Maintaining Hyperscale Data Center Connectivity Through Effective Cleaning

The higher the fiber count of fiber optic cable, the more vulnerable the connectors and end faces are to damage and contamination. Here's how to keep every fiber and connector perfectly clean to avoid potential problems.

By Liam Taylor / *MicroCare*

The need for reliable networks has never been greater. Emerging technologies, such as the internet of things, augmented reality, autonomous vehicles and advancements in 5G, have seen a big push in the requirement for high-speed bandwidth. The pandemic further accelerated the need for fast, flawless connectivity in recent years, as remote working and learning became the norm.

Amid the COVID-19 crisis, the global market for internet data centers, estimated at $59.3 billion in 2020, is projected to reach $143.4 billion by 2027, growing at a CAGR of 13.4 percent from 2020 to 2027.

According to Synergy Research Group, more than 100 new hyperscale data center facilities were built in 2020 alone, taking the total number to almost 600. The growing demand for faster speeds and increased bandwidth has put pressure on these facilities to ensure they have effective, reliable networks.

Companies with hyperscale data centers, such as Amazon, Google, IBM and Microsoft, have rapidly escalated their operations to keep up with the ever-increasing need for capacity. These huge centers include buildings that average 200,000 square feet, with millions of servers operating together via a high-speed network. Supporting the servers are thousands of feet of fiber optic cables and hundreds of thousands of optical connections, all of which must be effectively maintained.

CLEANING HIGH-COUNT FIBER AND COMPLEX CONNECTORS

To cope with the increasing bandwidth, fiber optic cable construction is replacing 1,728, 3,456 or 5,184 fiber counts with ultra-high-count fiber (UHCF) cable of 6,912 fibers or more. As UHCF trunks pack more fiber into a smaller footprint, they can be challenging to maintain because the higher the fiber count of the cable, the more vulnerable the connectors and end faces are to damage and contamination. Every fiber and connector must be kept perfectly clean to avoid potential problems, which could result in unreliable performance or a complete network shutdown.

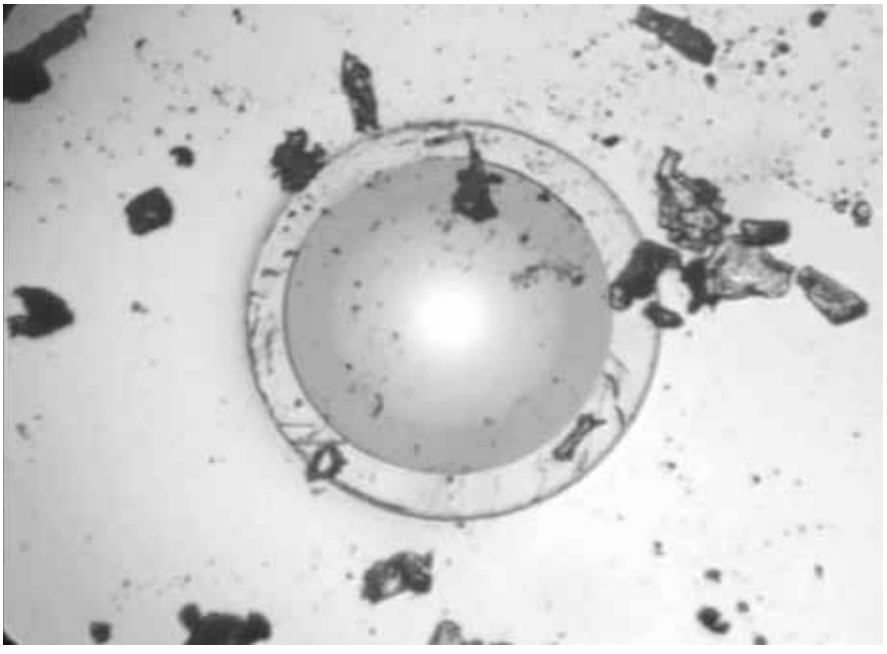
Whether installing a new fiber network or maintaining an existing one, implementing proper fiber cleaning procedures to guarantee clean cable connections and optimum network performance is essential. But fiber counts continue to grow, and new connecter options come to the market. Examples include the CS duplex connector system designed for next-

generation QSFP-DD transceivers, 16 fiber-array MT-based connectors, and lens-array ferrules for parallel optic and silicon photonics applications.

CS single-fiber and duplex connectors use the standard 1.25 mm LC form factor ferrule, but the spacing between the ferrules is much smaller. Pitch is nearly halved from the LC standard of 6.25 mm to just 3.8 mm. This reduction makes cleaning particularly difficult. However, using quality, non-linting fiber cleaning sticks, with a high-purity fiber optic cleaning fluid or a mini push-to-clean tool, will work effectively to clean these complex connectors.

