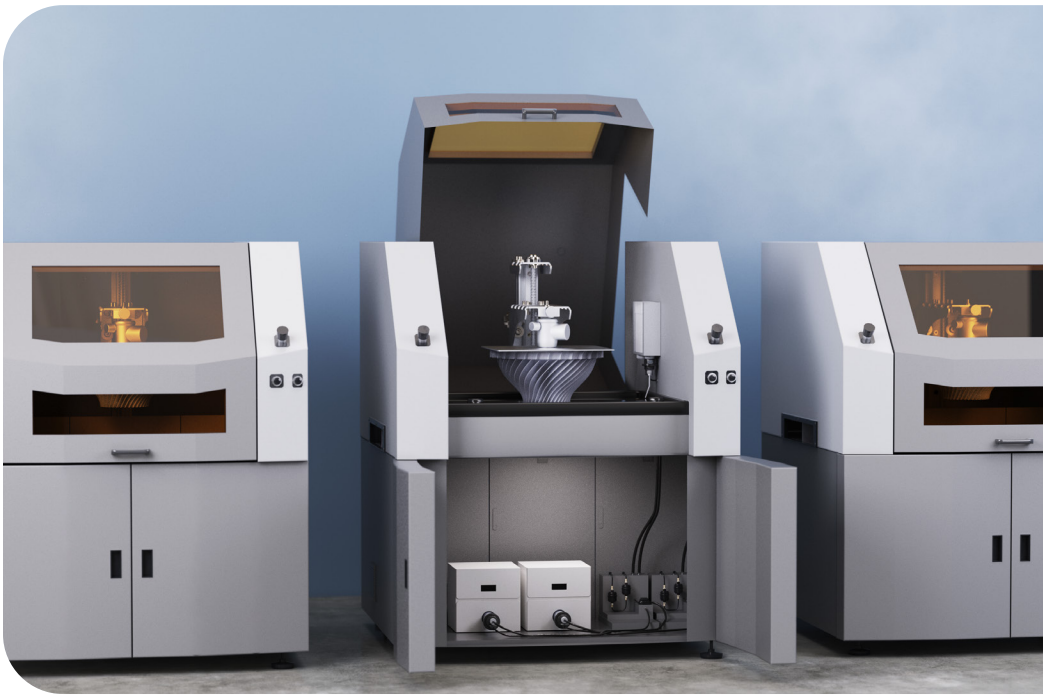
Connectors and CPC contribute to additive manufacturing in several ways including:

1. **Large-bore sizes:** High-flow connectors facilitate smooth transfer of viscous materials.

2. **Sustainability support:** Connectors offer controlled fluid handling before, during and after AM processes for less waste and exposure.

3. **RFID capability:** Radio frequency identification (RFID)-enabled connectors can validate correct media, usage and operational control settings, and more.

4. **Connector expertise:** With an exclusive focus on fluid connector design, manufacture and installation, CPC's deep expertise results in streamlined solutions for additive manufacturers and suppliers.



Additive manufacturing (AM) is expected to grow 20-22% annually for the next five years.[1] As the use of AM continues to expand across a wide range of industries, so do the needs to better handle the fluids used throughout AM processes.

From raw materials like resins to solutions that clean equipment, improved fluid management supports key AM goals of speed, quality and sustainability.[2]

The right connector technologies contribute to these objectives by simplifying the processes of loading, adding or using fluids in 3D printing, parts finishing, and equipment maintenance and cleaning.

BROAD APPLICATIONS

Multiple industries are exploring or incorporating additive manufacturing into their operations.

AM plays a vital role in helping manufacturers overcome supply chain challenges while enabling them to produce products more quickly. Digital files and 3D printers also offer the convenience and flexibility of creating products as they are needed instead of holding spare parts in inventory.

Today, tabletop 3D printers are found in classrooms, hospitals and dentist offices. Automobile, aerospace and consumer products makers, among others, rely on AM for large-scale production of components and finished goods. The Mayo Clinic, for example, has more than 30 3D printers in its Anatomical Modeling Unit as of 2023. Automobile manufacturer BMW expects to double the number of a vehicle's 3D-printed parts within the next few years.[3]

Regardless of size or scope, AM companies and users want to improve materials handling, streamline workflows, and reduce waste.

CONNECTION CONTRIBUTIONS

1) QUICK EFFICIENT FLUID HANDLING

As a rapidly evolving industry, AM is simultaneously managing expansion and growing pains.

From a macro level, manufacturers are juggling maintenance issues, consistent product quality, quickly evolving materials, and workforce shortages. In fluid handling specifically, the industry wants to maintain product integrity, ensure the use of specified materials, and avoid spillage for waste, exposure and clean-up reasons.

As the AM industry struggles with a workforce shortage, the ability to streamline materials handling takes on added importance. Surveys by the American Society of Mechanical Engineers (ASME) in the medical and aerospace sectors consistently show "the lack of individuals with the necessary skills and knowledge" as top challenge in AM.[4] A 2022 annual AM industry survey found that nearly half (49%) of the respondents said they are "likely" or "extremely likely" to change jobs within the next year.[4]

Too few skilled workers and high turnover rates mean that tools supporting ease of use and accuracy—like thoughtfully designed connectors—are critical.

From a raw materials standpoint, universal dispensing couplers (e.g., IdentiQuik® UDC) take complexity out of fluid transfer by providing a fast, universal connection to bulk packaging systems.

In the printers themselves, multiple tube sets connect pumps, filters and other components as part of delivering materials to the build chamber. Quick disconnect (QD) couplings facilitate faster tube set changes reducing downtime and speeding up maintenance. And QDs that incorporate easy-to-use, intuitive thumb latches allow one-handed operation at connection points, even while wearing gloves.

