Selecting the Right LED for Energy Efficient Lighting Retrofits

- What your salesman didn't tell you about your LED lighting. What you don't know can hurt you!

Dr. Matthew Maa
VP Sales & Marketing at Aleddra LED Lighting

Speaker Biography:

Dr. Maa received his Ph.D. in Electrical Engineering at Michigan State University and has filed over 12 patents related to LED light engines, luminaires, and lumen monitoring systems. Dr. Maa has in-depth knowledge on LED tube design, application, and industry trends. He regularly provides training to, and serves as the go to expert for lighting agencies, distributors, and other lighting professionals.

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The Dark Side of LED Light

- Have you joined the LED Dark Side?

The Bad and the Ugly

Over the last year, there have been:

- 700,000 ballast compatible LED tubes recalled by Cree.
- 50,000 ballast compatible LED tubes recalled by Sylvania.
- 1.6M linear fixtures recalled by Cooper Lighting
- Philips, TCP, and more.

- Who's next?
- Do you know the causes of these recalls?
  - Two common causes, but not root causes…

More Issues:

- Injury or burn hazards cost more
- Recalls cost you labor and facility downtime
- Rebates may cost end user more money
- Additional maintenance cost down the road
- Warranty may be useless
- DLC qualified tube may not be safe
- ETL certified LED tube may not be safe
- UL certificate is valid only if it is true

Trust But Verify – Who do you trust?

- Vendors – Making and selling unsafe LED products intentionally or unintentionally.
- Utility companies – Setting contradictory rebate policies.
- Energy managers – Faking it until they get it.
  - LED diode efficacy vs. LED lamp efficacy vs. LED fixture efficacy.

Universities: Welcome to the Party!

- East: 300,000 pcs T8 retrofit project awarded
  - 15W ballast-compatible LED tube at 105 lm/w.
- Central: 60,000 pcs 2-lamp linear fixtures recommended
  - 135 lm/w LED fixture at $200 each with better ROI than T8 replacement.
- West coast: 60,000 pcs project specified
  - 20W *dual-mode* LED tube at 120 lm/w on *frosted* lens
  - 2400 lm per lamp → 4800 lm/fixture (vs. 3000 lm/fixture by DLC)

➢ Who is the wise guy?
➢ How do you verify?

Retrofit Options for Linear Fixtures

1. Troffer Upgrade (DLC category #6)
2. Troffer Retrofit Kit (DLC category #12)
3. Fluorescent T8/T12 Replacement
   - 4-ft tube (DLC category #14)
   - 2-ft tube (DLC category #15)

- Different rebates are available for different categories.

Types of LED Tubes *per DLC*

- Type A: Internal driver tube on Instant Start ballast
- Type B: Internal driver tube on AC-in
- Type C: External driver tube on AC
- Type D: Dual mode tube = A/B Combo on Instant Start ballast

Wiring Makes A Difference

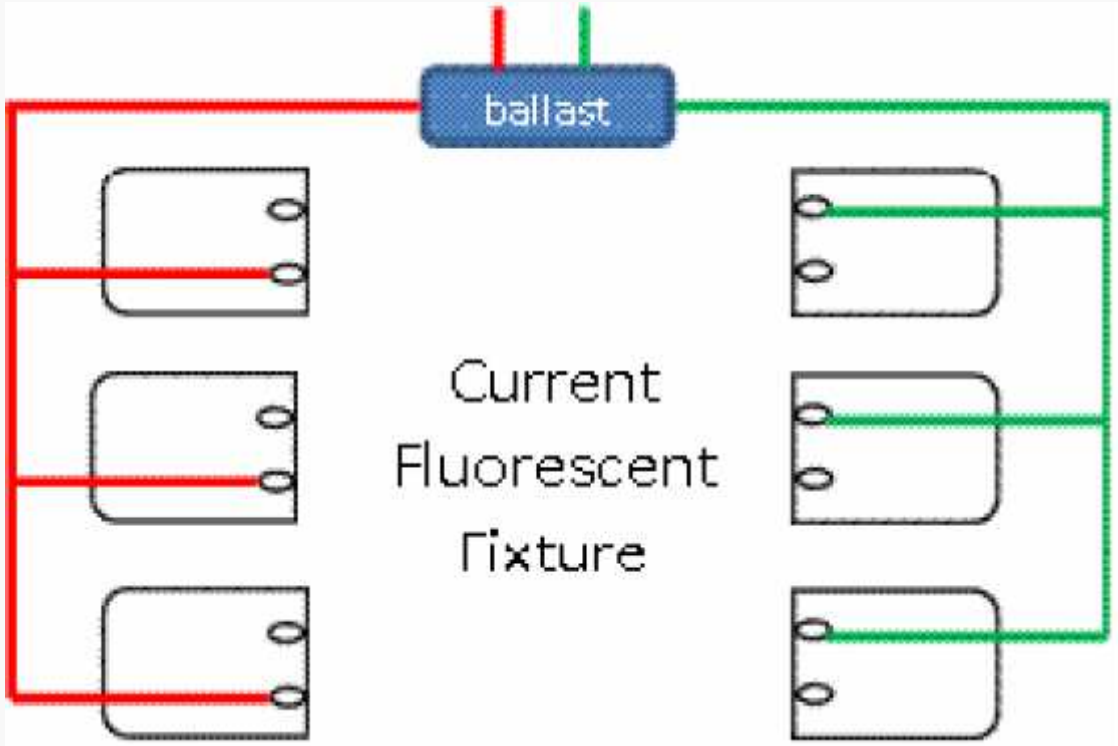
- Type A: Double-end wired
- Type B: Single-end wired, or double-end wired
- Type C: Single-end wired, or double-end wired
- Type D:
  - Double-end wired for both ballast and AC-in
  - Double-end wired for ballast, and single-end wired for AC-in

➢ They differ in terms of installation and maintenance cost.

