

Evolution of
HIL-Tech's Linear
LED Lighting
LEDline®

Originally Our Linear LED Lighting was Produced Via An Extrusion Process.

However, this was too limiting as to;

- ❑ Type of LEDs
- ❑ Type of optical systems
- ❑ Limited smart electronics
- ❑ Limited connectors, the weakest link in any electrical system.

Some Examples of Airfield and
Helipad Installations With The
Extruded Continuous Linear LED
Light Version

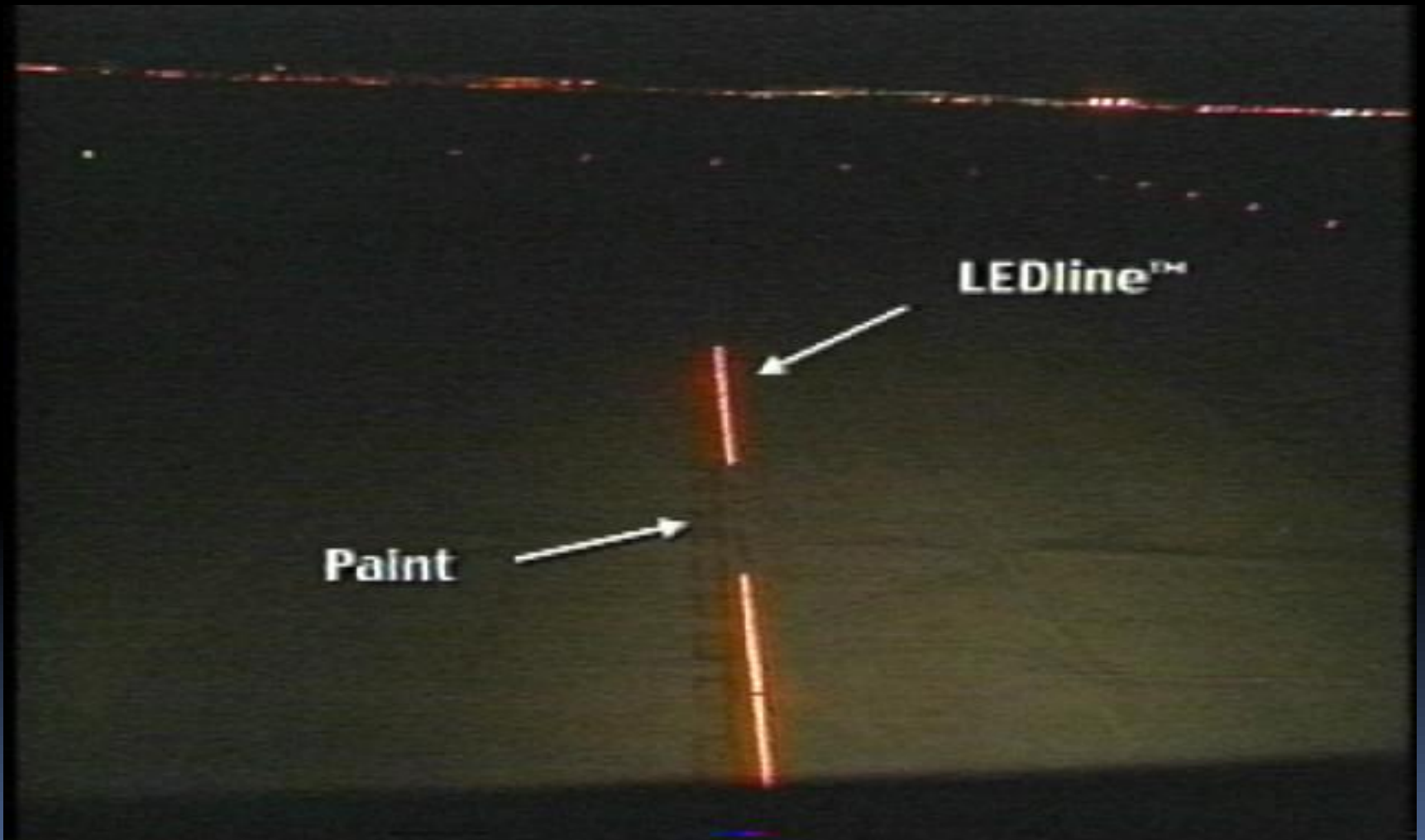
Extruded Linear LED Lighting At JFK As A Taxiway / Holding Pad Visual Aid



Linear Visual Aids Provide Both Positional and Directional Guidance; To Viewers , (If Only One Light Source Can Be Seen), Point Source Lights Provide Only Positional Information **No Directional Information!**

- ❑ The ideal directional guidance visual aid is a line, which is visible in all weathers, hence all the linear guidance markings on roads, airfields, everywhere, are painted markings, unfortunately paint is not always visible.
- ❑ A lit linear line, visible in all weathers, would be much better than painted markings and would be ideal for directional guidance. Such a lit line would be continuous and would do away with the necessity of mandated light output requirements, such as; the amount light needed per light source; or the number of point source lights sources that need to be visible at any time, to provide for directionality to safely taxi aircraft. A continuous line of light would be always present and would always visible providing the necessary directionality.
- ❑ Our Extruded Linear LED Lighting attempted to achieve this.

Extruded Linear LED Lighting At JFK , As A Delineation Visual Aid For Taxiway / Holding Pad



Extruded Linear LED Lighting At Vancouver International Gate Number 54 and Lead in Line



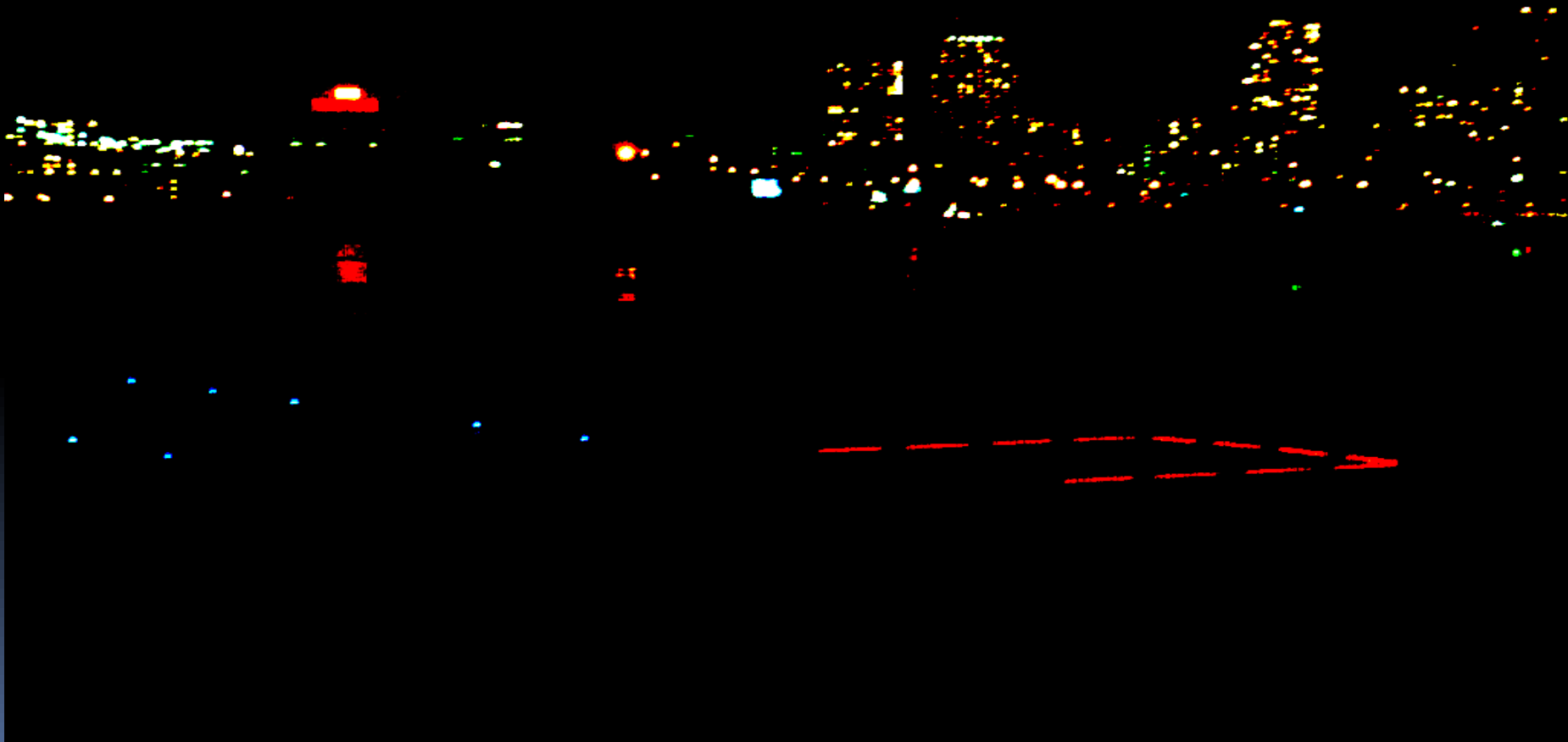
Because Depth Perception Is Lost At Night, Unless There Are Many, More Individual Point Source Lights Do Not Define Areas.



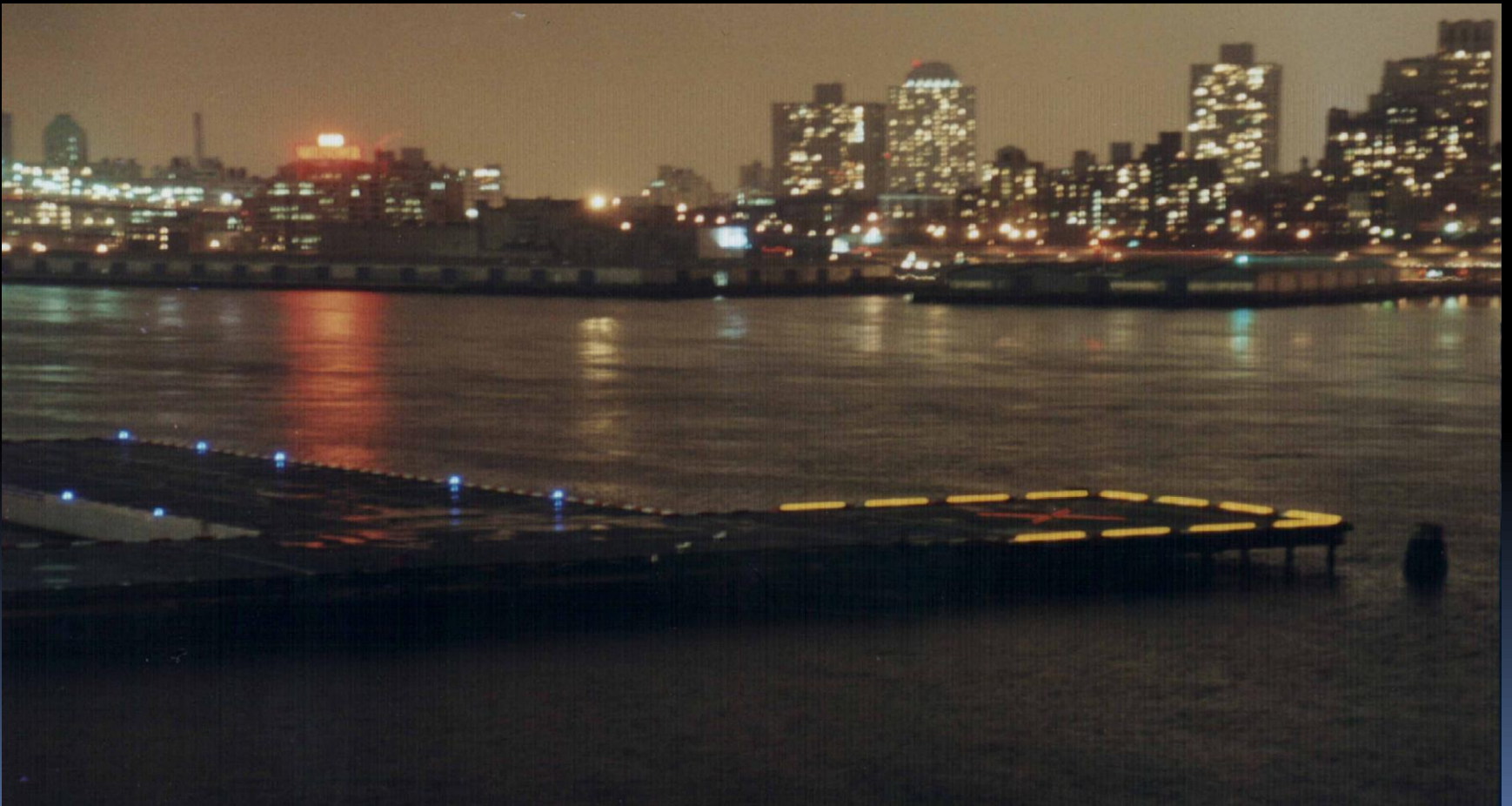
Because Depth Perception Is Lost At Night, Point Source Lights Do Not Define Areas Linear Lights Do.



Because Depth Perception Is Lost At Night, Unless There Are Many Individual Point Source Lights, They Do Not Define Areas. For Instance, Which of The Standard Blue Point Source Edge Lights Marking the Helicopter Parking Area At the Downtown Manhattan Heliport Is In The Foreground Or Background?



