LEDline® Cut Sheet

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LEDline® Visibility: At Anchorage International, highly visible, yellow, six (6) x LED, linear LEDline® and standard green FAA_taxiway lights are seen in identical deep snow weather conditions. **Both are highly visible.**



LEDline® is the only LED light source that melts snow without having any additional heating elements! Here, the FAA green taxiway lamps are melting the snow because of their Halogen/Incandescent bulbs which deliver more heat than light. Today's modern LED in-pavement lights MUST have added heating elements to melt snow.

LEDline® at Vancouver International's De-icing Pads, Installed in the fall of 2009. (Note: As of April 2025, LEDline® is still operating so has been working 24/07 for +15 years and counting).



Linear LEDline® Lit In-pavement Signage for Improving Airfield Pilot Guidance and Situational Awareness

Reduce or Eliminate Issues At FAA Hot Spots By Improvbing Pilot Guidance and Situational Awareness!



Improving Ramp Worker and Aircraft Safety and Gate Efficiency With LEDline®



Everyone Loses Depth Perception At Night. With point sources, because there is no "pattern" (one cannot tell which light is next to or in front of another), therefore, unless one is viewing them in parallel or is above them, point sources with no pattern cause confusion.





LEDline® Being Snow Ploughed on The Ontario 403 Freeway: (The picture taken from a video in a major storm).



At the Chesapeake Bay Bridges LEDline® Helps Guidance at Their Rush Hour Contraflow Control.



FHWA Crosswalk Trial:



Product Description:

LEDline® is a linear visual aid guidance lighting system, so each unit indicates the position and the direction to travel. It consists of linear arrays of high-intensity (daylight visible) light-emitting diodes ("LEDs"). The unique, proprietary design incorporates a heat sink and custom precision optics, depending on the application requirements. All these components are fully encapsulated in a solid, durable clear matrix, a formulation specifically engineered to make it completely submersible, tough, chemical and weather resistant, and able to withstand the challenges of various extremely harsh environments. For more details, see www.ledline.net

Whilst LEDline® can be powered via solar arrays or DC, for in-pavement applications, LEDline® takes anything from 90 – 220VAC 60Hz mains power line, then via an induction, non-contact, (no hard-wired), low-powered series circuit, powers the LEDline®.

With the LEDline® induction power pick-up connectors, it makes no difference if the environment is wet, saltladen or if the product is covered with chemicals like glycol or other airfield de-icing fluids, as the LEDline® and the glue-buried non-contact power connectors are also completely submersible. With a low-powered AC series circuit, power is induced into the LEDline® lamps via the completely sealed, hopefully never cut or spliced power cable and its induction power pickup connector.

The direct burial power line, bringing power to the lights, should not be cut or spliced, so it continues to benefit and has all the manufacturer's full cladding and protection, extending its life and preventing corrosion.

Non-contact (no Hardwiring) In-pavement Induction Power Connectors



Non-contact (No Hardwiring) In-pavement Induction Power Connectors and their IP69K Quick Disconnects.





IP69K Waterproof, Submersible, Quick Lamp Connector Disconnect.

For easy lamp maintenance, each LEDline® lamp unit comes with a quick disconnect, nickel-plated brass locking, screw together, and IP69K waterproof connector. (IP69K Specifications = "Protected against ingress of dust and high temperature and close-range high pressure, high-temperature spray downs").

This connector allows the non-contact induction power connector at the power cable to be buried in the glue and not accessible, yet should a replacement LEDline® lamp be required, the highest rated IP69K connector, is easily accessible for the replacement of the LEDline® unit in about a minute.



IP69K Quick Lamp Disconnect Connector



Specifications:

LEDline® was designed to meet the needs of extreme environments like the transportation industry by enhancing the visibility of pavement markings in all conditions that pilots or motorists find challenging. When illuminated, the LEDline® system can be seen at night, at dusk, under intense rain, with the wash of headlamps, under some +178mm (7") of snow (it melts holes in snow), and in sunlight. The twelve (12) x embedded LED system meets all the previous conditions and is even more visible in daylight/sunlight.

