

**Suggested Installation Guidelines for Retrofitting LEDline® LED
Guidance Lighting into Concrete Pads or Asphalt.
September 2021.**

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All LEDline® products must be installed by a HIL-Tech qualified installer or the LEDline® Limited Warranty is void. Please contact HIL-Tech for the nearest installer.

If there is not a locally qualified installer, then, for validation for the Limited Warranty, a person from HIL-Tech Ltd. must be present to ensure a correct installation.

To be a HIL-Tech qualified, installers must install at least one project under the supervision of HIL-Tech and their workers must receive a HIL-Tech Certification. Please contact HIL-Tech Ltd. for further details.

Request to Everyone: Global Warming is forcing everyone to rethink energy efficiencies. All projects must be evaluated as to their effect on Global Warming. Those that significantly add to Global warming need to be re-thought and other solutions proposed. (Note: Canada and the Arctic is warming up twice as fast as the rest of the world and, apparently, recent United Nations and other estimates now only give us some 20 years to come up with solutions to prevent the average world warming temperature rising by more than 1.5°C (2.7°F) causing major climate issues).

Applicability:

These ***Retrofitting Installation Guidelines*** apply to any light strip products forming part of the LEDline® family of products, (collectively, LEDline® products).

For installing LEDline® into new concrete pads or new asphalt, please contact HIL-Tech Ltd.

The installation methods and techniques documented in these guidelines are of a general nature and will apply in most retrofit situations. However, it is not uncommon for the detailed layout of a LEDline® system or certain aspects of an installation, to have unique requirements at a particular situation or location. Accordingly, we recommend that HIL-Tech engineers review all layout and installation plans prior to installation and preferably, prior to ordering a LEDline® system.

As the LEDline® changes, installation procedure may also change, so be sure to have the latest installation procedures.

These Installation Guidelines relate only to situations where the LEDline® is to be installed within a pavement, flush with a paved surface (e.g. concrete or asphalt road). However, it should be noted, that LEDline® is also used on barriers, signage, and other structures, to highlight them in any weather, improving road safety or structure aesthetics.

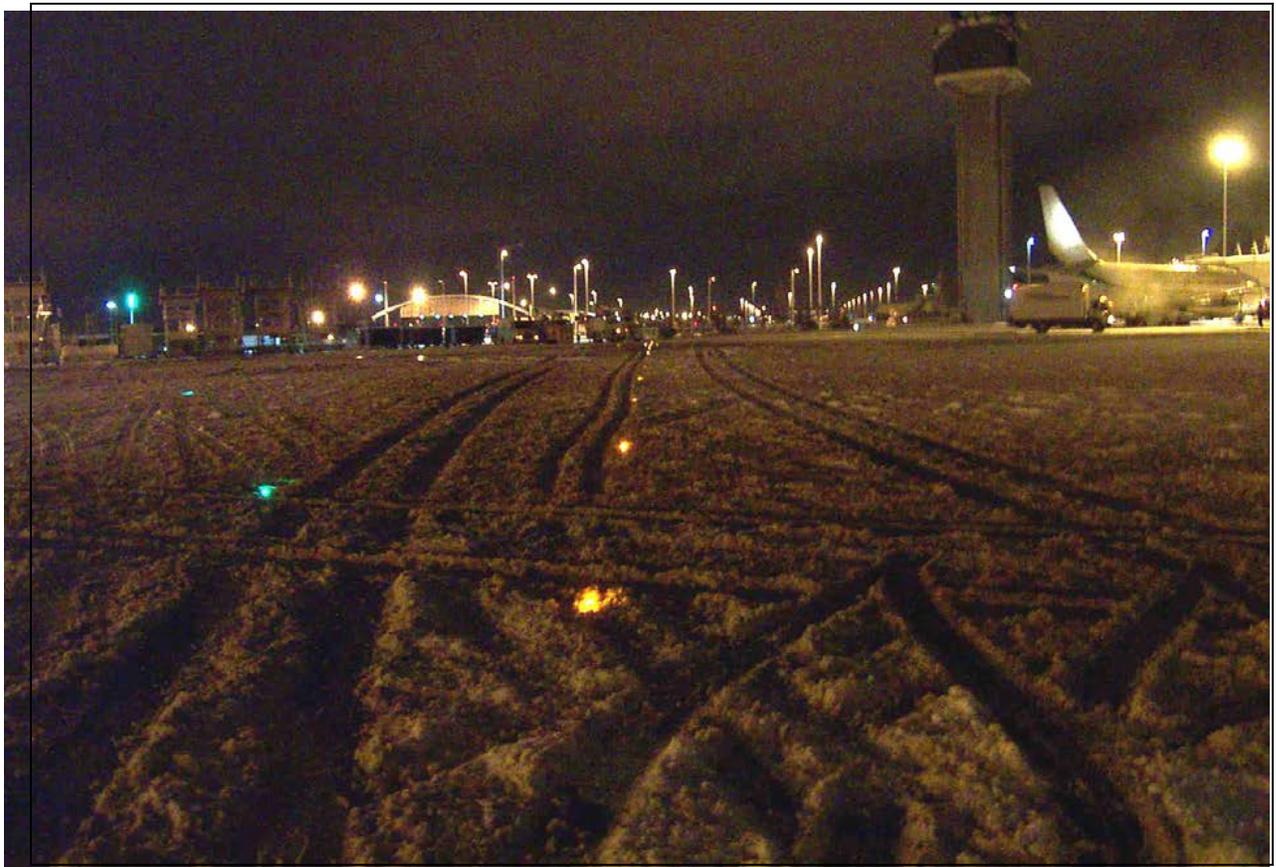


About LEDline®:

LEDline® is a lit guidance lighting system, which increases road / airport safety and efficiency. The linear array of encapsulated light emitting diodes (“LEDs”) provides for a high intensity lit guidance line (all LEDline® units daylight visible, the 12 x LEDs systems, particularly the semi-directional 12 x LED LEDlineSunDV™ units should be used in in-pavement sunlight visibility situations). The embedded LEDs are mounted on a printed circuit board embedded within a solid clear plastic matrix that is connected to a set of Power Supply (BUSS) wires.

Unlike painted or reflective markings, **LEDline® melts snow without any additional heating elements**, so is visible in most weathers, including heavy fog, (where it is seen far earlier than any reflector markings), heavy rains, snow white outs and dust storms.

At Anchorage International, standard green, incandescent, (more heat than light), FAA Taxiway lights (left) and old style yellow 6 x LED semi-directional LEDlineDV™ lamps (right) both seen in identical weather and snow depth conditions. Both melt snow and are equally visible and effective. (**Note:** HIL-Tech now has units with 12 embedded LEDs).





There Are Five Basic Types Of LEDline®:

For evening, nighttime visible systems, with 6 x embedded LEDs;

- LEDlineDV™ is a semi-directional system and
- LEDlineHB™ is an omni-directional system.

For sunlight visible applications, with 12 x embedded LEDs;

- LEDlineSunDV™ is a semi-directional system (the brightest in sunlight situations) and
- LEDlineSunHB™ is an omni-directional system.
- Custom LEDline® systems are available such as a unique hybrid LEDlineSunDV™, with 6 x LEDs in an omni-directional position, and 6 x LEDs in a semi-directional position with their embedded optical system focusing the light towards the driver. Other custom LEDline® systems can be created, so please ensure that these installation guidelines are applicable to the new customized systems by contacting HIL-Tech Ltd.

The “**HB**” designation means High Brightness and that the embedded LEDs are omni-directional, whilst the “**DV**” designation stands for directional visibility, having the unique proprietary precision optical system embedded in with the LEDs, focusing most of the light at low angles towards the viewers. The “**Sun**” designation means that the units are visible in sunlight. Again, whilst all LEDline® units are visible in sunlight those designated with the “**Sun**” are recommended for sunlight applications.

All LEDline® components are fully encapsulated in a durable, clear, weather resistant, UV resistant, solid plastic. As such, they are; submersible, (previous iterations tested to 300m (1000ft) seawater depth); are corrosion resistant; are extremely tough; highly chemically resistant; solid so not easily compressible, (will take the weight of 747 / A380 aircraft); should be explosion proof (need to be certified); and are specifically engineered to withstand the challenges of a variety of extremely harsh environments.

For in-pavement applications, the LEDline® system comes with; an low powered series circuit induction power supply; a Mounting Plate, which is inset into the pavement; and a non-contact, not hardwired, induction power pick up connection system. This is connected to the surface mounted LED lamps via a waterproof IP69 quick disconnect connector. The quick disconnect IP69 connector to the lamps, is the highest IP electrical connector system available, so maintenance and changing out a lamp from the Mounting Plate is easy. (Note: If needed for deep-sea use, custom, much deeper, high pressure certified connectors are available.)

For highlighting barriers, structures, signs and other special applications, LEDline® are usually specified with a Direct Current (VDC) configuration, again with the IP69 connector. For this configuration, there is also the optional computer special effects package. This allows for individual LEDline® lamp computer control, so that each lit individual LEDline® segment, can be controlled as to sequencing as well as dimming.

Standard LEDline® units have a nominal illuminated length of 415mm (16.3"), within a Mounting Plate "U" channel of 625mm (24.6") long, with a nominal width of 48mm (1.9") and a nominal depth of 30mm (1.2"). (Note: For in-pavement letters and numbers, there are custom LEDline® units, which are half this size, contact HIL-Tech Ltd. for details).

Custom linear units can be 115cm (47") long and there are individual point source, or linear combined units, able to provide light in all directions from zero degrees. Please contact HIL-Tech for details.

All light units are available in a wide variety of LED colours, plus Infra-Red (IR) and Ultra Violet (UV). (Please consult the LEDline® Technical Specifications for a list of currently available standard colours).

Linear LEDline® meets the needs of the transportation industry by enhancing the visibility of pavement markings, barriers, signs, obstacles etc. in all conditions, particularly when motorists and pilots find visibility a challenge. When illuminated, the LEDline® system is seen; in sunlight; at night; at dusk; under intense rain; in the wash of headlamps; and in snow depths of 200mm (8") or more, **since it melts snow** without needing any additional heating elements. Here, in melting snow it is self-cleaning. It is excellent for guidance in; fog; snow whiteouts; in dust storms; and is visible in broad daylight / sunlight when used on barriers or sign poles, directly facing the viewer or in-pavement applications, especially when the 12 x LED LEDlineSunDV™ system is used.

For in-pavement applications, LEDline® units are embedded flush with the pavement surface, so are not damaged by snow ploughs.

LEDline® is easily attached to any structure to highlight its presence. The Mounting Plate “U” channel comes with standard screw holes or holes can be drilled through it, to provide the necessary places for screw attachments.

Rule of Thumb of the Time for a Retrofit Installation: Provided temperatures are reasonable and the weather is dry, as per the glue manufacturer’s suggestions, LEDline® is easily and quickly installed. (Note: HIL-Tech has seen an electrical contractor, with no previous experience in installing LEDline®, with one saw cut machine and a crew of five (5), install 230 LEDline® units in about 5 days = 200 man-hours of work). Access, such as being able to work only at nights etc., can slow installations, as does rain, cold freezing temperatures, any and all of which prevents the glues adhering and curing. Provided the right conditions are available, for the selected glue, LEDline® is often installed in days not weeks.

Energy Efficient, Long Lasting and Chemically Resistant: The use of LEDs as the light source ensures that the LEDline® system is energy efficient, long lasting and requires minimal maintenance. Since the encapsulating material was formulated to be tough and resistant to a variety of chemicals (e.g. jet fuel, de-icing fluids etc.) and other contaminants in the transportation industry, LEDline® may be deployed in a host of outdoor, industrial or resource-industry environments. It is also suitable for a variety of indoor and commercial uses including being used for aesthetic structure outlining purposes, and as mentioned previously, if required, may be surface-mounted (e.g. on vertical surfaces).

Waterproof Connector: LEDline® comes with a quick disconnect, screw locking nickel-plated brass, or stainless steel IP69K waterproof connector. IP69K is the highest type of electrical connection, other than deep-sea high-pressure electrical connectors.

IP69K= Protected against ingress of dust and high temperature and close-range high pressure, high temperature spray downs. This is so that, should it become necessary, the induction power pick up connector, connected to the buried power distribution cable all buried in the glue, can be accessed, and a replacement LEDline® unit flush with the surface, can be easily connected.



In the previous IP69K picture, please note the red gasket with the locking mechanism, a key item to maintain the waterproofness of the IP69K connection.

IP69K Testing: On a rotating turntable, with a speed of 5 ± 1 revolutions per minute, the test requires a spray 4 “- 6 ” (101mm-152mm) from the product of 4 gallons/16 liters per minute with water pressure of between 1160-1450 psi, at a temperature of 176°F/80°C. The heat and spray must not cause damage. **The IP69K rating is the highest protection available, unless custom deep-sea connectors are required.** Please contact HIL-Tech for technical specs. on any required deep-sea connectors.

General Power Supply Considerations: The LEDline® Mater Controller/s with its Power Module/s generates a low power series circuit lighting system. These power supplies are generally connected to surge protected mains power;

- with an induction power and induction power connector system for in-pavement applications;
- a VDC power supply can be used when it is attached to building, barriers or any other structure;
- for airfields, LEDline® can be powered from the airfield series circuits with its power converter. However, because of the high powered series Constant Current Regulator/s (CCR) voltage surges, all designed to bypass any short circuits in the series circuit, as with any LED lamps, the required LED protections against these high voltage spikes negates most of any LED energy savings;
- alternatively, via renewable energy sources, such as solar power and / or wind generators or fuel cells (all with batteries), so the system can be powered when there is no mains power available.

LEDline® products usually operate on a low powered series circuit constant current, although other custom power supplies are available. In areas where mains power is problematical or when safety considerations require it to be lit at all times, LEDline® may have battery back up to remain lit during power blackouts.

With the induction system, the voltage in the BUSS wires varies depending on the total wire run distance and the number of and types of LEDline® modules connected. The constant current power module provides a known controlled low constant current into the main power BUSS wires, whilst the low voltage floats to accommodate the power draw until the maximum voltage of the circuit is achieved. This allows a number individual units of LEDline® to be connected (linked) together to create continuous or dashed illuminated lines of considerable length, (up to the maximum power rating of the power supply), without any degradation of brightness at the far end of a run.

As a “Rule of Thumb”, each connected LEDline® unit adds approximately 1V to the voltage in the BUSS wires over and above a minimum 12V for minimum loaded condition with a factory pre-set **minimum load** on a Power Module = 10 units. For example, a system with 10 units connected would expect approximately $(12V + 10V) = 22V$ in the BUSS wires. The voltage in

the BUSS wires will vary up or down, depending on the total wire run distance installed and the total number of units connected.

