Application Note

Installation considerations for cables with and without a Filler

Application Note ID:
NS-AN25-0006

Date:
2025-12-16

Product Line:
All Category 6 and 6A cables

Part Numbers Affected:
All Category 6 and 6A cables

Category 6 and 6A communication cables are available in multiple constructions; one such difference is whether a cross-filler (filler) is included (examples shown in Figure 1). Both designs are capable of meeting applicable performance requirements when installed in accordance with manufacturing recommendations and industry best practices. Proper pathway planning, controlled pulling tensions, careful handling, and correct termination practices are critical to achieving consistent electrical performance regardless of cable construction.

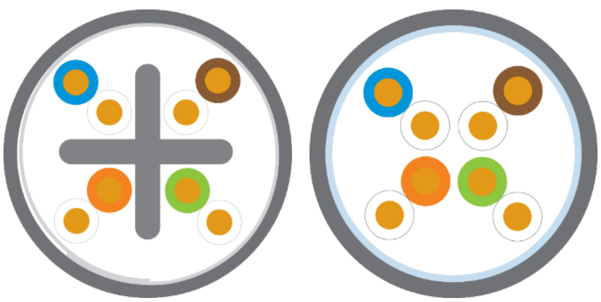

Figure 1: Filler (left) and Fillerless (right) cable examples.

Some examples of cables without a cross-filler (fillerless) manufactured by Leviton include:

- RDT Category 6A cable
- BERK-TEK's LANMARK™-6 Category 6 cable (available in North America Only)
- Leviton's Category 6 U/UTP 24 AWG cable (available outside North America only)

Installation Pathway Considerations

The first factor to evaluate is the cable's installation pathway, which encompasses both raceways and physical routing. Raceway selection depends on project constraints; for instance, new installations typically allow more space for raceways, while retrofit projects (for example, those in historical buildings) may be more limited. It is essential to follow industry standards for fill ratios (e.g., a maximum of 40% fill for conduit or 50% for cable tray). Because fillerless cables

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generally have a smaller outer diameter than those with fillers, more cables will fit for a given fill ratio compared to a cable containing a filler.

The physical pathway refers to the exact routes the cable will follow, including distances between pulling points and areas where resistance or tension may occur, such as corners, bends, or edges. A detailed plan should be established before pulling begins to ensure smooth installation. Key considerations include:

- Whether to use a pulley around bends or edges to reduce tension, or to store and pull cable directly from that point.
- Ensuring conduit pull lengths are short enough to avoid excessive strain.
- Avoid excessive bends, such as back-to-back 90° turns.
- Planning appropriate pull points along the pathway.
- Determining how cable will be temporarily stored at pull points (coil or figure-eight).
- Identify where service loops will be placed.
- Select appropriate packaging (boxes or reels).

Ultimately, pathway planning must address two critical factors: the amount of tension applied during the pull and the potential for added twist. Both can complicate installation and affect the quality of the final setup.

When installation best practices are followed (e.g. maintaining allowable pull tension, minimizing sharp bends, and controlling twist), both filler and fillerless cables can deliver reliable performance and successful certification results. In these conditions, geometry is preserved, pair balance is maintained, and performance margins remain intact.

Tension Considerations During Installation

During installation, cable tension must not exceed the manufacturer's specified limit, typically 110 N (25 lbf). Exceeding this threshold, such as when a cable rubs against a sharp corner or requires excessive force to continue pulling, distorts the cable's geometry. This distortion often results in sections of the cable becoming oval or flattened, bringing conductor pairs closer together, resulting in potential degraded performance.

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Impact of Geometry Alteration on Testing and Performance

In general, when installation practices are not strictly followed, differences in cable construction become more pronounced. Fillerless cables, which lack the additional structural support of a cross filler, are more susceptible to geometry changes caused by excessive tension, crushing, kinking, or unmanaged twisting during installation. These stresses can alter conductor spacing and lead to reduced performance margins or inconsistent star pass/fail test results, even when terminations are correctly executed.

Harsh installation stresses can cause permanent damage to the cable. These issues may arise with both filler and fillerless constructions, regardless of manufacturer. Improper cable pulls can negatively affect electrical performance, and when a star pass/fail result occurs despite correct jack terminations, the root cause is often poor installation practices.

Cable Installation Handling

Cables incorporating fillers provide additional internal support that helps maintain pair geometry under more demanding installation conditions. This added robustness can offer greater tolerance to minor installation deviations, such as higher pull forces or complex pathways, and can help preserve electrical performance in less than ideal scenarios.

At pull points, temporary cable storage between sections can influence both the ease of installation and the final appearance of the cable within the raceway. Proper handling techniques are essential to minimize twisting and maintain a clean installation. One effective method for managing slack (applicable to both filler and fillerless cables) is the use of a large figure-eight configuration. This approach naturally controls cable twists and ensures smoother pulls, similar to those performed directly from a box or reel.

It is important to note that the figure-eight must be flipped vertically before pulling. This step prevents dragging and ensures the pulled section is positioned on top of the figure-eight rather than underneath. Figure 2 illustrates this technique. When pulling the cable to the next section, it is best practice to have a second person assist with cable management, to prevent loops which may lead to potential kinking and snagging. Cables with fillers can be less susceptible to this impact.