Extruded LED Lighting, Defining The Downtown Manhattan
Heliport for the Port Authority of New York and New Jersey With
Standard Blue Point Source Lights Marking the Parking Area



Early UK CAA Helipad Test with the Extruded Linear LED Lighting



Injection Moulded Linear LED Lighting

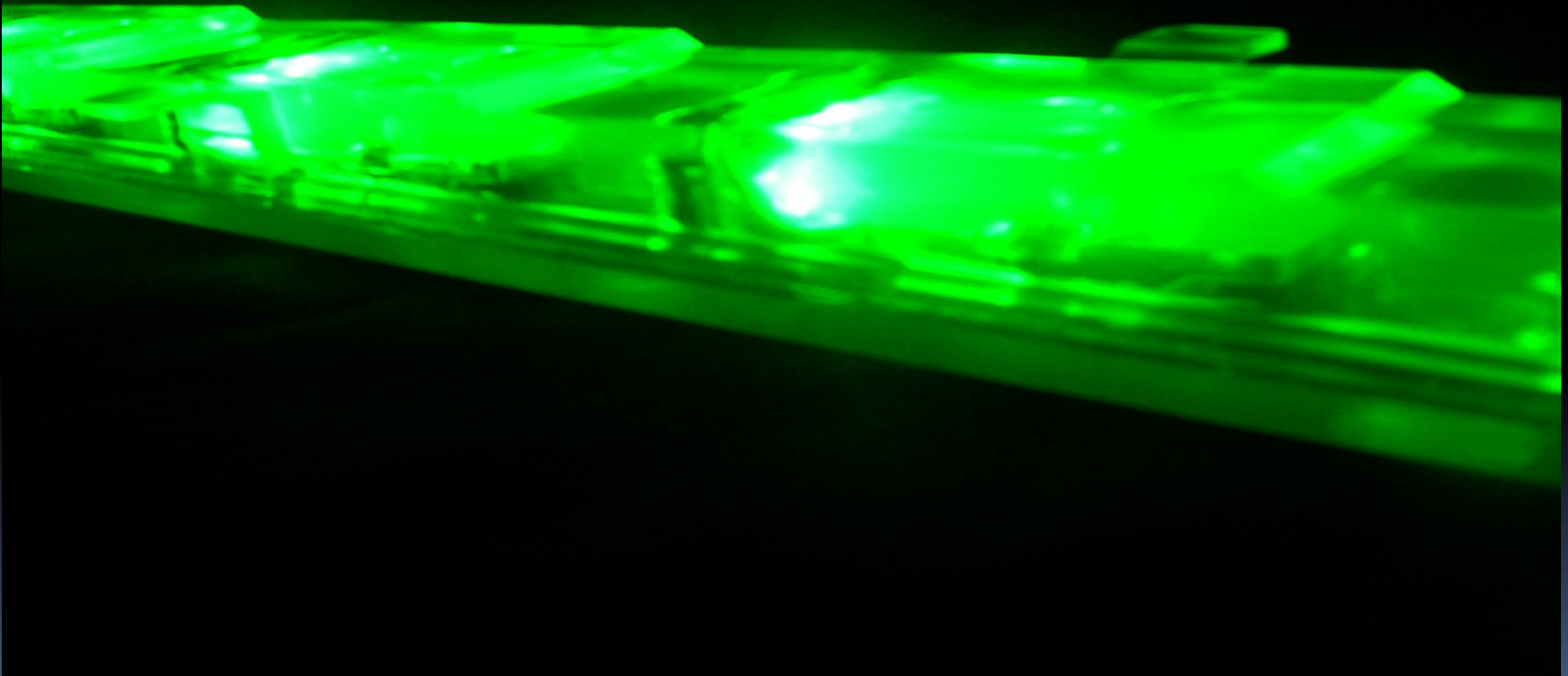
This was;

- ❑ Much more robust.
- ❑ Allowed for more powerful, brighter types of LEDs to be used.
- ❑ Allowed for the use of optics to be embedded within the unit.
- ❑ Allowed for smart electronics

Injection Moulded Semi-directional White
LEDlineSun DV™ with 12 x LEDs



Injection Moulded LEDlineDV™ (Semi-directional) Green with 6 x LEDs



Injection Moulded LEDlineDV™ (Semi-directional) Red with 6 x LEDs



Some Examples of Airfield and
Helipad Installations with the
Injection Moulded Product.

Induction Powered Linear LED Lighting for 4 x De-icing Pads at Schiphol; Copyright Spie.



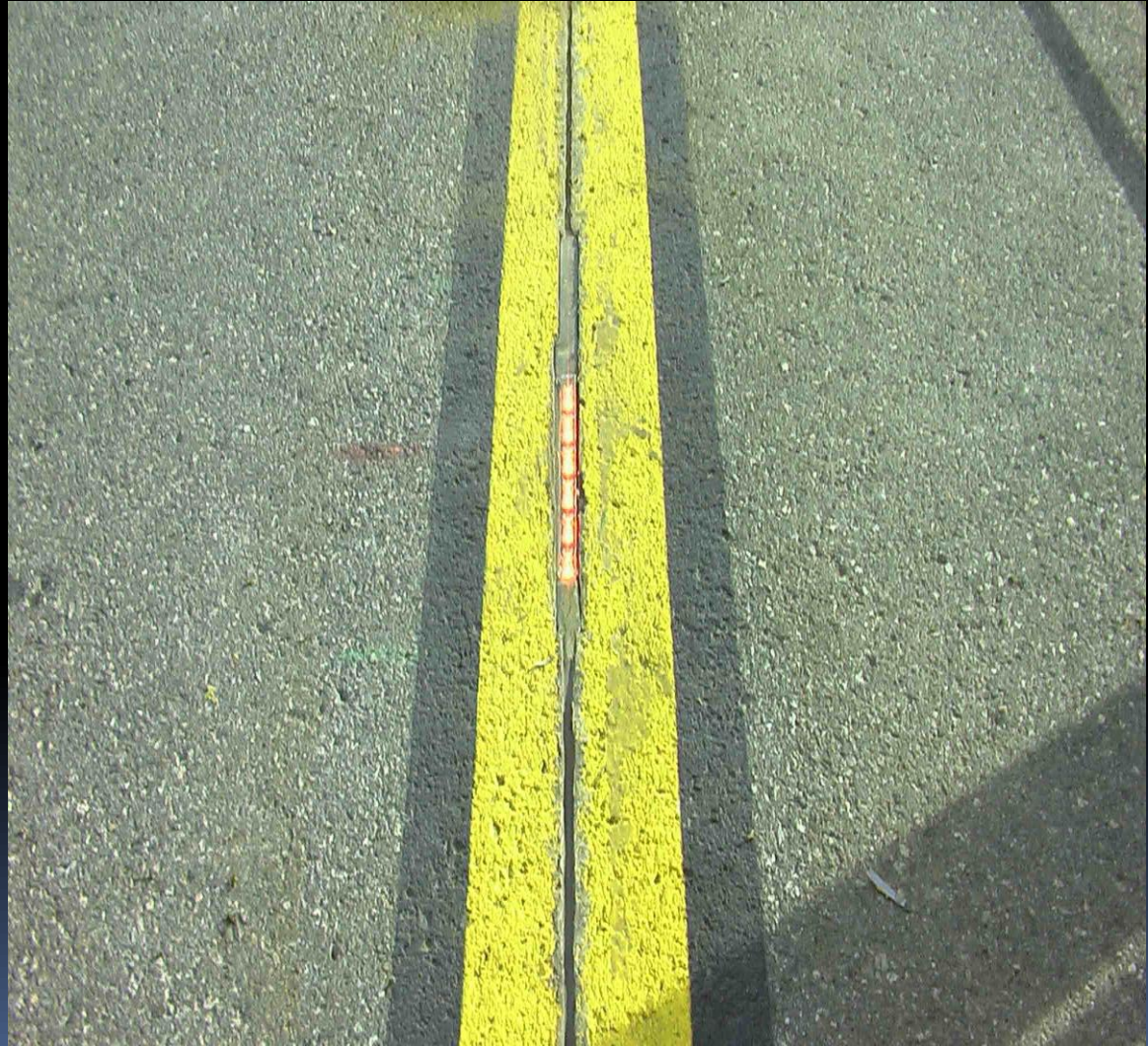
Induction Powered LEDline[®] for 4 x De-icing Pads at Schiphol; Copyright Spie.



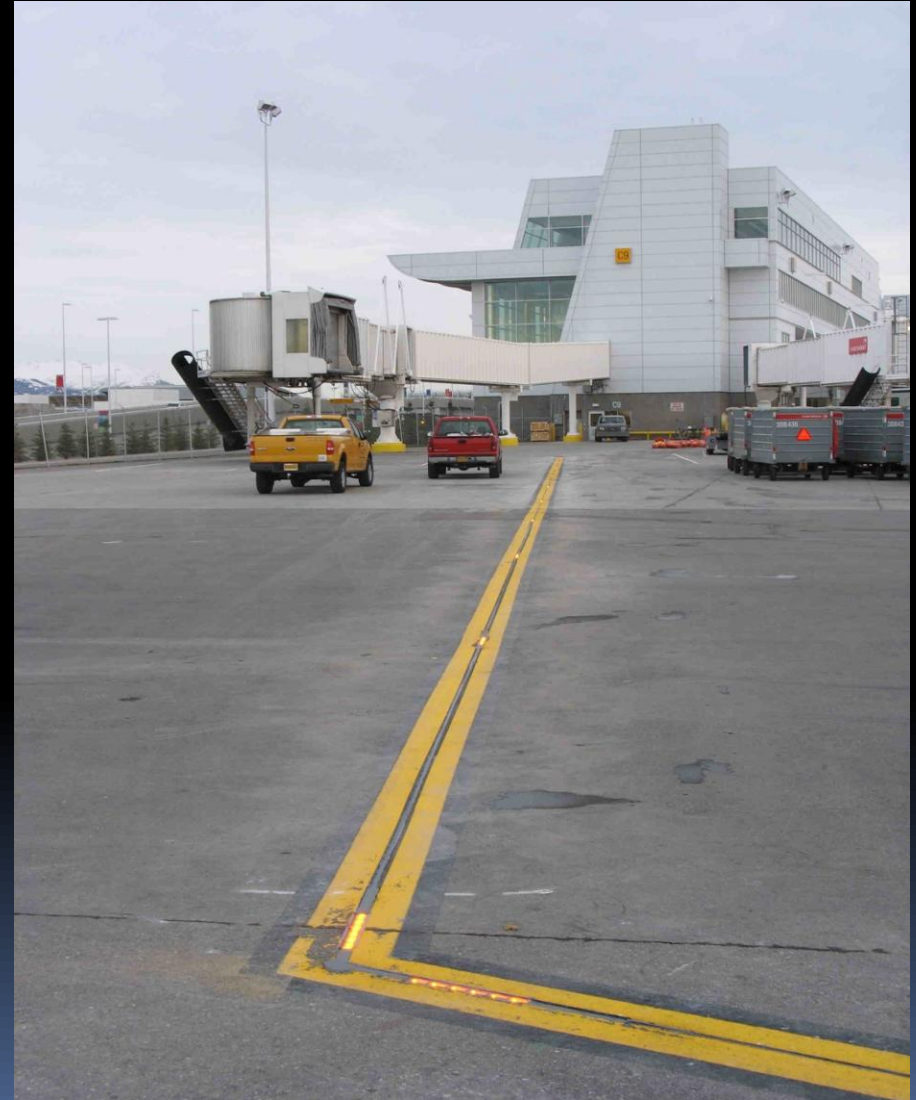
Stop Bar, Induction Powered Linear LED Lighting for 4 x De-icing Pads at Schiphol; Copyright Spie



Anchorage International Alaska Gate Lead in Line C-9 in Daylight; Copyright Mathew Shaw



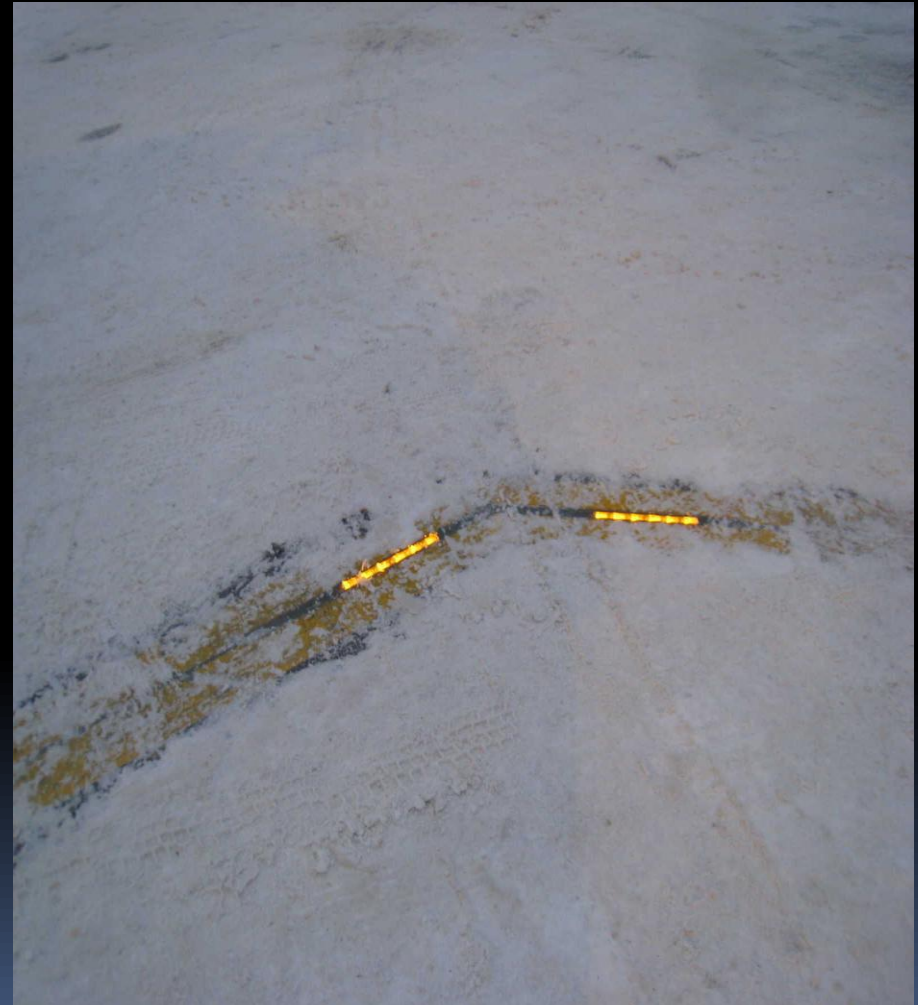
Anchorage Alaska LEDline[®] Gate Lead in Line C-9 Corner Dog Leg and Gate ; Copyright Mathew Shaw



