IRON GOPHER® LINEAR ANODE & MITIGOPHER™ AC MITIGATION SYSTEM

GOPHER FAMILY INSTALLATION MANUAL

TABLE OF CONTENTS:

Introduction - HDD Installation of Linear Anodes

HDD is challenging and difficult work and it is not possible to eliminate all risks during installation – the installer is cautioned that any linear anode will break when pulled to hard. The Gopher Family of products, including the Iron Gopher® and MitiGopher™, are specifically designed to have a much stronger pulling strength than MATCOR's standard SPL-FBR™ linear anode. This additional pulling strength allows the Iron Gopher and MitiGopher to be installed in broader range of HDD applications. This does not mean that every HDD application can be successfully pulled using the Gopher family of products and in some cases even the Iron Gopher or MitiGopher™ can be damaged during HDD installations.

I. INSTALLATION PLANNING

PURPOSE

To describe the proper installation planning and precautions that should be taken when deciding what type of linear anode product to select and what installation methodology is most appropriate. These guidelines are merely suggestions as every installation is unique and carries its own risks. Proper planning by an experienced drilling engineer is essential for any successful installation. Thorough planning identifies and addresses all project activities required to allow successful project delivery. The most important benefits of thorough planning are the cost and time savings that can be made without sacrificing efforts and without delaying project delivery.

INSTRUCTION

Site Geotechnical Investigation

Any discussion about HDD installation planning starts with a site geotechnical investigation. Obtaining a geotechnical survey or as much geological information about the respective jobsite is very important. A great amount of record information is available through sources including:

- United States Geological Society (USGS)
- National Geological Map Database
- Publications of the US Army Corps of Engineers
- Earth Explorer
- The National Soil Survey Center (NSSC) a division of the US Department of Agriculture
- State Departments of Transportation
- Highway Administrations
- Original construction records

In addition to record information, site-specific investigations (soil bores and soil sampling) by trained geologists and geotechnical service companies can provide valuable detailed data on the planned bore area geology. The geotechnical analysis should identify a number of relevant items including:

- Soil identification along the bore route to locate rock, rock inclusions, gravely soils, loose deposits, discontinuities and hardpan
- Soil strength and stability characteristics
- Groundwater

Local drillers with experience in the identified area can often provide valuable insight based on similar projects in the same area.

Terrain and HDD Route Mapping

Collecting accurate topographical information of the bore route is another critical component in the planning phase. Terrain and HDD mapping includes determining HDD bore hole entrance and exit locations, identifying and mapping elevation profile changes, ensuring that other utilities are appropriately identified and avoided, assessing the need for traffic control, evaluating any environmental considerations or limitations that might impact the use of drilling muds and hole conditioners.

Bore Planning Software

Several commercial bore planning software tools are available to assist in the planning phase. These programs utilize the soil and geotechnical data combined with the terrain and route mapping information to provide a graphic visualization of the job helping the driller more accurately “see” and perform the job from start to finish. These software tools help the contractor select the appropriate drill rig, drill bit type and backreamer based on the anticipated soil conditions and the total bore length. By choosing the drill stem and length, the desired bore path depth, desired minimum cover, diameter and bend radius of the product being pulled, the software plots a proposed bore pitch, calculates setback distances, figures point to point bore paths, estimates hole volumes and calculates pullback time. The software can also provide a fluid–mixing process map that shows how much mud should be used based on soil conditions, drill unit and tooling used.

If a bore planning software package is not used, field calculations should be performed to appropriately choose the correct drill rig, drill bit and backreamer tooling requirements, desired bore path and quantity and type of drilling fluids to be utilized.

