

## Ensuring Long-Term Performance in Cable Systems: Critical Steps and Choosing the Right Contractor

### BACKGROUND

In the realm of power transmission, the performance and longevity of cable systems hinge on meticulous attention to detail, from selecting the right materials to ensuring proper installation. Cable systems consist of three main components: the cable itself, cable accessories and the installation process. While cables and their accessories are manufactured under controlled conditions, the installation occurs in the field, where human factors introduce the potential for errors.

In fact, “The assembly of the accessories is the most vulnerable part of a project involving the manufacturing and installation of a new cable circuit,” according to the Council on Large Electrical Systems (CIGRE TB 177, Section 3, Page 29).

Improper cable accessory installation can result in significant financial losses for utilities. Beyond immediate repair costs, equipment failures can lead to extended outages, impacting both residential and commercial customers.

That’s why the proper installation of cable accessories and careful handling of the cable are paramount for the long-term performance of the cable system. The good news is that taking the following critical steps will minimize human error risks and increase successful cable system installation outcomes.



### Check Materials Before Exposing the Cable

Before installation begins, it is crucial to check all materials, especially for cable accessories that have been in long-term storage. This involves completing an:

- **Inventory Check:** Ensure no parts are missing to prevent installation delays and complications. For instance, missing gaskets or connectors can halt the installation process, causing costly downtime and project delays.
- **Damage Inspection:** Look for signs of animal or termite damage, water damage and mechanical damage. For example, water damage can compromise the integrity of insulation materials, leading to potential faults.
- **Expiration Check:** Verify that parts such as gaskets, o-rings and dry-packed tapes are within their 5-to-7-year shelf life. Expired parts can lose their effectiveness, leading to failures in insulation and sealing.

### Ensure Proper Environmental Conditions

The installation environment significantly impacts the quality of the work. Areas to evaluate include:

- **Temperature:** Extreme temperatures can affect worker performance and the handling of materials. For example, in hot conditions, workers might perspire on the cable, introducing moisture, while cold conditions can make dielectric fluids thick and difficult to work with.
- **Humidity:** Excessive moisture can infiltrate insulating papers, compromising their dielectric properties. This is especially critical in humid climates where moisture control is challenging.
- **Wind and Rain:** Dust, debris and water can contaminate the cable and materials. Enclosures can help maintain a controlled environment, preventing contaminants from affecting the installation process.

When any of these conditions are present, an enclosure should be created, and measures should be taken to control the temperature and humidity within the enclosure. For example, portable climate control units can be used to maintain optimal conditions inside the enclosure.

## Perform a GIS Dry Fit

In pipe-type applications, performing a dry fit of gas-insulated switchgear terminations with GIS gear is critical. This involves mounting the termination assembly to the GIS gear before installing the riser pipe, base plate and cable. Ensuring that gasketed seals are properly seated is essential to prevent future issues. Effective communication between the termination installer and gear installer is crucial to avoid misalignment and improper connections. For example, a misaligned termination can lead to leaks, causing outages and necessitating expensive repairs.

## Straighten the Cable

Proper cable alignment is vital to a successful installation. In pipe-type applications, ensuring the cable is perfectly straight aids in the correct application of the paper roll. Crooked cables can cause uneven insulation layers, leading to potential faults. When working with cross-linked polyethylene (XLPE) cables, straightened cables allow for uniform stripping of semi-con and insulation, ensuring a consistent termination. This is key because uneven stripping can result in high-stress areas that are prone to failure.

## Make Careful Cable Cutbacks

When trimming insulation for the connector, it is important not to cut into the strands of the conductor. Damage to the strands can reduce the mechanical and electrical strength of the termination. For example, a minor nick in the conductor strands can create a weak point that may lead to electrical arcing and failure under load. Additionally, experience is key when terminating cable shielding to avoid loose shielding or insulation damage.

## Correctly Install Paper Rolls for Pipe-Type Cables

Several steps are critical when applying the paper roll, including:

- **Final Inspection of the Cable:** Ensure that the outer cable tapes are tightly wrapped, and the insulation is free of contamination. This step is crucial for maintaining the integrity of the insulation system. If you spot a factory splice in the first couple layers of cable insulating tapes where the paper roll will be applied, step that tape down below the paper roll to ensure it does not break when tightening. When the cable conductor size is small, it is even more important to take your time when tightening the paper roll and not rush it. Cable tapes can break if the paper roll is over-torqued trying to remove gaps between the layers.
- **Heating the Paper Roll:** Thoroughly heat the paper roll to ensure even application. Uneven heating can cause voids, leading to dielectric breakdown.
- **Attention to Detail:** Carefully apply the paper roll at the correct location to prevent inaccuracies that can compromise the stress cone quality. For example, improper application can result in air pockets that reduce the dielectric strength of the insulation.



