

PHILIPS

sense **and** simplicity

SSL/LED Road to Standardization 2010

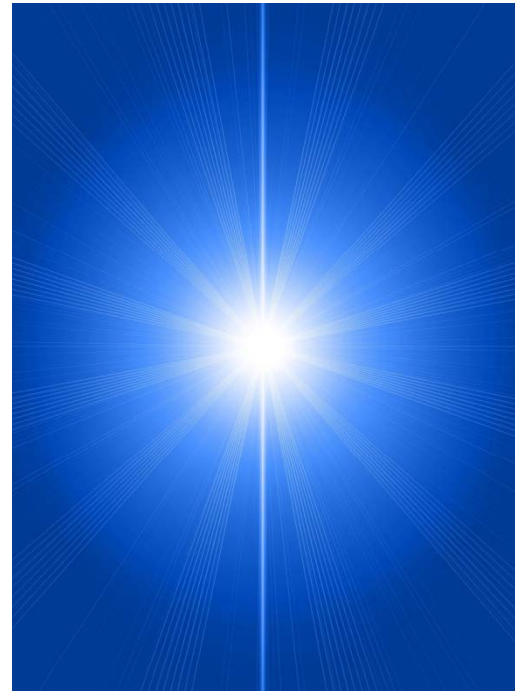
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Solid State Lighting – The Road to Standardization

- Presentation Scope
- Why Standardize?
- What are the benefits?
- Types of standards
- Who is working on SSL standards?
- SSL Standards Roadmap
- SSL Standards
- Accreditation, MRA/MLA, and global data acceptance



Solid State Lighting – The Road to Standardization

– Presentation Scope

- Standards for Drivers, LED, LED Array, LED Module, LED Light Engines, LED Lamps, Solid State Luminaires used in general illumination
 - Communication
 - Measurement
 - Performance
 - Safety
 - Electromagnetic Compatibility
 - Technology Development
- Standards that are complete and standards that are in development
- Not an exhaustive list of all international SSL standards
 - US and major international SSL standards development

Solid State Lighting – The Road to Standardization

– Why Standardize?

- What is a standard?
 - No more than a specification
 - May specify how a product claims to conform
 - May define common dimensions
 - May define interconnections
 - May define how a product is tested
- Why Standardize?
 - Enable products to work interchangeably/together
 - Provide assurance that a product meets performance levels
 - Provide the means for designers, manufacturers and users to communicate – terminology/common language
 - Provide strict methods for measurement - allowing comparison

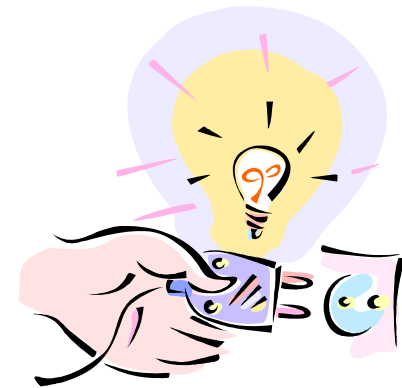


Solid State Lighting – The Road to Standardization – What are the benefits?

- Manufacturers:
 - Provide uniform methods for testing and rating products
 - Help to assure system integrity and safety for the application
 - Reduce liability
 - Encourage new product development
 - Help avoid confusion in communicating with customers
 - To enable products to work interchangeably or together
 - Rapid growth and adoption of SSL Technology
 - Modular approach economics
 - Rapid fixture and luminaire innovation
 - Innovative product platform designs

Solid State Lighting – The Road to Standardization – What are the benefits?

- Users:
 - Help educate users of LED lighting technology
 - Product performance and how it is measured, allowing comparison
 - Provides a common language for communication
 - Drive novel and creative applications of lighting
 - Provides embedded options for lighting through replacement with color and other dimensions of lighting
 - Provide repair/replacement components – economics
 - Choice!
- Government
 - Needed for incentive programs – Energy Star
 - Needed for Energy Efficiency requirements



Solid State Lighting – The Road to Standardization

– Types of Standards

- Communication Standards
 - Define the basic terms, symbols and other communication tools
- Measurement Standards
 - Define testing protocols to allow direct comparisons of product characteristics
- Performance standards
 - Provide methods for uniformly determining product performance and for rating products.
- Safety Standards
 - Define electrical, mechanical, thermal, optical radiation, or other safety considerations

Solid State Lighting – The Road to Standardization

– Types of Standards

- Electromagnetic Compatibility
 - Determination of unintentional generation, propagation and reception of electromagnetic energy
- Technology Development
 - Documents that contain best practices and that outline standards needs for advancement of SSL technology
- Design standards
 - Establish dimensions, tolerances or other physical characteristics of products. Enable interfacing and interchangeability.

