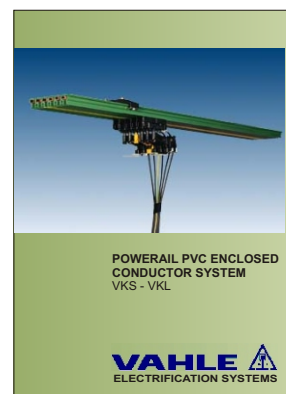
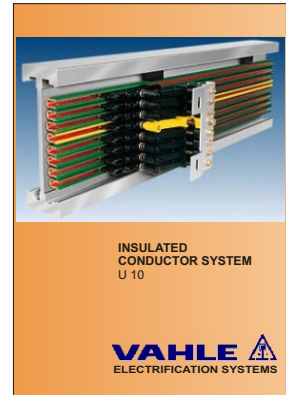


Unipole Conductor Systems User Documentation

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Unipole Conductor Systems - Installation Hints

The installation hints are not to be used a substitute for the installation instructions. You need to read, be familiar with and follow the installation instructions that are available for each conductor system. These hints are designed to assist with and make the installation process go easier.

- Install any curves, switches or other special sections first.
- For straight systems start at the Feed Area. Position the feed terminal as closely as possible to the power supply outlet. The connecting cables must not restrict free movement of the powerail system (expansion and contraction due to temperature changes).
- Anchor this first section with a temporary fixpoint hanger until the system is properly anchored at the recommended fixpoint (anchor) positions. Don't forget to remove the temporary fixpoint afterwards.
- Consider using double collector assemblies (for redundancy) for systems where the slightest loss of contact will cause operational problems (data signals, variable frequency drives etc.)

Also Remember to:

- Handle all components carefully, especially non-metallic parts.
- All components must be kept clean.
Make sure that joints and all other connecting points are clean of any residue.
- Tighten all hardware, using lock washers etc., carefully. Watch for proper alignment between conductor rails and runway (support structure).
- Install the conductor rails per installation instructions or layout plan if provided. Make sure that the position of expansion joints/section and fixpoint hangers is exactly per layout drawing and instructions.

When in doubt, contact VAHLE, Inc. at 800.725.9796 before proceeding. We are happy to assist you.

Commissioning

After the conductor rail installation has been completed, a final, visual inspection of the entire system should be conducted.

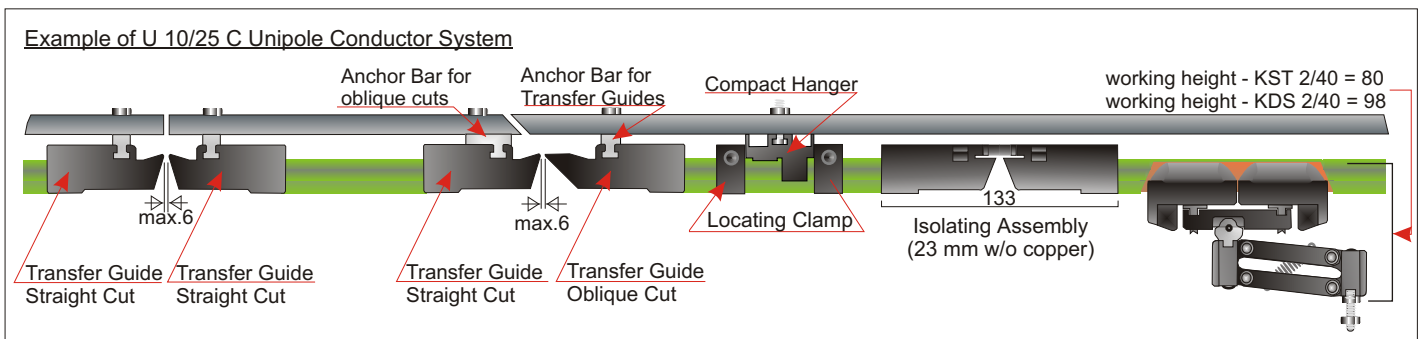
Check the following items:

- a. Correct placement and spacing of compact hangers.
- b. Line-up and correct installation of transfer guides.
- c. Correct expansion gaps at rail joints and expansion joints.
- d. Tightness of anchor bar screws (U 10 System only).
- e. Correct installation of covers at joint splices and feed terminals
- f. Loose wires.