WHEN TESTING AN INDUCTION CONTROLLER THERE MUST BE A MINIMUM LOAD ON THE CIRCUIT. WITH THE INDUCTION SYSTEM, ONE CAN NOT JUST LIGHT UP ONE OR TWO UNITS ALONE.

CAUTION: OLDER MASTER CONTROLLERS WITH OLDER POWER MODULES, BEFORE 2007, DO NOT USE POWER MODULE WITH LESS THAN 20 UNITS (OR THE POWER CONTROL BOARD WILL BE DAMAGED. (If in doubt, please contact HIL-Tech Ltd). MODERN UNITS AUTOMATICALLY ADJUST TO THE NUMBER OF LEDline® UNITS ON A CIRCUIT, HOWEVER, THEY STILL NEED A MINIMUM LOAD, WHILST THE OLDER CONTROLLERS, NEED MANUAL ADJUSTMENT.

CAUTION: NEVER WORK WITH ANY LEDline® POWER SUPPLY SYSTEM WITHOUT BEING SURE THAT THE POWER IS DISCONNECTED.

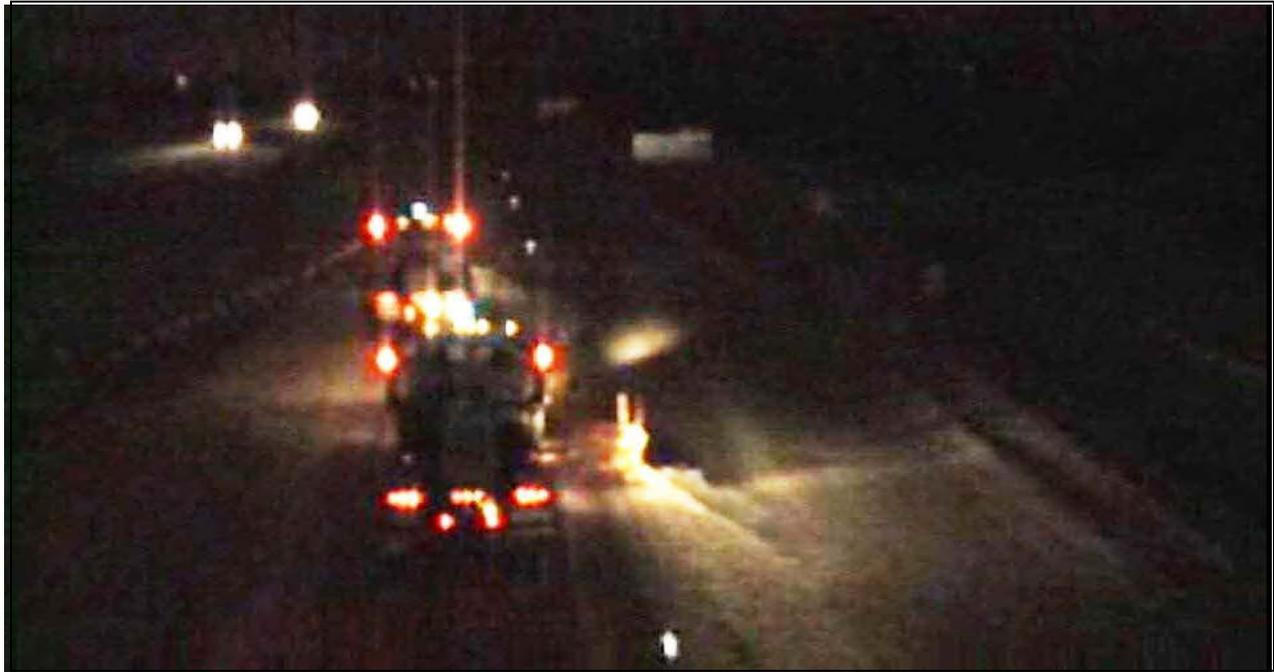
For Daylight Visible LEDline® Systems; for in-pavement or barriers/ structures, the 12 x LED embedded systems, LEDlineSunHB™ or LEDlineSunDV™ should be used and specified for sunlight visibility applications. Generally, if 12 x LEDs are being powered, (obviously twice the number of LEDs compared to the 6 x LED systems), this will tend to halve the number of LEDline® units which can be powered from a single Power Module. To be sure, please contact HIL-Tech Ltd for the distances and / or number of 12 x LED, LEDlineSunDV™ or LEDlineSunHB™ that can be powered on a single circuit with a single Power Module. A specialized booster circuit may be applied for very long wire runs, which will extend the number of these units that can be powered from a single Power Module. Please contact HIL-Tech Ltd for details.

Installation Weather Considerations: It is preferable that LEDline® be installed in dry conditions at optimum temperatures (above 5°C (40°F)), so that the two-part epoxy style adhesive can quickly set, resulting in the best seal of the in-pavement LEDline® and the installed electrical connections. However, some adhesives / sealers are tolerant of wet conditions and can cure and seal in these and in relatively cold temperatures, although cure times will be slower in these conditions. (Please contact HIL-Tech Ltd for glue types, and see and follow the specific glue specifications from the glue manufacture).

Visibility Considerations: Designers and engineers should be aware that lit marking visibility / conspicuity, depends not only on brightness, but also on the contrast ratio between the lit marking and its background. White on black will normally show in any ambient light, whilst white on white will be much less conspicuous, unless of course it is dark or nighttime, when it cannot be seen. Similarly, lit signs or visual aids, will be far more visible at night (a high contrast time) compared to daylight. LEDline® with 12 embedded LEDs is visible in sunlight, so please contact HIL-Tech Ltd for details.

Snow plough Safe Installation and Layout Considerations for Enhancing

Visibility: All LEDline® units which are driven over, must be placed into a groove in the pavement flush with or slightly below the pavement surface, to prevent damage occurring to the product by snow plough impacts. (**Note:** Picture below taken from video).



In-pavement applications, such as roads or airfields, where low angle distance visibility and viewing is important, special care should be taken to make sure that the all units are positioned at least 200mm (8”) away from the leading edge of the groove, so that the lip of the groove does not block any of the low angled light.

(It is important to have a uniform placement of the LEDline® within the groove, leaving as much space away from the front (leading edge) of the groove as is possible, (at least 200mm (8”). This is because if it is installed too deeply or too close to the front edge, the light from unit’s right up against the front edge of the groove will be cut off, changing the viewing of the light from distances. To achieve the uniformity, mark the 200mm (8”) away from the front edge of the groove and then start the LEDline® installation at this mark).

All LEDline® units are installed the same way; height, flush with surface, distance from the groove front etc., so that their appearance is uniform. **(They should be in the same position within the groove, with the same aspect ratio, with the same spacing away from the front edge of the groove, or the units may not have a uniform brightness or appearance and look uneven).**

Aspect Ratio: Aspect ratio means that the position of the LEDline®, its direction, its depth, its camber (left / right ratio), and the positioning of the LEDline® within the groove, should all be

the same for every LEDline® unit in the circuit. This way, the appearance is the same for every unit, whether they are in the line or put parallel to each other as at a pedestrian crossing.

The desired distance to view the installation should also play a major role in determining how to orient and position the LEDline®. From a distance, a line of LEDline® running across a road in front of the driver, will only be clearly seen, once the driver is close up to the line. This is because the lit side cross-section area, that anyone is looking at, is only some 35mm (1.4”) across, so there is not much to see as from long distance. (With distance, the lit area becomes smaller and smaller as the viewer sees it at lower and lower viewing angles). Therefore, the amount of light area available to be seen, drastically decreases with distance.

For optimum long distance low viewing angle of a lit line across a pavement, LEDline® semi-directional units should be chosen where most of their light is focused towards the viewer. Here the options are LEDlineDV™ (6 LEDs) or the much brighter LEDlineSunDV™ (12 LEDs). Here, each unit is in line with and parallel to the other at the specified separation distance. This way, the horizontal lit line is created with the directional LED light, focused towards the viewer, and the full length of the light will be available for the long distance low angle viewing.

The Units Installation Should Be Uniform: To achieve this, all in-pavement LEDline® units come with four (4) adjustment screws at the corner of the Mounting Plate “U” channel. Before installing any glue into the groove, the completed LEDline® unit and its Mounting Plate should be tried within the groove, at its appointed place, so that the four (4) adjustment screws can be individually adjusted to achieve the right depth and aspect ratio for that spot.

Some contractors have fabricated specific metal or plastic “T Bar” measuring tools to span the grooves width and fit into the groove, to ensure a uniform depth for the LEDline®. Again, for a uniform display, it is important that all units are at the same depth at each end and have NOT been “rolled” to the left or right when installed. Therefore, setting the right depth on the setscrews is important!

Again, in snow plough areas, under no circumstances should any part of the LEDline® be proud of or above the pavement surface so that it can be impacted by a snow plough blade! Any such units positioned like this should be repositioned if the glue has not cured or, if it has, be reinstalled so that snow ploughs cannot touch it.

For too deeply installed LEDline®, the pavement around the LEDline® should be ground down, or the product should be re-installed.

Longitudinal Markings: LEDline® shows best when used to replace or enhance pavement markings that run longitudinally (i.e. parallel) with the road. When installed longitudinally, LEDline® products have the full length of the installed product for the light to exit, whilst a horizontally installed product, only has the much smaller width of the product to view.

Horizontal Markings: If LEDline® units are intended to replace or enhance horizontal pavement markings, such that they will be installed across (i.e. perpendicular to) the direction of

travel, planners should be aware that unless specific counter measures are taken, such as widening the line with additional LEDline® units, as before, distance-foreshortening effects will reduce the intended visibility of the LEDline®. In addition, depth considerations become very important, since the deeper the unit is installed within the groove, the more the sides of the groove will cut off the low angled light, reducing the visible area of light from a distance.

Physics dictates that the further away one views anything; the lower the viewing angle will be. Thus, with horizontally installed LEDline®, with a small surface area, the further away one tries to see the unit, the smaller will be the surface area of light available to be seen and therefore, the less visible it will become. Therefore, viewed from long distances, the foreshortening effects and the low angles will only allow a fraction of the area of the light to be visible. As with the painted stop bars at traffic lights, which are deliberately widened to counteract this, additional LEDline® units should be installed to widen the horizontal visible area of light.

Alternatively, have the LEDline® units placed longitudinally and space them relatively close together across the road. This way, from a distance, a maximum-lit surface area will be available for viewing. Close up the driver will see the spacing's between the lit sections.

Pedestrian Crossing / Crosswalk Safety: At night, lighting up anyone on a crosswalk is key to improving safety. As trialed by FHWA at the Virginia Tech., here pedestrians are highlighted from all sides on the crosswalk, with the semi-directional LEDlineDV™ units. These directional lighting units, are placed on opposite sides of a crosswalk, facing in towards the walker and approaching vehicles, at night, fully highlight the walker and anything stepping in between the lights from any direction.

Copyright Dr. Ron Gibbons Virginia Tech. and FHWA Study, Side and Front Crosswalk



Again, for horizontal applications, particular care must be taken to ensure that LEDline® units are flush with the pavement surface and closely follow the contours of the pavement, so that the light is not cut off, (masked or hidden) from distance viewing by the edge of the groove. It is recommended that:

- planners decide on the desired visibility distance of the marking and consult HIL-Tech engineers for advice as to best layout and product selection to achieve their desire;
- for horizontal in-pavement installations, that a minimum of two tracks of LEDline® be placed side by side with a suitable gap between, to increase the width of the visible lit line, thus increasing its distance visibility, or alternatively;
- that any horizontal line is to be created by individual LEDline® units be installed parallel to the road direction, (like a lit ladder across the road). From a distance, this is the most visible horizontal pavement marking as the light has the full length of the LEDline® to exit towards the viewer.

For Helipads: Copyright Mr. Bruce Lomasky USA Helipad.



Perimeter Lights; TLOF: For the omni-directional helipad perimeter lights, the LEDline®, in snow plough areas, should be flush with the surface. **Make sure that the units are flush with the surface and not too deep or the light from the omni-directional units will be cut off by the sides of their installation groove, so the light from a distance will not be uniform.**

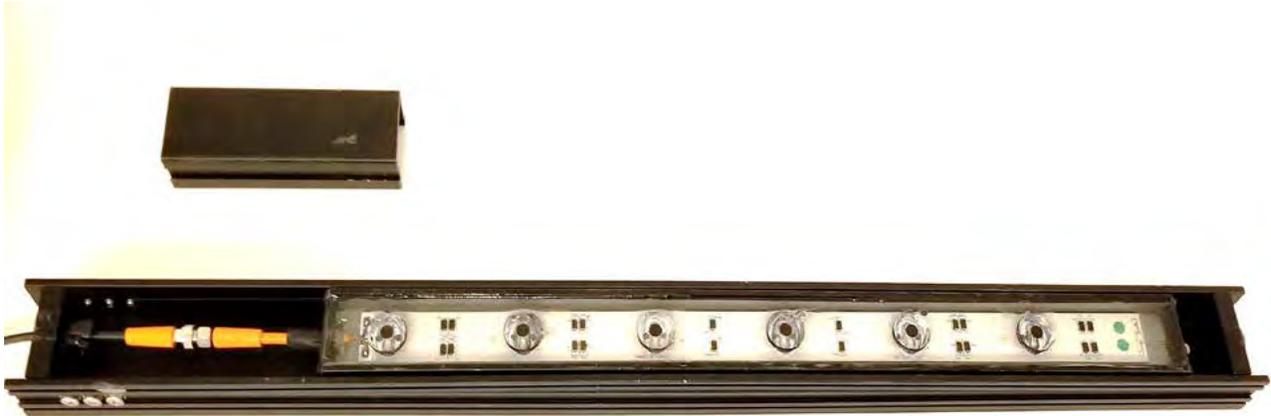
Aiming Circle and Lit “H”: For the Aiming circle, ICAO Annex.14 volume 2 calls for a minimum of 50% of the aiming circle to be lit. For the aiming circle of helipads in snow plough areas or the tropics, LEDline® should be installed flush with the pavement surface and be installed flat and even. To reduce glare for landing, hovering pilots, please specify if you need the vertical emitted light to be reduced.

The lit “H” or any other lit marking for the helicopter to land on is easily achieved with LEDline® omni-directional product, usually the embedded 6 LED system LEDlineHB™. To reduce glare for landing, hovering pilots, please specify if you need the vertical emitted light to be reduced.

LEDline® Comes with Mounting Plate “U” Channel and IP69 Waterproof Connector:

For all in-pavement applications, for ease of installation and ease of future maintenance / replacement, each LEDline® comes with a Mounting Plate “U” channel and waterproof connector. The LEDline® is locked in place within the Mounting Plate “U” channel, by one end being locked and the other being held by an attached bolt and nut. (Please see HIL-Tech drawings for details).