Solid State Lighting – The Road to Standardization – Who is involved?

Organizations Supporting SSL Standards						
	Communication	Measurement	Performance	Safety	EMC	Technology Development
	CIE (SDO)		ANSI ANSLPC (SDO)			ASSIST
	IESNA (SDO)		IEC (SDO)			US DOE/PNNL (CALIPER)
				UL (SDO)		NEMA
						NGLIA
						NIST



Solid State Lighting – General Illumination – Standards Roadmap and Development Activities

	Drivers	LED	LED Package, LED Array, LED Module, LED Light Engine	LED Lamp, Integrated	LED Lamp, non-Integrated	LED Luminaire (AKA SSL)	Manufacturing
Communication	<ul style="list-style-type: none"> •ANSI/IESNA RP-16 •IEC/TS 62504 	<ul style="list-style-type: none"> •ANSI/IESNA RP-16 •IEC/TS 62504 •IEC 60050-845 •IEC PAS025A (nano-grid) •ANSI C78.XX (Standard LED data sheet) 	<ul style="list-style-type: none"> •ANSI/IESNA RP-16 •IEC/TS 62504 •IEC 60050-845 	<ul style="list-style-type: none"> •ANSI/IESNA RP-16 •IEC 61231 •IEC/TS 62504 •NEMA/ALA LSD-51 •IEC 60050-845 	<ul style="list-style-type: none"> •ANSI/IESNA RP-16 •IEC 61231 •IEC/TS 62504 •NEMA/ALA LSD-51 •IEC 60050-845 	<ul style="list-style-type: none"> •ANSI/IESNA RP-16 •IEC 61231 •IEC/TS 62504 •NEMA/ALA LSD-51 •IEC 60050-845 	<ul style="list-style-type: none"> •ANSI/IESNA RP-16 •IEC 61231 •IEC/TS 62504
Measurement	<ul style="list-style-type: none"> •ANSI C82.XX (LED Driver Testing Method) 	<ul style="list-style-type: none"> •CIE 127 •CIE TC 2-63 •IES TM-21 •IES LM-80 •IESNA LM-xx •IESNA LM-xx2 •IES proposal (OLED Measurement) 	<ul style="list-style-type: none"> •CIE TC 2-50 •IESNA LM-xx (HP DC LED) •IESNA LM-xx2 (HP AC LED) •IES LM-XX-201X (PIF – Light Engines and integrated LED lamps) 	<ul style="list-style-type: none"> •CIE 13.3 •CIE TC 1-69 •IEC/TR 61341 •IES LM-79 •IES LM-XX-201X 	<ul style="list-style-type: none"> •CIE 13.3 •CIE TC 1-69 •IEC/TR 61341 	<ul style="list-style-type: none"> •CIE 13.3 •CIE TC 1-69 •IEC/TR 6134 •IES LM-79 •IES proposal (LM-80 luminaire level) 	<ul style="list-style-type: none"> •CIE TC 2-64
Performance	<ul style="list-style-type: none"> •IEC 62384 •ANSI C82-SSL1-200X 	<ul style="list-style-type: none"> •NEMA SSL-3 	<ul style="list-style-type: none"> •IEC 62xxx (LED Modules and Luminaires Performance Standard) 	<ul style="list-style-type: none"> •ANSI_C78.377 (color) •PAS ANSI C78-377 •IEC/PAS 62612 (Self-ballasted LED-lamps) •IEC62663-2 	<ul style="list-style-type: none"> •ANSI_C78.377 	<ul style="list-style-type: none"> •ANSI_C78.377 •PAS ANSI C78-377 •IEC 62XX (Performance standard for LED-Luminaires) •IEC 62xxx 	
Safety	<ul style="list-style-type: none"> •ANSI/UL 1012 •ANSI/UL 1310 •IEEE Project P1789 •IEC 61347-2-13 •UL 8750 	<ul style="list-style-type: none"> •CIE TC 2-58 •CIE TC 6-55 •UL 8750 	<ul style="list-style-type: none"> •IEC 62031 (module safety) •UL 8750 	<ul style="list-style-type: none"> •ANSI/IESNA RP-27.1 •ANSI/IESNA RP-27.2 •ANSI/IESNA RP-27.3 •IEC 62471/CIE S 009 •IEC 62560 Ed1 •IEEE Project P1789 •UL 8750, UL1993 •IEC 62663-1 	<ul style="list-style-type: none"> •ANSI/IESNA RP-27.1 •ANSI/IESNA RP-27.2 •ANSI/IESNA RP-27.3 •IEC 62471/CIE S 009 •UL 8750 	<ul style="list-style-type: none"> •ANSI/IESNA RP-27.1 •ANSI/IESNA RP-27.2 •ANSI/IESNA RP-27.3 •IEC 62471/CIE S 009 •IEEE Project P1789 •UL 8750 	<ul style="list-style-type: none"> •IEC TR 62471-2
Electromagnetic Compatibility	<ul style="list-style-type: none"> •ANSI C82-SSL1-200X •ANSI C82.77 •CISPR 15 •IEC 61547 •IEC 61000-3-2 (EMC) 			<ul style="list-style-type: none"> •ANSI C82.77 •CISPR 15 •IEC 61547 •IEC 61000-3-2 (EMC) 		<ul style="list-style-type: none"> •ANSI C82.77 •CISPR 15 •IEC 61547 •IEC 61000-3-2 (EMC) 	
Technology Development	<ul style="list-style-type: none"> •IEC 62386-207 •NEMA LSD-49 •NEMA SSL-1 	<ul style="list-style-type: none"> •ANSI C78.XX (Standard LED data sheet) •ANSI SR (Thermal Characterization of SSL Interconnects) •ANSI C78.XX (ANSI Standard LED Footprint) 	<ul style="list-style-type: none"> •IEC 60838-2-2 (connectors) •NEMA SSL-4 (form factors) •NEMA LSD44 (interconnects) •NEMA LSD45 (interconnects) •Zhaga 	<ul style="list-style-type: none"> •NEMA LSD-49 (dimming) •NEMA SSL-6 (dimming) 		<ul style="list-style-type: none"> •NEMA LSD 44 •NEMA LSD 45 •IEC 62386-207 	