LEDline® products come in various standard LED colors for airfields, helipads, roads, or military use. Custom LEDs with IR (infrared) or UV (ultraviolet) spectrum can also be ordered.

There are several alternative LEDline® visual aid products;

- LEDlineDVTM (semi-directional) with six (6) embedded LEDs,
- LEDlineHBTM (Omni-directional) with six (6) embedded LEDs,

And the LEDlineSunTM product family (sunlight visible) has up to twelve (12) x embedded LEDs within the clear solid matrix. This is by far the brightest system and is suitable for sunlight-visible applications. LEDlineSunTM comes in two types;

- LEDlineSunDVTM (Semi-directional) with twelve (12) x embedded LEDs.
- LEDlineSunHBTM (Omni-directional) with twelve (12) x embedded LEDs.

Dimension of an LEDline® Unit:

LEDline® Lamp Unit: Nom. Size: See drawings HT-6252 Length; 44cm (17.3") Width: 40mm (1.6") Height: 23.5mm (0.93")

The LEDline® Lamp Unit within its In-Pavement Mounting Plate: Nom. Size: See Drawing HT-6353

Length: 625mm (24.6") Width: 48mm (1.9") Height: 28.5mm (1.1")

Weight: LEDline® Mounting Plate and Lamp: 1.36 kilograms (3 lbs.) LEDline® lamp: 0.77 Kilograms (1.7 lbs.).

LED Colour Options: Any color of LEDs can be used within LEDline®, including infrared (IR) or Ultraviolet (UV), although the latter two colors are custom special-order units. (UV), although the latter two colors are custom special-order units. Both LEDlineSunDVTM (semi-directional) and LEDlineSunHBTM (omni-directional) products are sunlight visible and have twelve (12) x LEDs embedded within the product's clear matrix.

The LED arrays within the solid clear matrix are organized into a series/bypass circuit. As such, should one LED fail prematurely, the others will continue to function normally.

Below Are Induction non-contact Power Pickup connections and The IP69K Submersible Quick Disconnect With Semi-directional LEDlineSunDVTM Units of Various Colors. LEDline® omnidirectional units are also available in these standard colors.



LEDline® Is Tough, Completely Submersible, Chemical and Weather Resistant:

Unusual Survivability Tests: The LEDline® is normally embedded into the pavement slightly below with the surface so it is not damaged by snowplows as they pass over it. And, since the LEDs with their precision optics are completely embedded within HIL-Tech's custom clear matrix, LEDline® is extremely tough; impact resistant; submersible, and thus completely waterproof. (Please see our website for the video demonstration of how tough and impact-resistant LEDline® is when placed on top of the road surface and then repeatedly rolled over by a 10-ton roller. This demonstrates just how tough LEDline® is since it is normally always mounted flush with the pavement surface).

An Unusual Test: In September 2021 LEDline® was placed on the surface of a nearby road being redone, and a 10 Ton (20,000 lbs.) roller went over it many times. The video is at <u>www.ledline.net</u> or <u>www.ledline.ca</u>



Sudden Impact Test: LEDline® is

tough, please see the sudden impact hammer test video on YouTube www.youtube.com/watch?v=4h1Lnig_EPg

Temperature: Previous LEDline® fixtures have been tested from $-55C^{\circ}(-67^{\circ} \text{ F.})$ to $+65C^{\circ}(+149^{\circ} \text{ F.})$ with no effect on the fixtures.

Canadian Navy Tests: Early

LEDline® successfully passed Mil Spec. test for lighting the escape chambers of submarines. It was so successful that it was then used as lighting within the pressurization test chamber. There, the LEDline® cycled over +5000 times at seawater depths of 300m (1000 ft.). For verification, please contact Mr. Stephen.Mauchan@nete.dnd.ca.