Winter Day at Anchorage International Alaska; Gate Lead in Line of Linear LED Lighting Inset With 6 x Embedded LEDs



Winter Day at Anchorage Alaska, Linear LED Lighting for Gate Lead in Lines In-set With 6 x Embedded LEDs



Anchorage Alaska C-9 with Snow; Copyright Mathew Shaw



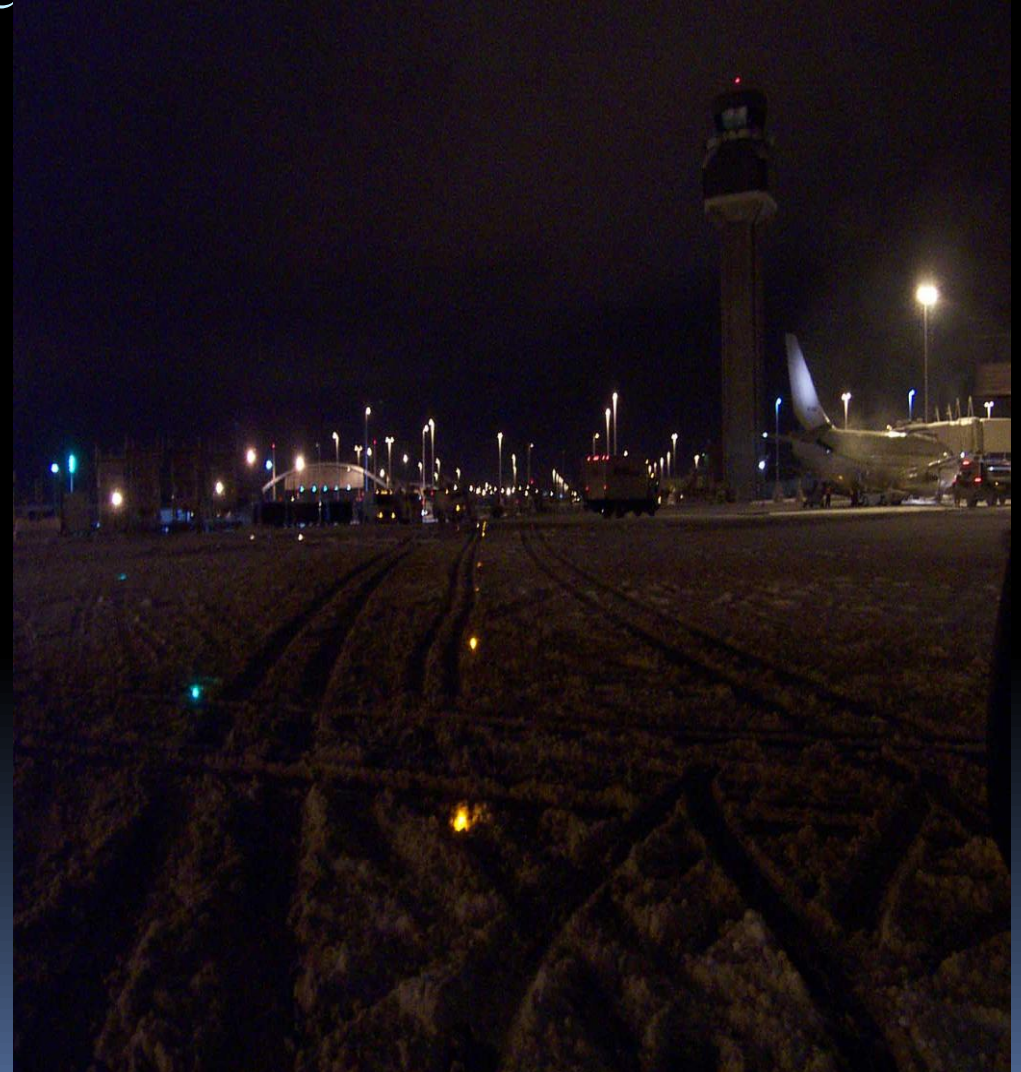
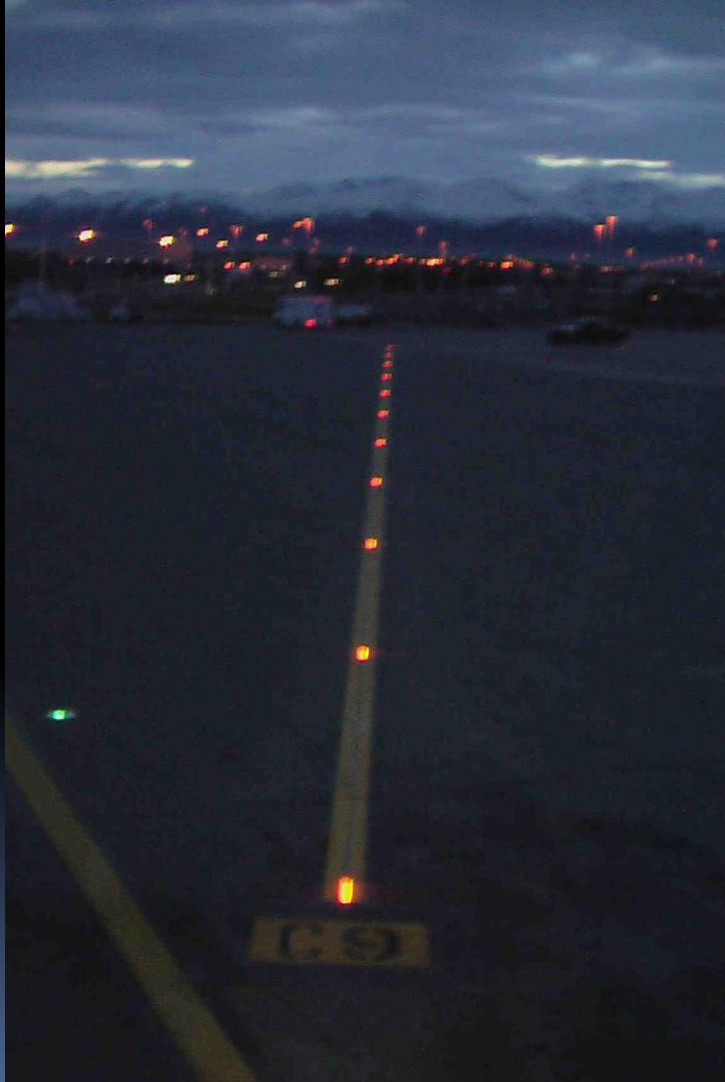
Anchorage Alaska Gate Lead in Line C-9 From Nighttime to Sunlight,
Pictures Taken With Standard FAA / ICAO Green Taxiway In-set Lights
On The Left, With Yellow Linear LED lights on Right.



Anchorage Alaska Gate Lead in lines With Snow , With Two Green
FAA / ICAO Taxiway Lights (on left) and Yellow LEDline®
To Gate C-9 (on right); Copyright Mr. Chas Trimborn



Anchorage Alaska Gate Lead in Line C-9 in Clear Weather With One Green FAA /ICAO Taxiway Light (on left) and Nighttime Snow Conditions With Two Green FAA /ICAO Taxiway Lights; (on left) , Yellow Linear LED Lighting On Right;
Copyright Chas Trimborn



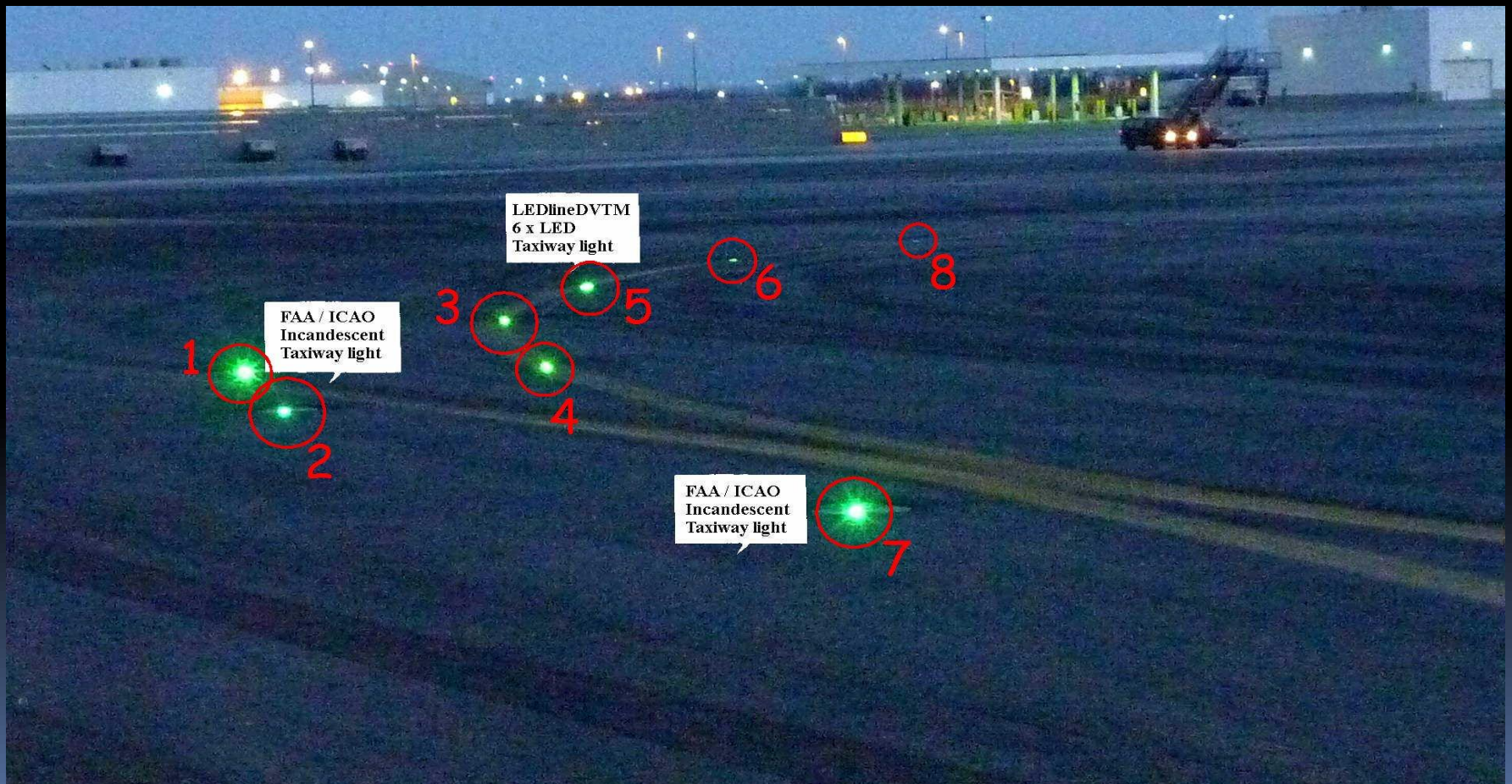
Anchorage Alaska Linear LED Lighting Green Centerline Aircraft Guidance at the New Re-fueling Area With 6 x LEDs



Anchorage International, Aircraft Guidance at the Re-fueling Area:
Standard Green FAA/ICAO Incandescent Taxiway Lights in the
Foreground Vs. Green Centerline 6 x LEDs Linear LED Lighting in The
Background.