The Mounting Plate “U” channel has four (4) adjustable screws at the corners (#8/32 gauge or M4 metric). These are used to set the LEDline® at the right depth and camber within the pre-cut groove. Prior to any glue being used, each LEDline® unit must be tried within its own groove and the 4 x set screws adjusted for that groove. Once the screws are set, the LEDline® unit can be removed from the groove to allow the glue to be added and then the Mounting Plate and LEDline® with its attached power line induction connector can be installed within the groove.



The reason for the Mounting Plate “U” channel is to hold the LEDline® within the shallow groove, so that access for long-term maintenance to the LEDline® is easy. The waterproof connector for the induction power pickup and Mounting Plate “U” channel will stay in the groove and should one be needed, is able to receive a new LEDline® unit. Such installations require a cut groove in the pavement for the LEDline® / Mounting Plate “U” channel of some 60mm (2.4”) wide, and the depth for the Mounting Plate and induction connector should be at least 45mm (1.8”) deep. (See drawing HT-6851 HT-6852 HT-6853).

The LEDline® power line circuit is always installed in a groove of a minimum depth of 55mm (2.2”). **It can be deeper but never shallower!**

The complete LEDlineDV™ or sunlight visible LEDlineSunDV™ and Mounting Plate “U” channel unit are installed together, flush with the pavement surface. **Note: The completed LEDline® installation should be flush with the road surface, so snowploughs cannot touch**

the product. Moreover, every unit should be installed in the same way within the groove, the same distance from the groove front, with the same aspect ratios, so that they all have the same appearance when lit.

General Preparation and Equipment:

To receive the LEDline® One (1) year Limited Warranty and to ensure proper installation, LEDline® must only be installed by HIL-Tech Ltd approved / certified workers / contractors, or a representative of HIL-Tech Ltd., must be present when it is being installed. Please contact HIL-Tech for details.

The Standard One Year HIL-Tech Ltd. Limited Warranty and No Liability declaration is on page 43. (Please Note: Up to three (3) years of additional Limited Warranty for the LEDline®, above the standard one (1) year, may be purchased at the time of acquisition,).

Some Suggested Installation Equipment: For Installing LEDline ® into Either Asphalt or Concrete, in Normal Summertime Conditions.

THIS IS NOT A COMPLETE LIST.

Note: Amounts will vary depending on the size of the Job:

For new concrete installations, grooving, grinding or saw cutting is unnecessary, since forms and spacers can be inset into the quick setting concrete to create the necessary grooves for the LEDline® installation. Contact HIL-Tech Ltd for details

- 1 – 2 saw cut machine/s with all necessary equipment (depends on the size of the job);
- 1 x 60mm (2.4”) wide blade to cut min. 40mm (1.5”) deep x by some 965mm (38”) long groove in concrete or asphalt for the LEDline® lights. These can be routed / ground out or saw cut with a compound blade made up of a number of blades with spacers. Multiple blades with spacers can make the 60mm (2.4”) wide cut with one pass.
- 1 x 12mm (0.5”) wide saw cut blade to create the min. 55mm (2.2”) deep groove for the LEDline® power lines.
- Direct Burial Wire: Suggested Type RWU #8 or XPL USE-2. Again, using #8 (USA) RWU gauge wire (= #35 metric wire gauge MAX O.D. of insulation 7.9mm (0.31”) or stranded copper area approx. 11 mm²), all suitable for direct burial according to local codes. There must be sufficient to complete all wire run distances from the Power Supply out to the furthest distance of a particular run then back again, (not forgetting to add in the amount to reach the power supply). The doubled wire run distance must be sufficient to create a complete unbroken loop over the entire distance;
- Glue, two-part epoxy style (please contact HIL-Tech for suggestions);
- Knee Pads Rubber / latex gloves;
- Squeegee/s;

- Trowels;
 - 15 - 20mm (6" - 8") wide Duct Tape to cover the edges of the cut grooves so that any glue spills do not make a mess;
 - 3M Gel to seal in the IP69 connector when installing it into the Mounting Plate "U" channel cavity 3M #8882 or equivalent;
- Saw Cut Machine with single layered 60mm saw cut blade.



The 1 blade 12mm (0.5") wide to cut min. 55mm deep (1/2" wide x min. 2.2" deep) groove for the power line. This groove can be ground or routed out, saw cut blade with a single pass.



- For concrete slabs where the power line crosses an expansion joint between slabs, a 100mm (4") diameter x minimum 55mm (2.2") deep hole should be drilled / cored so that it spans the expansion grooves between the separate slabs. This is to house a loop of wire to accommodate different slab movements. Once the wire loop is installed, sand should be placed on top of the wire loop to allow for its movement, then glue should be used on top of the sand to seal it all in and prevent water accessing this place.

Fig. 1. 100mm (4") diameter cut hole across an expansion joint to allow for a wire a service loop top move with the different slabs.



- Foam backer rods, to keep the wires in the grooves;
- Bricks to hold down the LEDline® so it does not float once it is installed into the glue;
- 55mm (2.2") tape to cover the surface of the LEDline® before installation, so that when installed any glue spills will not make a mess of the LEDline® surface. Note: This tape must **not** be removed from the LEDline® surface until the glue is set;
- Chalk and a tape measure, to mark the road where the LEDline® is to be installed;
- Electric drill (Phillips head) for the Mounting Plate screw adjustments;
- All night time applications will require good lighting to check the quality of the installation and to see that the colour of the glue is consistent when installing the LEDline®;
- Create a 2mm (0.16") deep "depth key" of metal or plastic, so that the LEDline® can be measured within the groove and properly set to the right depth below the groove's surface;
- One generator to test the LEDline® Master Controller and circuits;
- **Optional:** Plastic sheeting strips and sand to cover / hold down plastic over any open saw cuts to minimize rain delays;

Weather Considerations:

Make sure that the weather will support installation; temperature; humidity; wetness etc. and make allowances for the adhesive's setting times. i.e. Colder temperatures and wet conditions will slow the glue's setting times, very hot conditions will tend to speed up the setting times.

Please read and follow the adhesive manufacturer's specific installation specifications.

Off Site Preparation:

To speed installation, the LEDline®, Mounting Plate “U” channel and Induction power pickup with a service loop within the IP69 connector housing and 3M jell can be prepared off site, and be fully connected and sealed against moisture. (See preparations Page.17)

Basic Good Practice:

There are two (2) types of grooves needed, one for the power lines and the other for the LEDline® lights and their Mounting Plate.

- Make sure that the saw cuts for the LEDline® / Mounting Plate “U” channel unit and the wire power lines between the units are to the correct depth and width. Where the LEDline® unit is located, the groove should be a minimum depth of 40mm (1.5”) deep x 60mm (2.4”) wide, and some 965mm (38” long).

Where the uncut cladded wire power line is installed, **the groove can be deeper but should be a minimum of + 55mm (2.2”) deep and 12mm (1/2”) wide.** If more than one circuit is to be installed within the groove, then it can both be wider and deeper.

Depending on the installation preference of the power line, either to the side of or underneath the LEDline® lamps, for the side of installation, the hole for the induction connector is some 100mm (4”) diameter and a minimum +55mm (+2.2”) deep. If in line with the lamps, the induction connectors are accommodated within the same groove as the lamps.

- **The Preferred Installation Procedure:** the LEDline® units are placed on top of the narrow power line groove. Router out or plunge cut the grooves for the LEDline® units so that the LEDline® groove has the power line groove running through the middle and below it. See HIL-Tech Ltd drawings for details HT-6354 and HT-6355.
- **Note:** The alternate installation method is to have the narrower power line groove parallel to but slightly away from the wider LEDline® lamp grooves by about 300mm (12”). See HIL-Tech Ltd drawings for details HT-6354 and HT-6355.
- **For centerline asphalt installations, try to make sure that any LEDline® installation is at least 200mm (8”) away from the nearest asphalt cold rolled joint,** or this will become a weak section in the asphalt and with time, the asphalt may start to break down.
- For correct glue adhesion, all saw cuts must be clean (pressure wash after the saw cut, free of debris or saw cut sludge), dry and blown clear of moisture and debris. (“White glove” test).
- If there is a concern for getting excess glue on to the groove pavement edge, most contractors have elected to cover these edges with a 4” or 2” wide tape, so that once the glue is set and the tape is removed, the installation looks clean and neat.

- Remember to cover the top of each LEDline® unit with tape, so that spilled glue cannot get to it and its surface is kept clean. **DO NOT REMOVE THIS TAPE UNIT THE GLUE IS SET.**
- For maximum efficiency, whilst the saw cuts are being done, others should create the LEDline® harness. This is done by pulling sufficient wire to run from the Master Controller to the end of a circuit and back again to the Master Controller. **MAKE SURE THAT THERE ARE NO BREAKS OR SPLICES IN THE WIRE.** Before sliding on the induction power connectors onto the wire, a short test length of wire (say 5 m (15 ft.)) should be connected to a Master Controller, and a min 10 lamps (more if desired up to max of 40 lamps) to pre-test all lamps. Connecting the Mounting Plates with the LEDline® to each of the induction power pick up connectors may be done ahead of time, off site.

After testing, slide the assembled Mounting Plate with the induction connector CTs onto the installation wire, it should be positioned roughly where it is to be installed and then the wire should be tie wrapped together so as to prevent the assembly from moving.

For more in depth “Installation Details”, please see page 21 and page 36 below.

Wiring the LEDline® Together to Form a Harness Unit:

Lay out the main power supply wiring (BUSS wires) beside the groove and move the LEDline® / Mounting Plate “U” channel sections to approximate the installed lamp requirements. Again, ensure that the BUSS wire runs from the position of the Master Controller through each of the induction connector holes to the end of the entire lit feature and then back again to the Master Controller are without a break in the wire.

Only one wire goes through the inductive power connectors. The induction power pick up connector will allow a North American #8 gauge RWU#8 or USA type XPL-USE2 direct burial wire, (stranded copper area approx. 11 mm²), with a cable diameter, including wire cladding, of not more than 8 mm, so as to be able go through the induction power pickup central hole.

Make sure that the end of the circuit loop back is large enough not to kink or break over time, by having the wire go around a non-corrodible 75mm (3”) plastic pipe or similar wire guide. (If necessary, ensure that the end of a circuit has a slightly wider/ deeper section to accommodate this pipe and loop size). (Please see the enclosed picture).

Once the LEDline® sections are positioned along the length of the “**outgoing**” wire, in their designated areas, ensure that both the “outgoing” and the “return” wires are taped / tie wrapped together at 300mm (12”) intervals or less to form a single wire harness with the main power wires fixed in close proximity along its entire length. Any wire going through a conduit should be pre-taped or twisted together.

Similarly, each of the induction power collectors must be taped / tie wrapped on either side. (The power line wires must be continuously in contact with each other along their whole length (except where the “outgoing” wire passes through the induction power pick up connector). Again, any feed wires going through a conduit of exiting the Master Controller must be taped together also. This is necessary as it reduces the impedance levels and prevents the wires from giving off electromagnetic emissions, as the two wires in contact with each other will cancel each other out.

Make sure to have a big enough conduit, so that the taped together wires can be pulled through. If one cannot pull the taped together wires through a conduit, have sufficient extra length available, so that once the separate wires are pulled through the conduit they can be twisted together to ensure that the sections within the conduit will always remain in contact with each other.

Saw Cuts: The concrete slab or asphalt is routed out or saw-cut or along the line where the LEDline® is to be installed.

It is recommended that the "wide" grooved / routed out or plunge saw-cuts for the LEDline® / Mounting Plate “U” channel product **are made after the narrow wire power line grooves / cuts**, to a width of 60 mm (2.4”) wide and 40mm (1 5/8 ”) deep. The length of the grooved / routed out or plunge saw-cuts should be around 965mm (38”) so that there is plenty of room to position the LEDline® unit at least 200mm (8”) away from the front of the groove, so that low angled light is not blocked by the edge of the groove.

The “narrow” groove or saw cut for the power wire (12mm (½”) wide x a minimum of +55mm (+2.2”) deep) is routed out or cut where the circuit should go, then the “wide cut for the LEDline® units should be made.

For roads, when the connecting groove or saw-cut is made from the end of the LEDline® feature to the side of the road where the Master Controller is located, to avoid resurface milling machines, the depth of this saw cut can be much deeper than usual. It is not uncommon to have this depth some 100mm -160mm (4 - 6”) deep or more, below where the surface road pavement is normally replaced. The width of this saw cut is dependent on how many circuits are returning to the Master Controller at that particular point and so is dependent on the number of circuits it is to hold. However, where the LEDline® is to be installed, the groove should be only 40mm (1 5/8”) deep.

Any groove or saw cut for the power line wire that changes direction of the wire must have a radius to prevent the wire from being cut or breaking on a sharp corner if/ when it shrinks in cold, or expands in warmth. Wire/s within this groove should not be tight, but loose so that when it shrinks in cold weather it will not be damaged. If multiple lines from different circuits are being fed back across the road, stagger each groove line, leaving plenty of asphalt between them so as not to create a weakened area in the road.

As above, saw cuts back to the Master Controller must allow for wire expansion / contraction so must have a gentle radius or angle. To avoid possible breaks, remove any sharp edges around these curves, allow space, so that the wire does not contact any sharp edges, as it contracts or expands. In addition, to allow for some expansion and contraction, do not pull and install the wires too tightly within the groove.

All grooves or saw-cuts must be pressure cleaned and blown dry immediately after routing out or cutting and again immediately before glue is applied then dried. This will remove any mortar “slurry” created during the grooving /cutting process. (This is especially true when saw cutting concrete, as dust, fragments mix with the lubricating water cause a weak bonding area). This must be removed before it dries and sets or the glue will not bond properly. All debris must be removed and blown out of the grooves, before the glue then LEDline® is installed. (If after running your finger/s along the inside surface of a groove (white glove test), there is still a residue, the groove must be cleaned again.) Remember, that if left for a few days, open grooves will accumulate debris and again may need to be cleaned.

Make sure that any installation is at least 200mm (8”) or more away from the nearest asphalt cold rolled joint or this will become a weak section in the asphalt and with time, and the asphalt may start to break down.

All buss wires in circuits should be composed of a single length of wire without a break. For very long runs where a joint has to be made, it is advised to create a manhole at the edge of the road to allow access to the joint later should it deteriorate.

NOTE: DO NOT DRIVE OVER THE OPEN SAW CUTS, SINCE VEHICLE WEIGHT CAN CAUSE DAMAGE TO THE SAW CUTS!

Electrical Considerations:

For the induction connected / powered LEDline®, the Master Controller contains a pulse modulation power module which provides a constant current power of low voltage to the LEDline® light units.

Master Controller: A separate installation and activation manual is available from HIL-Tech Ltd. **Note:** All should be connected and protected via power surge protectors.