Linear Anode Selection Guidelines

MATCOR manufactures two linear anode products (SPL-FBR™ Linear Anode and the Iron Gopher®) and two AC mitigation products (the MITIGATOR® and the MitiGopher™) that are all, in the right circumstances, suitable for use in HDD installations. Each anode has its limitations. The installation contractor, along with the client, must carefully select the appropriate anode and the appropriate anode installation methodology. The two generally accepted methodologies are direct pulling of the anode through the properly conditioned borehole by attaching the anode to the backreamer after the initial pilot hole has been drilled. The second installation methodology involves pulling an HDPE pipe sleeve into the borehole, installing the anode inside the pipe, and then removing the HDPE sleeve. The tables that follow (page 5) are intended to assist the installer in selecting the appropriate anode and installation methodology. The selection of the appropriate anode type and installation methodology is subjective based on a qualitative analysis.

TABLE 1 – Linear Anode Application Difficulty

EASY	• Less than 200 foot pulling length • Minimal changes in elevation • No environmental restrictions on use of drilling muds/hole conditioners • Installation costs and risks are low
MODERATE	• 200-500 foot pulling length • Moderate elevation change • No environmental restrictions on use of drilling muds/hole conditioners • Installation costs are modest and risks are low
DIFFICULT	• 500-1000 foot pulling length • Moderate elevation changes • Some environmental restriction on use of drilling muds/hole conditioners • Installation costs are higher and risks are moderate
EXTREME	• 500+ foot pulling length • Extreme or multiple elevation changes • Restrictive environmental limits on use of drilling muds/hole conditioners • Critical application with high costs and risks

TABLE 2 – Anode Selection Guidelines

	Linear Anode Application Difficulty[1]			
SOIL TYPE[2]	EASY	MODERATE	DIFFICULT	EXTREME
Earth Loams	FBR	FBR/ Gopher	Gopher	Gopher*
Sand/Silt	FBR/ Gopher	Gopher	Gopher	Gopher*
Clay	Gopher	Gopher	Gopher*	Gopher*
Gravel / Cobble	Gopher	FBR*/Gopher*	Gopher*	Gopher*
Rocky	FBR*/Gopher*	FBR*/Gopher*	Gopher*	Gopher*

* Anode is to be installed in HDPE sleeve that is then removed

Notes

1. *Classifying the linear anode application difficulty using Table 1 is a qualitative analysis and may warrant taking into consideration other risk factors that may be appropriate. In general, the more difficult the application, the more costly the installation component, the greater the case to use the higher pulling strength Gopher products and the greater the incentive to use*

temporary HDPE sleeving to assure the lowest risk installation.

2. *Soil Types based on the US Department of Agriculture Soil textural classification guidelines. Earth Loams would include the broad range of Sandy Clay Loam, Loam, Silt Loam, and Clay Loam.*

Contingency Planning

Even with proper project planning and an experienced installation contractor, some consideration should be given to contingency plans in the event that something unforeseen happens during the HDD boring and anode installation.

- Are alternate bits available if needed to complete the pilot hole?
- Is a larger boring machine available if needed?
- If drilling is more challenging than anticipated, do we have ready access to HDPE pipe for sleeving if warranted?
- Does the project warrant having one or more spare anode assemblies in the event of an anode breakage during installation?

While these risks can be greatly minimized with proper planning, asking these questions before mobilizing to the site can help solve problems more quickly, saving time and money.

II. RECEIVING LINEAR ANODE ASSEMBLIES

PURPOSE

To describe the proper procedures to be followed when receiving MATCOR Linear Anode Assemblies as listed in the design's Bill of Materials. This section will describe the identification of the linear anode assemblies, the inspection procedures and communication procedures to be used in the process of handling the linear anode assemblies.

INSTRUCTION

Identification

Each cathodic protection system component has been labeled with a distinctive tag/packaging that identifies:

- The model code
- Anode rating
- Anode length
- Lead wire type and lengths
- Customer name

Locate the tag on each of the cathodic protection system components or on the corresponding box/crate and ensure that the quantity matches with the information provided.

Inspection

Typically, MATCOR linear anode assemblies are packaged in a shrink-wrapped wooden reel. Any damage that may have occurred during shipping and handling should be easily spotted by examining the exterior packaging for tears, punctures or other visible signs of damage.