Anchorage International Aircraft Guidance at their Re-fueling Area: Standard Green FAA / ICAO Incandescent Taxiway Lights in the Foreground Vs. LEDline® Green Centerline 6 x LEDs in The Background. **Note: #8 side emitted light vs. Possibly Confusing side emitted light Low Angle 1, 2, and #7 FAA / ICAO Lights**



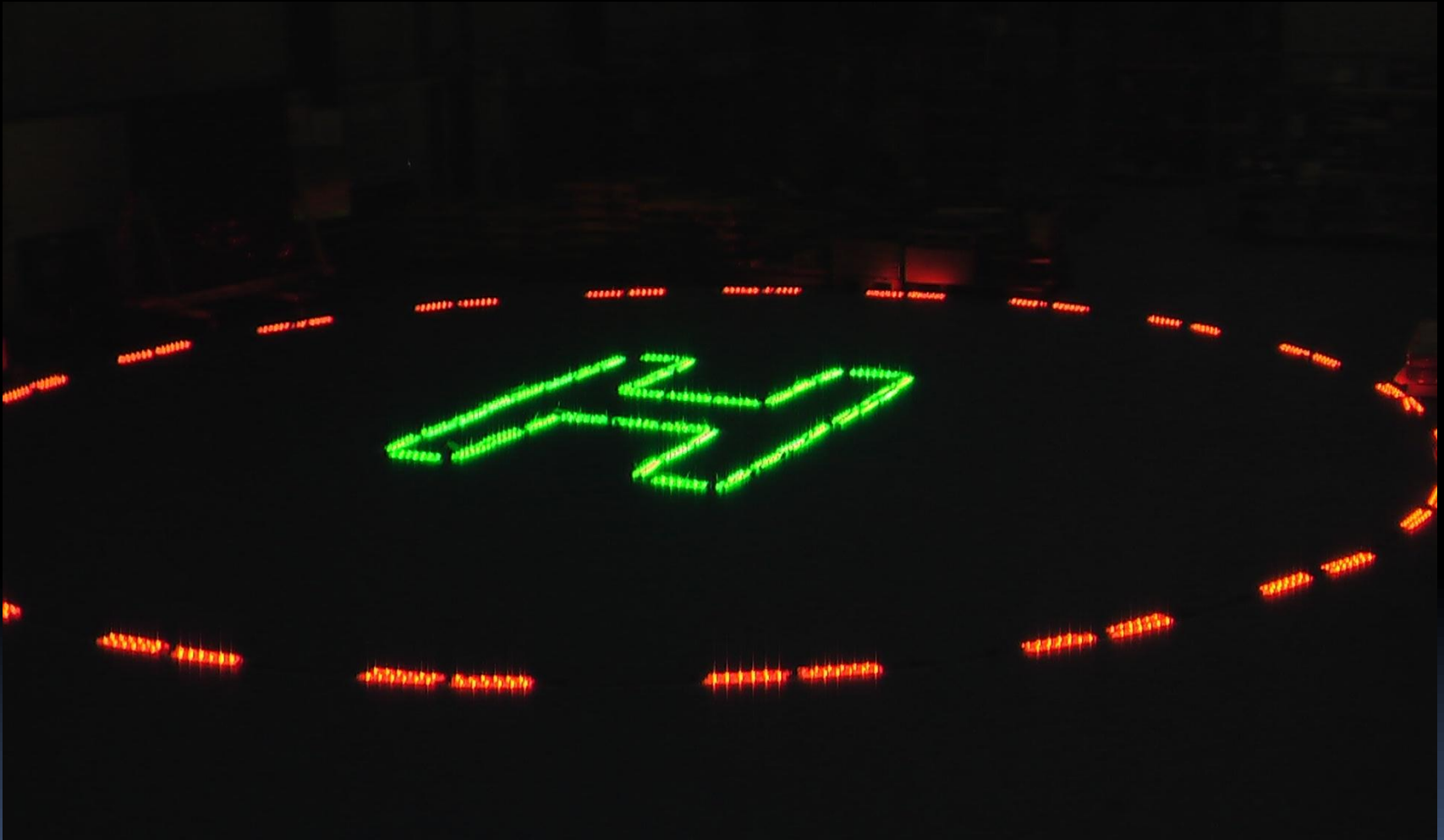
Anchorage Alaska LEDline[®] Green Centerline Aircraft Guidance at the New Re-fueling Area With 6 x LEDs



Anchorage Alaska LEDline® Green Centerline Guidance at the Re-fueling Area,
With 6 x Embedded LEDs; (This is Pilots Eye View from 9m (30ft.) High, With a
7.5m (25ft) Gap Between the Eleven Visible Lights = 82.5m (270ft)).



Linear LED Lighting Helipad Applications, Meet ICAO Annex 14 Volume 2 Requirements for the Aiming Circle and “H” Symbol.

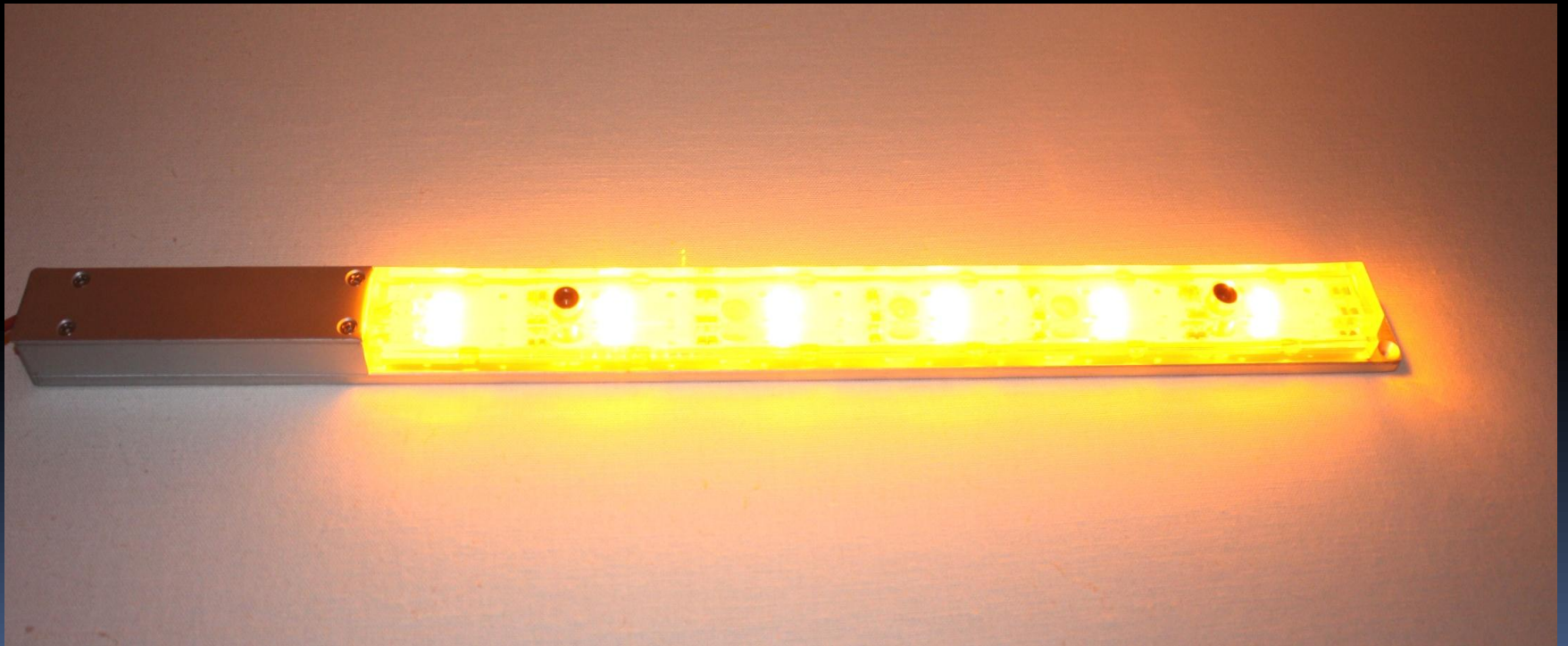


Injection Moulded LEDline® With Mounting Plate Design

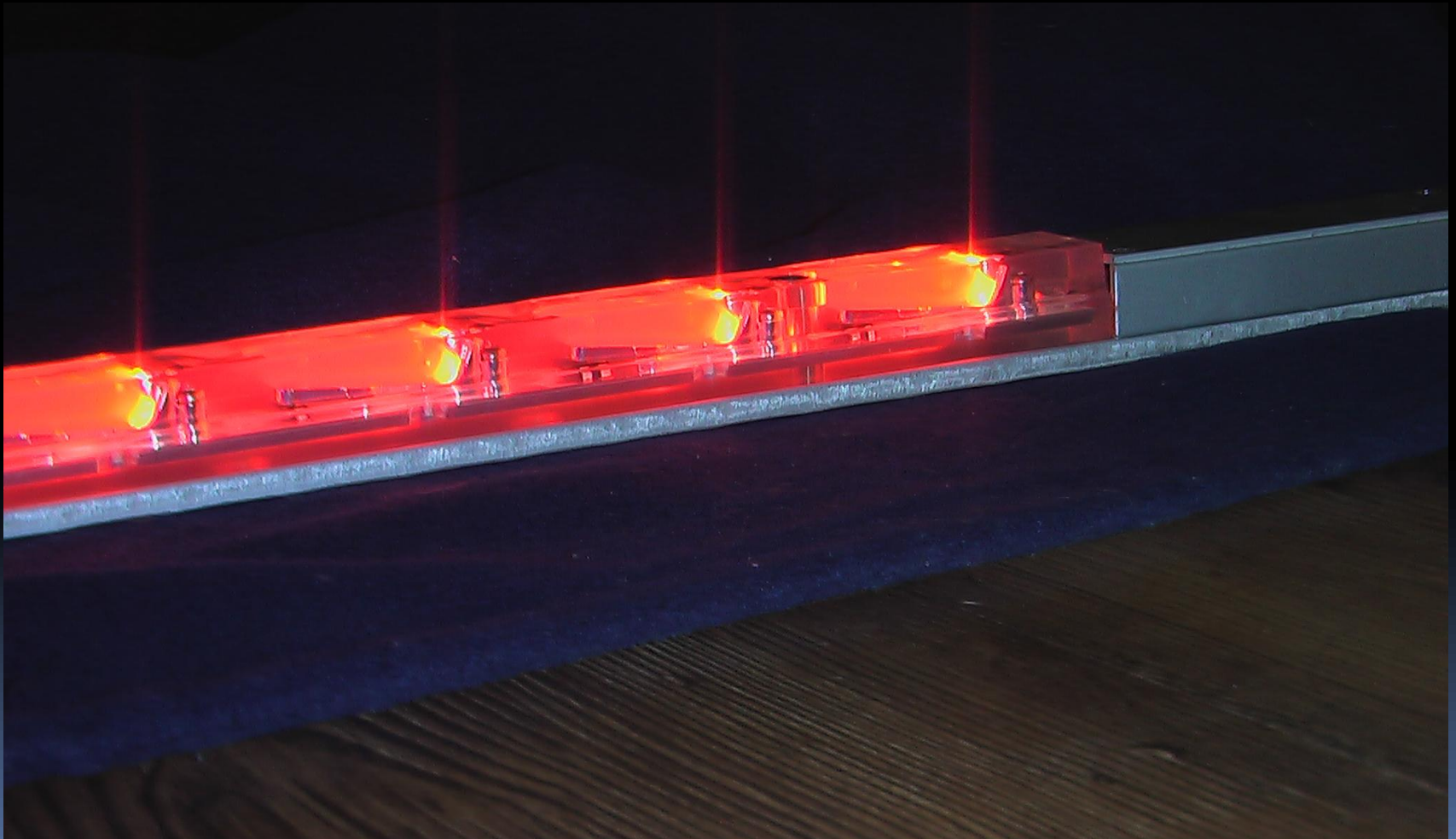
This was;

- ❑ Much more robust.
- ❑ Allowed for more powerful, brighter types of LEDs to be used.
- ❑ Allowed for the use of optics to be embedded within the unit.
- ❑ Allowed for smart electronics
- ❑ Allowed for Mounting Plate Design

Omni-directional Linear LED Lighting With 12 LEDs and Early Aluminum Mounting Plate



Red Semi-directional Linear LED Lighting LEDlineDV™ With 6x LED's with Early Aluminum Mounting Plate



Red Semi-directional Linear LED Lighting LEDlineDV™ With 6x LED's with Aluminum Mounting Plate



Linear LED Lighting LEDlineSunDV™ (Semi-directional) Yellow With 12 x LEDs on Mooting Plate