Master Controller: Each Master Controller can contain up to six (6) x Power Modules inside a (NEMA) rated (3R) weatherproof cabinet of some Height 992.5mm (39.1”) x width 558.8mm (22.0”) x depth 479mm (18.9”). **Note:** There is a single Power Module Master Controller, which is much smaller and narrower. The Master Controller must be installed at a suitable location, as close to the LEDline® installation as is possible, but far enough away from any possibility of vehicle contact. (See the separate Master Controller Installation Guidelines).

Below is A Master Controller with Six Power Modules



Wires: Pairs of #8 (USA) BUSS (= #35 metric wire gauge MAX O.D. of wire and insulation 7.8 mm (0.31")) suitable for direct burial according to local codes (suggested Type RWU #8 or XPL USE-2) are run inside the saw-cuts (See drawing HT-6257), or inside a conduit, from an individual Power Module to the start of the LEDline® feature. Again, all the wire runs to and back from any circuit should not be spliced, but should be a single continuous wire run and must be tied together.

The LEDline® Master Controller is rated 90 - 240VAC universal input 50 / 60 Hz input (please see power supply spec. sheet). Different variations are available for series circuits at airports or if the LEDline® is to be powered directly from a legacy CCR series circuit then LEDline®'s electronic regulator and isolation transformer must be used.

Wire Distance: Suggested Type RWU #8 or XPL USE-2. Again, using #8 (USA) RWU gauge wire (= #35 metric wire gauge MAX O.D. of insulation 7.9mm (0.31")) or stranded copper area approx. 11 mm², all suitable for direct burial according to local codes. For a circuit, measure off the complete wire run distance, (not forgetting to add in the amount to reach the power supply) and then double this distance, to have sufficient wire to create a complete unbroken loop over the entire distance. i.e. If the distance is 100m, (328ft) plus another 10m (32ft) to cross the road to

the power supply, then the wire loop distance needed would be 220m (722ft). Note, each wire run must start and end at a particular Power Module (i.e. the wire must be continuous, without breaks, joints or connections of any kind in order to avoid corrosion).

If the Mounting Plate “U” channels have been shipped separately to the LEDline®, mount the LEDline® into the Mounting Plate “U” channel. The connector between the LEDline® unit and the induction power pickup connector should be made within the IP69 connector housing. Afterwards, the plastic grommet should be closed and the hole blocked and sealed with 3M #8882 Jell or equivalent to prevent glue from entering the IP69 housing section when installing the LEDline®.

The direct burial loop of BUSS wires should be laid out alongside where they are to be installed and the LEDline® with their Mounting Plate “U” channels have their induction connectors threaded onto one of the wires.

Initially, leave the units close to the Power Module end, energized and test the LEDline®, prior to any installation. At this time, if desired, replace and make any changes to the LEDline®.

The tested LEDline® units are then slid along the BUSS wire until they approximate and are parallel to the positions where they are to be installed. The BUSS wires between the sections are then taped tightly together every 300mm (12”) intervals (or less) all along their entire length, (except where one of the looped wires is threaded through the LEDline® Connector and here tape / tie wraps can be used to hold everything together).

At the induction connector, the connector block is taped or tie wrapped on either side to the power wires. Once in position, the system should be energized as a final trial of the lit LEDline® units.

Note: The overall positioning of the LEDline® may need to be adjusted to avoid any individual LEDline® unit being positioned across a concrete joint or asphalt-to-bridge joint. Typically, all expansion joints are crossed by using the flexible BUSS wires coiled within a standard wire detail. Again, all LEDline® sections should be at least 200mm (8”) away from any cold rolled join of asphalt.

Retro-fit Installation into Concrete Slabs or Asphalt via Saw Cut:

Installing the LEDline®: For the LEDline® Limited Warranty to be valid, only certified HIL-Tech qualified electricians should install LEDline®. If there are no locally certified electricians, then a representative from HIL-Tech must be present on the job site to ensure the correct installation for the Limited Warranty to be valid.

Pre-installation Preparation of the LEDline®: Prior to going to the installation site, the LEDline® can be prepared and everything, other than the wire, can be connected so that installation will proceed very quickly.

Off Site Preparation of the LEDline®, Mounting Plate “U” channel, Induction Power Pickup and 3M Jell: Once the LEDline® has been received from HIL-Tech Ltd., open the box containing the LEDline® / Mounting Plate “U” channel and the induction power pickups to prepare it. The idea here is to have everything ready and pre-connected.

- Lay out the LEDline® attached to its Mounting Plate “U” channel and with clear tape, cover the surface of the LEDline® to prevent any future glue getting onto it. (The LEDline® needs to have its face covered with tape to prevent any glue getting on it when it is being installed.)
- Install the four adjustment screws that control the depth of the exterior Mounting Plate “U” channel. The four (4) x 10-32 x 0.75” – 1” machine screws need to be screwed into the four (4) x appropriate holes. All four (4) are accessed from the top of the Mounting Plate “U” channel. Just screw them in so that they are secure. These screws adjust the LEDline® to the right depth, slope and camber within the onsite cut grooves, so will need final adjustment before the LEDline® can be installed and glued in there.
- Undo the nut holding down the LEDline® and open the IP69 connector box.
- Connect the induction power pick up to the LEDline® within the box. **Note: Make sure that the red “O” ring is intact and present before the two (2) parts of the IP69 connector are joined together.**
- Block the wire exit hole from the IP69 housing so glue cannot enter this box from the outside by tightening the plastic grommet /nut around the wire of the induction power pick up connector.
- With a service loop, install the connected connector into the Mounting Plate “U” channel box.
- Again, make sure that the end where the induction power pickup enters the box is completely sealed so the 3M Jell will not leak out before it is set.
- Once the connector within the Mounting Plate “U” channel box is properly installed and taped together, replace the LEDline®. By inserting it back into the Mounting Plate “U” channel locking it down with a tightened nut, then install the 3M jell into the taped IP69 connector box
- Place the newly induction connected ready to install LEDline®, Mounting Plate “U” channel and induction power pick-ups into a box to take to site.

On Site Preparing the Installation Grooves for the LEDline® and the BUSS Wires:

All LEDline® units must be pre-covered with tape to keep them clean during the glue down process. Only cover the top of the LEDline® surface. Leave this tape on until the installation is complete and the glue is dry.

For a clean road surface on either side of the LEDline®, after its installation, duct tape or something similar can be used to protect the surface of the road from glue overfills and spills, keeping everything neat.

Note: A series of weights or bricks will be needed to ensure that once the LEDline® unit is installed into the glue that it does not float and so remains in position. Of course, once the LEDline® cannot move in the glue, these weights can be removed and used over again.

Select the Master Controller Site/s: The Master Controller/s power supplies should be located off to the side of the road, close to it but far enough away from it that traffic cannot be accident hit it. **Note: Installation of the LEDline® can proceed in parallel, since whilst the grooves are being cut, another set of people can be pulling the wire from the Master Controller site for each of the circuits and be preparing the wire harness, and the LEDline® and its Mounting Plate “U” channel, getting the harness ready for installation into the cut groove.**

- **Routing out or Cutting the Grooves:** First measure and chalk out, on the pavement surface, exactly where the power line and the LEDline® and its Mounting Plate “U” channel are to go. (If you are using the alternate (**not preferred**) side cut and induction power connector hole, then allow for at least 200mm – 275mm (8” - 10”) between the LEDline® saw cut and the power supply distribution wire. (HT-6355 and HT-6354) **Note: The wire depths are minimums and if required, the induction wire can be installed much deeper**
- Using a router, grinder or saw cut machine, groove or cut out the power distribution wire groove, then do the same for the LEDline® units. Please see suggested installation details. (HT-6355 and HT-6354). If using the alternate (**not preferred**) side cut and induction power connector hole, Cut the diagonal grooves and mill out the 102mm (4”) diameter x +55mm (2.2”) deep induction power pick up space, where the induction connector meets the power distribution wire. See DOT drawings or HIL-Tech drawing (HT-6355 and HT-6354)
- **High-Pressure Clean:** Once the grooves are cut they must be thoroughly cleaned so that the saw cut left over slurry does not dry or cake onto the bottom or sides of the groove forming weak areas for the glue to adhere to. **Cleaning must be done immediately after the saw cutting with a high-pressure water spray.** Note: If the grooves remain open for more than a few hours they may need to be cleaned again prior to the LEDline® installation, since dirt, grease and dust from passing traffic may have gotten into them again. Always check to see if they are clean (white glove test) and if they are not clean, clean them again. **ALL GROOVES OR SAW CUTS MUST BE DRY and CLEAN BEFORE INSTALLING GLUE INTO THEM.** Note: Once the groove, saw cuts are done, do not drive any vehicles over the open saw cuts, especially in asphalt or the edges of the saw cuts can break down.

- ***Working in Parallel on Site: One Group Created The Grooves, Saw Cuts, Whilst Another Makes The Wire Harness:*** As the grooves are being measured and cut, another group can be pulling the RWU #8 copper direct burial wire from the Master Controller location along the side of the road / circuit for the full circuit length and then back again to the Master Controller. There should be no breaks in the wire and there should be sufficient wire length so that when the wires are taped together, or are twisted together in a conduit, there is enough wire left over to easily connect up to the Master Controller and the circuits Power Module.
- **Check to ensure that there is sufficient wire to complete the required circuit.**
- Pull sufficient wire so that there are no breaks to complete a single circuit and thread the LEDline® / induction power pick up onto the outgoing wire, laying each LEDline® unit opposite its cut groove position.
- Once the wire for a circuit is pulled, the LEDline® induction power pick ups can be installed onto the outgoing wire, by sliding them and the pre-attached and jell filled Mounting Plate “U” channel boxes along the wire. (It makes no difference whether they are installed on the wire going away from the Master Controller or the one returning to the Master Controller.) The induction power pick up connectors can be slid along the wire until they are roughly in the position they will be installed into the road. The two wires can now be tied together every 300mm (12”) so that they make up a single harness with the LEDline®, Mounting Plate “U” channel and Induction power pickups.
- **(If this has not been pre-done in the shop)**, remove the LEDline® insert from the Mounting Plate “U” channel top box plate of the Mounting Plate “U” channel following the previous guidelines (pages 16 – 18) on connecting the induction power pick-ups with the LEDline® via the connector. *(see enclosed drawing (HT-6355 and HT-6354) and LEDline® Locking Connector picture.* Please ensure that there are two 150mm (6”) long service loops present within the box). Thread the induction connectors and LEDline® units on to the wire circuit.
- **Test all the LEDline® units once they have been installed on the wire harness before installing into the glue, as an induction power pick up connector might have been damaged in transit, so might need to be replaced.**
- Place a 75mm (3”) diameter piece of cut plastic pipe at the end of the circuit/s and tie wrap them together. This is to allow for a smooth return the power distribution wire circuit at the end of the circuit, thus prevent any kinking / breaking over time. See picture next page.
- Tie wrap the direct burial wire together every 300mm (12”) to reduce the circuits impedance starting from the furthest end away from the Master Controller, (where the wire bends back to return to the Master Controller). Make sure that each induction pick up

connector is tie rapped on each side of the induction connector to the power line circuit and that the induction power pickup is preferable on the bottom wire of the circuit.

Whilst the grooves are being made and are being cleaned and dried, the completed harness fabrication can be laid alongside the grooves where the LEDline® units are supposed to be installed. **Be sure to cover the exit hole from the LEDline® / induction power pick up, so that when the LEDline® fixture is pushed into the glue, for its final resting place, the glue cannot enter the IP69 connector.**

Installing the LEDline® Into the Pre-cut Grooves:

Setting the Correct LEDline® Height, Depth and Angle within the Groove: The only way that LEDline® survives snow ploughs is to completely avoid them. Therefore, it is very important to set the LEDline® unit flush with the surface of the road. No snow plough blade should ever be able to contact the LEDline® or the plastic will break. **Note:** Even though the LEDline® is installed flush with the pavement surface, LEDline® melts snow in snow depths of some 18cm (7") deep, so the light should not be obscured by snow.

To achieve the right depth for the LEDline® light unit within the groove, make sure that the groove is at least 40mm (1.5") deep. (Note: The groove for the power distribution circuit can be deeper, but must be a minimum of +55mm (2.2") deep).

Mark where the front of the LEDline® is to be within the groove, making sure that this is consistent for all LEDline® being installed.

The “front” of the LEDline® is the leading edge of the LEDline® facing the oncoming traffic, which must be set at a “**standard distance**” away from the leading edge of the groove, (**minimum 200mm (8”)**), so that the low angled light (vital for being viewed from a distance), is not physically blocked by the end edge of the groove. In areas that receive snow, **no part** of the LEDline® should be able to make contact with a snow plough blade, so it must be flush with the pavement surface. (Contact HIL-Tech for any guidance).

Once the grooves for the LEDline® and Mounting Plate “U” channel have been cut, cleaned and are dry, each LEDline® / Mounting Plate “U” channel unit should be tested within its designated groove and have its four (4) mounting screws adjusted to position the LEDline® unit to the right depth, aspect ratio and slope etc. These screws **do not have to be fully screwed down**, as they are just adjustment screws, so their heights will vary depending on the groove depth. Once the glue is set these screws help to hold down the LEDline® within the groove. (Note: For installation; the glue with glue gun; a metal or plastic depth gauge key; plastic gloves; knee pads; Philips type screw driver (cross type); and tape measure will be needed to properly install the LEDline®).

Using the four (4) x screws of the Mounting Plate “U” channel adjust the LEDline® position until it is right within the groove and the LEDline® is below the pavement surface at the right camber, pitch etc.

Introduce the glue into the groove, and then push the LEDline® / Mounting Plate “U” channel down into the glue. (The four (4) x Mounting Plate “U” channel screws will maintain the LEDline® unit at the right depth and the right angle, camber and pitch). All four (4) screws are accessed from the top of the Mounting Plate “U” channel. NO screws should be sticking up above the surface of the glue once it is installed. If they have not been positioned properly and the unit is too high once the glue is installed, the LEDline® should be immediately removed from the glue and the mounting screws recalibrated. **As pavement is not level, once the LEDline® is installed into the glue, with the depth-positioning key, make sure that the whole length of the LEDline® is flush with or slightly below the pavement surface.**

Again, all LEDline® should be installed flush with or slightly below (2mm (1/16”)) below the pavement surface so snow ploughs cannot contact them and set at a **minimum** of 150mm (6”) away from the front of the groove.

If, due to a road’s camber the LEDline® unit is to be installed on a ridgeline in the road, then extra care should be taken to ensure that the LEDline® unit is below the road surface. On a ridgeline, even flush mounting the LEDline® units will not be deep enough to avoid the ploughs, since the snow plough blade will be resting on the LEDline® as it moves along the ridge crest and will break the LEDline®. In this circumstance, if possible it is better to move the LEDline® away from the ridgeline. If it cannot be moved, then recess the LEDline® by an **additional 2 mm (1/16”)**. Again, it is very important that no snow plough blade is able to reach the LEDline®, so please ensure that the unit is at the required depth.