Solid State Lighting – The Road to Standardization – Communication

- ANSI/IESNA RP-16 Nomenclature and Definitions for Illuminating Engineering
 - Includes LED and SSL terms
- IEC/TS 62504 Ed. 1.0: Terms and definitions for LEDs and LED modules in general lighting
- IEC 60050-845 (CIE 17.4): International Electrotechnical Vocabulary: Lighting.
- IEC 61231: International lamp coding system (ILCOS)
- IEC PAS025A – Publicly Available Specification—standardized white binning nomenclature; the so called “nano-grid.”
- NEMA/ALA LSD-51 Solid State Lighting—Definitions for Functional and Decorative Applications



Solid State Lighting – The Road to Standardization – Measurement

- **ANSI C82.XX**: LED Driver Testing Method
 - CIE 127:2007: Measurement of LEDs
 - CIE 13.3-1995: Method of measuring and specifying colour rendering of light sources New edition
 - **CIE TC 1-69**: Colour Rendering of White Light Sources
 - **CIE TC 2-50**: Measurement of the Optical Properties of LED Clusters and Arrays
 - **CIE TC 2-63**: Optical Measurement of High-Power LEDs
 - **CIE TC 2-64**: High Speed Testing Methods for LEDs
 - IEC 61341: Method of measurement of centre beam intensity and beam angle(s) of reflector lamps
 - **IES TM-21**: Lumen Depreciation Lifetime Estimation Method for LED Light Sources
- Standards in blue are currently in development**