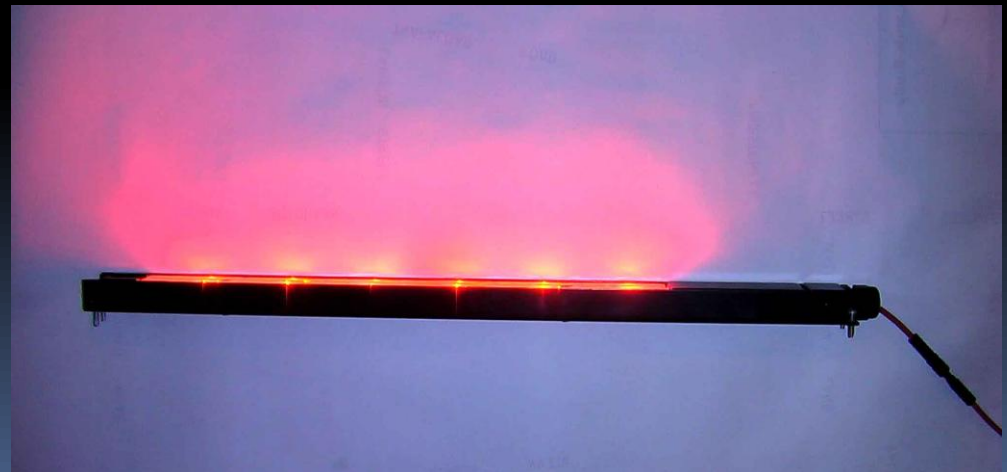
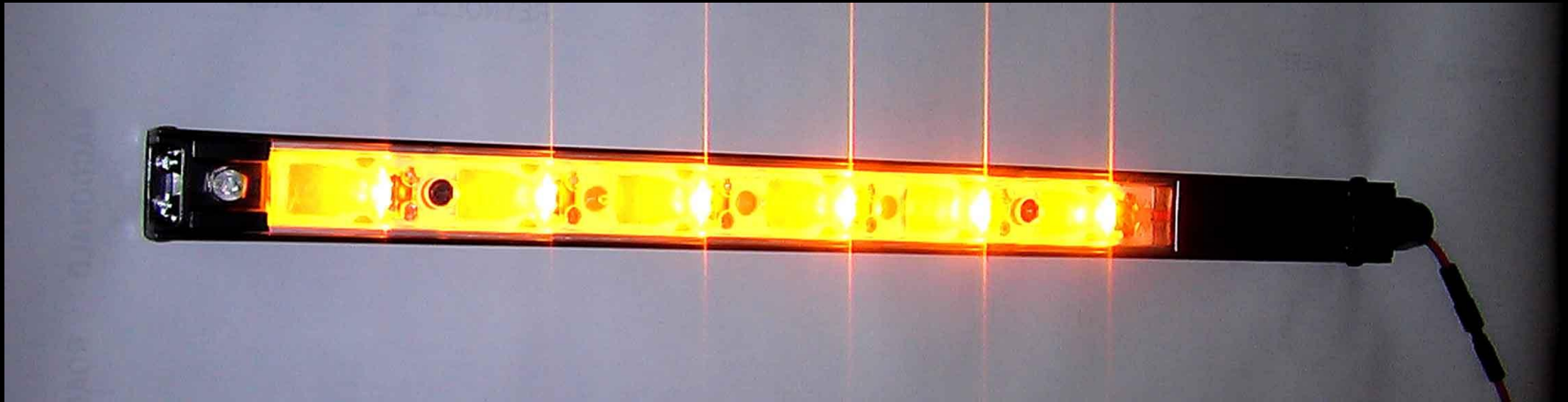


Linear LED Lighting With Latest Style of Plastic With Simpler Mounting Plate Design

This was;

- ❑ Much more robust.
- ❑ Allowed for more powerful, brighter types of LEDs to be used.
- ❑ Allowed for the use of optics to be embedded within the unit.
- ❑ Allowed for smart electronics
- ❑ New plastic
- ❑ New simpler Mounting Plate design

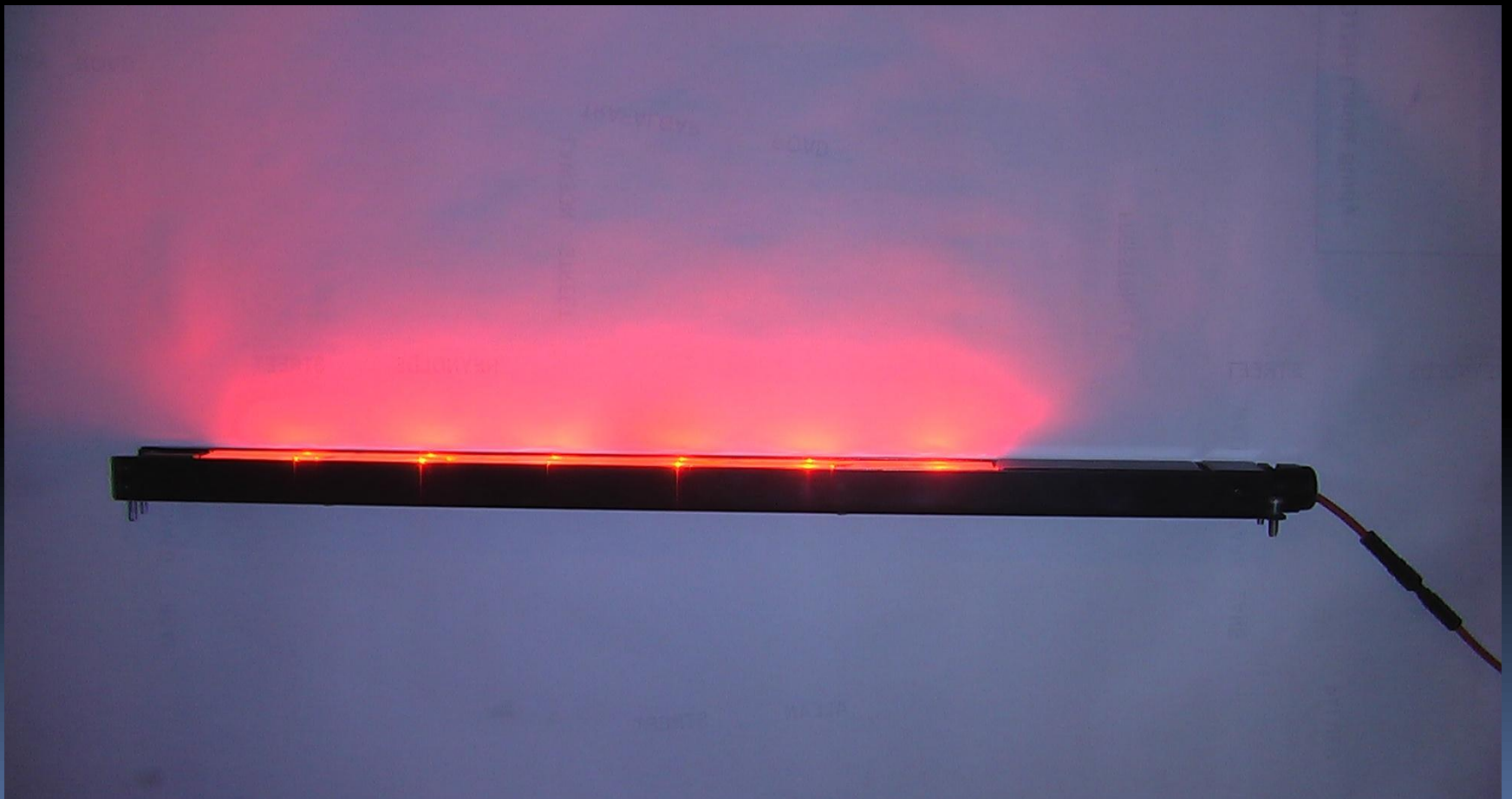
Yellow, Green and Red LEDline® Within Mounting Plate

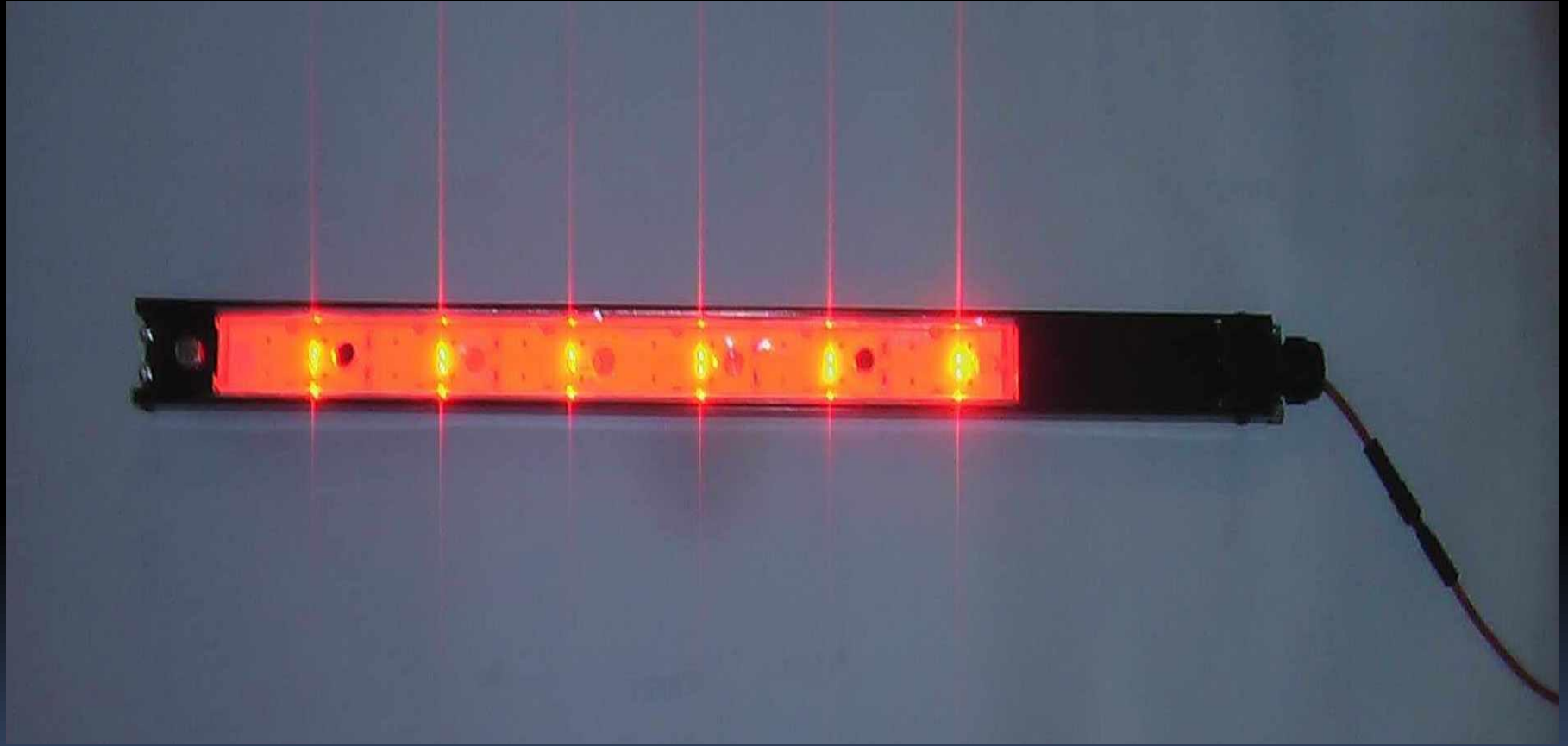


White and Blue LEDlineSunDV™ (Semi-directional) with 12 x embedded LEDs Within an In-pavement Mounting Plate

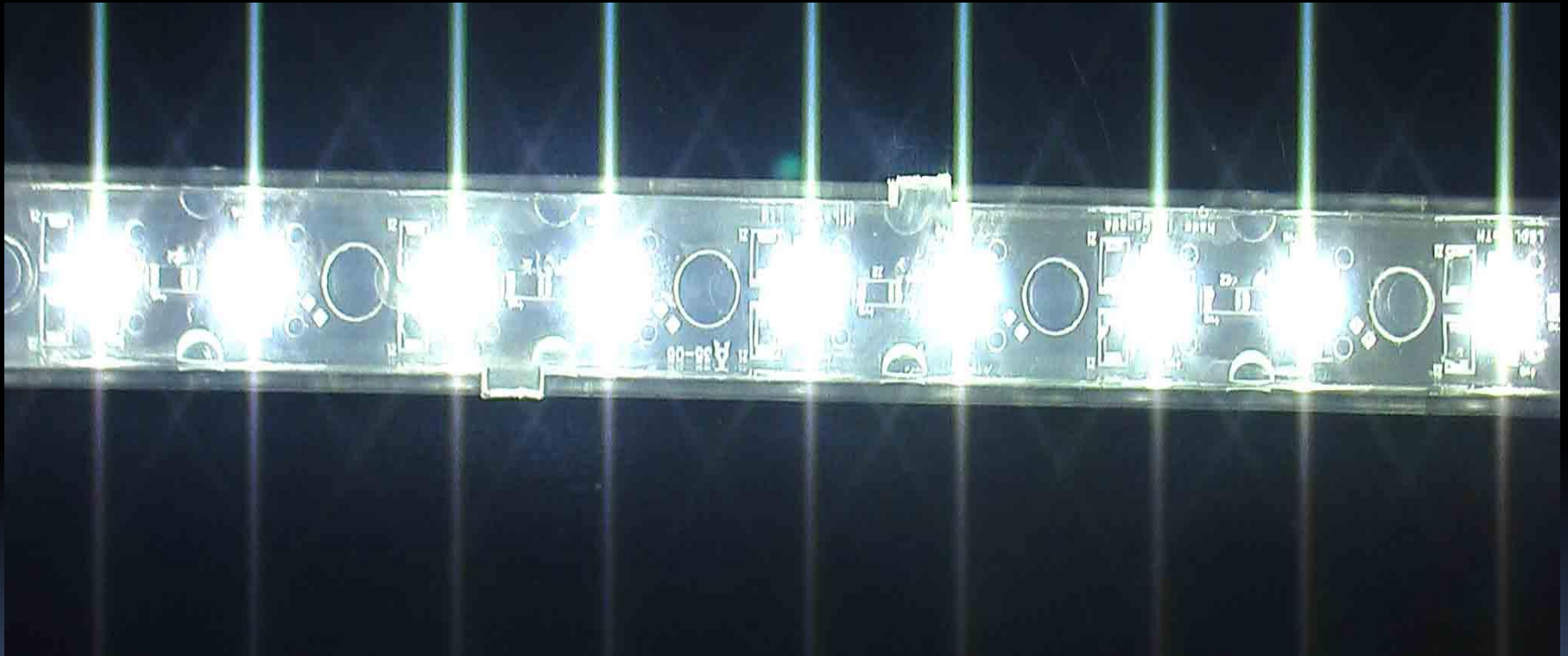


Side view of Omni-directional Red
Linear LED Lighting LEDlineSun HB™
with 12 x LEDs in New Mounting Plate





White , Sunlight Visible ,Omni-directional, Encapsulated Linear
LED Lighting, LEDlineSunHB™ ,
with 12 x 135 lumen 1W LEDs = +1600 Lumens.