FHWA Tests: FHWA 2012 Tests on an older style LEDline® lamp **Without Its Mounting Plate**. The LEDline® was bent some 76mm (3") out of true but was otherwise unaffected.



When surface mounted, again without its Mounting Plate or glued into a "U" Channel, the LEDline® withstood the maximum loading of the machine of 89,000 lbs. = 40.37 tonnes or 44.5 tons, on its 40mm (1.6") wide surface





The above methods to test the LEDline® to 89,000 lbs. weight or bend it some 76mm (3") out of true demonstrates LEDline®'s toughness since with so much pressure of even bending the lamp, the lamp did no fail, its lens did not even crack and the LEDline® continued to function normally.

Longevity of LEDline®: The oldest installation of the modern style of LEDline®, with 12 x LEDs and a Mounting Plate, is on Vancouver International's de-icing pads. Installed in fall 2009, they've never been turned off. As of April 2025, the system is still operational today so it has been on and operating 24/07 for some +15 years and counting. (For Vancouver references, please contact HIL-Tech Ltd.)

Why Vancouver International Is An Excellent Test Bed For Any In-pavement Applications;

- being on the Pacific Coast, in winter, the area has frequent freeze/thaw episodes, winds from the Pacific thaw everything and winds from the North or East freeze everything;
- Vancouver is on the Pacific "rim of fire" so with two nearby major fault lines, experiences an average of some 500 earth tremors a year;
- Vancouver is a cargo hub for the Asia Pacific area, so the area has so of the heaviest aircraft using their de-icing pads. Fully laden 747s; A-380s, and Antonov AN-124 etc., all when fully laden weigh over a million lbs., so the LEDline® can certainly take any weight of any truck that is to be found on roads;
- in winter, LEDline® is bathed in aggressive winter aircraft de-icing pad chemicals, like glycol. This illustrates how resistant to chemicals LEDline® is as well as demonstrating that it is submersible to water and is de-icing pad chemical proof;
- frequent winter snowplows and the airfield scraping de-icing brushes are used on the area when there is snow;
- **the LEDline® there has been left constantly on since it's installation (fall 2009),** so, as of January 2024, has been constantly on and working 365 days a year for some +14 years and counting. The installation still looks great.

Despite all of the above, the LEDline[®] there is still working and is still in use, and the installation still looks great with no cracking or spalling of any of the concrete slabs or asphalt breaking up.



The Above Early LEDline® Installation Picture is From Vancouver International's De-icing Pads. Picture by Stewart McIntosh of Vancouver International.

LEDline® Is Tough, Submersible to Depth, Chemical Resistant, and Resistant to Weather: LEDline® is very tough, please see the sudden impact hammer test video on YouTube www.youtube.com/watch?v=4h1Lnig_EPg **Base Materials Properties:** Custom proprietary crystal-clear matrix specifications not provided.

Complete LEDline® Assembly: The above specifications were developed by HIL-Tech based on successful tests performed on the previous generations of encapsulated LEDline® products. Because the tests are so extreme, such tests would not normally be repeated unless today's product was being used for similar extreme environments.

Low Power, Energy Efficient: LEDline® lamp units are RoHS certified and are usually induction powered (non-contact, no hard wiring of the connections), and are low powered. Depending on the LED's color, the 12 x LED system uses only 15 - 21VAC at 700mA, whilst the 6 x LED system uses 15 - 21VAC at 350mA.

Power Supplies: LEDline[®] units can be powered by any type of power from; mains; VDC power; or renewable energy like wind and/or solar power with batteries, as the units work with either AC or VDC power. For Most In-Pavement Applications HIL-Tech's Induction Master Controllers (MC) Should power the LEDline[®].

Illustrating how the induction power pickup works, below are two (2) MCs each with two (2) independently controllable Power Modules and several early style LEDline® units lit by their induction power connectors.

