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## Installation guide for MultiLiner UV - Cure



This installation guide for MultiLiner UV – Cure is for a standard situation, there can be variations for each different situation on the Jobsite, and this can have an influence on the setup.

The Installation guide is made as a step by step instruction, based on a standard situation!

### Installation procedure.

- 1.) **Preparation of the pipe for Installation**
- 2.) **Setup of installation equipment on Jobsite**
- 3.) **Pull in the Slide foil and the Liner**
- 4.) **Mounting of Manifold, and setting in the Lamp chain**
- 5.) **Cure process**
- 6.) **After cure, Lamp chain and Manifold dismount. And pull out the inner foil.**
- 7.) **Cutting of House connections / Services, and final TV - Inspection**



## 1.) Preparation of the pipe for Installation:

Before the Installation can be done, the company has to know about the pipe condition, exact pipe diameter and exact pipe length. This is needed for ordering the MultiLiner.

### **NOTE!**

**When measuring up the length of pipe, use a measuring tape, and remember to add the needed length for the free space in both manholes.**

**Do not use a measuring wheel, it can give too short of a Liner length!**

The preparation of the pipe for renovation can be very different from jobsite to jobsite, in some Pipe there is nothing to do except to Jet clean and TV inspect the pipe just before the renovation.

In other situations it is necessary to remove things in the pipe, such as Roots, Concrete and House connections / Services ends which have to be cut off.

This kind of work has to be done days before the renovation, so the renovation can start in the morning.

### **NOTE!**

**If there are House connections / Services on the pipe, they have to be measured, using a measuring tape, so there is an exact measurement from one of the Manholes and into each House connection / Services.**

**This has to be done, so the Cutter operator can find the House connection / Services again for re-opening after renovation. (Can also be done days before.)**

Therefore the following is the preparation and installation on the Installation day.

- ❖ Jet cleaning of the pipe, with high pressure Jet cleaner.
- ❖ TV – Inspection, to make sure the pipe is clean, and without damage as this can have influence on the Installation.
- ❖ Before the Camera is pulled back after TV – Inspection, a pull rope is attached to the front of the camera, and pulled back through the pipe with the Camera, for later use during the Installation.

## 2.) Setup of installation equipment on jobsite:

The standard setup is to place the Installation unit by the Downstream Manhole, because it normally is the dry Manhole, in the fact that the water is running away from the Manhole, also during the installation.



The reason is, it is better to load in and out, the Lamp chain in a dry manhole. If needed the system can be set up opposite, but then there need to be a small backup pump for the Manhole where the Lamp chain must go in and out, to ensure a dry Manhole.

Downstream manhole:

- ❖ Installation unit.
- ❖ Winch to Pull in the Liner.
- ❖ Bottom roller for winching, and later for the Lamp cable.
- ❖ Manifold and needed tools.

Top manhole: (Far Manhole.)

- ❖ Slide foil, with a steel shaft.
- ❖ Pipe plug, to stop water flow, and to block the Slide foil.
- ❖ Small compressor, 65 to 80 cfm. To inflate the Liner during the Pull through the guide rope for the Lamp chain.
- ❖ Manifold and needed tools.
- ❖ Pull guide / roller.
- ❖ The Liner in transportation box. (Can stay on a truck / vehicle.)

There may also be a need for traffic regulation and equipment, as required in the local area, so it is safe to work on the jobsite.

If the water flow is high, bypass pumping equipment will need to be set up as well.

Remember that the bypass must be minimum, one Manhole length away from the Manhole that has to be worked in.

### 3.) **Pull in the Slide foil and the Liner:**

To protect the MultiLiner during the Pull in, but also to reduce the friction, Slide foil has to be installed in the bottom of the pipe.

The widths of Slide foil should be a minimum of 1/3 of the pipe circumference.



The Slide foil is attached to the guide rope in the pipe, and is pulled from top to downstream manhole, with another guide rope on top.