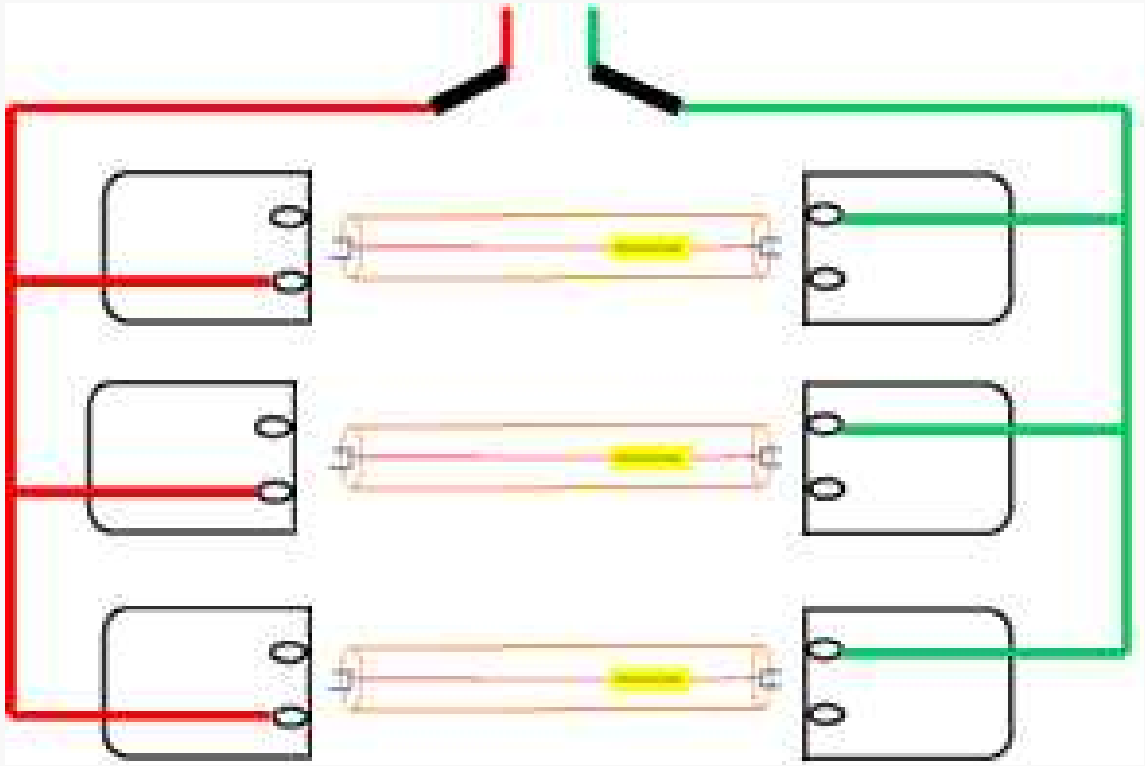
➢ They differ in terms of safety.

➢ Most Type D tubes are **NOT** UL certified → More injuries

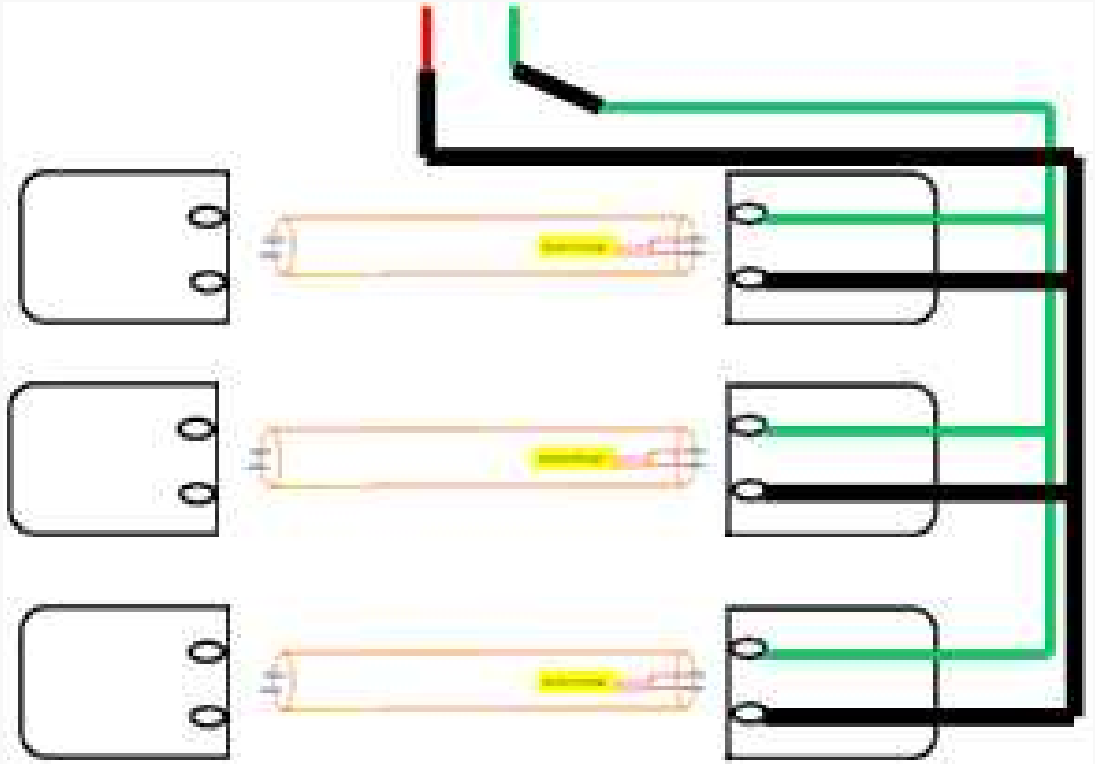
Fluorescent Tube Wiring



Double-end Wiring



Single-end Wiring Retrofit



Which LED Tube Should I Consider?

- The answer is: It depends …

It Depends …

- On how long you want to stay in your job.
- On whether you have a good lawyer.
- On whether you have good insurance coverage.