Occupational health experts note that dermal exposure to AM resins and solvents are among the most important health concerns associated with AM.[5] Valved connectors help minimize exposure to liquid materials and cleaning solutions by reducing drips and spills.

2) QUALITY INITIATIVES

Part-to-part variation is an ongoing concern in AM. This is sometimes due to improper material storage and handling. Other times, variation is attributed to material integrity itself, whether because of contamination or inconsistent application of the specified materials.

Reliable closures at the points of connection help maintain fluid integrity by limiting exposure to potential contaminants before, during and after printing.

Instead of pouring materials into a reservoir, couplers allow resin containers to connect to the printer — a cleaner, closed process.

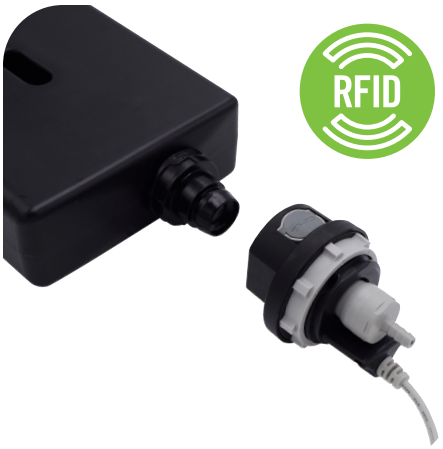
Radio frequency identified (RFID)-enabled couplers also enhance quality control. They facilitate data exchange when the coupling halves come within a few centimeters of each other.

RFID connectors can validate the correct media, usage and operational controls and more. They are capable of storing and transferring important information such as:

- Product data — date of manufacture, batch/serial number, date/time of installation, amount of material remaining, etc.
- Autocalibration parameters — e.g., machine operating settings, identification of media, and expiration date

RFID couplers can flag or stop the use of unauthorized fluids or signal the printer to accommodate material differences. Incorporating the correct material in builds not only protects product quality, but also is a measure to avoid print head or system damage.

These same RFID couplers protect consumable revenue streams for makers of resins and other fluids used in AM.



3) STREAMLINED PRODUCTION

As AM companies look to optimize their processes, connector technologies contribute in a variety of ways. Large bore, high-flow connectors, for example, support smooth transfer of viscous materials, while valved, non-spill connectors efficiently stop flow, reducing the chance of leaks at connection points.

Connectors are also available in a wide range of materials, which simplifies compatibility with the growing list of additive materials. Each of the many polymers available for mechanical extrusion, for example, has unique properties related to thermal stability and chemical resistance.[5] As these materials

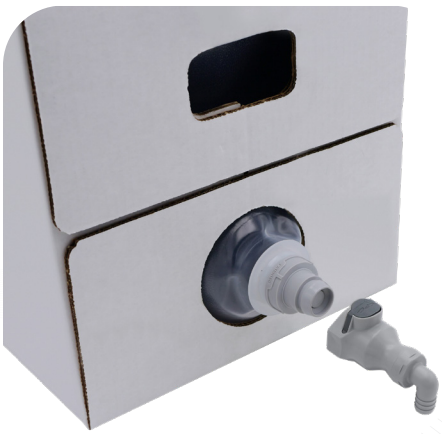
pass through the printers, connectors bodies, valves and other components (e.g., springs) need to withstand heat and chemical exposure without deforming or deteriorating.

Specialty AM processes like 3D bioprinting require aseptic components.[6] CPC offers a large range of sterile connectors in its AseptQuik® line that have long been used in biopharmaceutical manufacturing.

4) MORE SUSTAINABILITY

As AM users know, spilled fluids or product that remains in a container represent money wasted. Additionally, fluids applied in post-processing and cleaning must be well managed to avoid unnecessary exposures during use and disposal.

Packaging designs such as bag-in-box (BIB) for raw materials are increasingly being used in AM. In addition to using less plastic than all-plastic containers, they also offer highly efficient product evacuation. The incorporation of non-spill connectors into BIB solutions further enhances dispensing by avoiding product lost to drips or overflow.



Post-processing in AM uses fluids to remove support structures, wash away excess materials on the build, or aid in surface finishing. In this step, connectors are found on the fluid transfer lines from the BIB to the machine pump, and from the pump to the tools used to wash parts. Couplers help better manage fluids throughout this stage.

At the end of a manufacturing run, couplers on cleaning product containers allow easy connection to the printer, again reducing product waste and environmental exposure during cleaning.

DEEP CONNECTOR EXPERTISE SUPPORTS AM SUCCESS

Significant growth, new applications, automation, and sustainability goals are among the factors shaping the diverse AM industry. By partnering with a connector expert early in product development, AM companies and suppliers can ensure they are optimizing their products for current and future success.

Connector design — geometries, configurations, sizes, materials, chemical compatibility, etc. — impact flow rate, durability, overall function and more in additive manufacturing. CPC's engineer-to-engineer collaboration allows manufacturers to solve engineering challenges in real time. A wide range of products and custom capabilities also facilitate faster ways to arrive at solutions.

CPC's experience is enhanced by its own use of additive manufacturing technology. The company produces thousands of prototypes annually using in-house fused deposition modeling (FDM) and stereolithography (SLA) printers, saving significant time and money each year in product design and testing phases.

Additive manufacturers and suppliers rely on CPC's expertise in specifying, designing and implementing high-performance fluid couplings as part of delivering durable, reliable and top-quality AM products.

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