

Why LEDline® Should Be Used Instead of Standard Inset Lights!

Series Circuit Electrical Inefficiency and Dangers:	LEDline®
<p>Flat airfields collect a lot of water and often being close to the sea, usually have high water tables. Traditional series circuit lights need to be within armoured steel cans, to protect the lights from aircraft and snow ploughs and given these conditions;</p> <ul style="list-style-type: none"> • They are not waterproof, so are often fill with water; • They corrode and short circuit adding to the electrical power use and waste of energy as the Constant Current Regulator (CCR) increases the voltage in the series circuit to overcome the electrical shorts; as such these types of circuits are very hazardous to maintenance personnel. • It is not uncommon for the water to use the electrical conducts and inset lights to drain away. • Their electrical connection causes much maintenance, since they are not very waterproof, so they corrode and require maintenance. 	<p>LEDline® is totally submersible and needs no such protection as;</p> <ul style="list-style-type: none"> • The LEDline® is installed below the pavement level so avoids aircraft and snow ploughs; • The LEDs are embedded in solid plastic, so they are completely sealed and there is nowhere for water / de-icing fluids to get into to cause corrosion or electrical power drain. • Its IP68 plastic locking connector is similarly waterproof and non corrodible. • Its induction connector is submersible and has no hard wiring to its power supply line so there is nowhere for water / corrosion to go. <p>Note: (Previous LEDline® has been tested to seawater depths of 300m (approx. 1000ft.), and is used for the lighting of escape chambers of military submarines).</p>
<p>Has a sealed isolation transformer at each light source, however the system is prone to corrode and cause maintenance issues;</p> <ul style="list-style-type: none"> • Although there is a waterproof isolation transformer between the series circuit and lights, their supposed water proof connectors, to and from the series circuit are a major source of electrical inefficiency and when the connectors and the steel cans become water logged often fail, which is why the high powered series circuits were designed to overcome these shorts and why these series circuits are so dangerous. It is why every year 	<p>LEDline's® locking plastic IP68 connectors connect it to its induction (non-contact no hard wiring) power pickups are;</p> <ul style="list-style-type: none"> • IP68 connectors are made of plastic so cannot corrode; • IP68 connectors have a locking mechanism, so don't just pull apart; • IP68 connectors are tested and rated for 6 weeks in seawater depths of 20m (approx. 65ft.).

<p>maintenance people are killed or severely injured when someone accidentally shorts them out.</p>	<ul style="list-style-type: none"> • Induction power pickups are potted, sealed, waterproof and submersible and have no moving parts, so have long life.
<p>High powered series circuits are hazardous;</p> <ul style="list-style-type: none"> • In series circuits, the amperage is fixed but the voltage is allowed to go up to the maximum a CCR is designed for, therefore, many thousands of volts can be generated to overcome a short which is often fatal when an accident happens. Therefore, every year serious injuries and deaths occur because of accidents with the series circuits in both in the developed and undeveloped world, since because of its nature, being designed to overcome electrical shorts, the series circuit is dangerous if someone accidentally becomes the ground through which the thousands of volt energy flows. 	<p>LEDline® is a low voltage series circuit system with each light needing;</p> <ul style="list-style-type: none"> • For the 6 x LED system approx. 21VAC at 350mA; • For the 12 x LED system approx. 21VAC at 700mA. • The power within the distribution wire is variable and is dependent on the number of LEDline® units to be found on a circuit. The smart Master Controller knows how many lights are on a circuit and only puts out sufficient power to light these units. However, there is a max. limit of 60VAC allowed on any power distribution circuit. • No matter what the power is in the distribution wire, even if there is a lightning strike, the magnetic induction power pickups will only allow a small amount of current through before they becoming saturated and so stop any more power coming through, therefore the LEDline® is safe.
<p>19th Century Light Bulb Filament Technology with all its Inefficiencies, in Global Warming Times: Due to Global warming issues, many countries have;</p> <ul style="list-style-type: none"> • Banned the production and sales of incandescent bulbs. (19th Century technology) • This means that eventually, all series circuit lights must be changed. However, if new efficient LED lights are still powered via the old CCRs and old high powered series circuits, there is very little or no energy savings. • In addition, if these LED lights need heaters to 	<p>LEDline® is 21st Century Light Bulb Technology and Efficiency:</p> <ul style="list-style-type: none"> • It is more efficient than incandescent bulbs or any LED bulbs run on high powered series circuits, particularly when such LED bulbs are required to melt ice and snow, so have heaters built into them. • LEDline® melts ice and snow without any additional heaters!