LED Tube History Snapshot

- Generation 1: Type B double-end
  - Most G1 tubes have disappeared since UL1598C.
  - ETL certified models with shock hazard are still available.
  - Only a few G1 tubes are UL certified.
- Generation 2: Type B single-end
  - Most popular.
  - Neither fail-safe nor fool-proof.
  - Have the highest liability.

LED Tube History Snapshot

- Generation 3: Type A double-end
  - Plug-&-play promise reduced to plug-&-pray due to ballast-compatibility.
  - Ballast dependency.
  - More energy consumption. (~5W per fixture)
  - Arcing and burn hazards
  - Higher maintenance cost for ballast replacement.
- Generation 4: Type D double-end
  - Most are non-UL.
  - Manufacturers exploit ETL shock hazard loophole to get DLC certification.
  - There’s only a few UL certified models.

Live Demonstration

- Type B Single-end.
- Fluorescent Tube re-insertion.
- Type B Double-end.
- Anti-shock safety switch.
- Replaceable driver.
- Type D Double-end.
- Burn hazard demonstration.

Demo Recap

- Type A tube: Consumes more energy, has more ballast maintenance cost, burn hazard, ballast incompatibility.
  (Plug & Play → Plug & Pray)
- Type B single-end tube: Neither fail-safe nor fool-proof.
- Type B double-end tube w/o safety switch: Shocks you!
- Type D on ballast: All Type A issues.
- Type D on AC w/o safety switch: Shocks you!
- Ballast → Arcing → Burn hazard.