Communication

In the event that damage is observed to any of the materials, inform MATCOR and/or the shipper as soon as possible. DO NOT install any material that is suspected to be damaged.

Typical linear anode reel, shrink wrapped on plastic or wooden pallets ready for shipment.

III. INSTALLING MATCOR GOPHER FAMILY ASSEMBLIES

PURPOSE

To describe the general procedures to be followed in the installation of the Gopher family linear anode component of the cathodic protection or AC mitigation system. The Gopher family linear anodes are designed to be installed through a horizontal directionally drilled (HDD) borehole. It is not the purpose of this section to provide step-by-step HDD installation procedures and it is assumed that the installation contractor is familiar with HDD drilling equipment and cable pulling operations and has performed the requisite project planning.

It is important that the system's design drawings/specifications are reviewed for the lengths and locations of the linear anodes along with the system's other components. The installation contractor should thoroughly familiarize themselves with the installation requirements and review any other additional information that may be required. This section assumes that the procedures for receiving the system's materials have been properly performed.

INSTRUCTION

Preparation

1. Refer to the design/installation drawings for the locations where the anode is to be installed.
2. Measure and mark the distance from the pipeline or structure being protected to where the anode is to be installed. Refer to system design drawings for location of HDD entrance and exit locations.
3. Remove any protective material that may have been used solely for shipping purposes. **DO NOT USE A KNIFE OR OTHER SHARP OBJECT TO REMOVE ANY TAPE OR PLASTIC WRAP.** Utilize caution so as not to damage the anode's lead wire, pulling assembly, nosecone, or the stainless steel overbraiding that houses the prepackaged anode.

Installation

1. Drill the HDD borehole using the appropriate combination of water, drilling mud and other appropriate drilling fluids to assure a well-drilled open hole of the appropriate diameter as specified in the installation drawings.
2. Upon completion of the initial drilling, it is typical that the drill bit is removed and replaced with a backreamer. The Gopher family of anodes are provided with an integral pulling assembly – the pulling assembly loop is to be attached for pull back to the backreamer assembly. The pulling assembly loop must be attached to the backreamer to ensure a successful pull.
3. Pull Iron Gopher® or MitiGopher™ through hole using standard HDD pulling procedures

Figure 1 - Gopher and auxiliary anode header cable (red) attached to drill pipe prior to pulling through bore hole.

4. Upon completion of the pull, ensure that the label for the corresponding anode's lead wire is still intact and/or label each anode lead wire. Route the anode cable(s) in accordance with the design requirements. Where noted in the design details prepare a field splice in accordance with the project requirements and assure that the splice is properly cured prior to backfill in accordance with the splicing system installation requirements.
5. Route anode lead cables to the specified Junction Box or termination point as shown in the design drawings.
6. Terminate the anode lead cables as per the design requirements.

Figure 2 - Gopher exiting the borehole after completion of pulling operation.

IV. FIELD CUTTING OF GOPHER FAMILY LINEAR ANODE ASSEMBLIES

PURPOSE

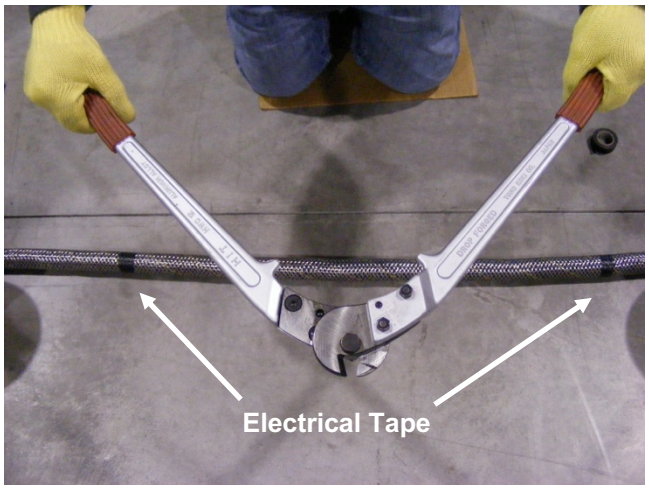
To describe the general procedures to be followed in the installation of Gopher family linear anodes when the anode must be cut to a specific length. The installation contractor should thoroughly familiarize themselves with the cutting requirements and review any other additional information that may be required prior to commencing the work.