Some Examples of Airfield and
Helipad Installations with the
Newer Injection Moulded Product.

Linear LED Lighting at The Vancouver International
De-icing Pads LEDlineDV™ Semi-directional with 6 x Embedded
LEDs; Sept . 2011 Copyright Stewart McIntosh



Linear LED Lighting at The Vancouver International
De-icing Pads LEDlineDV™ Semi-directional with 6 x Embedded LEDs;
Sept . 2011 Copyright Stewart McIntosh



Linear LED Lighting at The Vancouver International
De-icing Pads LEDlineDV™ Semi-directional with 6 x Embedded LEDs; Sept . 2011
Copyright Stewart McIntosh



Linear LED Lighting at The Vancouver International
De-icing Pads LEDlineDV™ Semi-directional with 6 x Embedded LEDs;
Sept . 2011 Copyright Stewart McIntosh



Video of LEDlineDV™ Semi-directional with 6 x
Embedded LEDs at the Vancouver International De-icing
Roads Sept . 2011 Copyright Stewart McIntyre Vancouver.

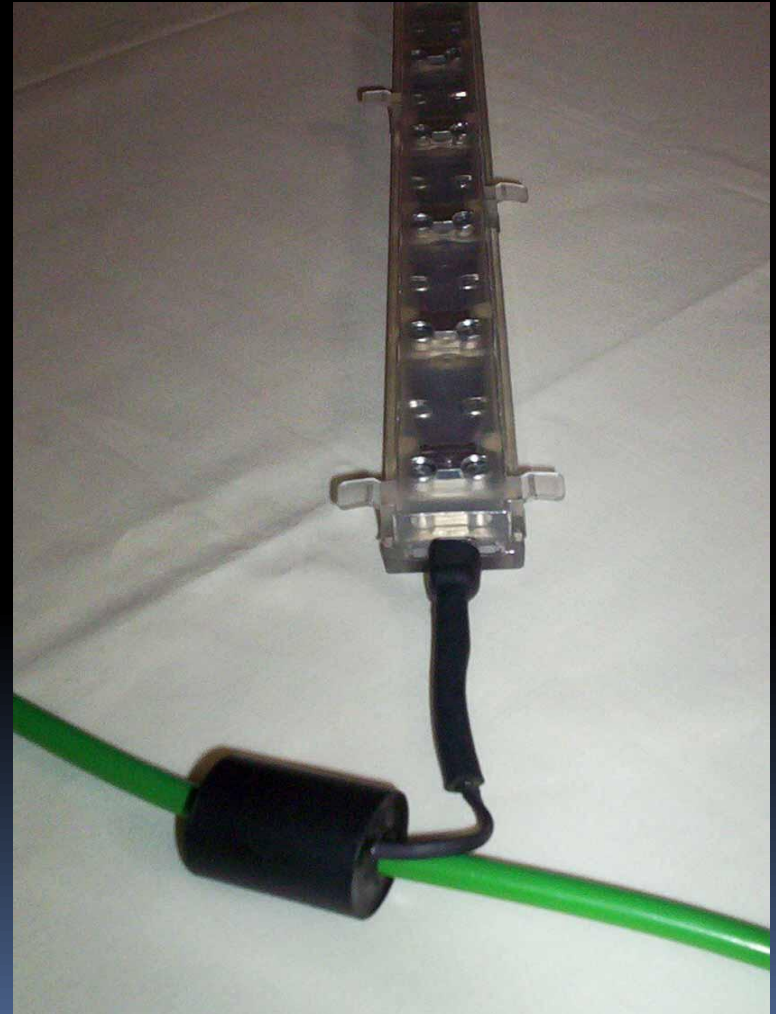
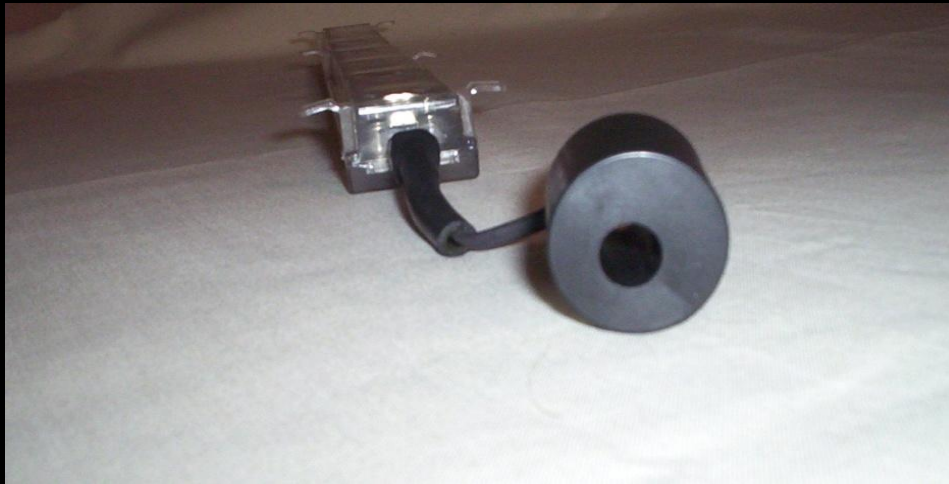
The Induction Power Pickup
Connector and Master
Controller have also Evolved.

All in- pavement applications are recommended to be powered via an induction power supply, and non contact induction power pickup connector. As such, connections are no longer the weakest link as they have become;

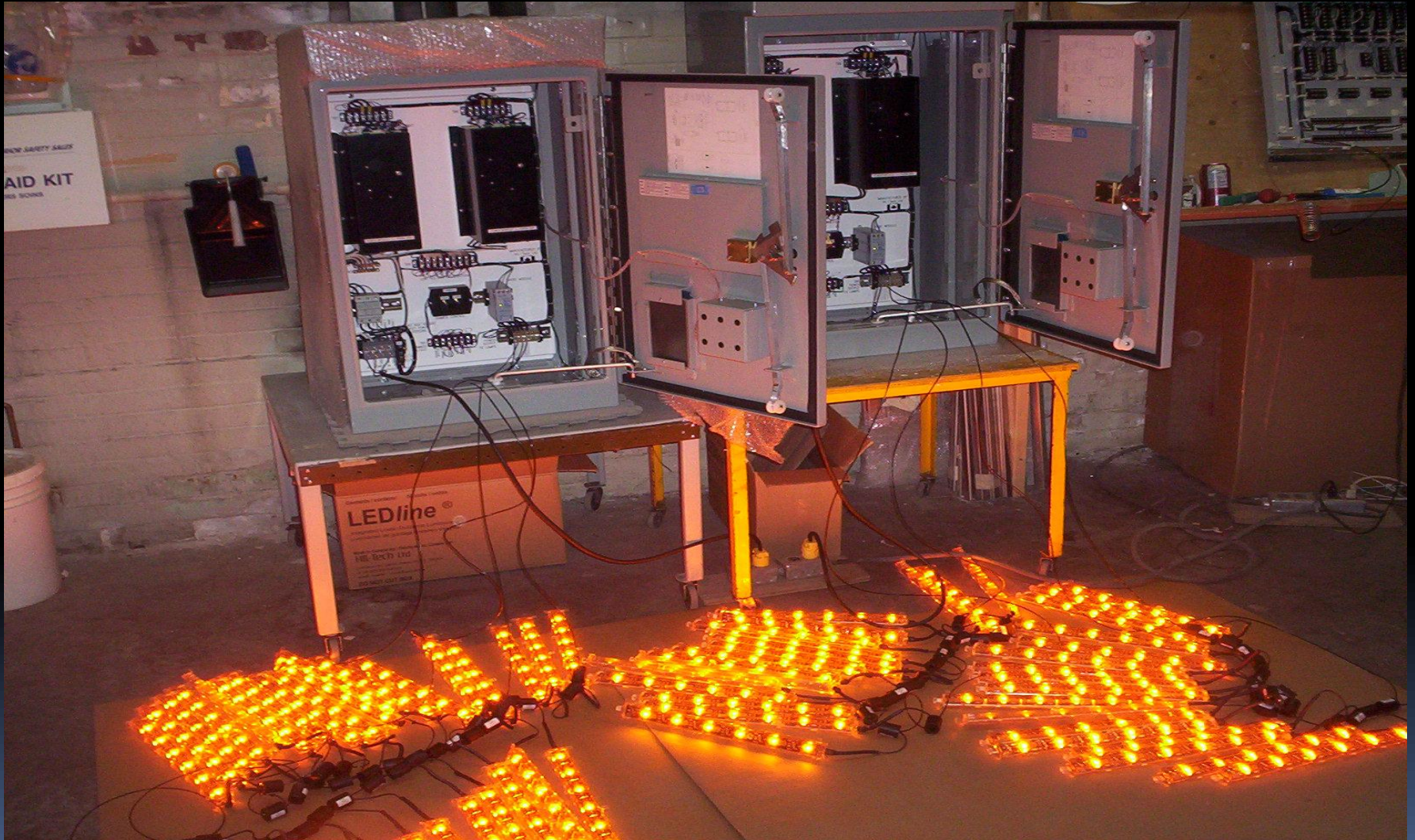
- totally sealed,
- totally submersible,
- No hard wiring, so nothing can corrode,
- The direct burial power distribution wire **is never cut**, spliced or needs any sealing as there were no hard wired LED Lighting connections to it.



The First Generation of Corrosion Proof, Submersible Induction Power Pickup Connection; (for in-pavement applications, non contact - no hard wiring), **However, it has no easy disconnect.**



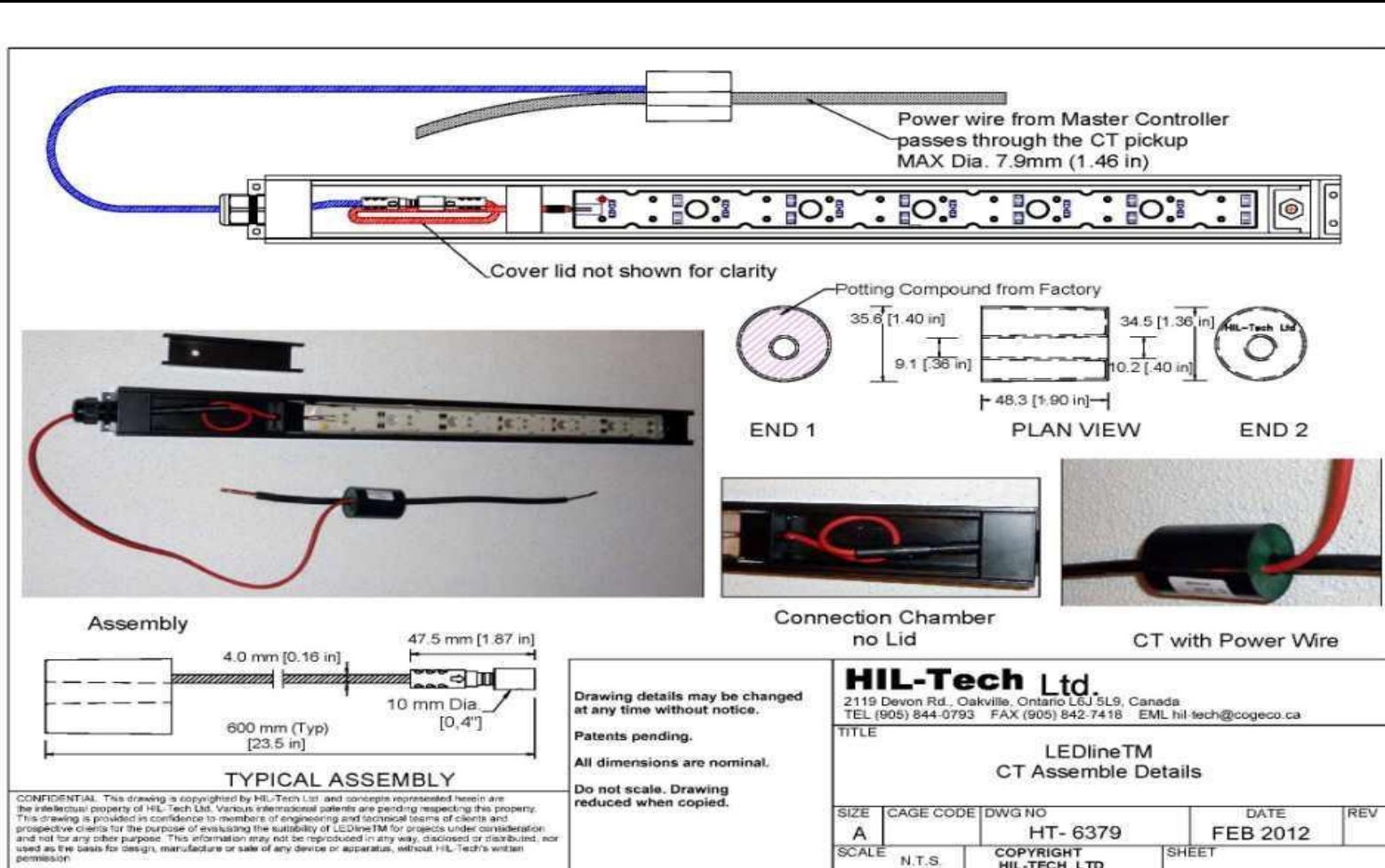
Induction Master Controllers: Lighting LEDline® with 6 x embedded LEDs, via their induction (non-contact) connectors.