## Assemble the Termination

The final assembly requires meticulous care. Just before you land the termination, after all work on the cable has been done, thoroughly clean everything. Remove any contaminants, including flux and solder beads. Solder beads can create points of weakness in the gasket seals. Next, use the proper lubrication to extend the life of the gaskets. Proper lubrication ensures a tight seal, preventing moisture ingress and corrosion. The next step is to ensure proper handling of the adapter plates to avoid surface damage that could cause a leak.

Landing the termination is a tricky step. You want the termination to be perfectly level when landing over the cable to ease installation while preventing damage and future leaks. Using rated lifting devices ensures smooth and controlled placement of the termination components.

Finally, make sure the top plate is properly sealed. Sometimes the ferrule is not perfectly aligned, causing the top plate to sit on the top of the termination at a slight angle. Double-check that the ferrule is straight, and the top plate is torqued uniformly. Not doing this can result in a leak down the road.

## How to Pick the Right Contractor for Cable System Installation

Selecting a qualified contractor is crucial to the success of cable installations. Consider the following factors when evaluating vendors.



## In-Depth Knowledge of the Exact Cable Types Being Installed

A contractor must have in-depth knowledge of the cable types being installed, including:

- **XLPE and ethylene propylene rubber (EPR) Cables:** Understanding proper preparation techniques is critical, especially for high-stress areas like the semi-con transition. For XLPE, a common method is using glass and sandpaper of different grits to smooth out the transition. For EPR, while many are easily removed by heating the cable and peeling the EPR off, some bonding methods can make the semi-con layer more difficult to handle. Tools to remove more difficult applications can range from stripping tools to stainless steel potato peelers. Handling of sheaths and shields also requires great care. Those without experience risk damaging these sheaths, which will result in loss of connectivity at the ground or damaging the cable underneath.
- **Oil Impregnated Paper Cables:** Knowledge of different types of paper cables (kraft paper and LPP) and their dielectric mediums (oil or gas) is essential. An experienced installer understands the nuances of working with various cable types and can avoid common pitfalls.

## Experience at Specific Voltage Levels

Contractors should have experience working with the specific voltage level of the cable system. The techniques, tools and skills required for voltages of 69KV and above differ significantly from those used for lower voltages.

Always keep in mind that the higher the voltage, the more critical it is to do the work properly. Errors at higher voltages can have catastrophic consequences, including severe equipment damage and extended outages. Having a contractor that has splicers experienced in distribution voltages doesn't mean they are qualified to splice higher voltages without proper training.

## The Proper Tools for the Job

Having the right tools is essential for efficient and accurate installation. Make sure your contractor has an array of common tools, including heating blankets, standard jointing tools, supplies for temporary protection of exposed cables and stress cones, as well as:

- **Stripping Tools:** These will vary based on cable size. The right tool ensures precise and clean cuts, reducing the risk of insulation damage.
- **Presses:** Different types are required for paper cables and XLPE/EPR cables. For example, a 4-ram press is used for paper cables, while a 60-ton press is needed for XLPE/EPR cables.
- **Cranes or Hoists:** These are necessary for lifting terminations or heavy components, ensuring safe and accurate placement.
- **Vacuum Pumps:** These are critical for filling oil or gas filled accessories, ensuring no air pockets are left that could compromise the cable accessory.

## Assemble the Termination

Safety should be a top priority for any contractor. A strong safety record indicates a commitment to employee well-being and adherence to industry standards. Look for contractors with comprehensive safety programs, including regular safety training, personal protective equipment (PPE) requirements and incident reporting procedures.

## References and Testimonials

Requesting references from previous clients can provide valuable insights into a contractor's performance. Contacting these references to discuss their experience with the contractor can help assess their reliability, responsiveness and project management capabilities.

## Strong Manufacturer Relationships

A good contractor maintains an open channel of communication with the manufacturer, ensuring quick technical support and long-term success. Programs like the G&W Electric's Python Training Program facilitate connections between contractors and manufacturers, promoting best practices and providing up-to-date technical expertise. Most installers going through the G&W Electric's Python Training Program will bring their tools to get the same feel as they will experience in the field. It also gives them a chance to check that equipment is working properly prior to being at the final job site.



## CONCLUSION

**Choosing the right installer and following critical steps in cable accessories installation can significantly impact the longevity and performance of cable systems.** Proper handling, environmental control and meticulous assembly are essential for minimizing vulnerabilities and ensuring reliable operation. By selecting knowledgeable and experienced contractors who are equipped with the right tools and maintain strong manufacturer relationships, you can enhance the reliability and durability of your cable system, ensuring it stands the test of time. The success of your cable installation project ultimately depends on the combination of high-quality materials, expert craftsmanship and a comprehensive understanding of the system's requirements.

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