Meeting power cable demands for AI data center installations

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Figure 1. Ensuring that whips are properly protected and easily identifiable plays a critical role in data center uptime. Source: DKPhoto/Adobe Stock

Selecting power whips with flexible electrical conduit that has a proven track record of performance and is built to the highest quality standards is essential to ensuring safety, efficiency and uptime in data centers.

The data center market is experiencing unprecedented growth, fueled by rapid digital transformation, cloud adoption and the rise of artificial intelligence (AI). Across the hyperscale and colocation segments, 100+ projects representing nearly 9 gigawatts (GW) of data center capacity is slated to start operation by the end of 2026. Almost half of these projects have already broke ground.

Virtually all data centers being built today feature GPU-heavy architectures for AI training and high-performance computing, which consume significantly more power than traditional central processing units (CPUs). Rack power densities in modern data centers are ~30 kW to 50 kW per rack, with some deployments exceeding 70 kW to 100 kW.

These higher power requirements, coupled with the massive number of data center projects planned or under construction, has put immense pressure on supply chains, particularly vendors that supply electrical components and associated infrastructure.

Though often considered a minor detail in the larger scheme of data center design, power distribution unit (PDU) cables are vital to safe and reliable facility operation. As they are typically one of the last pieces of electrical infrastructure to be connected before the data center comes online, their timely delivery is also critical to keeping projects on schedule.

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Whip functionality and construction

A branch circuit power distribution unit cable — also referred to as a "power whip" or just "whip" — is a cable that carries power from a PDU or remote power panel (RPP) underneath a raised floor (or overhead) to supply power to GPU racks. On one end of the cable is a tail, or exposed wire, which connects into the PDU. On the other end of the cable is a receptacle, which connects directly to the GPU rack.

Whips commonly use a liquid-tight flexible metal conduit (LFMC). The conduit plays a crucial role in protecting wiring from:

- Physical damage: Cables that are left unprotected or poorly routed are vulnerable to crushing, bending or accidental disconnection during maintenance. Over time, this can degrade insulation and increase the risk of short circuits.
- Thermal stress: Bundled or obstructed cables may overheat without adequate airflow. Heat buildup accelerates insulation breakdown and can lead to premature cable failure.
- Electromagnetic interference (EMI): Poor cable shielding or improper routing can expose cables to electromagnetic noise from nearby equipment, potentially disrupting sensitive IT loads.

The conduit's color is also important for identification purposes — for example, to differentiate between primary and secondary (i.e., redundant) power feeds, which are becoming increasingly common in modern data centers.

Meeting stringent cable protection and color requirements

Electri-Flex has over 70 years of proven experience delivering flexible wire and cable protection solutions, and AI data centers are beginning to reap the benefits. The company's Liquatite® flexible electrical conduit offers versatility and strength by integrating a high-quality metal core with a polymer jacket. The design creates a strong exterior that protects wire in both indoor and outdoor settings. This includes installations with complex bends or in cases when bending electrical metallic tubing (EMT) is not feasible.

Liquatite conduit features a unique construction that distinguishes it from alternatives on the marketplace. The majority of production tools and methods used in the conduit's manufacturing process were developed and built by Electri-Flex in its own tool shop. Some notable differentiators of Liquatite include:

- More convolutions per foot for enhanced flexibility
- Advanced quality control methods, ensuring precise inner (ID) and outer diameter (OD) tolerances
- Patented Flexi-Bond technology for non-sleeving, non-wrinkling jackets
- Squarelocked and interlocked metallic strips for added strength and durability

The Liquatite line features nearly 50 varieties of flexible electrical conduits, including LA and CBLA Type, which are ideal for AI data center applications (Figure 2). Both types are listed by the Underwriters Laboratories (UL) Inc. and certified by Canadian Standards Association (CSA) for "heavy-duty" applications. They offer outstanding protection against wet, oily conditions and are permitted for use in exposed or concealed locations.

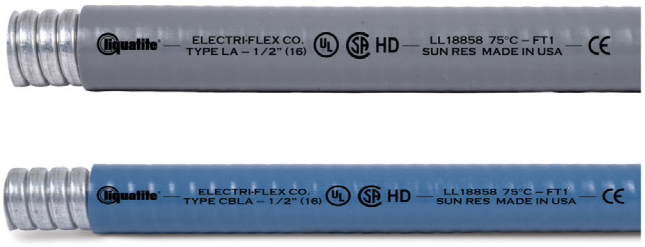

Figure 2. Type LA (top) and CBLA (bottom) Liquatite flexible electrical conduits are ideal for data center applications. Source: Electri-Flex

A wide range of sizes are available to meet customers' unique requirements. This includes 1 inch to 1.25 inch diameter conduit, which has become more prevalent as power feed amperages have increased in recent years.