The new easy disconnect for the induction power pickup connection is now an IP-68, all plastic (not corrodible), locking connector allows the Linear LED Lighting units to be easily disconnected from the glue buried Induction connectors. (IP68 = tested for 6 weeks to seawater depths of 20m (65ft.)). Ask HIL-Tech for even tougher connectors.



Corrosion Proof, Submersible Induction Power Pickup Connection; (non contact - no hard wiring, for in-pavement applications).



Installation Has
Been Refined

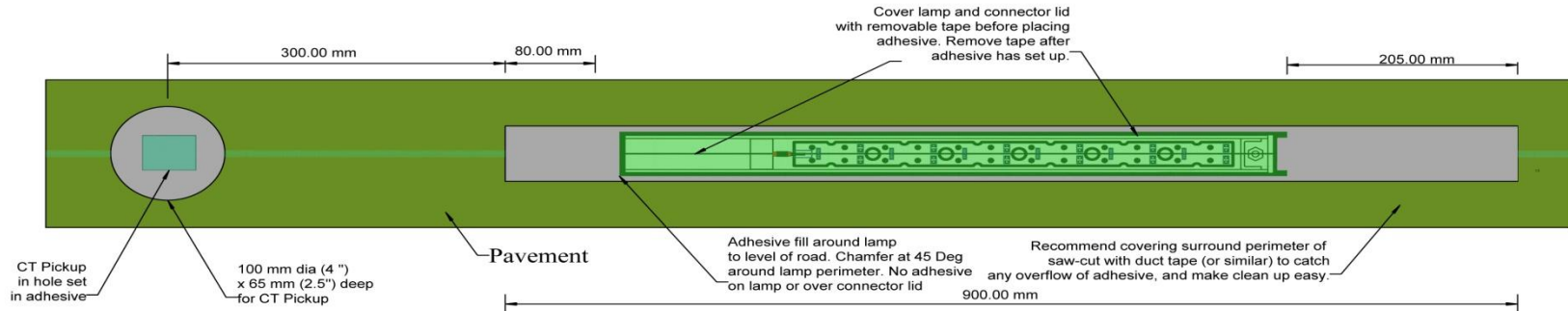
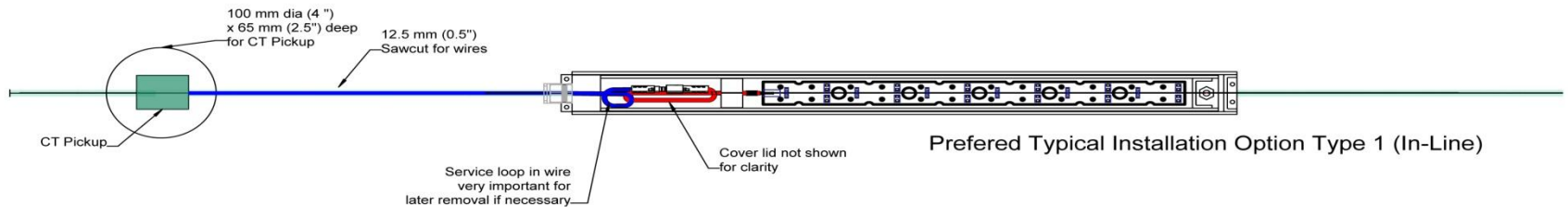
LEDline® Is Installed In Days Not Weeks!!

As a generalized truism; LEDline® is able to be installed in days what normally takes weeks with standard series circuit taxiway in-set lights.

At Anchorage International: A contractor unfamiliar with LEDline's® installation, with 5 people and a saw cut machine, installed some 230 x LEDline® units in about 5 days. Had this been standard series circuit lights, installing 230 x lights; with 230 steel cans; with all the series circuit trenching and wiring; the CCR power supply and its controls etc. ; weather and schedule permitting; would have taken major digging equipment months. **In addition, such major Equipment left in the area during the construction, would pose a major potential hazard to aircraft.**



LEDline® Typical Installation Detail #1



General Installation Notes

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.

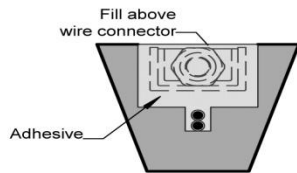
2119 Devon Rd., Oakville, Ontario L6J 5L9, Canada
 TEL (905) 844-0793 FAX (905) 842-7418 EML hil-tech@cogeco.ca

TITLE
 LEDline™ Typical Installation
 Details 1

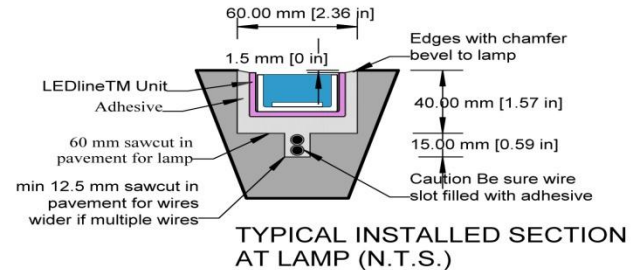
SIZE	CAGE CODE	DWG NO	DATE	REV
A		HT- 6370	Jan 2012	
SCALE	N.T.S.	COPYRIGHT HIL-TECH LTD	SHEET	

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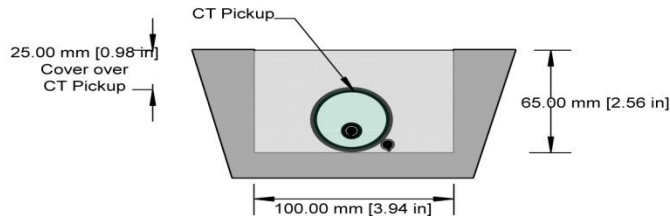
LEDline® Typical Installation Detail # 2



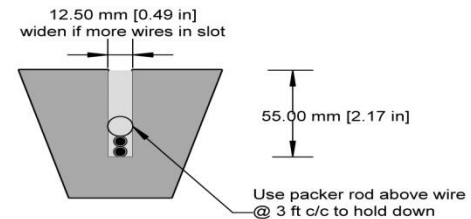
TYPICAL INSTALLED SECTION AT WIRE CONNECTION (N.T.S.)



TYPICAL INSTALLED SECTION AT LAMP (N.T.S.)



TYPICAL INSTALLED SECTION AT CT PICKUP (N.T.S.)



TYPICAL INSTALLED SECTION WIRE SAW-CUT (N.T.S.)

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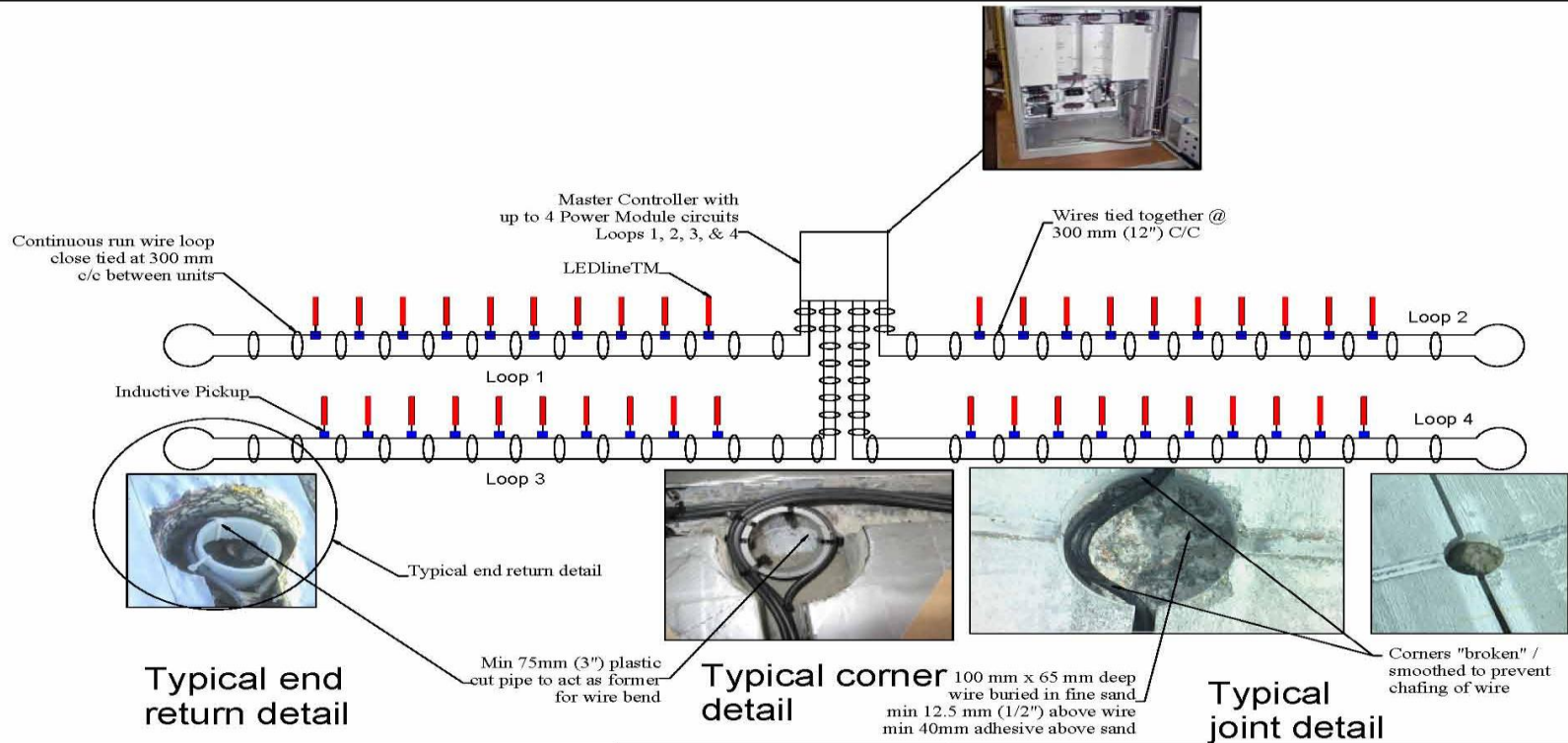
2119 Devon Rd., Oakville, Ontario L6J 5L9, Canada
 TEL (905) 844-0793 FAX (905) 842-7418 EML hil-tech@cogeco.ca

TITLE
 LEDline™ Typical Installation
 Details 2

SIZE	CAGE CODE	DWG NO	DATE	REV
A		HT- 6371	Jan 2012	
SCALE	N.T.S.	COPYRIGHT HIL-TECH LTD	SHEET	

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LEDline® Typical Installation Detail # 3



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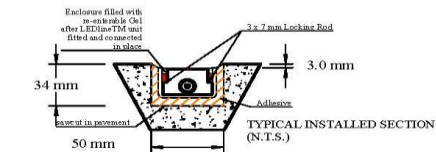
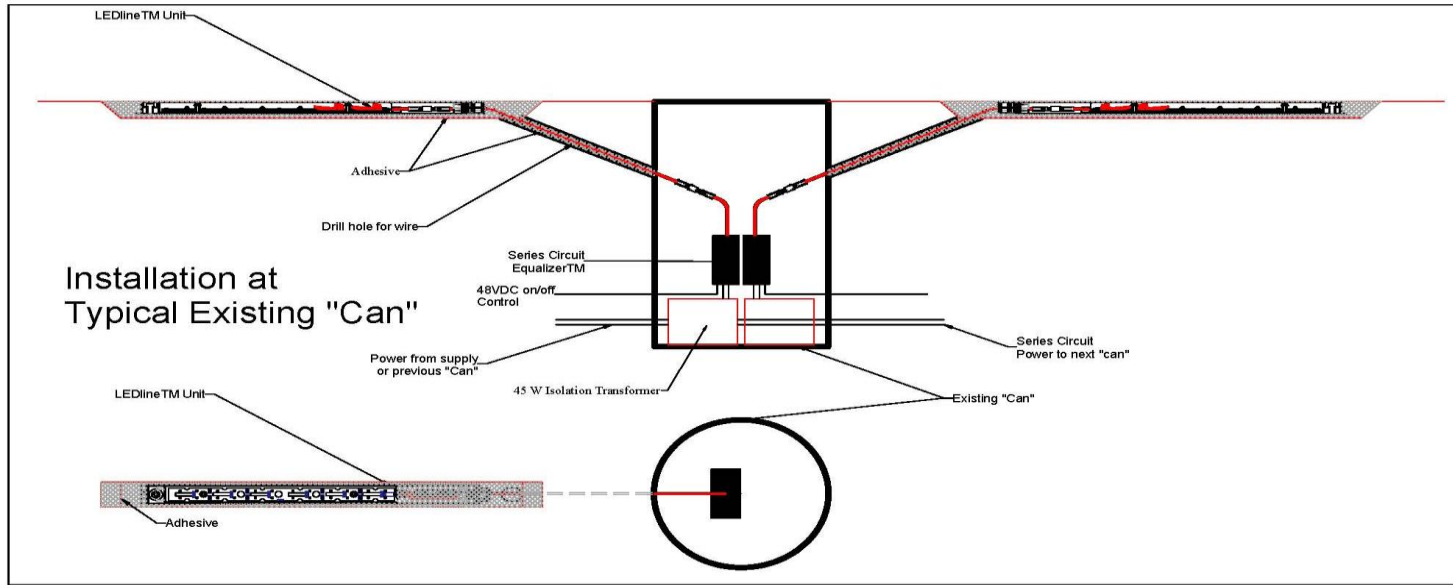
TITLE
 LEDline™ Typical Installation
 Details 3

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SIZE	CAGE CODE	DWG NO	DATE	REV
A		HT- 6372	Jan 2012	
SCALE	N.T.S.	COPYRIGHT HIL-TECH LTD	SHEET	

Linear LED Lighting can also be connected to and be powered by standard series circuit power supplies and CCRs.