Solid State Lighting – The Road to Standardization – Measurement

- IES LM-79-08: Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products
- IES LM-80-08: Approved Method for Measuring Maintenance of LED Light Sources (under revision).
- **IESNA LM-xx**: Approved Method for Electrical and Photometric Measurement of DC High Power LEDs and Arrays
- **IESNA LM-xx2**: Approved Method for Electrical and Photometric Measurement of AC High Power LEDs and Arrays
- **IES LM-XX-201X**: Approved Method for the Characterization of LED Light Engines and Integrated LED Lamps for Electrical and Photometric Properties as a Function of Temperature
- **IES (proposal)**: Measurement of OLEDs
- **IES (proposal)**: LM-80 luminaire level

Standards in blue are currently in development

Solid State Lighting – The Road to Standardization – Performance

- **ANSI C82-SSL1-200X**: Driver Performance Standard
- ANSI_NEMA_ANSLG C78.377-2008: American National Standard for Electric Lamps—Specifications for the Chromaticity of Solid State Lighting Products (under revision).
- IEC 62384: D.C. or A.C. supplied electronic control gear for LED modules - Performance requirements
- **IEC 62XXX**: Performance Standard for LED Modules & Performance Standard for LED-Luminaires
- **IEC PAS ANSI C78-377**: Publicly Available Specification of the existing ANSI_ANSLG C78.377 standard. Includes a translation table that expresses the specification in terms of LED grid coordinates.

Standards in blue are currently in development

Solid State Lighting – The Road to Standardization – Performance

- IEC/PAS 62612 ed 1.0: Self-ballasted LED-lamps for general lighting services - Performance requirements
- IEC62663-2: Performance standard for self-ballasted LED lamps by voltage <50 V
- NEMA SSL-3: High Power LED Binning for General Illumination

Standards in blue are currently in development

Solid State Lighting – The Road to Standardization – Safety

- ANSI/IESNA RP-27.1-05: Photobiological Safety for Lamps and Lamp Systems-General Requirements
- ANSI/IESNA RP-27.2-00: Photobiological Safety for Lamps and Lamp Systems - Measurement Systems
- ANSI/IESNA RP-27.3-96: Photobiological Safety for Lamps - Risk Group Classification and Labeling
- ANSI/UL 1012: Power Units Other Than Class 2
- ANSI/UL 1310: Standard for Class 2 Power Units
- UL 1993: the Standard for Safety of Self-Ballasted Lamps and Lamp Adapters (supplement to include devices using LEDs)
- CIE TC 2-58: Measurement of LED Radiance and Luminance
- CIE TC 6-55: Photobiological Safety of LEDs

Standards in blue are currently in development

Solid State Lighting – The Road to Standardization – Safety

- IEC 61347-2-13:2006: Lamp controlgear - Part 2-13: Particular requirements for d.c. or a.c. supplied electronic controlgear for LED modules
- IEC 62031: LED modules for general lighting - safety requirements
- IEC 62471 Ed. 1.0 b:2006/CIE S 009 (CIE S 009:2002): Photobiological safety of lamps and lamp systems
- IEC/TR 62471-2 Ed. 1.0: Photobiological safety of lamps and lamp systems - Part 2: Guidance on manufacturing requirements relating to non-laser optical radiation safety
- **IEC 62560 Ed1**: Self-ballasted LED-lamps for general lighting services > 50 V – Safety specifications

Standards in blue are currently in development

Solid State Lighting – The Road to Standardization – Safety

- IEC 62663-1 Ed. 1.0: Non-ballasted single capped LED lamps for general lighting - Part 1: Safety requirements
- IEEE Project P1789: Recommended Practices of Modulating Current in High Brightness LEDs for Mitigating Health Risks to Viewers
- UL 8750: Outline of Investigation for Light Emitting Diode (LED) Light Sources for use in Lighting Products

Standards in blue are currently in development

Solid State Lighting – The Road to Standardization – EMC

- ANSI C82.77-2002: Harmonic Emission Limits – Related Power Quality Requirements for Lighting ([Under review to include SSL](#))
- CISPR 15: Limits and Methods of Measurement of Radio Disturbance Characteristics of Electrical Lighting and Similar Equipment.
- IEC 61000-3-2: Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)
- IEC 61547-1995: Equipment for General Lighting Purposes - EMC Immunity Requirements