<p>melt the snow, as the old incandescent bulbs do, it would be more efficient to keep the old incandescent heater bulbs as the LED combination with heaters causes more energy to be used.</p>	<ul style="list-style-type: none"> Any LED lighting powered from legacy high powered series circuits, due to the electronics present needed to protect the LEDs, is not energy efficient and provides for NO energy savings.
<p>Inefficient Light:</p> <ul style="list-style-type: none"> Incandescent and halogen bulbs have a large filament, so their reflectors are also inefficient. Like the heat they produce, much of the light they produced is wasted. Light efficiency visibility for point sources is specified as to how much candela output there must be at specific angles. 60 years ago, this was to ensure that the inefficient point source lights provided enough light at low angles to be seen by pilots from a distance. to provide the necessary directionality for pilots ICAO / FAA regulations require that many lights need to be viewed simultaneously. <p>Note: To assist point source directional guidance, (as individually point sources provide no directional guidance), for safe taxiing; a number of these lights were mandated as being necessary to be viewed together, so as to provide pilots with a sense of direction.</p> <p>Governments and International government agencies like ICAO Annex. 14, and the FAA specifically sets the minimum number of visible point source lights that must be seen at one time, ICAO as being 4, whilst the FAA specifies 3 as the required number.</p> <p>However, with snow whiteouts, rain squalls or fog, all Category 111 C low visibility conditions, weather can suddenly change for taxiing aircraft. In these situations pilots may only be able to see a single light source ahead</p>	<p>Efficient Light, Provided They Are Properly Powered:</p> <ul style="list-style-type: none"> LEDs are small point sources so they can be efficiently coupled to reflectors. LEDline® is an efficient LED, linear /area source, which relies for its visibility on its intensity / luminance area. <p>Note: All visibility is based on; contrast ratio with the background; and for traffic signs; its font; its height; and letter width = area.</p> <p>The visibility of LEDline® is similarly based on; the size / area of the light; its width and length, as well as its intensity.</p> <p>Each LEDline® unit is linear, so each provides both positional and directional guidance, obviating the need for pilots to be able to see the mandated 4 or 3 light units ahead of them. Therefore, for safe taxiing, a single LEDline® unit will provide the direction pilots need.</p> <p>At Anchorage International (a Cat111C airport), in low visibility conditions, 100% of pilots, daily using both the ICAO / FAA certified green taxiway lights and LEDline®, preferred LEDline® as their</p>

<p>of them and so receive no directional guidance. This situation slows taxiing aircraft down, as pilots feel their way to or from a terminal, adding to the bad weather delays and increasing airport and airline costs.</p>	<p>guidance, over the standard ICAO / FAA green taxiway lights. (Please see pilot reports).</p>
<p>Energy Efficiency:</p> <ul style="list-style-type: none"> • Incandescent bulbs produce mainly heat, (some 60% - 70%), not light. For airfields with winter conditions, the heat was useful to melt snow and ice, but at only + - 30% generation of the light output, these bulbs are very inefficient. • Quartz Halogen bulbs again produce mainly heat, but are more efficient than incandescent producing about 35% - 40% light. • Fluorescent bulbs are generally more efficient at producing light than either quartz halogen or incandescent. 	<p>Energy Efficiency: LEDline® is made of LEDs, so;</p> <ul style="list-style-type: none"> • Is efficient, particularly when powered via its low powered induction power supply and its non-contact (no hard wiring) induction connectors, or its DC power supply. • If powered via a high powered series circuit, as with all other LED lights, LEDline® efficiencies suffer because like other LED lights, it needs electronics to protect the LEDs within LEDline® from the high powered series circuit. • If powered via renewable resources, the efficiency of LEDline® is further increased and its costs drastically reduced since; there is no need for mains or high powered series circuits; there is no need for large backup generators; and there is no need for ICAO / FAA mandated two separate mains power supply lines for the airfield.
<p>Incandescent Bulbs Are Point Sources, As Such;</p> <ul style="list-style-type: none"> • Whilst they provide positional information to pilots, <u>they provide no directional information</u>. • To overcome this deficiency Annex 14, specifies that; to be safe, taxiing pilots must be able to see at least 4 of these light sources ahead of them, so as to get the proper directional information. However, at night, in bad weather, low visibility conditions, such as; fog; snow whiteouts; very heavy rains, etc., taxiing pilots may only be able to see one of these point light sources, so receive no directional guidance. 	<p>LEDline® is linear / area light source;</p> <ul style="list-style-type: none"> • Which provides both positional and directional guidance, as being linear, each light points in the direction to go. • Therefore, in severe low visibility conditions, even if only one light were visible, pilots would still know in which direction to proceed to get to the next light source. (Please see the 2008 Anchorage International