Below is a modern Master Controller with six (6) independent Power Modules, each able to separately power induction circuits of some 1,400m (4,593 ft.), with each circuit powering some thirty (25 - 30) LEDline® lamp units.



(Note: All HIL-Tech power supplies are individually CSA inspected and certified to conform to electrical standards for US (UL), Canada (CSA), and/or European (CE) certifications).

The Master Controller Power Modules contain custom pulse width Power Modules that take any power from 90VAC to 220VAC and turns it into the correct low-powered series circuit voltage suitable for LEDline® units. There are VDC and other types of power supplies which vary with application. (Please contact HIL-Tech Ltd. for details).

Induction Power Supply, with Induction Non- Contact Power Connectors:

Induction-powered and connected lamps are required for all in-pavement applications where vehicles are driving over the lamps. The induction system is by far the most robust electrical connector since it functions regardless of any vehicle vibration, water, or moisture. In addition, since there is no hard wiring or connecting required, it allows the direct burial wire, bringing power to the lamps to remain pristine and uncut. Therefore, to prevent corrosion, as much as possible, it is recommended not to cut or splice the Direct Burial Wire, so that as much as possible, it continues to have all its factory cladding intact.



Each LEDline® lamp comes with the IP69K (male part) of the connector. It therefore requires one completely sealed induction power connector unit with its attached IP69K (female part) connector system to connect to the Direct Burial wire.

DC Power Supply: HIL-Tech's DC power supplies are suitable for surface mounting and other applications. Hard-wired DC powered LEDline® connections must use HIL-Tech's Power Equalizer to maintain uniform brightness. Additionally, hard-wired lamps can be controlled individually via a DMX signal.



Renewable Energy Power Supply: LEDline® can be powered via solar panels; wind power and batteries. Battery size is dependent on the installation size. Where the sun and/or wind are not dependable, it is recommended that a propane backup generator is included to top up the batteries when the solar or wind fails.

LEDline® IP69K Connectors (electrical): LEDline® comes with the top-of-the-line IP69K electrical induction non-contact connector with one (1) sealed (male) locking IP69K quick disconnect. The IP69K has a screw-together locking nickel-coated brass connector and is the highest possible IP rating connector available. (Note: There are stronger deep sea pressure connectors available, if these are required, please contact HIL-Tech for details).

IP69K Connector: The highest type of IP electrical connector is submersible. Below are its test results.



Copyright Ifm; M8 Male and Female Pico DC Cord sets and Field Wirable Connectors EVC141 (Rated IP69K)

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, temperature spray downs.				
?69 Test: (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 unle custom deep-sea connectors are required. Please contact HIL-Tech for technical specs. on any required deep-sea connectors	ss s).			
Tightening torque	e: 0.3 0.5 Nm				
Ambient temperati	ture: -25 90 °C				
Flex rating:	> 5 million cycles				
Material body: Nickel-plated. brass	TPU housing, Viton O-ring Material coupling nut:				
Cable: PUR, halog	gen-free, 24 AWG conductors, Ø 3.7 mm				
Approvals:	cURus and RoHS standards				
Technical Specs	s– Field Wirable Connectors				
Operating voltage: Protection rating:	60 V AC / 75 V DC				
Ambiant tamparat					

 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:

- Cord sets feature a "Lock-in-Place" coupling nut that resists high levels of shock and vibration.
- Cord sets 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.
- Cord sets are designed and tested to resist harsh conditions in industrial automation.

(Please Note: For those requiring connectors for submersible deep-sea applications, there are custom other deep-sea

connectors available. Please contact HIL-Tech for details).

Direct Burial Wire:

For the induction wire, a direct burial wire type should be used #8 (USA) RWU gauge wire (= #35 metric wire gauge MAX O.D. of insulation 7.9mm (0.31")) suitable for direct burial.

According to local codes, 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 200m. (656ft.), and another 10m (32ft.) is needed to cross the road to the power supply, then the wire loop distance needed would be 420m. (1,377ft.)).