Note: In spite of being flush with if it is set back away from the groove front some 150mm – 100mm (6” – 8”), the low angled light can still exit towards the viewer, so the LEDline® will remain visible. (For those wanting even lower angled light facing the viewer, via the four corner screws, it is possible then make the end of the LEDline® slightly higher than the front. However, make sure all of the lamp is flush with or slightly below the surface.

End of the Circuit: Make sure that at the end of a circuit, where the cable doubles back in on itself, the small wire loop is supported with a disc of non-corrosive material, such as a piece of plastic pipe. A cut piece of 75mm (3”) plastic pipe, etc., or something similar, can be used and must be installed with the wire going around this radius device, at the right depth, 75mm (3”) minimum so that this loop is maintained over time and does not kink and break. As per the picture below, tape or tie wrap the wire to the pipe so that the two cannot separate by themselves.



Do not tighten the wire run harness within the groove, but install it in a loose configuration. Make sure that the wires are taped or tie-wrapped together, every 300mm (12”) and allow some slack, for expansion and contraction, especially when going around bends. **Note: All sharp within the groove corners should be removed or rounded.**

It is critical to have the right depth for the power wire runs between the LEDline® units. **The minimum required depth is 55mm (2.2”).** They can be much deeper than the 55mm (2.2”) however, any installation of these wires in less than 55mm (2.2”) in depth is unacceptable and will void any product warranty. The depth required where the LEDline® is installed is a minimum of 40mm (1.6”). Too shallow installations cause nothing but trouble. If the power distribution wires are too close to the road surface, they will expand in summer heat, and so can work their way on to the road surface and be damaged / broken by traffic. Again, any such installation will void the HIL-Tech Ltd., Limited Warranty.

Choosing the Glue: Please Note: HIL-Tech Ltd does not recommend or take any responsibility for the selection or use of glues, since it is the installer’s responsibility to select the glue. In all cases, the glue manufacturer’s instructions must be followed to the letter!

The ideal glue will harden quickly and once cured, will remain slightly flexible (not brittle) even in cold temperatures, so it can expand and contract with weather temperatures, sticking to the asphalt or concrete edge so as not to allow any water ingress, any time.

The adhesive should be an epoxy style glue, which meets the above ideal, which should be mixed together at the time of installation using a static mixing nozzle of the right length and size, or be hand mixed. (Again, please refer to the glue manufacturer’s instructions for nozzle sizes and glue set times, since the latter is usually temperature and wet weather dependent).

For self-leveling situations; Webertec cable grout was used in Vancouver International’s installation, and there are others equally satisfactory.

For slopes, where the firmer “stay put” glue is suggested, Bond Seal 800 glue or an equivalent has been used, which can be ordered in hand pumped tubes. For glues that are more tolerant of damp conditions Flex 2 or an equivalent has also been used.

Again, Please Note: The above reports some glues that have been used, but it is the installers responsibility to select the glue. HIL-Tech Ltd does not recommend or take any responsibility for the selection or use of glues. In all cases, the glue manufacturer’s instructions must be followed to the letter!

Glues:

- Make sure that the chosen glue will function in the proposed installation temperatures, moisture, and expected weather conditions.
- Once everything is positioned for installation and the depths of the LEDline® / Mounting Plate “U” channel have been set using the four (4) levelling screws, electrically test the feature again prior to its installation.

Installing the Glue and LEDline®: Make sure that there is sufficient glue available for the project. On flat level areas, self-leveling glue can be used. On grades use the two (2) x part epoxy style glue that stays where it is placed, this way the glue can be deliberately placed and squeezed and smoothed into place. Whatever the glue, clean off any excess.

The glue should be installed first into a section of a groove and then the wire, induction power pickups and / or LEDline® fixture be pushed down into the glue. This ensures that there are no air pockets left to potentially fill with water and then, with freeze / thaw conditions expand causing damage to the groove or to the LEDline® by lifting it so that it may be damaged by snow ploughs or traffic. A little experimenting will determine how much glue is necessary before the LEDline® is pushed down into it. Again, the process must avoid having trapped air, causing voids for water to get into.

Make sure that the wires are taped or tie-wrapped together, every 300mm (12”) and allow some slack for summer / winter expansion and contraction. Any wires crossing an expansion joint should have a standard loop to allow for the expansion. Do not tighten the wire run harness in the groove, since it must be able to shrink without breaking.

- Ensure that the grooves are very clean and ready for the glue.
- For a clean look, using 75mm (3”) – 100mm (4”) duct tape, tape the edges of the cut grooves so any spilled glue will not affect the road surface.
- If possible, load the induction connectors onto the bottom power line in the circuit, so that they are attached to the bottom wire, so have the maximum amount of glue around and on top of them.
- For installations where the power line is located below the lamps, starting at the end of the circuit, (the farthest point away from the Master Controller), apply the glue for the

buried wire for a small linear section. Then sequentially pick up and push down the tied together wire harness, then induction connector and then the lamp into the glue. The glue should flow around the hard where sections. Then, add enough glue into the grooves, so that when installed, the wire, the induction connectors and the LEDline® will be buried, with only the surface of the LEDline® showing flush with the pavement.

By installing the glue first and then pushing the LEDline® into it, the LEDline® and Mounting Plate “U” channel should displace the glue so that it rises up on either side, forming a slight meniscus, at the level of the road. This is to ensure a watertight seal and so that no air voids will form within it. Infill any areas which need more glue.

- Clean off any excess or spilled glue areas, especially any glue obscuring the taped LEDline® top. At this time, the LEDline® should still have the tape on its surface so that no glue can get onto its surface and the edge of the grooves should still have their tape protecting the surface of the road there.

Again, starting at the furthest end of the wire circuit and working towards the Master Controller / Power module/s, the wire harness and LEDline® units can be sequentially placed into their glue-filled grooves and pushed down until they contact the bottom of the groove to ensure the right harness / groove fit is accomplished. This is achieved by having a bed of the properly mixed two part adhesive pumped / placed into the bottom of the power line’s groove to a pre-determined level (found by a small test with an the actual saw-cut).

Depending on the circumstances, drawings and circuits, the power line can be installed first into the glue, or into its separate hole and groove from the LEDline® grooves. (HT-6355 and HT-6354)

Again, typically, the saw cuts are filled to about 25mm (1”) below the top before the LEDline® and Mounting Plate “U” channel is installed into the glue. (Varying depths of groove will alter this.)

The glue should hold the LEDline® and its Mounting Plate “U” channel with the four (4) adjustment screws and there should be no holes around it. If there are, fill up the holes with extra glue. The waterproof connector is protected within the 3M Jell and its box within the LEDline® inset and has a plastic Sine plug, covering the wire hole leading out of the IP69 connector housing, so that when it is screwed tight, it will grip the wire preventing any glue from entering the connector housing.

Installing glue just prior to installing the LEDline® or the wire power lines means that the glue will contact both the bottom and sides of the cut groove and will flow around the installed wires and LEDline® units eliminating any cavities. This means that there will be nowhere for water to penetrate and the glue will have maximum adhesion to the groove and to the LEDline® Mounting Plate “U” channel.

The taped together BUSS wires and LEDline® assembly (LEDline®, Mounting Plate “U” channel and waterproof induction power pick up connector) are sequentially pushed down into the sections of glue bed within the saw-cut, as a single unit.

- If possible, load the induction connectors onto the power line so that they are on the bottom wire, so have the maximum amount of glue on top of them.
- After having being pushed down through a bed of glue, make sure that the wire power lines are installed towards the bottom of the groove in a loose fashion (not tightly pulled) so that they can move a little with road expansion and contraction.
- A foam backer rod should be installed every 600mm (24”) on top of the wires to keep them within the groove until the glue cures.
- Again, with LEDline® installations, units are pushed down into the groove and the glue, at their marked place until the Mounting Plate “U”, channel adjustment screws make contact with the bottom of the groove and LEDline® is at the right depth, flush with the pavement surface. If something has changed so the LEDline® is too high or low, immediately adjust it in place by using the four (4) adjustment screws. The adhesive-sealer should squeeze up between the walls of the saw-cut and the side of the LEDline® units, to fill the saw cut edges to be flush with the paved surface. **Note:** Again, make sure that the LEDline® is always below the road surface so that snow plough blades cannot touch it.
- Once the LEDline® units, and power BUSS wires and induction power pick-up connectors are all in their groove, and the LEDline® units weighted so as not to float in the glue, additional glue may be added to any area where the glue is below the norm to bring up the glue’s level to the top of the groove edge. Smooth out the edge glue. **DO NOT OVER FILL AND REMOVE ANY SUCH OVERFILLS IMMEDIATELY BEFORE IT DRIES, ESPECIALLY ANY GLUE ON THE LEDline®, AS IT WILL OBSCURE THE LIGHT OUTPUT. DO NOT REMOVE THE PROTECTIVE TAPE ON THE LEDline® UNTIL THE GLUE IS PROPERLY DRIED.**
- At this time, infill any missing glue before the original glue dries. **Note:** The fixing times for the glues are temperature and wet weather dependent, (please see the glue manufacturer’s recommendations). For most two part epoxy style glues, in normal summertime temperatures, the glue / LEDline® units etc. should be allowed to set undisturbed for at least two (2) – four (4) x hours (for approved quickset epoxies) before traffic is allowed over them. (The glue manufacturer’s instructions must always be followed).
- Again, all LEDline® products must be installed flush with the paved surface, in tropical climates the product is also installed flush with the pavement.

Beware of Pavement Camber. As previously mentioned, in snowplough areas, if the pavement camber is causing a ridge in the road, install the LEDline® at the side of the ridge NOT on the APEX of the ridge. If the LEDline® units have to be installed on the apex, then as before, the LEDline® units must be installed the 2-4mm (1/16” – 1/8”) below the road surface, so snow plough blades cannot touch them (slightly lower at the leading front compared to the back adjustments done with the supplied leveling screws).

The LEDline® should be at least 200mm (8”) away from the leading edge of the groove. Under no circumstances should the snow plough blade rest on or even be able to reach or touch any part of the LEDline®. (As a test, place a brick or other straight edge firmly onto the road surface and move it over the leading edge of the LEDline®, if it catches, then that edge may need to be pushed down further into the glue, so adjust the four (4) adjustment screws and push the LEDline® down further into the glue.)

At airport installations, or where it is not desirable to view any light from the side, (until one is right on top of the LEDline®), the units may be installed deeper below the surface to take advantage of the groove’s sides ability to physically cut off low angle light from the side of the LEDline®. This way, visibility from the side is eliminated until one is right on top of the LEDline®. Experiment on site in a groove that has no glue in it to achieve the correct depth, or if in doubt, consult HIL-Tech Ltd.

- As before, in snow plough areas, it is paramount that the LEDline® be below the pavement so snow ploughs cannot pick it up or even touch the LEDline®.
- Depending on the glue, adequate weight / pressure must be applied to the LEDline® units so that they cannot float in the glue and will remain below the surface of the road, until the glue is cured. If necessary, concrete blocks or bricks spanning across the groove can accomplish this.
- The glue must be in contact with the bottom of the Mounting Plate “U” channel / LEDline® unit, and cover over both of the ends of it (locking in the LEDline®), and must flow around and up the sides and eventually be flush with the surface, so that there are no voids for water to collect in.
- In addition, any gaps left beside the LEDline® units and the road edge, or where the induction connectors are submerged in glue, must be in-filled and sealed to the surface of the pavement. Preferably, infill any deficiencies before the glue dries, since many types of glue do not stick well to glue that is already dried.
- After the glue has set (this is temperature and moisture dependent), there should be no gaps between the LEDline® and the groove wall. (With “normal summertime temperatures”, it requires a minimum of 2+ hours before traffic can travel over it. Please see the glue manufacturer’s recommendations for curing times). If there are any gaps, then again infill using the glue to the top of the saw cut wall and allow another 2 hours (temperature and wet weather dependent) for this final application to cure.

- **Once the glue has set and there is no need for further applications of glue (all the edges etc are filled with glue) ONLY THEN** can the protective tape covering the top surface of the LEDline® be removed. Scrape off or clean any glue that has accidentally gotten onto the surface, since the surface must be clean and clear. If necessary, mechanically clean off the glue.

For Very Cold Areas: Contact HIL-Tech for special precautions and installation instructions if LEDline® is to be installed in areas where temperatures can go below minus -30°C (minus -30°F). If this is the case, then the Master Controller must have its internal heater set to prevent water condensation when the dew point is reached when the unit is off and set to come on at around 10°C (50°F).

For the LEDline® in extreme negative temperatures, no matter what its programming, the LEDline® must be temperature controlled so that the LEDline® units will automatically switch on if the temperature falls below -30°C (-31°F), so that they keep themselves warm. Such settings are achieved within the Master Controller.

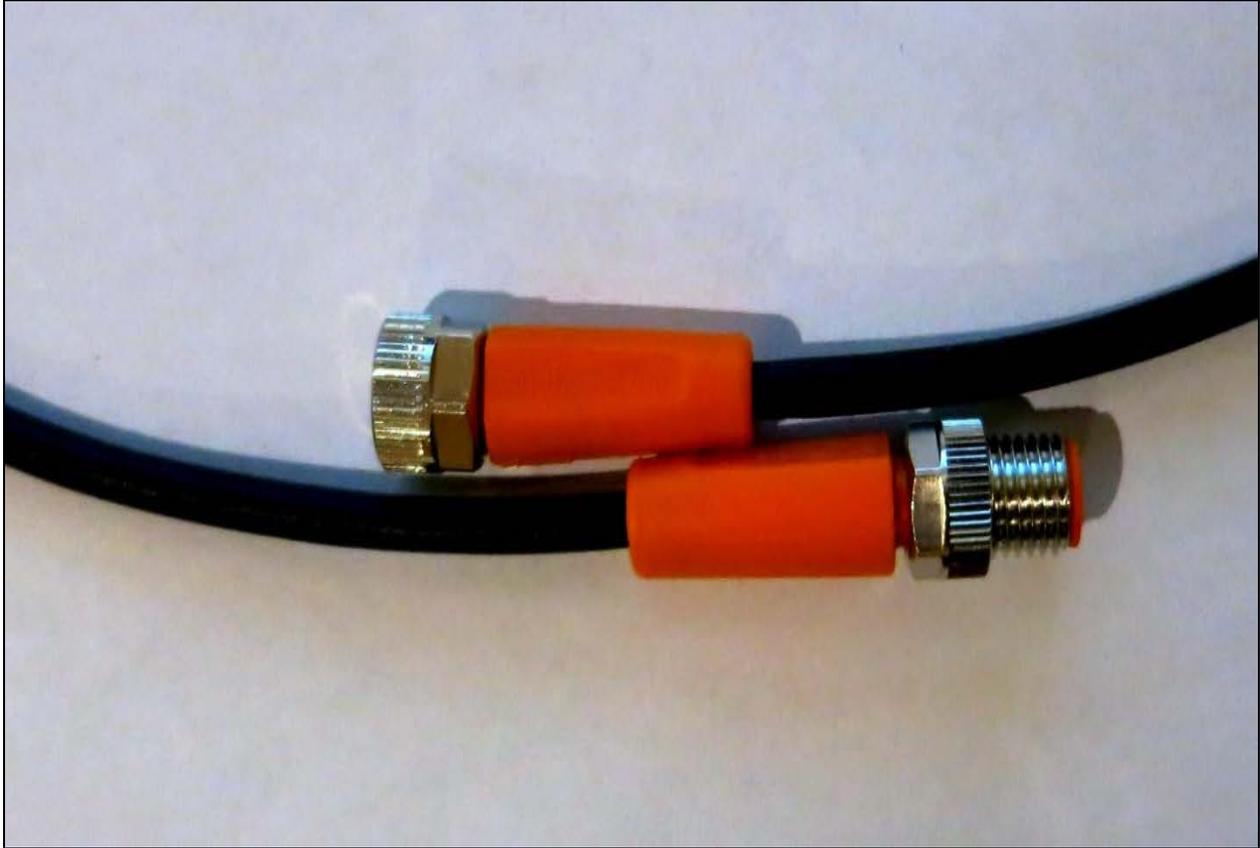
Custom Adjustments to the Master Controller: Only HIL-Tech certified qualified electricians can install LEDline® or adjust the Master Controller. If there are no locally certified electricians, then a representative from HIL-Tech must be present to ensure correct installation for LEDline®'s Limited Warranty to be valid.