UL 101 – Fake UL Certificate

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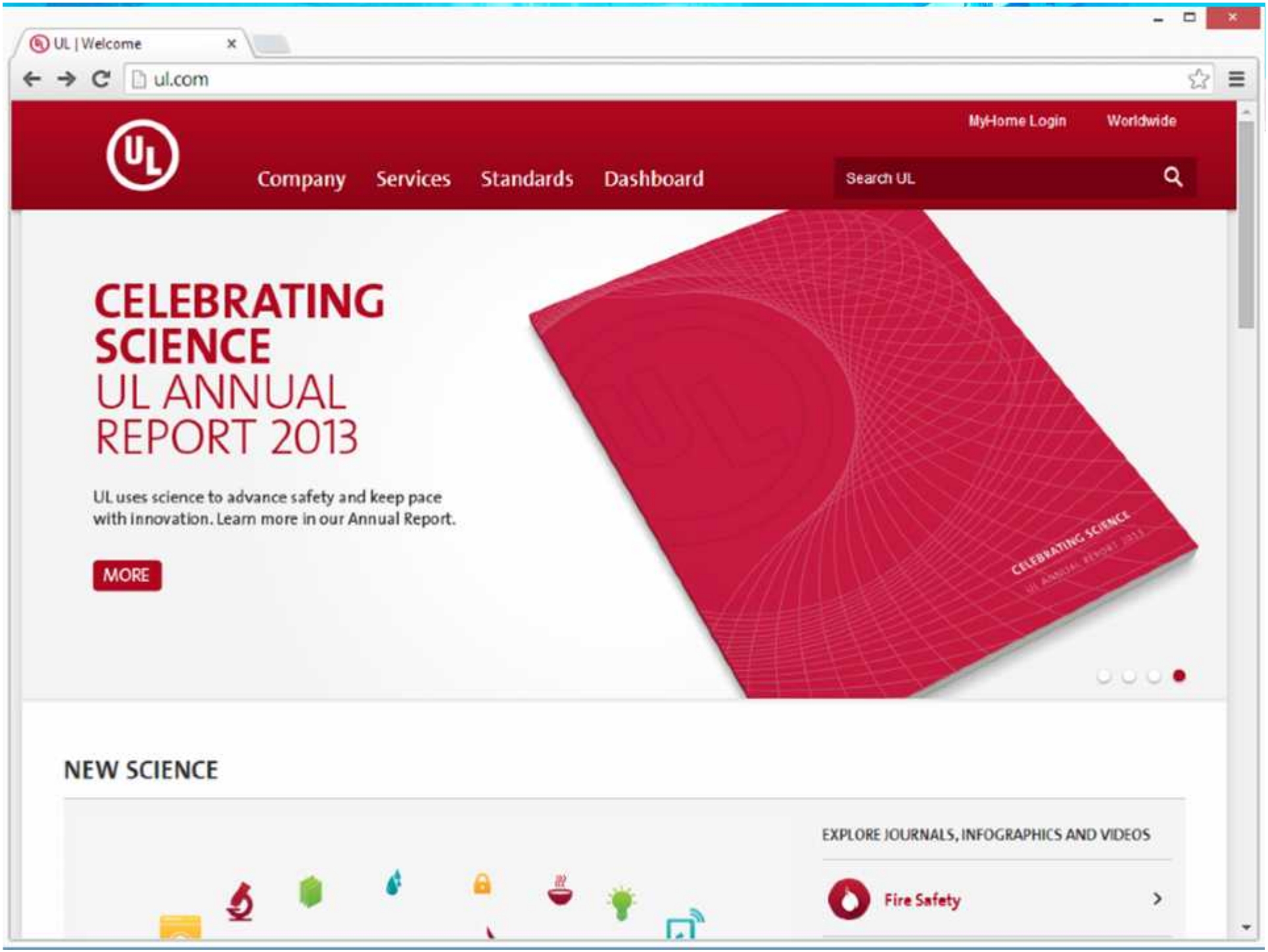
UL 101 – Misuse of Valid UL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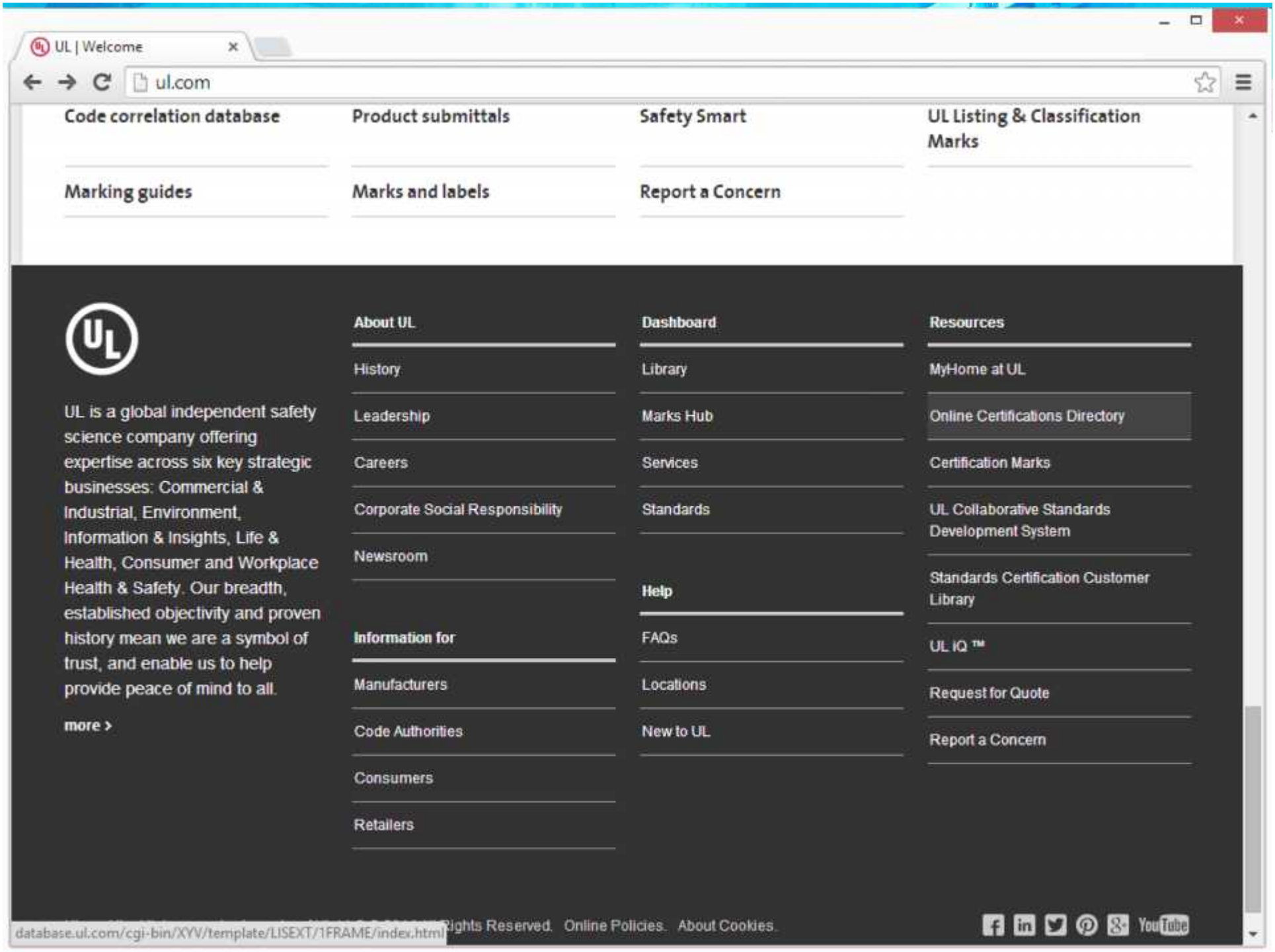