<ul style="list-style-type: none"> • Pilots without any directional references to guide a taxiing aircraft, will slow down the taxiing aircraft, increasing the bad weather delays and ensuing that the backlog chaos will last long after the bad weather has gone. • The lack of directional guidance will also add to aircraft operating costs in added time and wasted fuel, and reduce an airport's profit as fewer aircraft use the gates during the bad weather and in the ensuing delays. 	<p>Chief Pilot Alaska and Northwest Airline reports, of all pilots using both ICAO / FAA Taxiway lights and LEDline® in identical weather conditions. 100% of all pilots surveyed judged LEDline® to provide superior guidance, especially in low visibility conditions).</p>
<p>Painted Taxiway Guidance Markings Are Linear,;</p> <ul style="list-style-type: none"> • Linear painted guidance are supposed to help point source lights in providing directional guidance, however, as anyone who drives at night knows, painted markings tend to disappear in bad weather, so are un-reliable, which means that at night, the pilots primary guidance system are the inset lights. 	<p>According To The Pilot Reports From Anchorage International;</p> <ul style="list-style-type: none"> • LEDline® provides for better visual aid guidance, especially in low visibility conditions.
<p>Versatility: Standard series circuit lights are only used for airfield lighting, since;</p> <ul style="list-style-type: none"> • They are very high cost, particularly their installation. • They are installed in protective steel cans, parts of which are often above grade, so are hit by snow ploughs which can damage them. • Their steel cans penetrate some 460mm (18") below the pavement. As such, with freeze thaw conditions, they can provide a water path to the pavement's structure weakening it. • If placed in close proximity, without the pavement being significantly strengthened, like any perforation through a material, they will structurally weaken the pavement. 	<p>Versatility: LEDline® is very versatile as it is installed in a 40mm (1.5") deep x 50mm (2") wide x 930mm (36") long groove, so is only a surface installation and does not penetrate to the pavement sub structure;</p> <ul style="list-style-type: none"> • it is used for airfields and roads for guidance lighting; • for creating larger in-pavement multiple unit compound lights; • for lit in-pavement signage and symbols; • for tunnel roof traffic guidance; • for barrier highlighting; • for sign highlighting; • for marine, mining and military applications, (tested to 300m (approx. 1000ft), it is used for the emergency lighting in submarine escape chambers); • and for aesthetics for outlining structures.

Cost High Powered Airfield Series Circuits:

Being high powered; their controls; their lights (especially the LED ones); their maintenance; operations and most of all their installation are very expensive since;

- The materials and in their installation are expensive, so they cost a lot;
- Because of the high power the series circuits are installed some + / - 2m (6.6ft.) depth, below the pavement in conduits and the steel cans of the lights are installed some 460mm (18") into the pavement, heavy digging equipment are require to install the system;
- Installing standard series circuits and lights takes weeks and months to install;
- The heavy construction equipment, being too large to remove each night when work stops, causes major airfield disruptions because it is left on the airfield. As such, it is a hazard and a potential serious obstruction for aircraft and serious accidents and crashes at airports have been cause by such equipment;
- Large equipment provides for major operational disruptions to the airfield operations for the full construction time. Any open trenches and equipment on the construction site must be clearly sealed off; pilots notified; and aircraft routed away from the site because of the potential hazards and dangers to the aircraft and passengers.
- High powered series circuits, being dangerous, require specially trained electrical staff to install and maintain them, this increases the costs for their installation and maintenance.