On high-performance MT-based connector ferrules, the risk of incomplete cleaning is greater because of the 16-fiber array being used in the same 2.5 mm x 6.4 mm standard MT ferrule footprint. Plus, there are a high number of moving parts on these connectors, all of which can create wear debris.

Wear debris dust is caused by the contact friction when connectors mate. Examples include debris from the connector slider as it moves, the retention clips as they snap into adaptors, or guide pins as they move against the connectors. The same mating force that holds termini together also pushes dust particles onto the central ferrule surface, resulting in scratched, pitted or scarred end faces.



Wear debris dust

Techs should use specially engineered, optical-grade cleaning fluid that is fast-drying, static-dissipative and contained in hermetically sealed packaging.

This damage can cause back reflection, signal attenuation, instability in the laser system and even a complete system failure. In addition, denser connectors use 80 percent glass to improve thermal expansion control. This results in an increased static charge on the end face that attracts dust. A static-dissipative, optical-grade cleaning fluid should be used to deflect impurities, especially dust from the surface being cleaned.

Lens array connectors are other dust traps. They use a very small, tightly focused, spot-size beam to pass the signal into the receiving lens. Although this reduces problems associated with scratching and contamination between the lenses, the connectors are made from soft, easily scratched molded plastics that can attract dust into the central signal "spot-zone." To ensure contamination is removed, the most effective cleaning method is using fast-evaporating, plastic-safe, static-dissipating cleaning fluid. This should be followed by an optical-grade duster to dry the area.

TIME IS OF THE ESSENCE

High fiber counts and complex connectors require considerable cleaning. More cleaning means extra time needed for maintenance. For example, the new 6,912-fiber cable can take a technician up to four days to inspect, clean and install. But upkeep and installation of UHCF in large hyperscale data centers must be completed efficiently and quickly to guarantee fiber performance and network reliability.

Cleaning should be a major consideration for network providers. The fiber used in these vast infrastructures must be free from contaminants to ensure seamless connectivity. To make sure fiber is installed and maintained correctly, addressing the need to train technicians so they understand how to clean effectively is important to future-proof each installation.

One standard every engineer working within a data center should clearly understand and consistently follow is the International Electrotechnical Commission (IEC) 61300-3-35. This specification was developed to guide the industry in determining best practices for the inspection and cleaning of fiber optic connectors. It sets the inspection requirements for connector cleanliness quality and for determining the need for connector cleaning or replacement. Without this knowledge and training, connectivity can be at risk. Without forward planning and the allocation of the correct time requirements, new cable installation or routine cleaning procedures could be negatively impacted, affecting the network's connectivity.

TECH'S TOOLBOX

Training technicians in cleaning and inspecting fiber should be a priority for data center operators, but so too should the tools used to achieve pristine connectors. UHCF and CS duplex connector systems require the very best cleaning equipment. The tools need to be robust enough to stand up to the high volume of usage yet easy enough to use to deliver consistent, repeatable, reliable results every time.

At the top of the list when it comes to filling a tech's toolbox is specially engineered, optical-grade cleaning fluid. It should be fast-drying, static-dissipative and contained in hermetically sealed packaging to prevent the fluid from absorbing airborne contaminants such as moisture, dust, exhaust particles from traffic and pollen from plants. These contaminants degrade the cleaning process.

It is also important to invest in nonflammable, nonhazardous cleaning fluid, which is safer to store and easier to transport by air or in service vehicles. Many large, hyperscale data centers are located in wide-open, remote locations to accommodate the centers' large footprints, and safety and easy transportability of cleaning fluids and tools should be high on the priority list.

When cleaning with optical-grade fluid, it's important to also use wipes, single-use connector cleaning sticks or a push-to-clean tool that can provide hundreds of cleans before it must be replaced. Each type of cleaner is sized to the specific dimensions of the connector used in the installation. Using the right cleaning stick or push-to-clean tool ensures a highly absorbent solution that will effectively remove oils and particulate contamination from the surface of the end face.

FUTURE-PROOF THROUGH CLEANING

As data center speeds increase, the performance of UHCF is critical to deliver the bandwidth the world needs. Network infrastructure and the highly complex fiber systems that support the escalating data rates must perform to the highest degree. It is therefore a priority that modern cleaning and inspecting processes, together with tools and fluids engineered specifically for fiber optic applications, be used to guarantee uninterrupted, seamless connectivity.

When choosing fiber optic cleaning fluids, tools and methods, installers should seek the advice of an experienced supplier that specializes in fiber optic cleaning about products that will work best for their fiber networks. ❖

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