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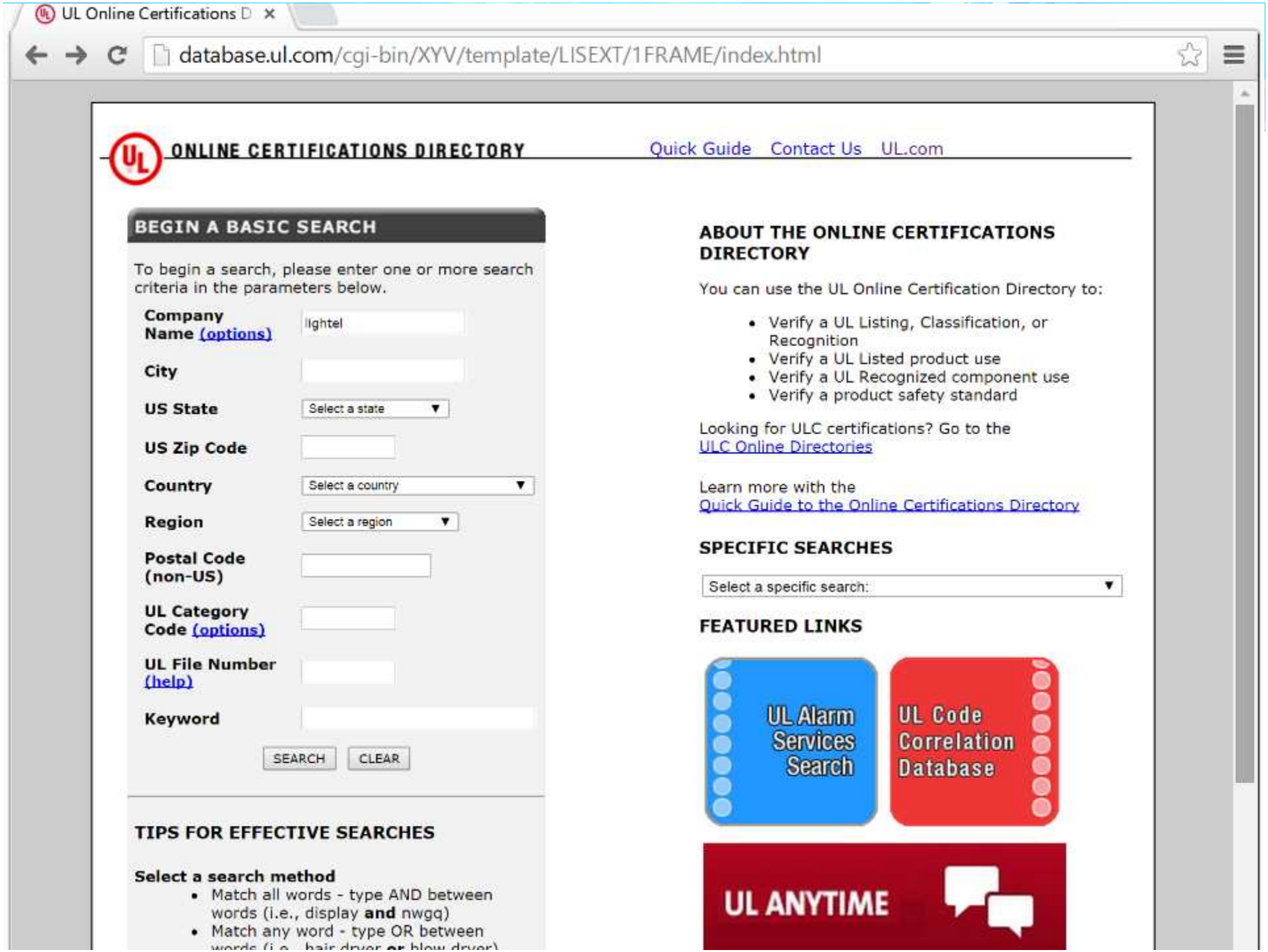
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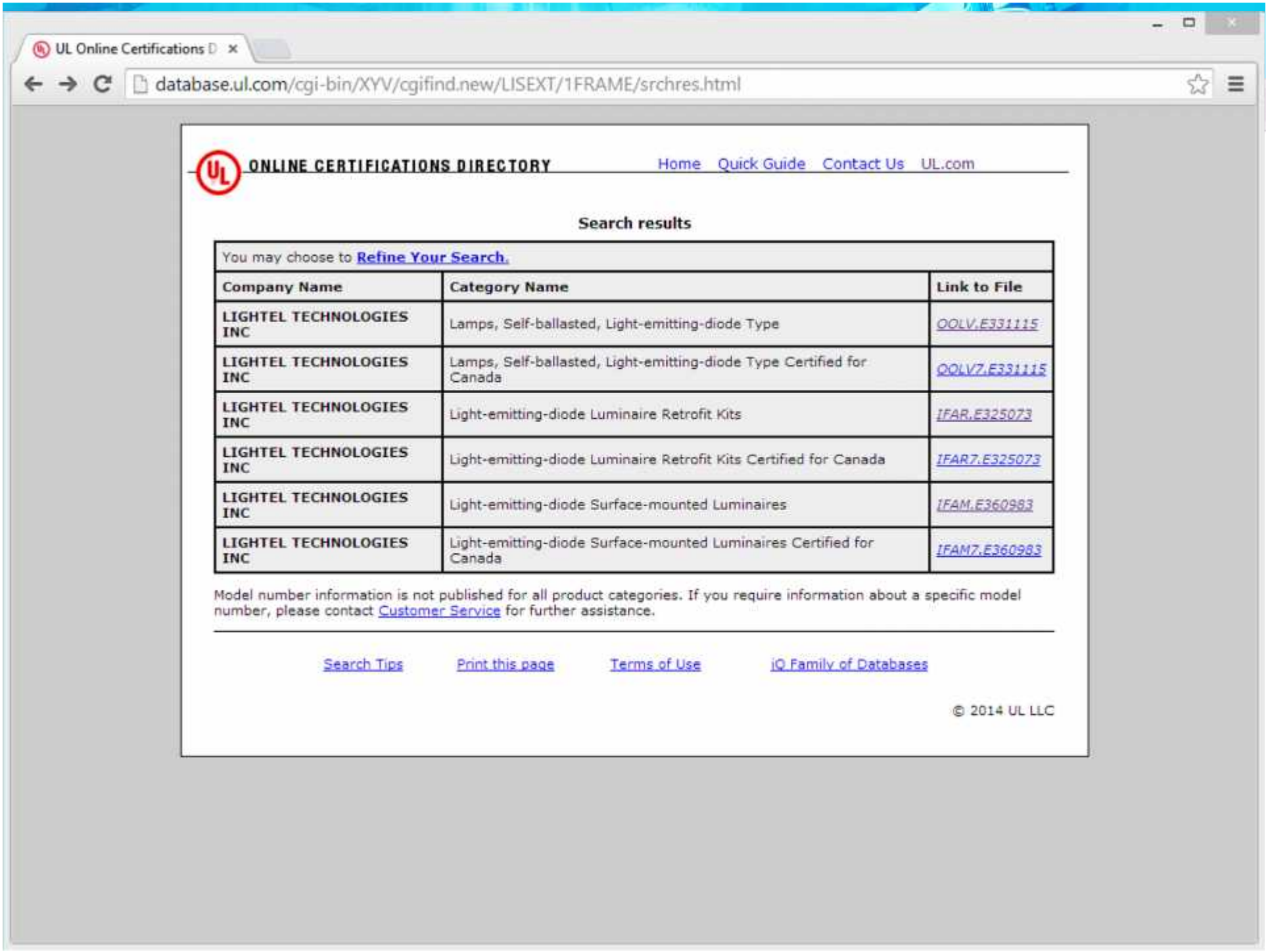