When the Slide foil is through, the end of the Slide foil in the top manhole is blocked into next Manhole length, with a pipe plug.



**NOTE!**

**When the pipe is blocked with a plug, it is necessary to bypass pump during the rest of the Installation time.**

**Also remember that when there is work in the Manhole, where the plug is sitting, to be sure it keeps the pressure, but also that the Water column / pressure, can affect the plug, especially in the situation where no Bypass pumping is used.**

The Winch can now be set up by the downstream manhole, and the wire can be attached to the guide rope on top Slide foil, and can later on be pulled to the top end.

The Liner can now be made ready for pull in, the Liner is folded double, and 3 to 4 feet layed back on top of the Liner, so a loop is made.

A pull belt is layed inside the loop, and 2 to 3 ratchet straps are used to tighten around the Liner behind the pull belt.

**NOTE!**

**The 2 to 3 ratchet straps have to be very tight.**

Liner loop with 3 Ratchet straps

Soft pull belt through the Liner loop



The pull wire is now attached to the pull belt, and the winching through the pipe can now begin.

It is important that the Pull-in speed is not higher than the feed in of the liner in the manhole, so no damage is made on the Liner when it is passing into the pipe.

A couple of workers are folding the liner double on the ground / road, or in the transport box, before it goes into the Manhole.

For installation of larger diameter Liner (Larger than 21 inc.) the use of a short conveyer is suggested, between the Liner transport box, and the manhole.

#### 4.) Mounting of Manifold, and setting in the Lamp chain.

When the Liner is through the pipe, and out in the free space in both Manholes, the pull equipment is removed from the Manhole.

- ❖ First a Canvas protection sleeve, has to be pulled over the outside of the Liner, so the free end is protected in the Manhole.  
The Canvas protection is mounted in both Manholes.

#### **NOTE!**

**Remember to make a small cut in the outer foils under the Canvas, so the rest air can escape, this is very important!!**

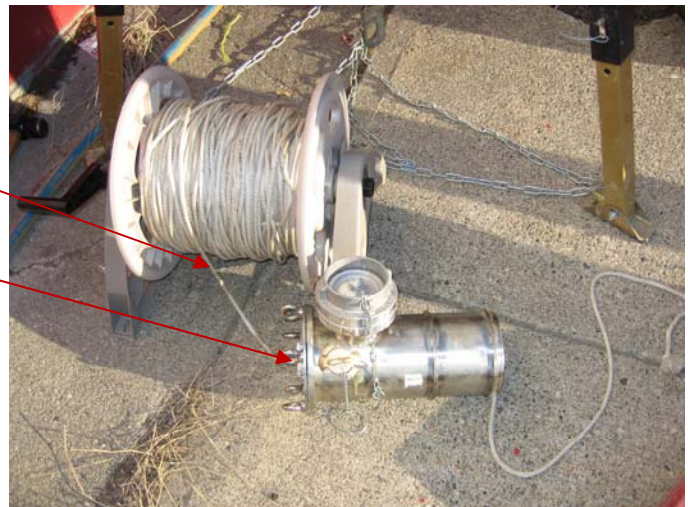
2 to 3 foot long Canvas sleeve to protect the free Liner end out in the manhole.



- ❖ The manifold in the far Manhole can now be mounted, the 6mm Nylon rope is put through the Nylon nozzle in the end of the manifold.

6 mm. Nylon rope.

Nylon rope through the Nylon nozzle in the end of the Manifold.



- ❖ The end of the Nylon rope is now handed down to the worker in the Manhole, where the worker open up the end of the Liner into the Inner bag, where a thin Kevlar string is mounted, the Nylon rope is attached to the Kevlar string, as far inside of the Inner bag as possible.

Be sure it is attached to the Kevlar string, so it does not release during the pull through of the Liner.

6 mm. Nylon rope, attached to the Kevlar string inside the inner bag.