- Once the LEDline® pavement installation is complete, the LEDline® should be again energized and the custom adjustments at the Master Controller should be implemented (Please see the relevant Master Controller instructions).
- Client specific nighttime dimming requirements of the LEDline® should now be pre-programmed into the Master Controller. There is a low voltage circuit within the Master Controller, which accepts a photocell input so automatically dims the LEDline® units for nighttime applications. Both the high output and (nighttime) low output light levels can be adjusted to suit clients' wishes. (Please see the relevant Master Controller instructions).
- The site should then be cleaned and the duct tape around the cut grooves removed.

Once Installed: When lit, the LEDline® should be at a uniform height and position within the pavement and should look even and uniform along its entire length. Any units that do not should be immediately investigated and attended to.

- If any units are too high, so that snow ploughs will touch them, then the LEDline® should be dug out and reset into the groove so that they are flush with the pavement surface.
- If any units are too low, then grind down the pavement around them so that they can be seen.

**IP69K Connector: Ifm M8 Male and Female Pico DC Cordsets and
Field Wirable Connectors EVC141**



Technical Specs – Cordsets (ifm)

Operating voltage: Without LED: 50 V AC / 60 V DC
Current rating: 3A
Protection rating: **IP69K = Protected against ingress of dust and high temperature and close-range high pressure,**

IP69 Test **Temperature spray downs.**
 (On a rotating turntable, with a speed of 5 ± 1 revolutions per minute, the test requires a spray 4 “- 6” (101mm-152mm) from the product of 4 gallons/16 liters per minute with water pressure of between 1160-1450 psi, at a temperature of 176°F/80°C. The heat and spray must not cause damage. The IP69K rating is the highest protection available, unless custom deep-sea connectors are required. **Please contact HIL-Tech for technical specs. on any required deep-sea connectors).**

Tightening torque: 0.3...0.5 Nm
Ambient temperature: -25...90 °C
Flex rating: > 5 million cycles
Material body: TPU housing, Viton O-ring
Material coupling nut: Nickel-plated brass
Cable: PUR, halogen-free, 24 AWG conductors, Ø 3.7 mm
Approvals: cURus and RoHS standards

ifm Technical Specs – Field Wirable Connectors

Operating voltage: 60 V AC / 75 V DC

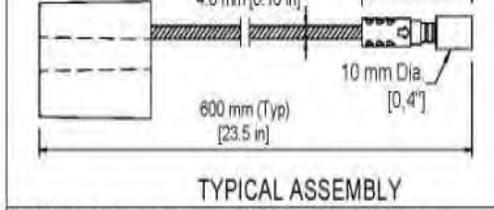
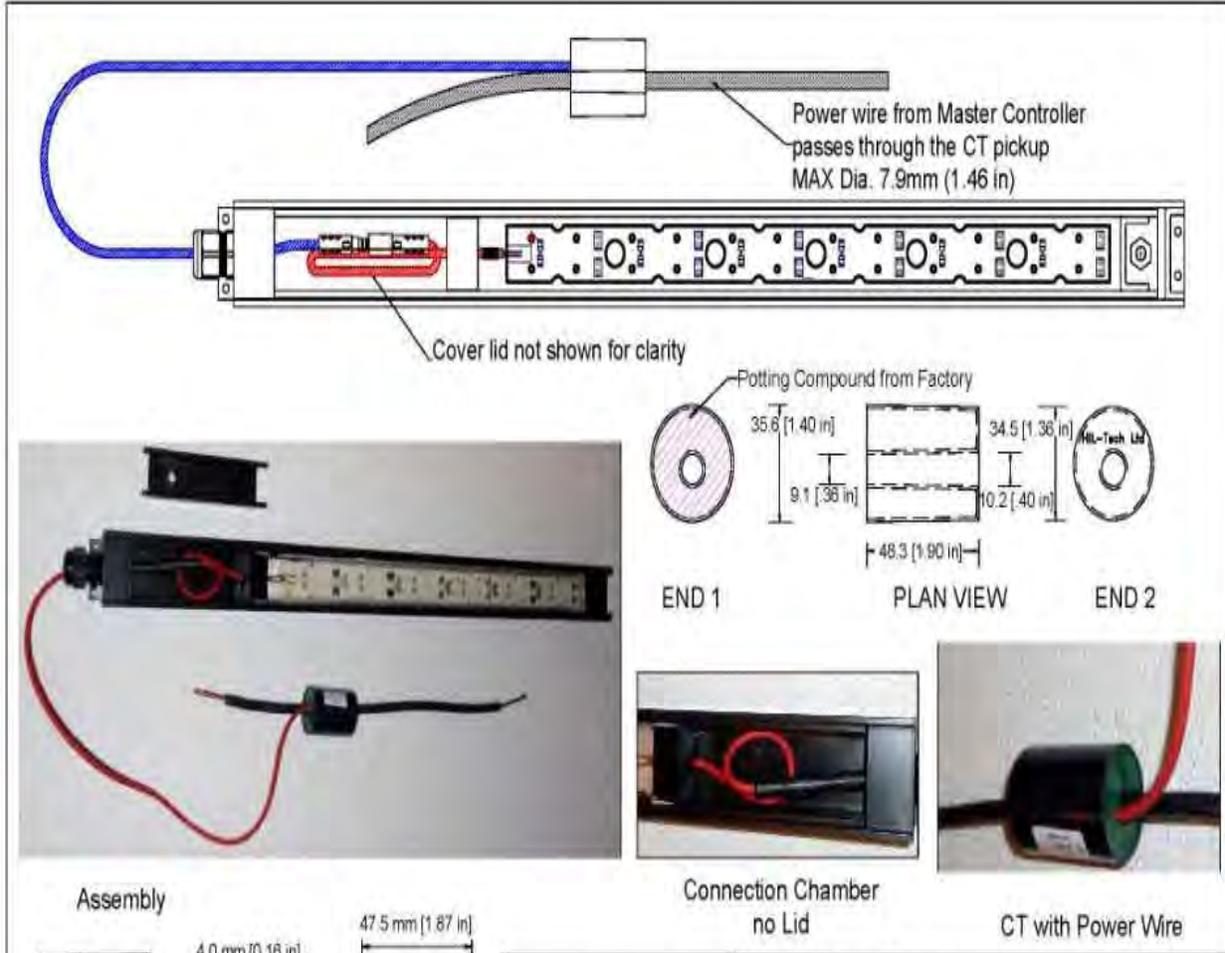
Protection rating: IP69
Ambient temperature: -25...90 °C
Material body: Nickel-plated brass (L33600,
L33601, E18216, E18218)
PA (L33602, L33603, E18217, E18219)

Material Coupling Nut: Nickel-plated brass

Cord Set Features:

- Cordsets feature a “Lock-in-Place” coupling nut that resists high levels of shock and vibration
- Cordsets offer high-flex PUR-jacketed cable rated for over 5 million flex cycles
- A special insert design includes a mechanical end stop preventing damage to Viton O-ring from over-tightening
- Cordsets are designed and tested to resist harsh conditions in industrial automation

HT-6379 (Not to scale) Drawing of Induction Power Pick up Connector (CT = Current Transformer and older type IP68 connector).



Drawing details may be changed at any time without notice.

Patents pending.

All dimensions are nominal.

Do not scale. Drawing reduced when copied.

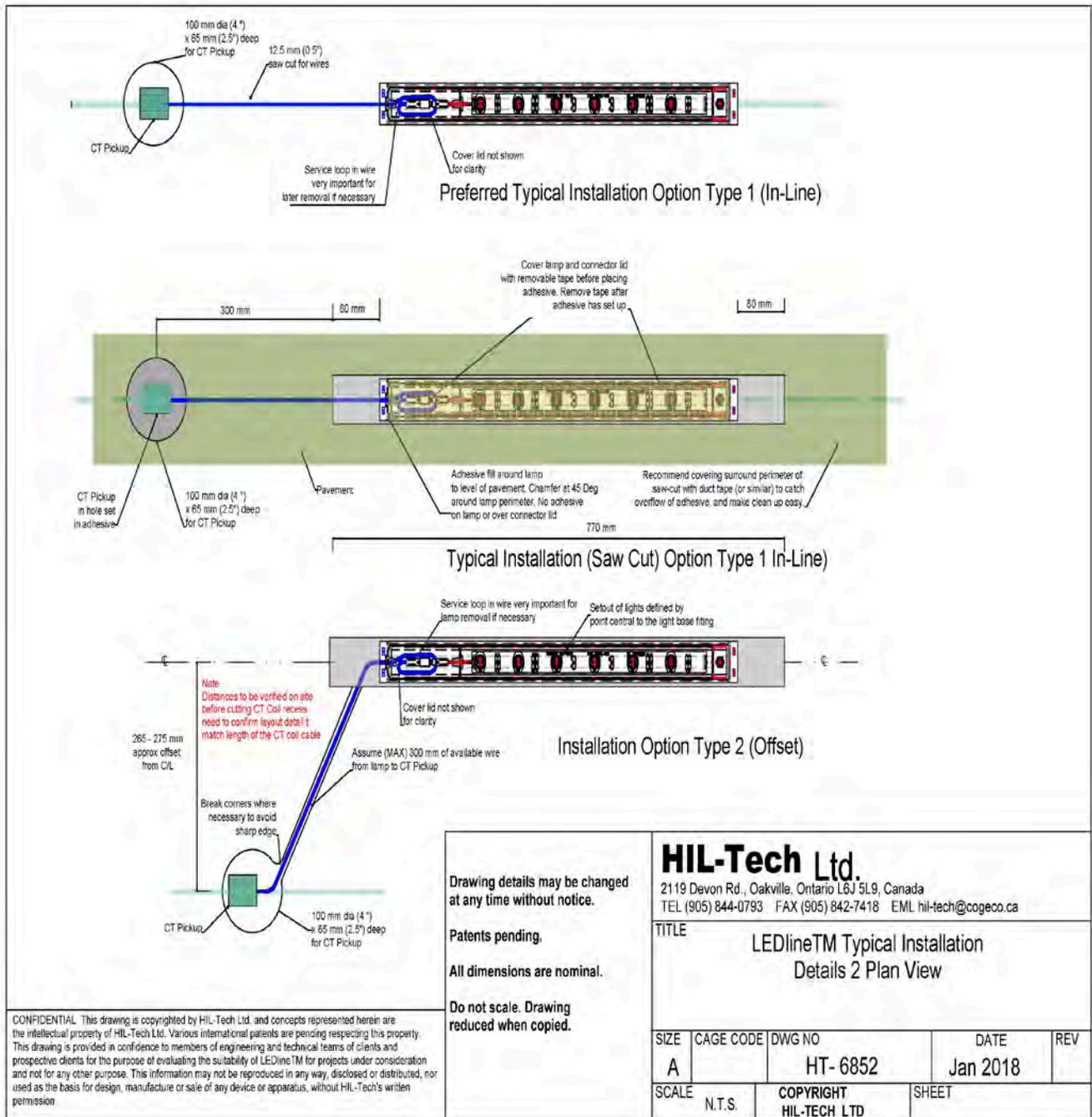
HIL-Tech Ltd.
 2119 Devon Rd., Oakville, Ontario L6J 5L9, Canada
 TEL (905) 844-0793 FAX (905) 842-7418 EML hil-tech@cojeco.ca

TITLE
**LEDline™
 CT Assemble Details**

SIZE	CAGE CODE	DWG NO	DATE	REV
A		HT- 6379	FEB 2012	
SCALE	N.T.S.	COPYRIGHT HIL-TECH LTD	SHEET	

CONFIDENTIAL. This drawing is copyrighted by HIL-Tech Ltd. and concepts represented herein are the intellectual property of HIL-Tech Ltd. Various international patents are pending respecting this property. This drawing is provided in confidence to members of engineering and technical teams of clients and prospective clients for the purpose of evaluating the suitability of LEDline™ for projects under consideration and not for any other purpose. This information may not be reproduced in any way, disclosed or distributed, nor used as the basis for design, manufacture or sale of any device or apparatus, without HIL-Tech's written permission.

HT-6852 (Not to scale) LEDline® Typical Installation Details



The picture below, demonstrates the preferred installation method, of having a single saw cut with the lights following the saw cut and the direct burial wire buried beneath the LEDline®.

Note: The enclosed picture was taken in October 2019 and is of the **Fall 2009 LEDline® installation at Vancouver International's concrete and asphalt de-icing pads.** Taken by Tim Holtz, Vancouver's key Airfield Lighting Maintenance Engineers, it illustrates that **despite the 500 or so yearly earth tremors; the frequent winter frequent freeze / thaw conditions; and the fact that the lighting has never been turned off, so has been working for some +11 years,** yet is still visible in bright sunlight; just how well the LEDline® lasts over time.