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Company Name	Category Name	Link to File
LIGHTEL TECHNOLOGIES INC	Lamps, Self-ballasted, Light-emitting-diode Type	*QOLV.E331115*
LIGHTEL TECHNOLOGIES INC	Lamps, Self-ballasted, Light-emitting-diode Type Certified for Canada	*QOLV7.E331115*
LIGHTEL TECHNOLOGIES INC	Light-emitting-diode Luminaire Retrofit Kits	*IFAR.E325073*
LIGHTEL TECHNOLOGIES INC	Light-emitting-diode Luminaire Retrofit Kits Certified for Canada	*IFAR7.E325073*
LIGHTEL TECHNOLOGIES INC	Light-emitting-diode Surface-mounted Luminaires	*IFAM.E360983*
LIGHTEL TECHNOLOGIES INC	Light-emitting-diode Surface-mounted Luminaires Certified for Canada	*IFAM7.E360983*

Model number information is not published for all product categories. If you require information about a specific model number, please contact Customer Service for further assistance.

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IFAR.E325073
Light-emitting-diode Luminaire Retrofit Kits

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Light-emitting-diode Luminaire Retrofit Kits

See General Information for Light-emitting-diode Luminaire Retrofit Kits

LIGHTEL TECHNOLOGIES INC E325073
SUITE 100
2210 LIND AVE SW
RENTON, WA 98057 USA

Retrofit Kit Model/Part No.	Retrofitted Luminaire Type or Model/Part No.	Light Source	Rating
LED retrofit luminaire conversion kit			
LLT-2-TT-X-YZ-BA-110	Type Surface Mount Luminaire with G13 Bipin	Non-replaceable type LED Array with driver	120V, 60Hz, 9.5W
LLT-2-TT-X-YZ-BA-227	Type Surface Mount Luminaire with G13 Bipin	Non-replaceable type LED Array with driver	277, 60Hz, 9.5W
LLT-3-TT-X-YZ-BA-110	Type Surface Mount Luminaire with G13 Bipin	Non-replaceable type LED Array with driver	120V, 60Hz, 14W
LLT-3-TT-X-YZ-BA-227	Type Surface Mount Luminaire with G13 Bipin	Non-replaceable type LED Array with driver	277, 60Hz, 14W
LLT-4-TT-X-YZ-BA-110	Type Surface Mount Luminaire with G13 Bipin	Non-replaceable type LED Array with driver	120V, 60Hz, 19W
LLT-4-TT-X-YZ-BA-227	Type Surface Mount Luminaire with G13 Bipin	Non-replaceable type LED Array with driver	277, 60Hz, 19W
LLT-5-TT-X-YZ-BA-110	Type Surface Mount Luminaire with G13 Bipin	Non-replaceable type LED Array with driver	120V, 60Hz, 24W
LLT-5-TT-X-YZ-BA-227	Type Surface Mount Luminaire with G13 Bipin	Non-replaceable type LED Array with driver	277, 60Hz, 24W

Notes:

Nomenclature:

LLT-2-TT-X-YZ-BA-110V-D-3

LLT	2	TT	X	YZ	BA	110V	D	3
I	II	III	IV	V	VI	VII	VIII	IX

I - LLT: Series name

II - Length of tube: 2 - 2 ft, 3 - 3 ft, 4 - 4ft, 5 - 5 ft

III - TT, Tube type: T8

IV - Diffuser Type: C - Clear, D - Diffused

V - LED Color: SW - Sun White

VI - BA, Beam Angle: 75, 90 or 120

VII - Input voltage, 110V, 277V or U: 110-120V Universal Voltage

VIII - Pin Configuration Type: D - Double ended, S - Single ended

IX - Number of LEDs used in 4-ft LLTs: 3 - 312 LEDs, 2 - 264 LEDs, 27 - 273 LEDs, 10 - 104 LEDs; in 2-ft LLTs: 52- 52 LEDs

Trademark and/or Tradename: aleddra

Last Updated on 2014-05-06

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Retrofit Kit Model/Part No.	Retrofitted Luminaire Type or Model/Part No.	Light Source	Rating
LED retrofit luminaire conversion kit			
Model LiLEDs-T8-2FT-I	Permanently-connected fluorescent	Replaceable-type T8 self-ballasted LED lamp	100-277 V ac, 0.1.A
Model LiLEDs-T8-4FT-I	Permanently-connected fluorescent	Replaceable-type T8 self-ballasted LED lamp	100-277 V ac, 0.2.A
Models LiLEDs-T8-2FT-E, LiLEDs-T8-3FT-E, LiLEDs-T8-4FT-E, LiLEDs-T8-4FT-E23, LiLEDs-T8-4FT-E30, LiLEDs-T8-5FT-E, LiLEDs-T8-6FT-E, LiLEDs-T8-8FT-E23, LiLEDs-T8-8FT-E30	Permanently-connected fluorescent	Replaceable-type T8 self-ballasted LED with external driver	100-277 V ac

Last Updated on 2014-02-17

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Costs – Upfront and Down the Road

- Installation costs:
  - Materials: Lamp, non-shunted socket, ballast.
  - Labor: Depends on amount of re-wiring involved.
  - Rebates.
- Operation and Maintenance costs over 10 years:
  - Materials: Lamp, ballast for ballast-compatible tube.
  - Labor: Any new wiring required? Yes for ballast replacement.
  - Energy consumption: Lamp, ballast (3 more watts per lamp)
  - Disposal: 5-year or 10-year.

Timeframe Matters on ROI - 10-year ROI Comparison

Cost	Type B – Double-end with Replaceable Driver	Type A - Ballast Compatible Tube
Material	1x lamp purchase 1x driver purchase (1/3 tube cost)	2x lamp purchase 2x ballast purchase
Labor	1x ballast removal & tube install. by electrician 1x tube spot replacement	1x tube installation 1x tube spot replacement 2x ballast spot replacement by electrician
Extra energy consumption	None	10-year energy consumption on ballast

Rebate Policy Confusion:

- Most utilities rebate all DLC LED tube types.
- A few utilities rebate only Type A LED tube.
- A couple utilities rebate only Type A LED tube using a new ballast.
- Some utilities offer no rebates for LED tubes.
- All provide rebate for troffer upgrades and troffer retrofit kits.

➢ Can you afford to take rebate? It depends.