After inspection has been completed and any problems have been corrected, run the collector/vehicle through the system at low speeds:

- g. Check that the collector is installed and operating throughout the system at the proper working height (especially in curve sections)
- h. Follow the vehicle through the entire system and observe the collector passage at switches, turntables and lift stations.
- i. Collectors should pass smoothly and always remain in contact with conductor rail.
- j. Check the catalog or installation instructions for maximum vertical and horizontal offset at transfer. No sparking should occur at collector brush. Sparking indicates dirt or oxidation on conductors, clean as required.*

* Sparking may occur on systems where the collector assembly enters and/or exits the conductor system via a funnel. The size of the spark would depend on the potential (current) on the conductors at the time of entry or exit. Minor sparking is acceptable and should have no detrimental effect to the operation of the system (see also under maintenance). To eliminate sparking a switched or power-up/power down zone would need to be added to the system configuration.



Maintenance

VAHLE Unipole Conductors require very little maintenance. The following checklist will help to maintain the reliability of the installation; it may be modified in accordance with on-site conditions. Follow proper safety procedures prior (i.e. lock-out, tag-out) to making any modifications or repairs on the system or collectors.

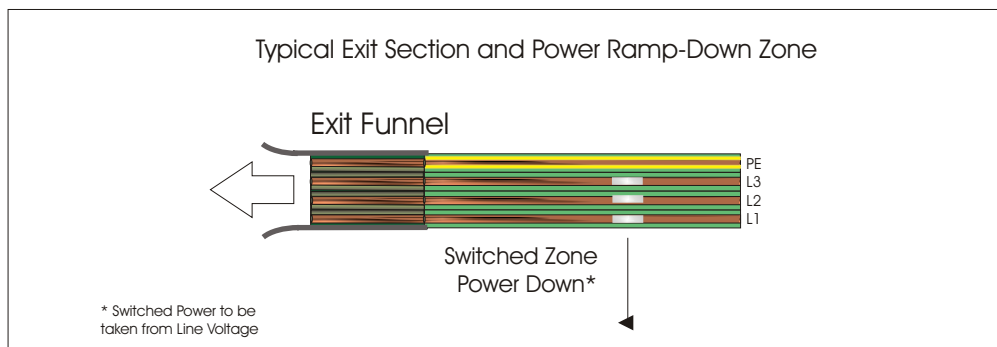
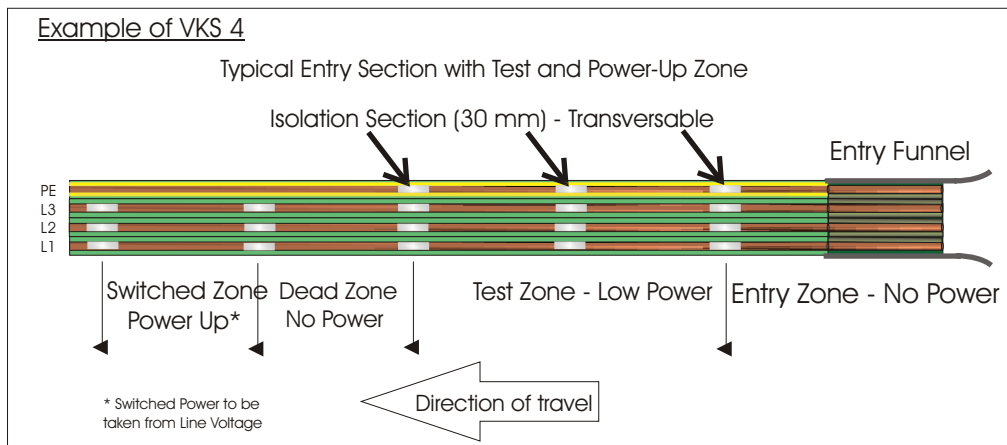
- 1.) Visually inspect Conductors at 4-week-intervals.
Check for and repair the following items:
 - a. Locating and spacing of compact hangers
 - b. Alignment at switches, turntables, lift stations etc.
 - c. Correct gaps at joint splices (plug in joints only)
 - d. Correct gaps at expansion sections
 - e. Loose wires
 - f. Damaged insulation
 - g. Fit of splice joint covers etc.
 - h. Wear or damage due to arcing especially at transfer or entry/exit sections.

Sparking may occur on systems where the collector assembly enters and/or exits the conductor system via a funnel. The size of the spark would depend on the potential (current) on the conductors at the time of entry or exit. Minor sparking is acceptable and should have no detrimental effect to the operation of the system. Component life of the funnel and brush wear may be reduced.

It is important clean excess graphite (collector) dust especially at funnels. The combination of excess dust and arcing could cause a fire hazard.

To eliminate arching a switched or power-up/power down zone(s) would need to be added to the system configuration.

- 2.) Inspect current collectors at 8-week-intervals.
 - a. All moving parts, linkages, springs etc.
 - b. Contact brush for excessive or uneven wear, vacuum off graphite dust if required.
 - c. Electrical connection of wires.
 - d. Replace worn or damaged contact brushes



Unipole Cleaning Systems

Cleaning Collector Assemblies

These are to be used to scour away any deposits on the conductor rail such as oxidation.