Solid State Lighting – The Road to Standardization – Technology Development

- **ANSI 78.XX**: Standard LED data sheet
- **ANSI SR-XX**: Thermal Characterization of SSL Interconnects
- **ANSI C78.XX**: ANSI Standard LED Footprint
- IEC 60838-2-2:2006: Miscellaneous lampholders – Part 2-2: Particular requirements – Connectors for LED-modules
- IEC 62386-207 Ed.1: Digital addressable lighting interface - Part 207: Particular requirements for control gears; led modules (device type 6)
- NEMA LSD 44: Solid State Lighting—The Need for a New Generation of Sockets & Interconnects
- NEMA LSD 45: Recommendations for Solid State Lighting Sub-Assembly Interfaces for Luminaires
- NEMA LSD-49: SSL Dimming Recommended Practices

Standards in blue are currently in development

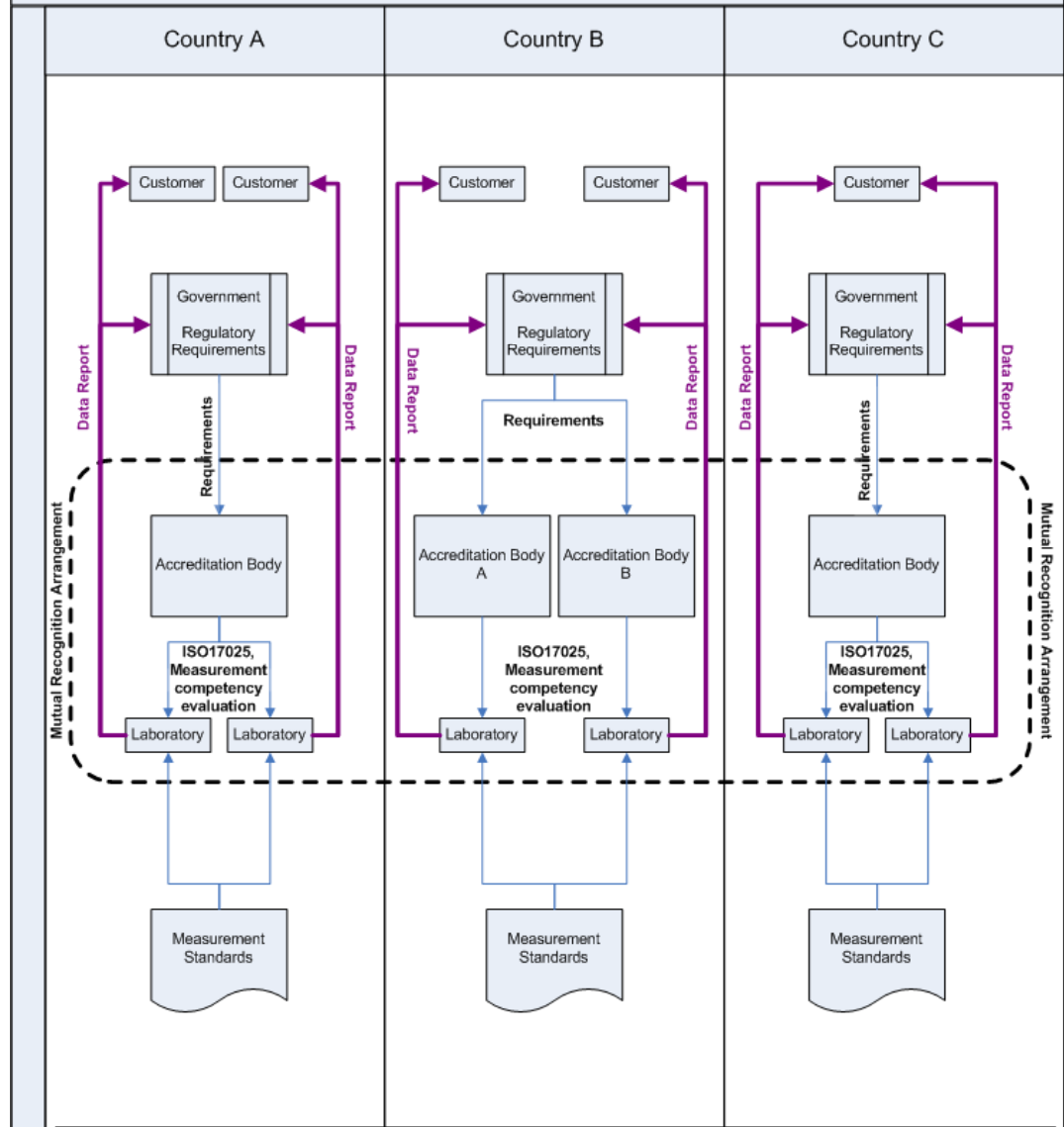
Solid State Lighting – The Road to Standardization – Technology Development