Cost LEDline®:

LEDline® uses low power so everything costs much less; to buy; to operate; to maintain; and is far, far less expensive to install;

- LEDline's® materials are less to purchase and its installation is far, far less.
- Installed in a 40mm (1.5") deep x 50mm (2") wide x 930mm (36") long groove LEDline® only needs a small saw cut machine and an operator to cut all the grooves for both the light units, their induction power pickups, and the power distribution wire.
- LEDline® is installed in days not weeks or month. At anchorage International 230 LEDline® units were installed by a contractor, unfamiliar with the product, with 1 saw cut machine and 5 workers in only 5 days.
- Usually all saw cuts are made on the first day, after which the saw cut machine is removed from the airfield, so there is no equipment left on the airfield to cause possible hazards to aircraft.
- The open saw cut grooves are not a hazard to aircraft since they are only 40mm (1.5") deep x 50mm (2") wide x 930mm (36") long, so pose no danger to taxiing aircraft which can easily drive over them. As such, using LEDline® minimizes any operational problems, disruptions and procedures and is much safer for all concerned.
- Low powered, LEDline® is usually powered from standard mains power, or renewable

	<p>energy sources, so any qualified electrician can install and maintain it., reducing installation and ongoing operating costs.</p>
<p>According to Vancouver International’s Engineers Hatch, Mott and Macdonald;</p> <ul style="list-style-type: none"> • In 2009 in the Vancouver area, a series circuit installation was 4-7 times more expensive per installed linear meter (3.28084ft.) compared to LEDline®. • Installed standard series circuit lights varied from 2009’s high of \$700.00 per m., to the 2010 estimate (due to the recession and contractors being more hungry) of some \$430.00 per m installed. • Since Vancouver International already had CCRs and their controls, I believe that none of the CCR or its control costs, for the standard series circuit lights, were included in their costing, thus the standard series circuit costs were much under estimated.) 	<p>According to Vancouver International’s Engineers, Hatch, Mott and Macdonald, in the Vancouver area;</p> <ul style="list-style-type: none"> • In 2010, after the recession, (hence the 4 - 7 times cost per liner meter installed for the standard series circuit lights), the LEDline® cost was approx. \$110.00 per m. installed, whilst standard series circuit lights varied from 2009’s high of \$700.00 per m., to the 2010 estimate (due to the recession and contractors being more hungry) of some \$430.00 per m installed. • (Note: Since Vancouver International already had CCRs and their controls, I believe that none of the CCR or its control costs, for the standard series circuit lights, were included in their costing, thus the standard series circuit costs were much under estimated.) <p>(Please contact HIL-Tech Ltd for Vancouver costing.)</p>
<p>Any Warranty Is Dependant Of The Company Supplying The Lights.</p>	<p>LEDline® Limited Warranty comes with;</p> <ul style="list-style-type: none"> • a 1 year Limited Warranty (limited to replacement parts only) and • at the time of purchase, customers may purchase additional years/s of Limited Warranty. (Please see HIL-Tech Ltd for details.)

<p>ICAO Certification;</p> <ul style="list-style-type: none"> • Series circuit lights are certified, provided they follow the 60 years ago ICAO Annex 14, which was specifically written around inefficient point source incandescent bulbs. Therefore, lights that comply with these may be ICAO certified. • The new LED lighting systems are being forced to follow these old ICAO guidelines, so guidance is not being improved. Become point sources cannot provide direction, without a number of them being seen simultaneously, all the requirements for taxiing pilots will still be needed to provide direction. 	<p>ICAO Certification:</p> <p>Not yet because it is an area / linear light source, not a point source.</p> <ul style="list-style-type: none"> • Point sources provide no directional guidance; linear ones do, so are better. • The ICAO Visual Aids Committee has seen LEDline® and is familiar with it. • All major Civil Aviation Authorities (CAA) will allow trials in movement areas. • The FAA Tech Centre has been tasked to find the equivalency between standard ICAO / FAA taxiway certified lights and linear lights.
<p>Annex 14 also specifies;</p> <ul style="list-style-type: none"> • That an airport is supposed to have at least two separate mains power lines supplying independent into the airport. • That a backup generator be available in case these fail. As such, in case of mains failure, because of the present large power lighting requirements, standby generators have to be large and complex to provide the necessary power. All this is costly to provide and is maintenance heavy, particularly for developing countries, where even the fuel and spare parts for the backup generators may be in short supply. 	<p>Because LEDline® is low powered, in areas with a lot of sun; LEDline® could be powered via renewable infield solar arrays, with buried batteries, so mains access could become completely unnecessary, as would be the need for any backup generator system.</p> <p>If the LEDline® airfield lights are mains powered, then Annex 14 mains requirements are still required and LEDline® would still need the standby generators. However, being a low powered system, these generators would be much smaller; easier to look after; use less fuel; and require cheaper spare parts; and therefore, would be much less expensive.</p>
<ul style="list-style-type: none"> • Series Circuit Lights can be installed Anywhere on Airfields 	<ul style="list-style-type: none"> • LEDline® can be installed on airfields in non-movement areas and, with CAA permission, in movement areas.