LEDline® Can Also Be Powered By A



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 TEL (905) 844-0793 FAX (905) 842-7418 EML hil-tech@cogeco.ca

TITLE				
Typical Schematic LEDline™ Installation Existing "Can" with Series Circuit				
SIZE	CAGE CODE	DWG NO	DATE	REV
A		HT- 6316	JUNE 2010	
SCALE	N.T.S.	COPYRIGHT 2010 HIL-TECH LTD	SHEET	

LEDline®: Applications and Versatility

I

Roads

- Dynamic road markings, creating extra lanes during rush hours
- High accident locations
- Barrier markings
- Pedestrian Crossing
- Rail Road marking
- Longitudinal markings
- Transverse markings
- Merge guidance
- Words & symbols
- Intersection markings
- Obstruction markings
- Emergency lane highlighting / dynamic emergency response
- Temporary work zone highlighting
- Construction zone highlighting

II

Airports / Helipad Non-movement Areas

- Gate lead-in lines
- Gate numbers
- Parking positions
- Holding pads
- De-Icing pads
- Helipads
- Nose wheel turning
- In-pavement signage
- Helipad aiming circles and "H" designations

III

Airports Movement Areas

- Taxiways
- Taxiway / runway hold lines
- Highlighting the new hold line
- warning dash lines
- Centreline / nose wheel turning radius
- Taxiway centre line lighting.
- In-pavement symbols & signage.
- In-pavement symbols.
- Closed taxiway and runway markings
- SMGCS
- RWSL

IV

Other

- Rail transport
- Marine lighting
- Military helipads
- helicopter navigational aids
- other lighting
- Mining
- Architectural (emergency & decorative)

LEDline[®] - Benefits for Airports

- **Snow ploughable:** Embedded slightly below the pavement surface, ensures that LEDline[®] will not be disturbed by either steel brushes or snow plows.
- **Melts Snow:** Made of solid plastic the unit is the heat sink, so it melts snow.
- **Long Life;** LEDs have a longer life compared to incandescent or halogen bulbs = less maintenance!
- **Low Powered Induction Connection;** = Non-contact electrical connection = no hard wire connections to corrode or go bad = increased safety for electricians to maintain and operate.

LEDline[®] - Benefits for Airports

- ❑ **Inexpensive:** to buy, install, operate, or maintain compared to traditional inset lights.
- ❑ **Easily and Quickly installed in 45mm (1.5") Deep Groove:** = very inexpensive to install compared to traditional inset lights! At Anchorage International 230 lights were installed by 5 people and 1 saw cut machine in about 5 days.
- ❑ **LED Light Source;** ⇒ high energy efficiency, ⇒ long economic (useful) life, and ⇒ virtually maintenance-free.

Operating costs are very low !

According to Vancouver International's engineers, installation costs per installed meter are 4-7 times less

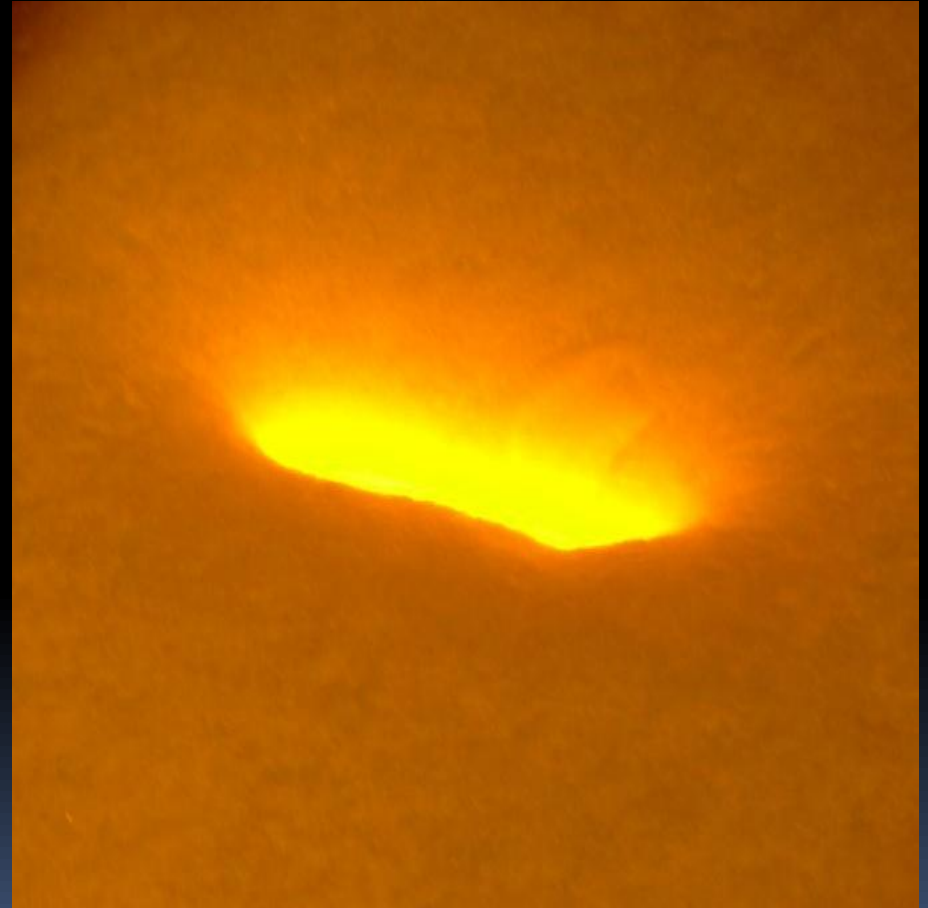
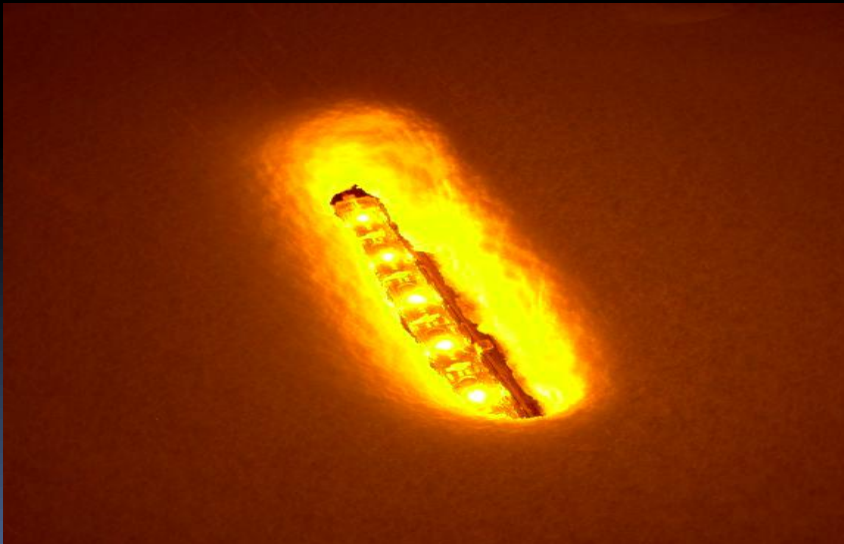
LEDline[®] - Benefits for Pilots

- **Linear Visual Aids;** provide for greater directionality / visibility than other marking systems, especially in adverse weather conditions, as each light source points the way to the next. **Therefore every light source gives both POSITIONAL and DIRECTIONAL guidance = enhanced pilot situational awareness = better pilot guidance.**
- **Far Less To;** buy, operate, and maintain, and much, much faster to install and therefore less costly –

These translate into better visual aids, at a fraction of the cost of standard inset lights, provides pilots with increased situational awareness, so can minimize bad weather delays.

Increased pilot situational awareness and increased safety = increased airport capacity!

LEDline® Trial in Anchorage Alaska in 2006 Melting A Heavy Snow Fall, Copyright
Mr. Matthew Shaw of AvAir Pros Engineering



Northwest Airline Group Pilot Assessment of the Anchorage International LEDline® Installation.



Northwest Airlines, Inc.
Flight Operations
6300 Boeing Avenue
Anchorage AK 99502
nwa.com

Northwest Airlines Pilot Survey of the LED line Guidance System Installed at Ted Stevens Anchorage International Airport

Dear Mr. Hutchins,

The Pilots at Northwest Airlines have been using the LED line guidance system since it was installed here in September 2007 on gates C-8 and C-9. Note: Northwest Airlines only uses gates C-9 and C-8. The system is also installed on Gate C-7, used by Alaska Airlines.

The lights are bright and highly visible in all weather conditions and have been helpful in speeding up the process of properly aligning the aircraft at the gates.

Given the above and because the lighting systems are new as Chief Pilot of Northwest Airlines, in Anchorage, I conducted an informal survey of the Northwest Airline Pilots using the system on inbound flights last winter.

The feedback from the Pilots was very positive.

- The Pilots were impressed with how visible the system was in the snow;
- All thought that the guidance provided by the LED line was better than the standard green taxiway center line lighting.
- They also liked the directionality each light source provided.

They were able to assess the comparative merits of two guidance systems in similar weather conditions, since the systems followed on from one to the other. The differences between the systems were especially noticeable in heavy snow, low visibility conditions, where the linear aspect of each of the LED lines providing direction was very helpful.

I also observed a taxi-in operation personally from a 757 jumpseat and came away similarly impressed.

The LED guidance line lighting system would certainly have other airport applications to help increase Pilot situational awareness. Airport safety could be significantly enhanced by using the system in-pavement for Stop signs, Hold Short bars, Taxiway lights, etc. Additionally, Runway centerline lighting, required for low visibility take-offs and also CAT 111 landings could be vastly improved.

I would encourage the LED line product to be assessed by the U.S. Department of Transportation Federal Aviation Administration, the Airline Pilots Association as well the Airlines.

I would recommend installing LED line at all our gates system wide.

Regards

Captain Tim Tobin
Northwest Airlines
Director of Flying/Chief Pilot Anchorage Base
Office: 907-266-5664
Cell 907-382-9383
E-mail: tim.tobin@nwa.com

23rd June 2008

Chief Pilot Tim Tobin -

“The lights are bright and highly visible in all weather conditions and have been helpful in speeding up the Process of properly aligning the aircraft at the gates. “

“The feedback from the Pilots was very positive.

- **The Pilots were impressed with how visible the system was in the snow;**
- **All thought that the guidance provided by the LEDline was better than the standard green taxiway center line lighting.**
- **They also liked the directionality each light source provided.”**

“The differences between the systems were especially noticeable in heavy snow, low visibility conditions, where the linear aspect of each of the LED lines Providing direction was very helpful.”

■
“I would recommend installing LED line at all our gates system wide.”

Alaska Airline's Group Pilot Assessments of the Anchorage International LEDline® Installation.



From: "Sean Ellis" <Sean.Ellis@AlaskaAir.com>

Sent: Tuesday, May 13, 2008 3:19 PM

To: "Nick Hutchins" <nhutchins@cogeco.ca>

Subject: Re: Pilot Input for ICAO Visual Aids Committee

Dear Mr. Hutchins,

The Pilots at Alaska Airlines have been using the LEDline® since the system was installed here at Ted Stevens Anchorage International Airport on gates C-7, C-8 and C-9. The feedback from the Pilots and Ramp Crews has been very positive.

The LEDline® is bright and provides linear guidance when only one segment is visible unlike conventional single point incandescent lighting. The lights are bright and highly visible in all weather conditions.

The way the LEDline® system is installed it is not exposed to snow removal blades and therefore is not likely to be damaged by the snow plow during winter operations. Marshalers (ramp crew) credit the system with making the job of aligning the jet with the jet bridge much easier since the pilots can see the J-line with greater ease. I recommend installing LEDline® at all our gates.

Clearly the LEDline® would have other airport applications that could increase situational awareness and enhance safety during both ground and flight operations. LEDline® could easily be used where conventional stop bars and hold lines are in place to enhance their visibility. With the ability to have multiple colors available, in pavement control devices become practical and colored taxi routes are possible.

LEDline® could easily be one of the biggest Airport safety tools on the horizon. I encourage you to promote your LEDline® product to the U.S. Department of Transportation Federal Aviation Administration, Airline Pilots Association and Airlines.

Captain Sean J. Ellis



Anchorage Base Chief Pilot Alaska Airlines

907-266-7542

4750 OLD INTERNATIONAL AIRPORT ROAD, ANCHORAGE, AK 99502-1090

Chief Pilot Sean Ellis -

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HIL -Tech Ltd.

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