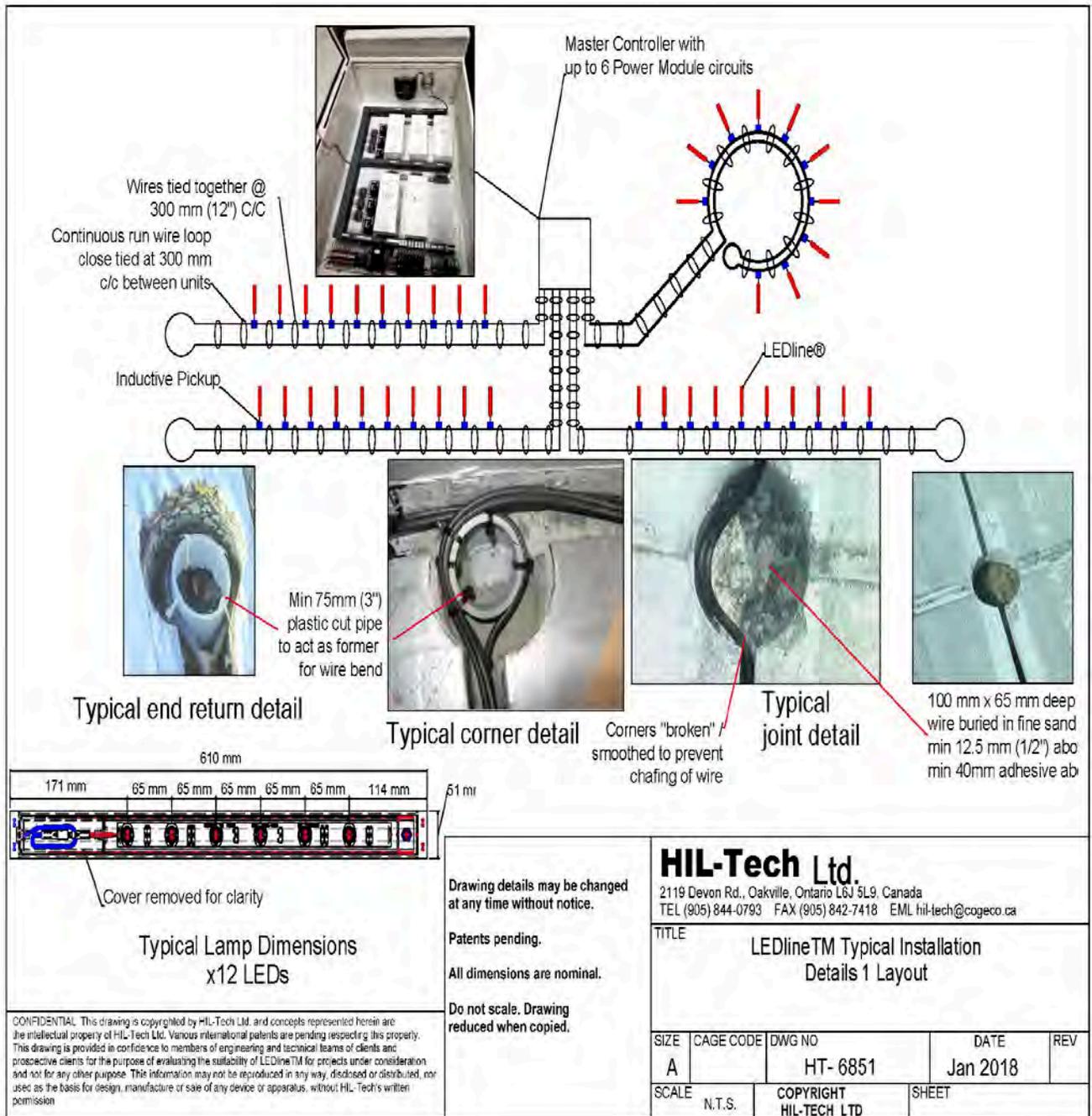


There are many other pictures illustrating how well LEDline®, concrete slabs and asphalt does over the years.

Here, in this MUTCD no passing zone, the induction power cables and induction power pick up connectors are in the middle, separated from the lamps, which run either side of them.

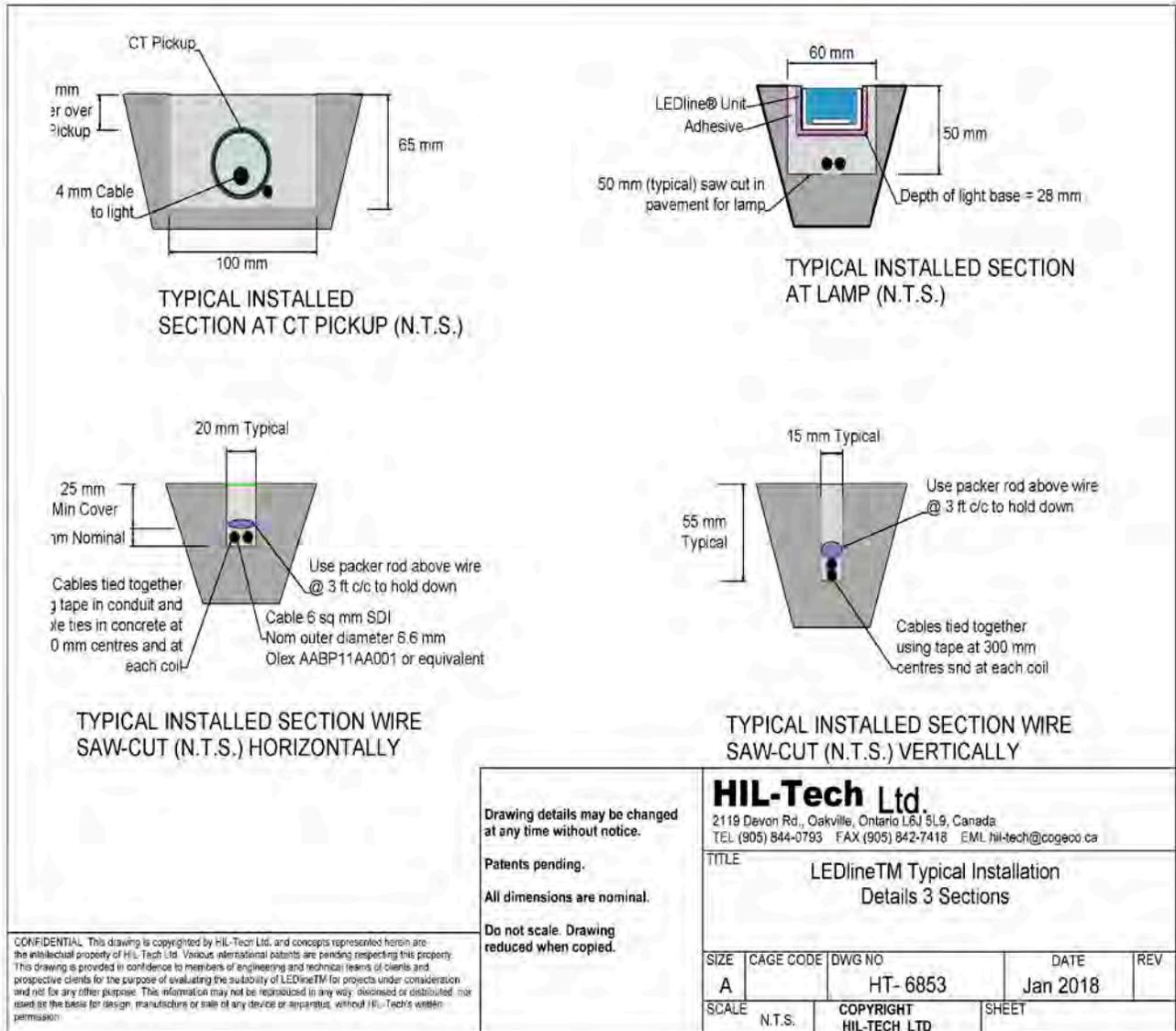


HT- 6851 Typical LEDline® Installation Details (not to scale). Copyright HIL-Tech Ltd.

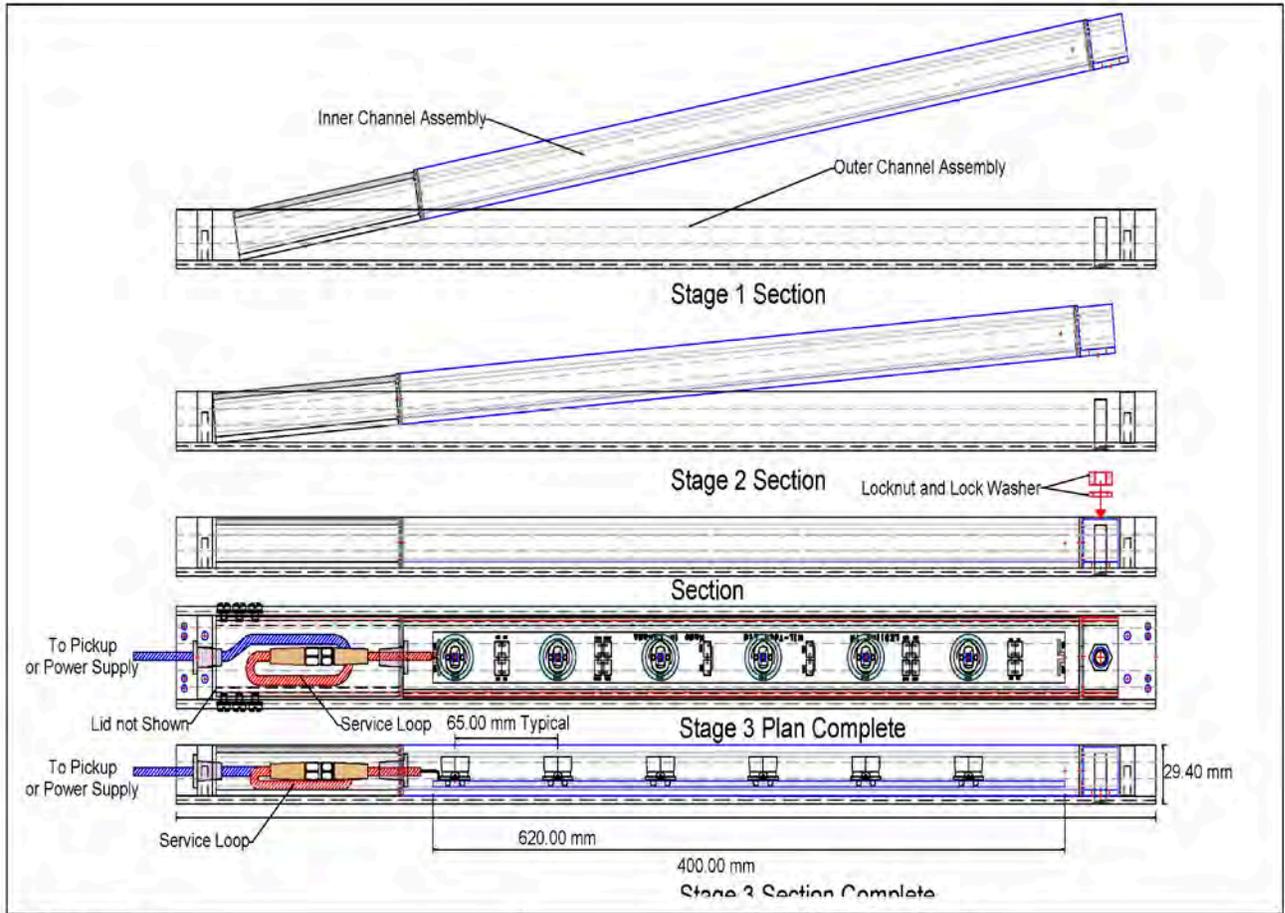


Typical saw cut depths for the direct burial wire induction power distribution cable; the unique induction power pick up connectors; and the LEDline® lamps are available below:

HT-6853 (Not to scale). LEDline® Drawings, Copyright HIL-Tech Ltd.

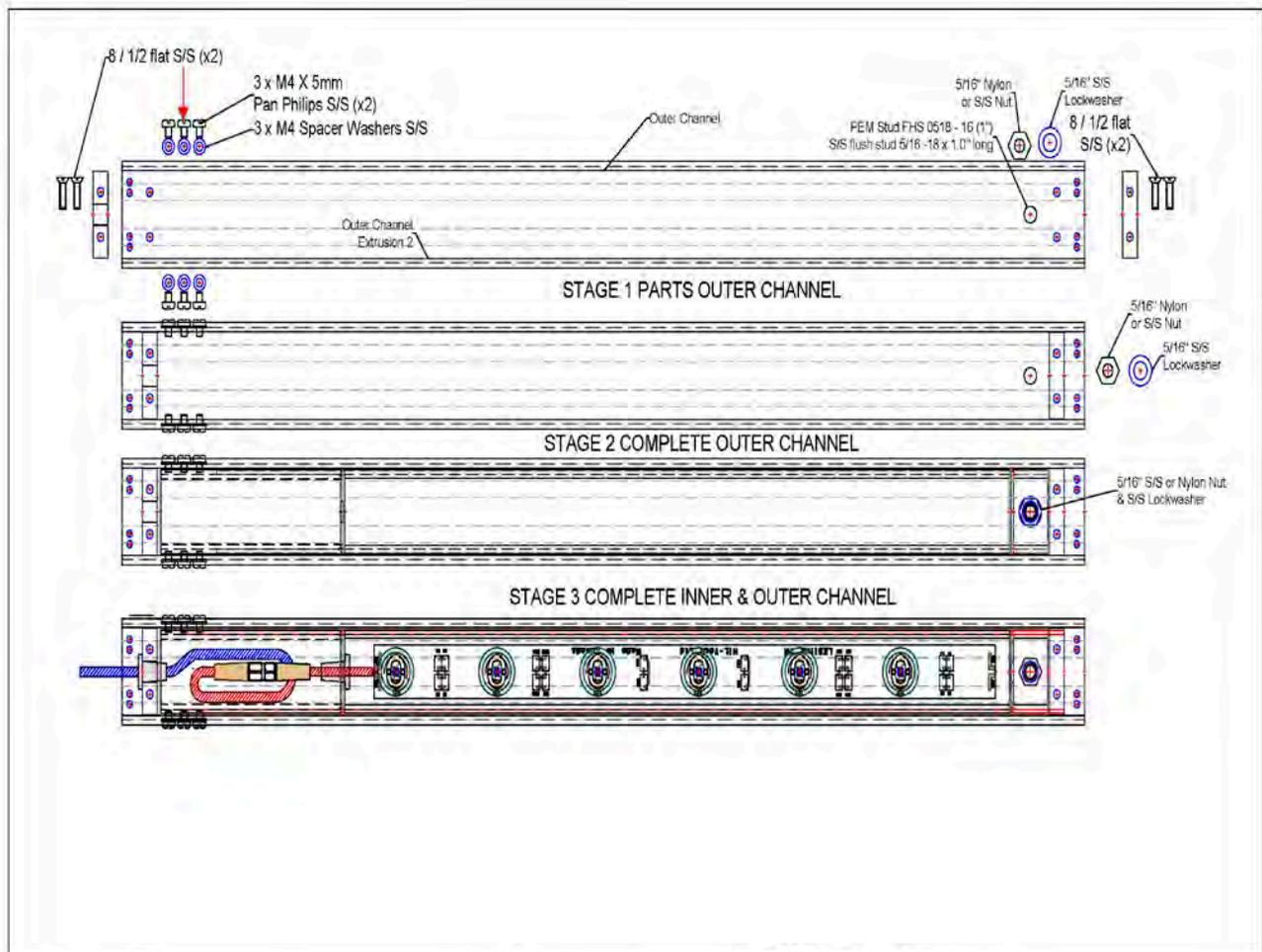


**HT-7134 (Not to scale). Channel Mount Assembly to Mounting Plate.
Copyright HIL-Tech Ltd.,**



<p>Aluminium 6063</p> <p>Exterior Surface Double Black Anodised</p> <p>Interior Surface Inner Channel Only Natural Aluminium sand blasted</p>	<p>Drawing details may be changed at any time without notice.</p> <p>Patents pending.</p> <p>All dimensions are nominal.</p> <p>Do not scale. Drawing reduced when copied.</p>	<p>HIL-Tech Ltd. 2119 Devon Rd., Oakville, Ontario L6J 5L9, Canada TEL (905) 844-0793 FAX (905) 842-7418 EML hil-tech@cogeco.ca</p>			
<p><small>CONFIDENTIAL This drawing is copyrighted by HIL-Tech Ltd. and concepts represented herein are the intellectual property of HIL-Tech Ltd. Various international patents are pending respecting this property. This drawing is provided in confidence to members of engineering and technical teams of clients and prospective clients for the purpose of evaluating the suitability of LEDline® for projects under consideration and not for any other purpose. This information may not be reproduced in any way, disclosed or distributed, nor used as the basis for design, manufacture or sale of any device or apparatus, without HIL-Tech's written permission</small></p>		<p>TITLE</p> <p align="center">LEDline® Metalwork Final In-Field Assembly Extrusion 10</p>			
<p>SIZE A</p>	<p>CAGE CODE</p>	<p>DWG NO</p>	<p>DATE</p>	<p>REV</p>	
<p>SCALE N.T.S.</p>	<p>COPYRIGHT HIL-TECH LTD</p>	<p>SHEET</p>			