	<p>LEDline® can also be used for roads, tunnels, barriers and signs to improve highway safety and increase highway capacity, reducing traffic congestion, <u>without needing to build new roads.</u> (Please contact HIL-Tech Ltd for details).</p>
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ICAO Certification: LEDline® is not yet Annex 14, ICAO certified for airfields, although it meets helipad Annex 14 Vol. 2 requirements for helipads. Annex 14 was written some +60 years ago, around inefficient point source incandescent bulbs and so called waterproof connectors, which are prone to short and which cause airfields everywhere all sorts of issues. At that time, the need to drive electrical current the distances around an airfield and to overcome the connector issues determined the use of the high powered series circuit, a system designed to overcome shorts. However, because of its +60 year old design, the system today is inefficient; dangerous for maintenance workers (every year maintenance staff are killed) and is essentially 19th Century technology. Today’s 21st Century engineers can do much better. However, because of the difficulties of changing an internationally recognised standard, Annex 14 requirements remain and new airports continue to use outdated series circuit design, despite drastic changes in operating conditions with high energy costs, Global warming and a host of other issues like pollution.

Being an area / linear source, so that the light exits differently to point sources, this makes certification difficult, as such, LEDline® is not yet certified. The ICAO Visual Aids Committee having seen the lights, and the FAA and other Civil Aviation Authorities (CAA), including most of the major countries in Europe, recognising the difficulties to certify the lights under the old Annex 14 requirements, are prepared to see LEDline® trialed in movement areas. Recently the FAA Tech Center was tasked to find the equivalence between standard point sources and linear lights, so hopefully this will be done quickly, so that LEDline® certification becomes a non-issue.

LED lights are far more energy efficient than incandescent bulbs, **provided they are coupled to efficient power supplies.** Many airports have been switching over to LED lights, however, when powered via the old CCRs, because of all the electronics designed to protect the LEDs from the old high power series circuit, there are no energy savings. In addition, if the airport wishes to have the lights melt ice and snow, as the old incandescent bulbs did, then the LED lights (with the exception of LEDline® as LEDline® melts snow), have to have a heating element built with them, so there is not only no energy savings, but the LEDs lights will be using more energy than the old incandescent bulbs they were designed to replace.

Global Warming: Based on high energy cost increases; serious Global warming; pollution and other key criteria issues, I believe LEDline® is the way of the future and is the best way to go as it; is by far the least cost and easiest and quickest to install; has the least “hassle factor” (bother)

for airfield operators and operations; is safer for airfields whilst being installed; is by far the safest for maintenance personnel; can easily be maintained; and is the most energy efficient, a key ingredient in these high energy costs and Global warming times. And, if a country is part of a “carbon trading area”, LEDline® is much more likely to be able to obtain them compared to LED lights powered by old series circuit technology, which provide no energy savings.

In the mean time; would you or the other engineers like to see a sample of the new LEDline® lights with their new Mounting Plate, (they can be changed in a minute), if so I would be happy to loan you one?

In addition, if you would care to provide HIL-Tech with drawings or the proposed area where there is an interest in using LEDline®, please send drawings and we will reply with a quote for the use of LEDline® there.

To conclude; LEDline® is by far the “best bang for the buck” and provides superior value, particularly since the pilots at Anchorage International rate it superior to standard ICAO green taxiway lights; especially in low visibility conditions. In addition, apart from its standard 1 year Limited Warranty, LEDline® can also carry a two year or more Limited Warranty provided the extended Limited warranty is purchased at the time of order.

LEDline® is so much less costly so it will provide huge savings over traditional lights.

N. D. Hutchins,
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