Lighting energy consumption	Type D Tube on AC-in	Type D Tube on Ballast	Regular T8
days/year	365	365	365
hrs/day	24	24	24
hrs/year	8760	8760	8760
Energy consumption per lamp (watt)	18	21	32
Energy consumption per year per lamp (watt)	157680	183960	280320
Electrical rate (dallor/KWh)	$ 0.09	$ 0.09	$ 0.09
Annual energy cost per lamp	$ 14.19	$ 16.56	$ 25.23
Ballast maintenance cost over 5 years			
Ballast material cost per fixture	$ -	$ 9.00	$ 9.00
Number of lamp per fixture	3	3	3
Ballast material cost per lamp	$ -	$ 3.00	$ 3.00
Ballast replacement labor cost per fixture	$ 9.00	$ 15.00	$ 15.00
Ballast replacement labor cost per lamp*	$ 3.00	$ 5.00	$ 5.00
Ballast maintenance cost per lamp over 5-years	$ 3.00	$ 8.00	$ 8.00
Energy and maintenance costs over 5 years			
Energy cost per lamp over 5 years	$ 70.96	$ 82.78	$ 126.14
Ballast maintenance cost per lamp over 5-years	$ 3.00	$ 8.00	$ 8.00
Total energy and mainteance cost over 5 years	**$ 73.96**	**$ 90.78**	**$ 134.14**
Lamp cost over 5 years	**$ 13.00**	**$ 13.00**	**$ 5.00**
Addition cost per lamp over LED tube on AC over 5 years		**$ 16.83**	**$ 52.19**
Energy and maintenance costs over 10 years			
Energy cost per lamp over 10 years	$ 141.91	$ 165.56	$ 252.29
Ballast maintenance cost per lamp over 10-years	$ 3.00	$ 16.00	$ 16.00
Total energy and mainteance cost over 10 years	**$ 144.91**	**$ 181.56**	**$ 268.29**
Lamp cost over 5 years	**$ 25.00**	**$ 25.00**	**$ 10.00**
Addition cost per lamp over LED tube on AC over 10 years		**$ 36.65**	**$ 108.38**

And the Winner Is …

And the Winner Is …

- **Type C:** Use only when the external driver is a must.
- **Type A:** Use if you will be retired in 3 years.
- **Type B Single-end:** Use when safety is not an issue.
- **Type B/D Double-end w/o Safety Switch:** Use if your company has a very good lawyer or you have a superb insurance policy.
- **Type B/D Double-end w/ Safety Switch:** Use if you will be retired in 5 years.
- **Type B/D Double-end w/ Safety Switch & Replaceable Driver:** Use if you want to stay in your job for more than 5 years.

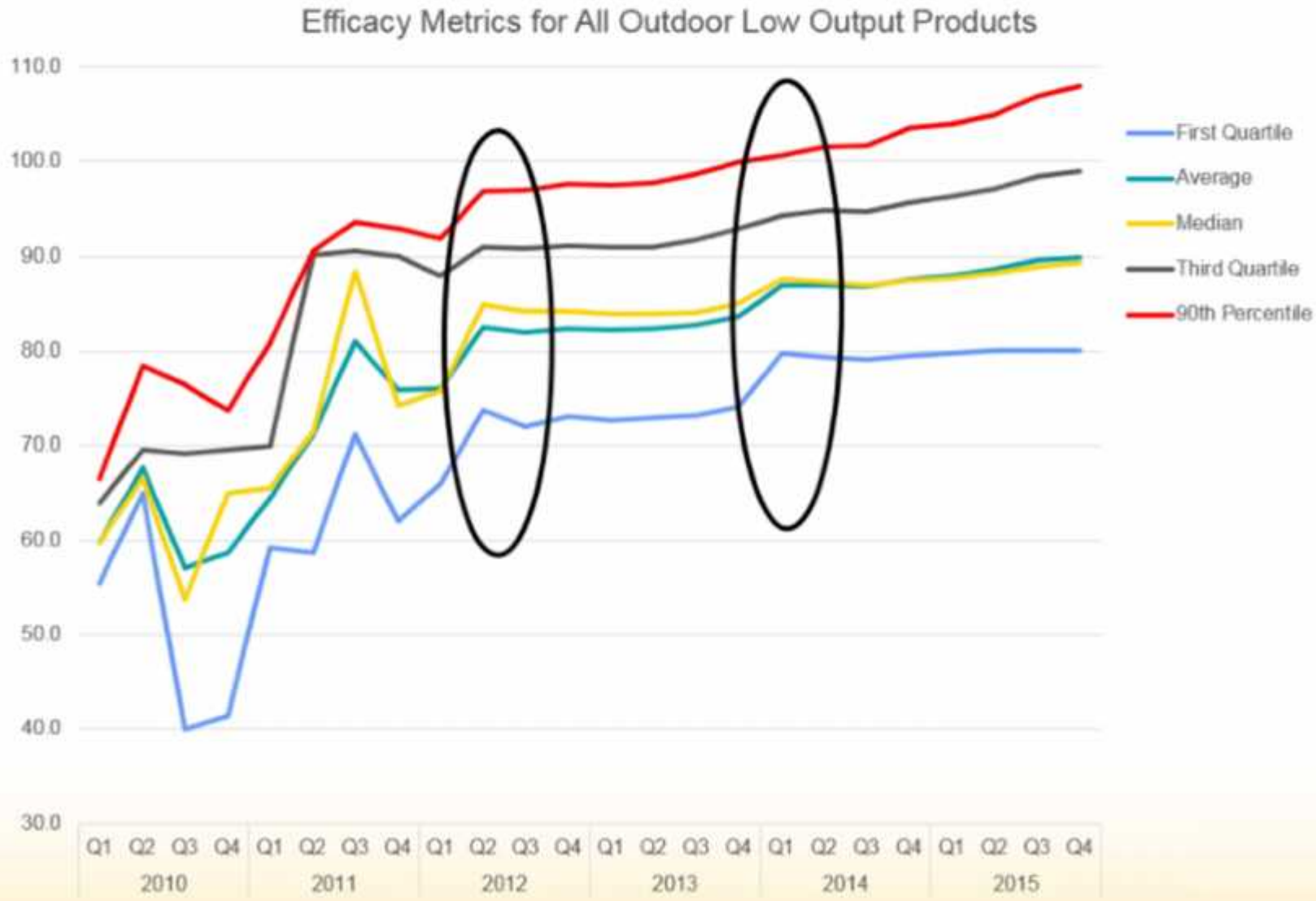
Who is the Wise Guy?