The cleaning collectors should only be used as required to clean conductors. Visual inspections of the system should be performed monthly on the system (see maintenance instructions). The cleaning collectors are to be used only as needed (i.e. installed and for several circuits of the system and removed). The cleaning pads on the collector assembly can be changed as required with replacement pads. The cleaning collector is not designed to remove debris from the collector rail. It is designed to clean the contact surface of the conductor.

The cleaning collector cannot be used when there is excess collector dust in the rail as this could cause electrical problems at isolation sections or transfer areas. The dust must first be removed (see also RG 10 Conductor Vacuum system).

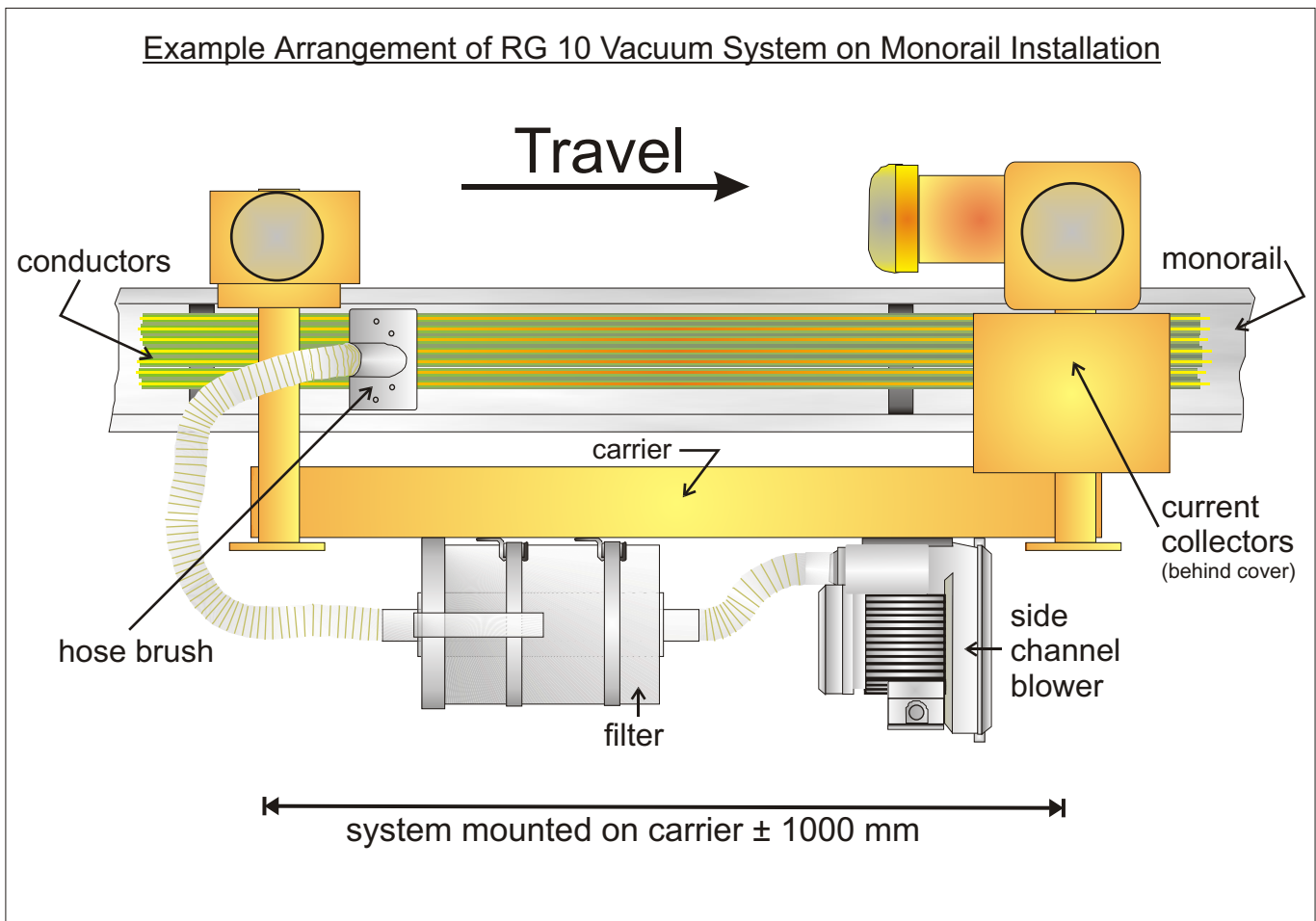


The RG Conductor Vacuum System

This system is to be used to remove loose debris such as collector dust from the conductor rail.