Special safety precautions must be taken with the stainless steel overbraiding as the steel wires are very sharp when cut. Appropriate personal protection equipment would include leather or Kevlar gloves and appropriate eye protection.

INSTRUCTION

Preparation **(continued on p. 10)**

1. Measure the anode required anode segment length in accordance with the design requirements and add an additional 20 cm (8”) for lost anode material during the field cutting process.
2. Use electrical tape to secure the stainless steel wire braiding by thoroughly taping approximately 2 inches on each side of the anode where the assembly is to be cut.

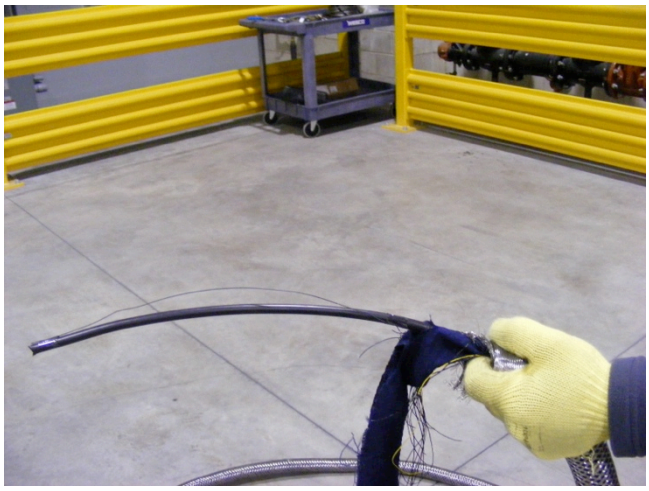


3. Using an appropriately sized cutting tool cut completely through the entire assembly including the anode and internal header cable yielding to separate pieces.

4. Carefully pour coke backfill from each end to approximately 30 cm (12”) of length. Dispose of coke backfill in accordance with acceptable site regulations and requirements.

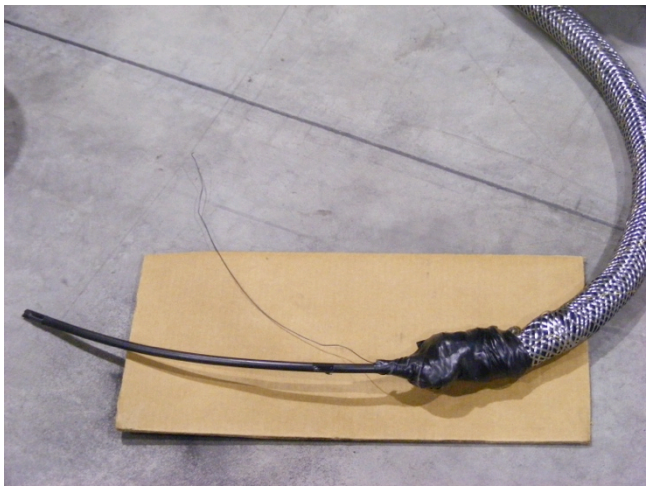
5. Tightly compress the coke backfill around the internal anode fabric housing, header cable and anode assembly.

6. Expose the anode header cable and anode wire by trimming away the fabric and inner braiding.



7. Using a knife, carefully trim away excess braiding materials and inert fabric housing leaving approximately 10 cm (4”) of fabric that is rolled back over the exposed steel braiding. Take care not to damage or cut the insulation of the internal header cable while removing the excess materials.

8. Carefully tape the end starting with the insulating cable and taping over the fabric and the stainless steel braiding to complete the splice.



9. Trim the excess exposed MMO anode wire.