Depending on the number of LEDline® units required to be lit and the impedance of a circuit, a single Power Module should be able to power some 25 - 30 x LEDline® units, over a 700m (2,296ft.) circuit. The greater the circuit distance and impedance the fewer the number of LEDline® units can be lit. (Contact HIL-Tech for guidance as HIL-Tech can boost the circuit to potentially carry more).

Note:

- <u>HIGHLY RECOMMENDED</u>: To minimize any power line corrosion, the direct burial power line circuit wire should be continuous, without breaks, joints, or connections of any kind. Each wire run must start go out to the end of that wire run and end at the same particular Power Module.
- The power line wire loop circuit must always be closely tied together with plastic ties or tape every 30cm (12") to minimize any impedance or EMI emissions.
- •

Intellectual Property of HIL-Tech Ltd.:

HIL-Tech Ltd. is a leader in developing LED-based illuminated in-pavement, barrier, and sign markings for; airports; roadways; the marine; mining; military, and other markets. Responding to the demands of the transportation industry, HIL-Tech Ltd. has developed a design and process to encapsulate the brighter and more powerful daylight-visible LEDs into a solid, clear, submersible, and extremely tough matrix.

All LEDline® products are the intellectual property of HIL-Tech. LEDline® has Patents and pending patents in respect of this innovative addition to the family of LED-based linear and other guidance lighting systems.

LEDline® is a registered trademark of HIL-Tech Ltd.

Product Status: Based on the Company's experience LEDline® should meet the technical specifications provided herein.

Specifications May Change: All information herein indicates preliminary specifications for LEDline® products and accessories. Any of <u>this information may be changed at any time without notice</u>.

Any specifications of other manufacturers' materials are provided by the manufacturer(s) of the component. Any of this information may be changed at any time without notice.

HIL-Tech's LEDline® Limited Warranty:

<u>Only if the product and any related HIL-Tech Ltd. services have been paid for in full</u> will HIL-Tech provide and recognize the HIL-Tech Ltd. LEDline®.

<u>Limited Warranty</u> of one (1) year on parts only from the date of the shipment from the HIL-Tech factory. (Please contact HIL-Tech Ltd. for full details):

Possible Additional Years of Limited Warranty: HIL-Tech is pleased to offer additional years of Limited Warranty, please contact HIL-Tech for prices. **Additional Years of Limited Warranty are available for purchase at the time of order.** An extended additional Limited Warranty is available for purchase of;

- an added one (1) year;
- two (2) years; or
- three (3) years.

Any Additional Limited Warranty above and beyond HIL-Tech's standard one (1) year Limited Warranty <u>must be purchased at the time of order</u>. (Please contact HIL-Tech Ltd. for details).

For Any Limited Warranty Claim: For Any Limited Warranty Claim the product must be returned to HIL-Tech for evaluation. Therefore, all LEDline® Returns Must Have A Return Goods Authorization (RGA). All

returns must have and be accompanied by a pre-authorized return goods authorization (RGA) number obtained from HIL-Tech Ltd. before such return or the returned goods will not be accepted. Credit for any goods returned AND accepted under the Limited Warranty may be granted once the goods have been inspected.

Returned product will be tested. (Note: LEDline® light units that have had their wires pulled out but still fully light when tested will NOT be accepted as a return or credited under the HIL-Tech Limited Warranty as the product connections were broken at site).

Under no circumstances will HIL-Tech Ltd. or its successors be responsible for any collateral, consequential, or installation damages. For a complete copy of the Limited Warranty details, please contact HIL-Tech Ltd.

As above, the restrictions and conditions apply on any issued HIL-Tech Ltd. extended Limited Warranty.

No Liability:

Notwithstanding that HIL-Tech has, to the best of its knowledge and belief, provided accurate information herein, HIL-Tech assumes no responsibility for the accuracy or completeness of representations made, nor the accuracy or completeness of representations made by component manufacturers, or for any expressed or implied recommendations concerning LEDline® products. 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.