HT-7133 (not to scale) LEDline® Outer Channel Metalwork Copyright HIL-Tech Ltd.,



<p>Aluminium 6063</p> <p>Exterior Surface Double Black Anodised</p> <p>Interior Surface Inner Channel Only Natural Aluminium sand blasted</p>	<p>Drawing details may be changed at any time without notice.</p> <p>Patents pending.</p> <p>All dimensions are nominal.</p> <p>Do not scale. Drawing reduced when copied.</p>	<p>HIL-Tech Ltd. 2119 Devon Rd., Oakville, Ontario L6J 5L9, Canada TEL (905) 844-0793 FAX (905) 842-7418 EML hil-tech@cogeco.ca</p>			
<p><small>CONFIDENTIAL This drawing is copyrighted by HIL-Tech Ltd. and concepts represented herein are the intellectual property of HIL-Tech Ltd. Various international patents are pending respecting this property. This drawing is provided in confidence to members of engineering and technical teams of clients and prospective clients for the purpose of evaluating the suitability of LEDline® for projects under consideration and not for any other purpose. This information may not be reproduced in any way, disclosed or distributed, nor used as the basis for design, manufacture or sale of any device or apparatus, without HIL-Tech's written permission.</small></p>		<p>TITLE</p> <p style="text-align: center;">LEDline® Metalwork Outer Channel Assembly Extrusion 9</p>			
<p>SIZE A</p>	<p>CAGE CODE</p>	<p>DWG NO HT- 7133</p>	<p>DATE Jan 2020</p>	<p>REV</p>	
<p>SCALE N.T.S.</p>		<p>COPYRIGHT HIL-TECH LTD</p>	<p>SHEET</p>		

Below are some examples of installations with 6 x LED LEDline® at Anchorage International, for lit gate lead in lines, which are visible both during the day and at night. Because of the nighttime contrast, the LEDline® then obviously shows up much better.



The same Anchorage Lead in Lines day and night



Green LEDline® Taxiway Guidance at Anchorage International, through the Refueling Area .

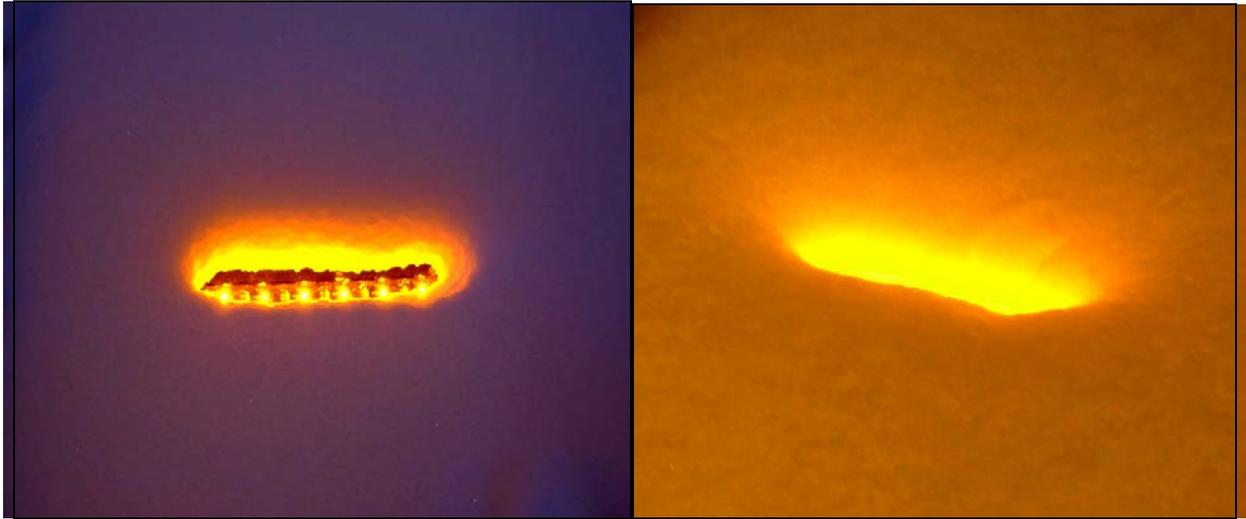


Anchorage International Lit Gate Lead in Lines: On the left, standard green FAA / ICAO with their old incandescent bulbs, (more heat than light) taxiway lights. On the right are yellow 6 x LED semi-directional LEDlineDV™. Both are in identical snow conditions. **Both are highly effective as visual aids, (pilots preferred the LEDline®) and both are self-cleaning, as LEDline® generates enough heat to melt snow without any additional heating elements.** LEDline® is the only LED visual aid that can do this so highly energy efficient.



According to surveys at the time, by the Chief Pilots of Alaska Airlines and Northwest Airlines, 100% of their pilots preferred the LEDline® because of the linear directionality. (Please contact HIL-Tech for survey results.)

Note: LEDline® melts snow without any extra heating elements. Here, in Alaska, the LEDline® with only 6 x embedded LEDs melted the snow. HIL-Tech now has LEDlineSun™ with 12 LEDs.



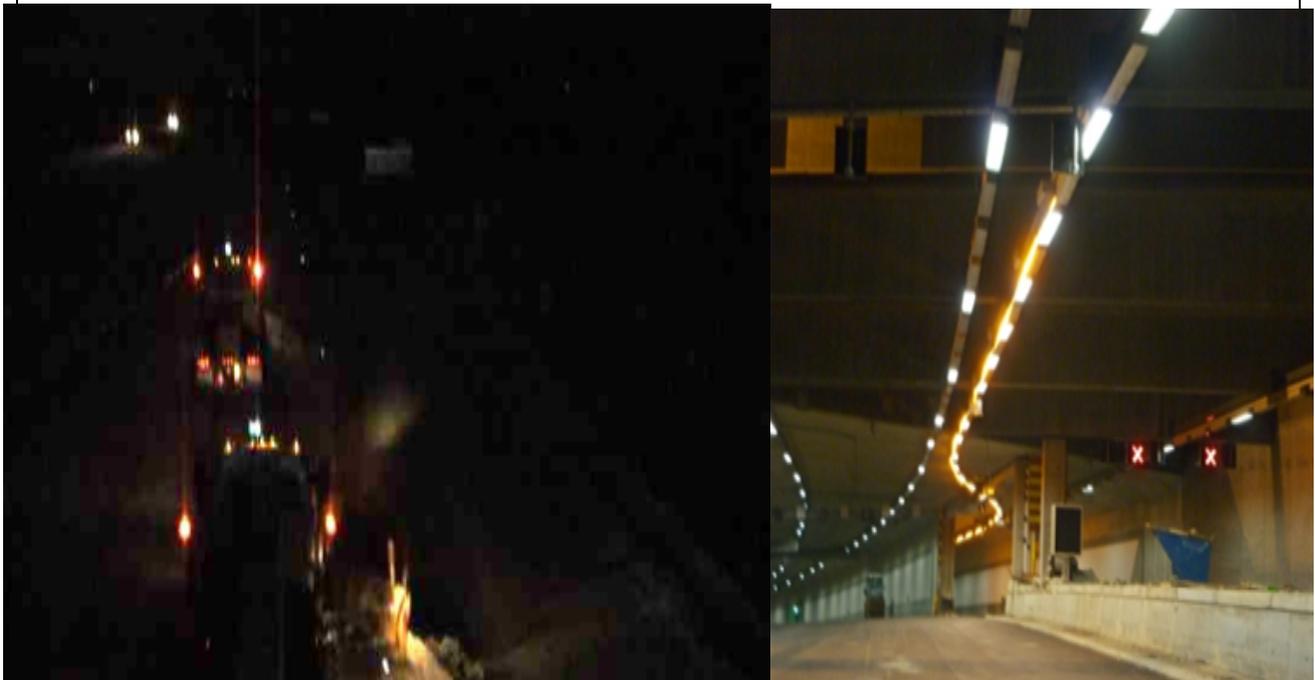
Vancouver International De-icing Pad (Jan. 2010) with semi-directional yellow 12 LED LEDline®.



Kilmore Hospital Helipad Australia, Copyright Peter Simpson PSNK Aeronautical Services AU.



Road and Tunnel



TROUBLE SHOOTING: IF the LIT LEDLINE® UNITS DO NOT LOOK UNIFORM: If the lit LEDline® units do not look uniform, the problems might be that the LEDline® unit/s is / are, too high. In snow plough areas, this is a major issue and if left unresolved, will void the Limited Warranty.

If this is discovered after the glue has cured, then the LEDline® should be ground down to be flush with the road surface. This will affect the light output from the particular LEDline® unit that is high and might affect its uniformity look. However, this is preferable to having the LEDline® broken by a snow plough blade.

If the LEDline® unit is too close to the front end of the groove, (the edge closest to the oncoming traffic), so that the low angled light is cut off from being viewed by drivers at long distances. Here, removing part of the asphalt or concrete blocking the light with a shallow 6mm (1/4") deep groove should be made ahead of the LEDline®. By extending a slight depression in front of the LEDline® this should repair the look.. Make sure that the LEDline® unit/s are undamaged by the pavement grinding or removal.

If the LEDline® is too deep, if possible, try to grind down the pavement around the LEDline®.

If glue has somehow covered the surface of the LEDline®, despite the tape, it should be immediately mechanically removed so that the surface is clean. Note: The main problem that causes this is that the covering tape on top of the LEDline® was removed before the glue properly cured; This will happen if:

A) the two part epoxy style glue, hardener and filler is not mixed properly, according to the manufacturer's instructions, so that the glue never sets; or

B) if the weather and temperature have delayed the glue's curing; or

C) if the time allowed for the glue to sufficiently cure before allowing traffic onto the site is too short, so that the wheels of vehicles have spread the wet glue onto the LEDline®. Since all of these are avoidable, if they occur, it is the installer who is at fault.

The one sure thing to remember is; **DO NOT REMOVE THE PROTECTIVE TAPE FROM THE SURFACE OF THE LEDline® BEFORE THE GLUE HAS SUFFICIENTLY CURED.**

Removing a LEDline® Unit;

To remove and replace a LEDline® insert within the Mounting Plate channel is simple.

- Unscrew the nut from the bolt holding in the LEDline® insert.
- Remove the insert.
- Open the IP69 connector box
- Remove the electrical tape preventing the locking slide of the IP69 connector from moving
- Take apart the IP69 connector.
- Reinstall a new LEDline® unit by connecting the new LEDline® insert to the IP69 connector.
- Tape up the two sides of the IP69 connector to prevent the locking mechanism from moving.

- Replace the LEDline® insert within the Mounting Plate “U” channel, making sure that the far end away from the nut and bolt are slotted properly into the slots, so that they cannot be removed without undoing the nut and bolt
- Tighten down the nut onto the bolt
- Test the whole circuit again

HIL-Tech Ltd Limited Warranty: LEDline® products bear a **1-year Limited Warranty**, limited to replacement of parts determined by HIL-Tech Ltd. to be defective. HIL-Tech Ltd. shall not be liable for any consequential damages that may arise from the installation or use of LEDline® systems / products. Customers are responsible to evaluate the suitability of LEDline® systems / products for their intended uses and to read and understand the LEDline® Manufacturer's Limited Warranty (call for copy to review detailed terms & conditions). No other warranties are expressed or implied.

Extended Limited Warranty, beyond the standard one (1) year Limited Warranty can be purchased at the time of purchase, call for written details and prices. ****Note: Unless HIL-Tech Ltd has been paid in full for any delivered product and / or services; there is no product Limited Warranty.**

CAVEATS:

The information contained herein outlines only the preliminary general *Installation Guidelines* for LEDline® products and accessories. These *Installation Guidelines* are only intended to be of assistance to installers. They are of a general nature and do not necessarily apply to any specific installation. These *Installation Guidelines* may be changed at any time without notice. Installers are advised to check with HIL-Tech Ltd. to ensure they have the most current version of these suggested Installation Guidelines and should familiarize themselves with the most current version, before commencing any installation (see "No Liability").

No Liability:

Notwithstanding that HIL-Tech has, to the best of its knowledge and belief, provided accurate information herein with respect to the installation of LEDline® products, HIL-Tech Ltd. is not an installer and therefore assumes no responsibility nor liability in respect of the actual installation of its LEDline® products.

Furthermore, HIL-Tech Ltd. assumes no responsibility for any representations made by it or third parties concerning LEDline®; LEDlineDV™, LEDlineHB™, LEDlineSun™, LEDlineSunDV™, or LEDlineSunHB™ products, its power supplies or any HIL-Tech Ltd. LEDline® product. Before utilizing any LEDline® systems, products, accessories, or ancillary equipment, all prospective users should evaluate the suitability of said systems, products, accessories and ancillary equipment for their own intended uses or purposes and should draw their own conclusions. The user assumes all risks and liabilities in connection with such use or uses.