The RG 10 can be installed on a standard carrier, as required, and provides an integrated vacuum cleaning system for the Unipole conductor installation. The system will vacuum dust and graphite residue out of the individual conductors (up to 10 pole).

The RG Vacuum system is available for the U10 - U 15 and VKS conductor systems.



Troubleshooting

We have been informed of, seen and inspected a number of VAHLE systems that have been improperly configured and/or installed (not per VAHLE Specifications). We feel it is a tribute to the quality of VAHLE components and design that these systems continue to operate reliably despite the incorrect installation. However, longevity may be reduced. There are systems that will not operate or function properly if the installation or configuration is not correct. It is our experience that operational issues can easily be fixed by reviewing the system configuration and/or adjusting the installation.

EXPANSION AND CONTRACTION DUE TO TEMPERATURE CHANGE

It is critical to use expansion sections as shown in our catalogs for certain configurations (consult product catalog). Expansion sections will only work properly if fixpoint and sliding hangers are installed at their proper positions. Moreover, sliding hangers must not be installed cocked or against a joint or feed that will restrict the expansion/contraction of the conductor system. Symptoms of this issue include: warping or bending of the conductor rail, joints pulling apart.

COLLECTOR (CONTACT) BRUSH WEAR

The contact brush is the “wear item” on the system. The contact brush is composed of copper graphite. As the brush wears graphite dust may deposit in the conductors. The dust should be periodically removed as it is conductive. If you choose to vacuum the dust you will need to use a vacuum that is designed so that the intake does not flow (designed for cooling) through the motor. We also offer cleaning components (see optional components). If you have excess carbon graphite dust build up or premature brush wear you need to check the installation of the system. Cleaning of dust should only be an annual project (assuming the system is installed in a clean environment).

JOINT AND JOINT COVERS

The proper installation of joints and joint covers is critical to a properly operating system. After installing a joint **(and before powering up the system)** run your finger or collector over the connection. The connection should be snug, secure and smooth. If there is an edge you should sand it lightly. An edge will act as a file on a contact brush causing it to wear quickly and cause a build up of carbon graphite dust; in extreme cases an edge can cause a collector brush to jump or break. Joint covers must be in place for safety reasons. To identify problem joints on an existing system you can run a collector through the system. The collector should not snag, or when passing over a joint jump (do not have power on the system when doing this).

UNEVEN OR PREMATURE BRUSH WEAR

JAMMING OR BREAKING OF COLLECTOR BRUSHES OR ARMS

LOSS OF ELECTRICAL CONTACT

Some of the most common installation issues include: conductor alignment not consistent, gaps at transfer areas are too wide or conductors are out of alignment, the collector assemblies are installed at the wrong working height, the wrong collector is being used for the system configuration. Symptoms of the above issues include: uneven or premature brush wear, jamming or breaking of collector brushes or arms, loss of electrical contact.

You can get a feel for the quality of the installation by calculating the kilometers of travel for your collectors between brush changes. **For an application in a clean environment at moderate speeds brushes should last about 10,000 12,000 + km.**

Complex systems that have many joints, isolations and transfers must be carefully installed to maximize the life of the contact brushes. Conductor rail sections that are cut and installed on site must be de-burred and filed smooth. Likewise alignment and/or gaps at transfer sections must be within VAHLE tolerances. A single rough joint or transfer area will act as a file on contact brush causing premature brush wear. Many rough joints or transfer areas will greatly reduce brush life. Evidence of this problem may be carbon graphite dust deposits.

COLLECTOR HEADS OR NECKS BREAKING

Another sign of installation issues is collector heads or necks breaking. In this event watch a collector assembly run through the system at slow speeds. If the collector binds or jumps, check that area for alignment, damage or installation problems. It is also important to make sure the collector working height is consistent throughout the system (especially at curves). An over-compressed collector could prematurely wear, get jammed at transfers, jump or break.

If you have any operational concerns regarding VAHLE components or systems please give us the opportunity to work with you to identify and correct these. From experience we know that most problems can be resolved and often it can be very easy and quick fix.

VAHLE Certified Installation

VAHLE certified installation technicians are available for complete installation or supervisory services. We highly recommend you use a VAHLE technician for complex installations. VAHLE trained technicians can typically install a system in a third of the time of non-trained installers. Additionally the VAHLE technician's attention to detail at the critical areas (transfers, curves, lift stations, switches, turntables) insures a very smooth operating system, which in turn promotes long life of contact brushes (2 to 4 times the standard life). Our technicians are also available to troubleshoot existing installations.