- ❖ Now the Manifold is handed down in the Manhole, the Manifold is then mounted into the Inner bag, but at the same time the Nylon rope must be pulled tight, so neither the Rope or the Kevlar is not laying between the Manifold and Liner.
- ❖ When the Manifold is in the wanted position in Liner inner bag, 2 to 3 ratchet straps are tighten around the Liner where the Manifold is placed, this will keep the Liner material tight around the Manifold during the Cure process.

6mm. Nylon rope through the Manifold.

Air hose attached to Manifold.

Ratchet straps around the Manifold, and Liner material.



**NOTE!**

**It is very important that the Ratchet straps are very tight, so the Manifold is not blown off during the Cure process.**



- ❖ When the manifold is mounted, an air hose is connected to the Manifold in the Manhole, and to a Compressor on the ground.
- ❖ A small guide or guide roller has to be mounted in bottom of the Manhole to insure a straight feed of the Nylon rope, into the Manifold nozzle, during the pull forward and back.
- ❖ Now some air can be introduced into the Liner, at the same time a person is keeping the free Liner end in the other Manhole (Manhole by Installation unit.) closed by hand, so the Liner will inflate in pipe.
- ❖ When the Liner is inflated, the Liner will stand open, and by finding the Kevlar string in the Inner bag, the guide rope for the Lamp chain can now be pulled through the Liner inside the Inner bag.
- ❖ When the rope is through the Liner, the Lamp chain will be handed down into the Manhole, and the guide rope is attached to the front of the Lamp chain.

By still inflating air into the Liner from the other end, the Lamp chain can be pulled into the Liner so the end of the Lamp chain is just 1 foot inside the Liner.

- ❖ The electric wire for the Lamp chain is pulled through the Nylon nozzle in the Manifold, and after this the connector is connected to the Lamp chain in the Liner.
- ❖ The last manifold can now be mounted, but be sure, the wire is not between the Manifold and Liner material.
- ❖ 2 to 3 Ratchet straps are now tightened around the Manifold, and remember to make them very tight.

**NOTE!**

**Make sure the Ratchet straps are very tight, around the Manifold.**

- ❖ A pressure sensor hose is attached to the Manifold, in the Manhole.
- ❖ As the last setup, a bottom roller has to be mounted in the bottom of the Manhole; the roller is a guide roller for the Electric Lamp cable!

It has to be mounted to ensure a total straight pull direct out of the Nylon nozzle in the manifold, so there will be no damage at the Cable.

- Ratchet straps.
- Manifold I manhole by the Installation Truck.
- Air hose to Pressure sensor for Liner Pressure.
- Guide roller for the UV-Cable.
- UV-Cable
- Outlet air hose.



Depending on the Installation unit, air can be inflated into the Liner from the far end, or from the end where the Installation unit is standing; it doesn't matter, during the installation.

Important is that there is an air outlet in the opposite end, so if needed an air flow can be made, especially the small Liner diameter, so inside air temperature is not going to be too high.

### 5.) Cure process.

Now the Liner is ready for the Cure process.

To be able to understand this part of the Installation guide, we need to explain how the UV – Cure process works.

First of all, the Curing agent in the Impregnated Liner, is reacting to the UV – Light, and is not reacting to Heat, it means it is only the UV – Light that is getting the cure agent to react, not the heat.

When the cure process is running in the Liner wall, the process is making heat, and at the same time there is also some heat coming from the UV – Bulb, this 2 heat force will heat up the Liner wall, and also the air inside the Liner!

Therefore it is important to keep an eye on the temperature sensors on the Lamp chain during the Cure process. If the temperature is too high, there can be a risk to melt the Inner foil inside the Liner, this can create problems to keep the air pressure on the Liner during the installation, but also create problems later on when the Inner foil has to be pulled out again.