- **NEMA SSL 1-200X**: Electric Drivers for LED Devices, Arrays, or Systems
- **NEMA SSL-4**: Form Factors
- **Zhaga**
 - an industry-wide cooperation aimed at the development of standard specifications for the interfaces of LED light engines.
 - LED light engine is an LED module with defined interfaces that do not depend on the type of LED technology used inside the light engine.

Accreditation, MRA/MLAs and the Global Market

- Accreditation:
 - formal recognition by an authoritative body
 - covers the capability and competence of the laboratory
 - lab provides scientifically sound and valid calibration and/or testing services.
- MRA/MLA:
 - Mutual Recognition Arrangements/Multilateral Recognition Arrangements
 - signatories accept that the accreditations granted by other signatory accreditation bodies
 - signatories promote the acceptance of calibration and/or test results across accreditation bodies.

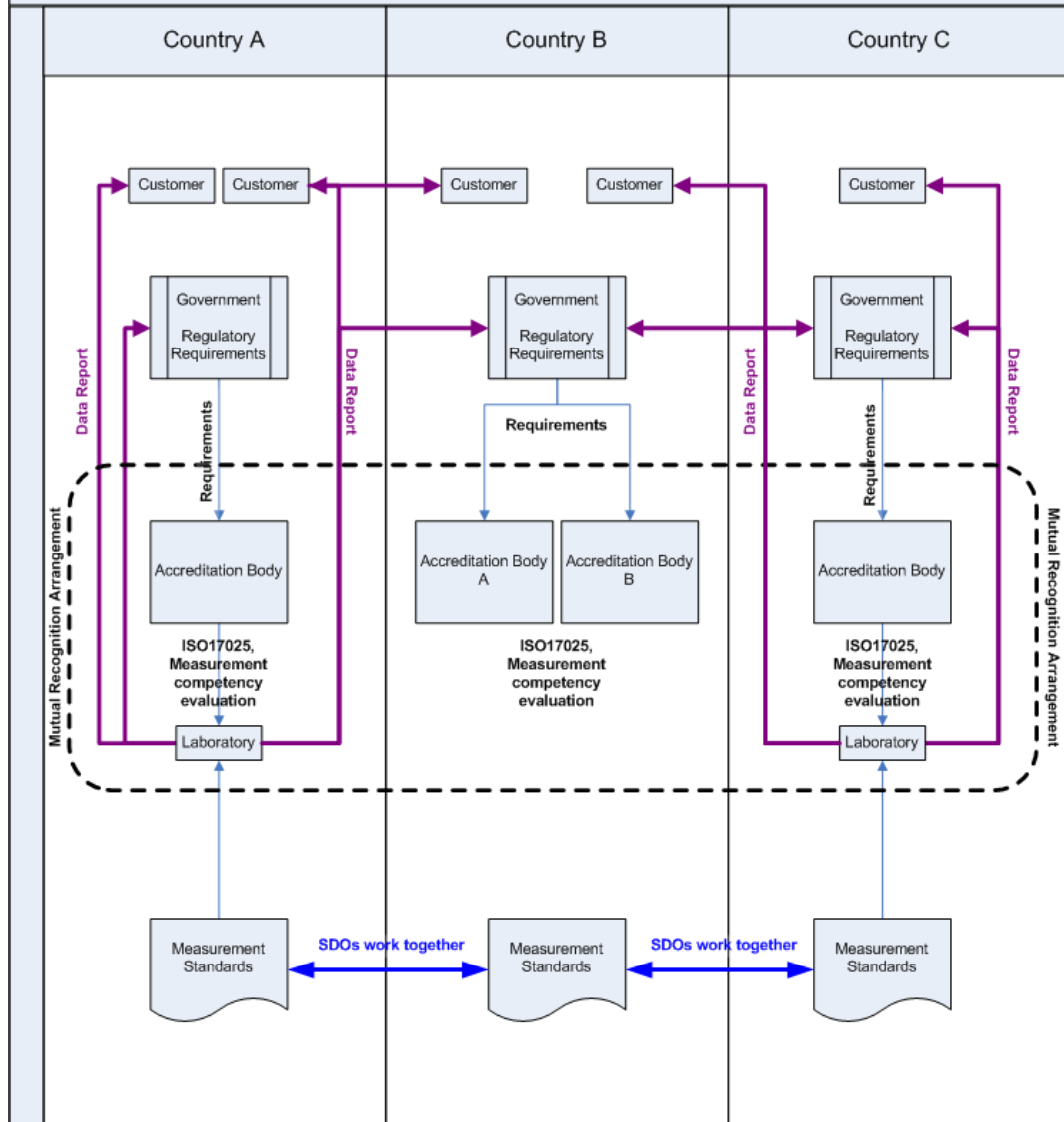
Current Accreditation, Reporting, and MRA Process