Appendix 1: Installation Details.

Drawing Not to Scale:



Drawing Not to Scale:

Typical Schematic for Sawcut Depths for The Lamps, Induction Power Distribution Cables, and Induction Quick Disconnect IP69K Connectors.

(Please Note: The installation of the induction power cables can also be separate from the lamps, please see the more comprehensive details in our Instillation Guidelines).

Drawing Not to Scale:



Drawing Not to Scale:

Schematic of Typical Induction Power Pickup:

Drawing Not to Scale:



Drawing Not to Scale:

Schematic of Typical Induction Circuit:



Appendix 2: LEDline® PART NUMBERS

Part Number Format for Ordering

The part numbers for LEDlineDV[™] (semi-directional) and LEDlineHB[™] (omni-directional) are detailed in the Attachment Optical specifications which include:

Colour - Representing available LED colour choices {R - red, A - airport yellow / amber, G - green, B - blue, W - white} — The six (6) LED LEDlineHB[™] system, is an omni-directional light system with embedded optics, whilst the six Optics (6) LED LEDlineDV[™] styled system includes an embedded semi-directional optical system, needed to focus much of the light at low angles towards the viewer. — The LEDlineSunHB[™] system is omni-directional but has twelve (12) embedded LEDs with its precision optics, whilst the LEDlineSunDVTM is semi-directional and has twelve (12) embedded LEDs with its precision semi-directional embedded optics. All Parts are LL-**** - *****-xx for LEDline® generic product. Lamps: Example: LL – DV00 – 0003W-12 = LEDlineDVTM with directional optics, with an

	Induction connector in the colour white.		
1 st Pair = Choice of Optics			
DV	=	With directional optics	
HB	=	No optics	

No optics

2^{nd} Pair = is for the sunlig	ht visible variant S with the number of LEDs, 6 x LEDs, or 12 x LEDs
SÕ	= Sunlight visible
	$LL - HBS12 - ICW0 = LEDlineSunHB^{TM}$ (omni-directional)
	with 12 x LEDs optics, with an Induction Connector in the colour white.
	$LL - DVS12 - ICW0 = LED line Sun DV^{TM}$ (semi-directional) with 6 x LED directional
	optics and 6x LED (omni-directional), with an Induction Connector in the colour white.
	$LL - DVS6 - ICW0 = LEDlineSunDV^{TM}$ (semi-directional) with 6 x LED directional
	optics and with an Induction Connector, in the colour white.
3 rd Pair = Connector Type	
ĨC	= With Induction Connector
00	= no Induction Connector, (with standard 3m length of wire) anything over
	3m has an extra charge. (Please contact HIL-Tech for the price)
	Length can be specified here in m.
P1	= Power equalizer (for Dc power supplies only)
P2	= Power equalizer with addressable DMX

LL - HBS12 - 06W0 = LEDlineSunHBTM (omni-directional) with 12 x LEDs optics, with 6m* wire in the colour white. *There is an extra charge.

4th Pair = Colour Code. It is possible to have two colors specified in one LEDlineSunTM unit 6 x LEDs of one colour and 6 x LEDs of another.

W0	= White
Y0	= Yellow
B0	= Blue
R0	= Red
G0	= Green
IR	= Infra-Red

LL – **HBS12** – **06WR** = LEDlineSunHBTM (omni-directional) with 6 x white LEDs and 6 x red LEDs, with 6m* wire in the colour white. *There is an extra charge.

Power System Example: 1 st Pair = Power System = PS		LL-PSMC-0000			
2 nd Pair = Type of Syst	em				
	MC	=	Master Controller		
	PM	=	Power Module		
3 rd Pair = Power Module System Configuration					
01 = Use with less than 20 LEDline® Units					
	02 = Use with 20 or more LEDline® Units				