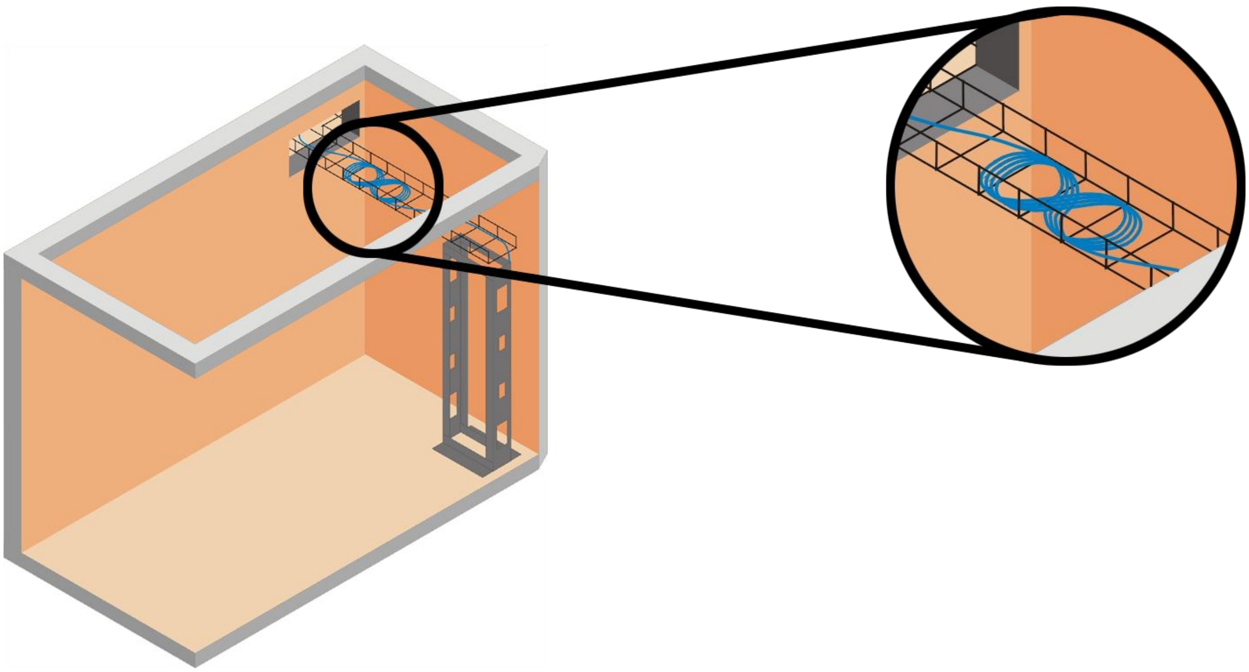

Figure 2: Example Figure 8, stored in the cable tray.

When a cable is pulled directly from a box, it will not be as straight as one pulled from a reel, regardless of the presence of a filler. This effect will be more pronounced with the first pull and will lessen with more pulls from the box. The opposite effect will occur with the reel, with the last pulls having more potential for natural curling (and therefore not laying straight). These variations are normal and results from the packaging process during manufacturing.

Electrical Considerations

Another key consideration is the electrical performance required of the cable and the overall channel. In general, fillerless cables meet the minimum category requirements for internal parameters. However, cables with fillers inherently provide greater crosstalk margin due to the spacing between pairs created by the cross-filler. This added margin enhances performance and reliability, even when a product guarantee is not explicitly offered.

Crosstalk margin is critical for mitigating electromagnetic noise within the channel. The higher the margin (for example, the MILLENNIUM™ global solution margin guarantees), the more resistant the cable will be to external interference. If the cable's geometry is altered during pulling, crosstalk performance can be compromised. For this reason, proper installation practices are essential.

Termination and Connectivity Considerations

Termination practices play a critical role in overall electrical performance. Fillerless cables terminate more quickly since no filler material needs to be removed. However, even when installed without tension-related issues, poor termination can still result in failures. Cables with fillers are generally more forgiving, as their higher initial crosstalk margin helps offset minor variations in termination technique. Similarly, using high-performance connectors, such as Leviton's ATLAS-X1™ jack, can reduce the impact of termination inconsistencies. Fillerless cables benefit from precisely following all manufacturing instructions when terminating to ensure full passes.

To achieve optimal results, installers should maintain minimal distance between the cable jacket and the termination point and maintain pair twists along with reducing pair and conductor exposure to preserve electrical integrity. Even with cables with fillers, it is important to adhere to all recommended practices and manufacturing instructions. Only approved tools should be used; for example, pliers are unnecessary for toolless installations.

Service Loop Management

Service loops also influence performance. The recommended method for storing excess cable length is a figure-eight configuration, which minimizes twist and return loss. If used, circular loops should not be tight, as small diameters can degrade performance. Increasing loop size or converting to a figure-eight can often resolve electrical issues. While fillerless cables are more sensitive to service loop effects, both filler and fillerless constructions can be impacted.

Troubleshooting PASS*/FAIL Results

When handheld testers indicate a PASS* or FAIL, several corrective actions may be taken:

- Review time-domain crosstalk measurements to identify the source of the issue.
- If the problem is at the termination region, re-terminate the jack.
- If the issue is near a service loop, loosen the loop or convert it to a figure-eight, then retest.
- If repeated re-terminations fail, consider upgrading to a higher-performance connector (e.g., ATLAS-X1™).
- Assess whether the cable experienced high-tension events; if so, replacement may be necessary.
- Consult Application Engineering for additional guidance.

Cable Selection Guidance

In summary, both filler and fillerless cable designs are viable solutions when best practice installation methods are consistently applied. Fillerless cables may offer advantages in size and ease of termination, while filler-based designs provide added resilience during challenging installations. Selecting the appropriate cable construction should consider the installation environment, pathway complexity, and the installer's ability to maintain recommended handling and installation practices.

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