**NOTE!**

Therefore if the air temperature is too high (Over 80 - 85° c. / 175 - 185° f.) there is 2 parameters to adjust on:

- **Create an airflow through the Liner, by opening up the Air outlet in the other Liner end, then where the air inflates into the Liner, it will cool down the air.**

**Be sure that under this operation, the Liner pressure is maintained by opening up the air inlet, as well opening up the outlet.**

- **Speed up the pull speed on the Lamp chain, to maximum cure speed from the Cure – diagram (Cure – diagram comes from the Liner producer / supplier.)**

**If needed the pull speed can be over passed, but then the curing has to be done twice. (A second cure pulls.)**

This is normally not a problem, but may be required in warm Summer time by very small Diameters, in  $\varnothing 150\text{mm}$  /  $\varnothing 6''$  inc. Liner size.

Now the cure process:

- ❖ If there is a Recording Device or Program, on the Installation unit, it has to be Turned ON.

The important parameters by UV – Curing is: **Liner pressure, Air Temperature, Lamp chain speed, and how many Lamp / Bulbs are in operation.**

- ❖ Start to inflate the Liner by Air, carefully until Liner pressure is indicated on the pressure guage.
- ❖ The Liner pressure is raised slowly until the wanted pressure is reached. It is normally around 0.5 bar. / 7.2 psi. (Look in cure diagram.)
- ❖ When the Installation pressure is reached, then wait for a minimum 10 minutes, for smaller diameters 15 minutes, so the Liner material gets time to fit to the Pipe.
- ❖ In the waiting time, be sure the Lamp chain is back in position, by pulling back in the electric cable for the Lamp chain. When it is back in position, reset the Distance counter on the Installation unit.



**NOTE!**

**Make a fix point on the electric cable, close to the top roller on the Installation unit, by setting a thin tape around the Cable, never trust 100% on the Distance counter.**

- ❖ After 10 to 15 minutes, the Light chain can be pulled to the far end of the Liner. During the pull through, there is a mounted Camera on the front end of the Lamp chain, so it is possible to see how good the Liner fits to the pipe. (Indication from inside that the offset joint is to be seen through the Liner wall.)
- ❖ When the Lamp chain is close to the far end, slow down the pull, so the Camera head does not crash into the Manifold at the far end.

It is recommended to have radio communication between the operator and the person that is pulling in the far end.

- ❖ When the Lamp chain is in position at the far end, the UV – Bulbs can be turned ON.

Normally by an 8 Lamp chain it is done as follow: Lamp 1+2 wait 30 second, and then Lamp 3+4 wait 30 second, and then Lamp 5+6 wait 30 second, and then Lamp 7+8 and then wait 1 ½ minutes.

After this time it is good to control the free end in the far Manhole, that the Liner end is Hard / Cured. If not wait until it is full Hard.

- ❖ When the Liner end is Hard / Cured, start to pull back the lamp chain, using the Pull winch on the installation unit.

In the first stage, only ½ speed from cure diagram, when the Lamp chain is pulled the distance of the Lamp chain length for ½ speed, it is sped up to full speed.

This is for compensation of the shadow in between each Lamp.

- ❖ During the Curing / Pull through under process, it is important to keep an eye on Liner pressure and Air temperature inside the Liner, and if needed adjust, out from the written in the first of this chapter.

**NOTE!**

**If a UV – Bulb has gone out during the process, it will be indicated on the Installation unit, as a “Warning!”**

**In the case that one, out of 8 Bulb is falling out, then reduce the pull speed by 1/8 of the Pull speed.**

**If an example 2 out of 8 Bulbs is falling out, then reduce the pull speed by 2/8 of the pull speed.**



- ❖ When the fix mark on the Cable is 1.5 meter / 6 feet from back position, the pull speed is reduced again to ½ speed, for compensation of the shadow in between each Lamp.

**NOTE!**

**The last ½ meter / 2 feet is pulled by hand, remember to reliefs the cloche at the cable winch, so no damage is done on the Cable connector on the Lamp by hitting the end of the Manifold.**

- ❖ When the Lamp is in back position, the Lamp is turned OFF in same order as when it was Turned ON.