Helping cable suppliers meet demanding turnaround times

As the demand for digital infrastructure continues to surge, data centers are being designed, built and commissioned at an unprecedented pace. Hyperscale operators, cloud providers and colocation companies face immense pressure to deliver capacity quickly to advance their AI initiatives. In this fast-moving environment, the supply chain for even the most basic components, including power cables, can significantly impact project timelines.

If whips are not delivered on time, electrical contractors cannot complete rack installations, test power systems or move forward with commissioning. In some cases, a late cable order can halt progress across multiple trades, rippling through

the entire construction sequence. Quick turnaround times from cable suppliers help ensure that projects remain on schedule and critical milestones are met.

Electri-Flex is widely recognized by customers for its quick turnaround times. Over the last two years, the company has been highly proactive in scaling production capacity and adapting its manufacturing processes to meet evolving market demands and ensure timely delivery of its conduit to data center cable suppliers. An example is the company's recent partnership with leading data center power whip supplier, PDU Cables™.

PDU Cables™ offers 24-hour turnaround for building and shipping most cable orders. Electri-Flex helps PDU Cables™ meet delivery times by ensuring that conduit arrives at power whip manufacturing facilities on time and ready for wire/cable to be pulled.

Color and customization options

Modern data centers are typically built with dual power feeds to ensure that servers and racks remain powered even if one source fails. Without a clear visual system, technicians risk plugging both feeds into the same PDU, undermining redundancy. A color-coded scheme makes it obvious when equipment is properly balanced across independent power paths. This is essential for maintaining uptime, particularly in facilities where service-level agreements (SLAs) demand virtually 100% uptime.

Color-coding also simplifies cable management and can save time when tracing runs during maintenance or troubleshooting. If or when a problem arises, such as a tripped breaker, an overloaded circuit or a failed PDU, technicians must be able to identify the path of power quickly. Color-coded cables make this process faster and more accurate, reducing time to resolve the issue. In large colocation or hyperscale environments, where thousands of cables run across racks and rows, the increase in efficiency can translate into lower operating costs and fewer service disruptions.

Figure 3. Color-coding whips simplifies cable management in data centers and ensures that power feeds can easily be identified in the event of a problem. Source: Electri-Flex

Overall, color-coding whips may seem like a minor detail in the context of managing a modern data center. However, its impact on safety, efficiency and reliability can be significant. By reducing human error, supporting redundancy and enabling faster maintenance, a color-coded system strengthens the backbone of facility infrastructure.

Electri-Flex Liquatite flexible electrical conduit can be manufactured in all 11 of the colors offered by PDU Cables™ (blue, black, red, orange, green, yellow, gray, pink, white, brown and purple). Additional colors are available upon request, as are other customization options.

Ensuring cable reliability

Designing a fault tolerant critical power system involves more than redundancies, it requires high quality, safe and reliable products that meet the stringent obligations of the environment. Whips are the final link in the power chain that keeps servers, storage, and networking gear operational. As a result, poor manufacturing quality or improperly specified cables can create risks that cascade through the entire facility.

Electri-Flex's vertically integrated manufacturing system ensures complete quality control over every step of the conduit production process, from raw materials processing to assembly. Testing is performed by a team of quality assurance experts at each production stage. Every foot of conduit is tested for proper dimensional characteristics prior to leaving the facility. Additional testing is also performed using the latest measuring tools and devices to ensure that cables meet the highest standard of protection against thermal, mechanical and chemical elements.

Making the right choice

In the context of AI data center design and construction, a great deal of attention is often placed on high-level infrastructure like uninterruptible power supplies (UPS), generators and cooling systems. However, power whips that deliver electricity directly to racks and IT equipment are equally vital. Selecting power whips with flexible electrical conduit that has a proven track record of performance and is built to the highest quality standards is essential to ensuring safety, efficiency and uptime in data centers.

Where possible, contractors and developers should engage early with their power cable supplier to ensure that cable requirements for color and jacketing are met and to minimize the likelihood of logistical issues that can result in potential project delays.

Contact the experts at Electri-Flex about Liquatite flexible electrical conduit or for questions regarding whip protection in data centers.

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ABOUT ELECTRI-FLEX COMPANY

Electri-Flex Company is backed by 70 years of family ownership and proudly manufactures nearly 50 varieties of American-made Liquatite® conduits. Dedicated to superior craftsmanship and high industry standards, offering customized, in-stock and ready-to-ship conduit solutions that meet industry needs with excellence. A true innovator in the liquidtight conduit industry. Standard conduit varieties include Jacketed Metallic (LFMC), Unjacketed Metallic (FMC), and Nonmetallic (FNC) flex. Specialty products are engineered to solve design challenges for a variety of markets, and include EMI/RFI Shield-Flex, Antimicrobial Food Grade, Corrosion-Resistant Stainless Steel, High/Low Temperature, Zero-Halogen, and Custom Colored Jacketing.