MRAs/MLAs are not fully functional for regulatory reporting!

- Measurement standards are not uniform or equivalent across borders.
- Accreditation scopes are not compatible (tied to different measurement standards).
- Governments dictate specific accreditation bodies that are acceptable.
- Causes duplicate measurement and reporting efforts for global companies.
- MRA DOES allow labs to use calibration standards traceable to other NMIs. For example, lumen standards from NPL or PTB are acceptable for NVLAP accredited laboratories.

Desired Accreditation, Reporting, and MRA Process



MRA is a powerful tool for regulatory reporting!

- Measurement standards are uniform or equivalent across borders. SDOs work together to ensure equivalency or cross border adoption.
- Accreditation scopes are compatible and equivalent.
- Governments accept accreditation from other regions provided: 1. Accreditation body is a signatory within the MRA; 2. Accreditation scope is compatible with regulatory requirements.
- Results and implications: 1. Elimination of repetitive testing; 2. Better resource utilization; 3. Simplification of global supply chain requirements—better for commerce; 4. Better able to support customer needs; 5. Accredited laboratories will have greater global responsibilities and will require greater global regulatory knowledge.

Solid State Lighting – The Road to Standardization – Future Work

- Completion of “in progress” standards
 - A lot of work!
- SSL Interconnects
 - Thermal interface measurement standards
 - Performance standards
 - Interconnect standards covering all Mechanical, Electrical, and thermal aspects.
 - “base and holder” like standards
- Flicker
 - Important to consider, especially with AC driven LED systems
 - Remember magnetically ballasted fluorescent lamps
- MRA/MLA – make it useful!

Solid State Lighting – The Road to Standardization – Conclusions

- SSL standards will drive:
 - Consumer confidence
 - Uniform methods for testing and rating products
 - Direct comparison of product/component performance
 - Technology advancements
 - A common language for communication
 - Market advancement
 - Faster adoption of new technology
 - Governmental program and energy efficiency legislation
 - Reduction in liability risk
 - Possibility of standard interconnects
 - Replacement and choice!

Solid State Lighting – The Road to Standardization – Further Information

- CIE: http://www.cie.co.at/index_ie.html
- IEC: <http://www.iec.ch/>
- IEEE: <http://grouper.ieee.org/groups/1789/>
- ANSI: <http://www.ansi.org/>
- ASSIST: <http://www.lrc.rpi.edu/programs/solidstate/assist/index.asp>
- NEMA: <http://www.nema.org/>
- NGLIA: <http://www.nglia.org/>
- NIST: <http://www.nist.gov/index.html>
- UL: <http://www.ul.com/global/eng/pages/>
- US DOE: <http://www1.eere.energy.gov/buildings/ssl/>
 - CALiPER Program:
<http://www1.eere.energy.gov/buildings/ssl/caliper.html>
 - PNNL: <http://www.pnl.gov/>