It means that Lamp 1+2 is Turned OFF first, then after 30 second, Lamp 3+4 Turned OFF, then wait 30 second, then Lamp 5+6 Turned OFF, ten wait 30 second, and the Turned OFF Lamp 7+8.

**NOTE!**

**Let the Lamp cool off for 10 minutes with some air flow through the Liner, so the UV – Bulbs get cooler, its extend the life time of each Bulb.**

The cure process is now finish and the inflation of air can be stopped as well.

**6.) After cure, Lamp chain and Manifold dismount. And pull out of Inner foil:**

After the process is finish, it is time to dismount the Manifold, it is important that the Liner pressure is down to 0. So there is no pressure in the Liner.

Because the Cure process is made by UV – Light the Liner material around the Manifold will still be quite soft, therefore it is not so difficult to remove.

Removal is as follow:

- ❖ The first manifold to be dismount is the Manifold by the installation truck! Do not disconnect anything else before the Lamp chain is out of the Liner

**NOTE!**

**Nothing can be disconnected from the Liner before the Manifold in the Manhole by the Installation truck is OFF, and the Lamp chain is out of the Liner.**

**There can stand water in the far Manhole, and it may not run into the Liner and flood the Lamp chain.**



- ❖ The bottom roller for the electric Cable must be removed first.
- ❖ The Pressure hose, and if used Air inflation hose is disconnected from the Manifold.
- ❖ Release the 2 or 3 used Ratchet straps, and remove them totally from the Liner end.
- ❖ The Manifold can now be pulled out of the Liner end, because the Liner material around the Manifold is still soft. Some time it is necessary to move the Manifold a bit from side to side to release it from the Liner end. The manifold is now handed up the Manhole by sliding it up of the Cable.
- ❖ Now the top ½ part of the liner out in the free space in the Manhole can be cut away, with an Air grinder.
- ❖ After this the Lamp chain can be taken out from the Liner.

**NOTE!**

**The Lamp chain can still be quite warm, so take care not to be burned on the hands, use some Gloves.**

- ❖ Another pull rope is attached to the Nylon rope that has pulled the Light chain. Now this rope is pulled through the Liner, to the far end.
- ❖ Now the Manifold at the far end can be removed, like in the first Manhole.
- ❖ When the Manifold is dismounted in the far Manhole, the Pull rope we just pulled through the Liner must be attached to the Inner foil inside the Liner, when it is attached, another rope is attached behind, so if necessary, it is possible to pull back again.
- ❖ The inner foil can now be pulled out by pulling in the rope inside the liner, it is important that the Inner foil is inverting out, otherwise it can stock up inside the Liner.
- ❖ After the Inner foil is taken out, both Liner ends in the Manholes, has to be cut off in wanted length.
- ❖ As the last, the Pipe plug can be removed, and the water flow can run as normal, if bypass pumping has been set up it can be taken down again.



**NOTE!**

**After removing the Pipe plug, there can stand quite a lot of water behind, so be sure that the plug is not sucked into the Liner or next Manhole length.**

**Also the person that is removing the plug has to take care, because the water can raise in the manhole.**

7.) **Cutting of House connections / Services, and final TV – Inspection:**

After installation is finished, the cutting work can be done, if there is House Connections / Services to be open on the renovated pipe.

It is important to note, that the measure data, from before the renovation is precise, so the measurement can be layed in on the cutter, to find the connections again.

Because it is a glass reinforced Liner product, there is only a little bit of indication, to see from inside the Liner or no indication at all, therefore it is important that the measurement is correct 100%, and at the same time to trust them.

After finishing the cutter work, a final TV – Inspection can be made, as one of the documentation for the renovation of the pipe.

Technical manager by MultiLining

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**Appendix Nr. 1** : UV – Cure diagram, metric.

**Appendix Nr. 2** : UV – Cure diagram, psi / foot.

**Appendix Nr. 3** : UV – Cure comments.