- East: 300,000 pcs T8 retrofit project awarded
  - 15W Type A ballast-compatible LED tube at 105 lm/w.
- Central: 60,000 pcs 2-lamp linear fixtures recommended
  - 135 lm/w LED fixture at $200 each
- West coast: 60,000 pcs project specified
  - 20W Type D LED tube at 120 lm/w on *frosted* lens
  - 2400 lm per lamp → 4800 lm/fixture (vs. 3000 lm/fixture by DLC)

- Reality Check

DESIGNLIGHTS CONSORTIUM

DLC QPL Efficacy Changes Over Time



Efficacy Level Revision History

Category	V1.5 (Sept 2010)	V1.6/1.7 (July 2011)	V2.0/2.1 (April 2013)	V3.0/3.1 (June 2015)	V4.0 (Proposed)
Outdoor, All	40-56	35-70	50-80	65-75	90-100
Outdoor Area	50	60	70	*Low 65*	*Low 90*
Outdoor Fuel Pump	56	70	80	*Mid 70*	*Mid 95*
Outdoor Decorative	40	40	60	*High 75*	*High 100*
REF/Display Case	35	45	50	50	80
Interior directional	30	40	45	45	65
Troffer	55	60-65	85	85	100
Linear Ambient	n/a	n/a	n/a	85	105
High-Bay/Low-Bay	60	70	80	80	105
Linear Replacement Lamps (bare lamp)	n/a	75/96	85/100	85/100	100/110

Who is the Wise Guy? None

- East: 300,000 pcs T8 retrofit project awarded
  - 15W Type A ballast-compatible LED tube at 105 lm/w.
  - Gotchas:
    - Type A tube superseded by Type D tube in two years
    - Pay more for energy and ballast maintenance
    - Take on burn hazard
- Central: 60,000 pcs 2-lamp linear fixtures recommended
  - 135 lm/w LED fixture at $200 each
  - Gotchas
    - A fixture is 20-year investment but the efficacy of a fixture with non-replaceable LED could be *energy-inefficient* in 7 years.
    - No advanced dimming or color control

Who is the Wise Guy? None

- West coast: 60,000 pcs project specified
  - 20W Type D LED tube at 120 lm/w on *frosted* lens
  - Gotchas:
    - No bidder could meet the 120 lm/w o frosted lens; the specification is for show only
    - Awarded to lowest bidder but it failed to delivered
    - Awarded to the next lowest bidder who used Type D type with UL for ballast operation *only*, and has shock-hazard for AC operation
    - Bought all lamps in one purchase: causing significant cash burden and leaving 60,000 pcs tube in warehouse (for stocking, for theft, or forever?)
    - The Chinese manufacturer is about to change company name due to several lawsuits, and the warranty is out of window before the university installing the LED tube

Takeaway Points on LED Tube

- Type A tube phased out by Type D tube
- Type B single-end tube losing market share due to safety issue
- Type B double-end without shock protection is a non-starter
- Type C external driver tube is for niche applications
- Type D tube without shock protection is an invitation to liability
- Type D tube with anti-shock protection is the future
  - No additional labor required for immediate T8 replacement
  - Taking out the ballast when it dies, no additional labor costs

- Don’t fall into the LED Dark Side.
- May the Force be with you!

Troffer, Retrofit Kit, vs. Lamp Replacement

- Look and feel (aesthetic)
- Functionality/controllability
- Energy consumption
- Safety
- Ballast compatibility
- Initial cost
- Maintenance cost
- Upgradeability
- Disposal cost

Showdown

	Troffer	Troffer Retrofit Kit	Type A	Type B SE	Type B DE no-SS	Type D DE no-SS	Type D DE+SS+RD
Look & Feel	☺	☺	😐	😐	😐	😐	😐
Functionality	☺	☺	😶	😶	😶	😶	😶
Energy Consumptions	☺	☺	☹	☺	☺	☺	☺
Safety	☺	☺	☹	☹	☹	☹	☺
Ballast Compatibility	😐	😐	☹	😐	😐	☺	☺
Initial Cost	☹☹	☹	☺	😐	☺	☺	☺
Maintenance Cost	☺	☺	☹	☺	☺	☺	☺
Upgradability	☹	😶	☺	☺	☺	☺	☺
Disposal Cost	☹☹	☹	😐	😐	😐	😐	☺
Total Coast of Ownership	☹	☺☺	☹	☹	☹	☹	☺☺

Warranty and IP Issues

- Warranty is only good for as long as the manufacturer exists.
- Product warranty is only good if the product is still UL/ETL certified when you need it.
- How to protect yourself on a recall?
- Would you like to get sued for using patent-infringing products?

➢ Ask for indemnification coverage or protection for breach of warranty, recall cost, IP-related legal liability.

Do Your Institution a Favor – Buy Smart

- Total Cost of Ownership (TCO)
  - Material Cost: Over 10-15 year life span.
  - Labor Cost: Installation and maintenance.
  - Hidden Costs:
    - Energy Consumption: Upgradable/improvable?
    - Safety / Liability Cost: ETL ≠ UL, UL ≠ arcing-free.
    - Quality Cost: Brand ≠ quality, non-brand → higher risk.
    - Rebate: Really free?
    - Risk Mitigation Cost: Out of your pocket or not?
  - Return on Investment (ROI): For initial price and labor is not good enough.

Resources

- Demo videos: www.YouTube.com/aleddra
- UL: www.UL.com
- DLC: www.designlights.org
- Aleddra: www.aleddra.com

Contact Information

Matthew Maa

Matthew_Maa@aleddra.com

425-430-4555 ext 234